New from Conrad Fischer

General Surgery

CORRELATIONS & CLINICAL SCENARIOS

for the USMLE Step 3

- Progressive cases with Q&A and pearls
- Basic science correlations
- CCS navigation tips

Mc Graw Hill Education

NIKET SONPAL • CONRAD FISCHER

Notice

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The authors and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the authors nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they disclaim all responsibility for any errors or omissions or for the results obtained from use of the information contained in this work. Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this work is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.

General Surgery

CCS

Correlations and Clinical Scenarios

Niket Sonpal, MD
Assistant Clinical Professor of Medicine
Touro College of Medicine
New York, New York

St. Georges University School of Medicine
Department of Gastroenterology
Lenox Hill Hospital, Northshore-LIJ Health System
New York, New York

Series Editor
Conrad Fischer, MD
Residency Program Director, Department of Medicine
Brookdale University Hospital Medical Center
Brooklyn, New York

Associate Professor of Physiology, Pharmacology and Medicine
Touro College of Medicine
New York, New York

Mc Graw Hill Education | Medical

New York Chicago San Francisco Athens London Madrid
Mexico City Milan New Delhi Singapore Sydney Toronto

ISBN: 978-0-07-182915-1
MHID: 0-07-182915-6

The material in this eBook also appears in the print version of this title: ISBN: 978-0-07-182855-0, MHID: 0-07-182855-9.

eBook conversion by codeMantra
Version 1.0

This limitation of liability shall apply to any claim or cause whatsoever whether such claim or cause arises in contract, tort or otherwise.

To my grandparents, Purshottam Thacker and Zaver Rachh. Their guidance, love, and blessings have inspired me to be the educator I am today.

CONTENTS

HOW TO USE THIS BOOK

The primary purpose of this book is to coach you in the precise sequence through time to manage the computerized case simulation (CCS) portion of the step 3 exam, specifically for questions pertaining to the specialty of Surgery. You will find directions on moving the clock forward in time and the specific sequence in which each test or treatment should be done in managing a patient. This will cover the order in which to give treatments, order tests, and how to respond to test results. All CCS-related instructions appear in RED TYPE.

If you have never seen a particular case, this book is especially for you. It never has statements about "using your judgment" because you basically do not have any in these areas. We have made a cookbook that says "Do this, do that, do this." We do not consider the term "cookbook" to be inappropriate in this case.

You need to learn the basics of surgery. Less than ten percent of physicians are in this specialty, but the other 90% need to have at least a working knowledge of it.

This book will prepare you for multiple-choice questions, which comprise the majority of the exam, as well as the computerized clinical case simulations and the new basic science foundations that have just been added to the exam.

USMLE Step 3 or COMLEX Part 3 is the last phase in getting your license. Most of you are in residency and have no time to study. Here is how to best use this book.

First read about the disease or subspecialty in any standard text book. We personally suggest either *Master the Boards Step 3* book (Conrad Fischer) or the *Current Medical Diagnosis and Treatment book*.

The cases in this book are meant to enhance your understanding of the subject. All initial case presentations and their continuing scenarios appear in yellow boxes. There are also hundreds of new multiple-choice questions that are not in anyone's Q bank.

Every single case has related basic science foundations (which appear in blue boxes), so you will get a solid grasp of these simply by following along in the case. You do not have to consult any of your old step 1 books or basic science texts. The basic science correlates should be painless. You need not search for extra information. Just learn what we have selected in these chapters.

We always wanted to write something specifically for CCS. This is it. Because new test changes are frightening and the basic science questions are new for step 3, we made one book to cover both the simulations and the basic science.

Niket Sonpal, MD
Conrad Fischer, MD

PREOPERATIVE EVALUATION

CASE 1: Preoperative Assessment for Low-Risk Patients

Setting: *Office*

CC: *"I am having a knee replacement."*

VS: *BP, 106/54 mm Hg; R, 12 breaths/min; P, 75 beats/minute; T, 98.6°F*

HPI: *A 65-year-old woman presents after seeing her orthopedic surgeon 1 week earlier. Her right knee osteoarthritis (OA) is no longer tolerable, and she is planning to undergo a total right knee replacement next month. Her surgeon tells her she needs to have "clearance" before surgery. She is only able to walk two blocks or climb one flight of stairs before feeling tired. However, she denies shortness of breath and chest pain while walking.*

PMHx:
- *Right knee OA*
- *Mild obesity*

PSH:
- *History of smoking; quit 5 years ago*
- *Drinks socially*

ROS:
- *No chest pain on exertion*
- *No shortness of breath on exertion*

Physical Exam:
- *Crepitations on flexion and extension of right knee*
- *Swelling and pain to palpation of the lateral right knee*
- *Decreased range of motion in the right knee*
- *Antalgic gate favoring the left leg*

Which perioperative risk category does a total knee replacement fit into?

a. High risk
b. Intermediate risk
c. Low risk

Answer c. Low risk

Surgeries involving the intraperitoneal and intrathoracic regions, carotid endarterectomy, head and neck surgery, orthopedic surgery, and prostate procedures are all considered intermediate risk and

carry up to 5% perioperative risk. Low-risk or less than 1% perioperative risk for death are endoscopic and superficial procedures, cataract surgery, breast surgery, dental procedures, and ambulatory surgery. High-risk procedures that carry a greater than 5% perioperative risk are those that involve peripheral vascular structures or the aorta.

Higher risk = Higher complication rate = Higher mortality rate

About which of the following lifestyle factors should this patient receive counseling regarding the risk of perioperative complications?

a. Exercise
b. Smoking
c. Alcohol use

Answer a. Exercise

This patient has poor preoperative exercise tolerance. A patient's ability to exercise is a strong predictor of postoperative complications from neurologic or cardiac events. This patient does not have shortness of breath, which in the setting of congestive heart failure (CHF) can prohibit surgery if the ejection fraction is less than 35%. Her exercise tolerance is low; we want patients to be able to walk more than four blocks or climb more than two flights of stairs. This patient would benefit from preoperative physical therapy. Smoking any kind of tobacco increases the risk of pulmonary complications after surgery. Therefore, if any patient smokes, he or she should be told to abstain for at least 8 weeks before surgery. Outcomes data have shown abstinence for this period of time or greater significantly decreases perioperative complications. This patient quit more than 5 years ago and therefore does not need to be counseled on smoking cessation. Alcohol consumption increases the risk of perioperative complications, especially in elderly adults. During all preoperative evaluations, the evaluating physician must ask about the quantity, use, and times since the patient's last drink. Physicians should also assess the use of illicit substances. Our patient only drinks socially, which on the USMLE means less than two drinks per week.

CCS TIP: *In patients with non-urgent surgery, preoperative "tuning up" can be done, and surgery can be delayed to improve outcomes.*

Initial Orders:
- *Physical therapy*
- *Bring the patient back in 1 month*
- *Acetaminophen for pain relief*

Use non–nonsteroidal antiinflammatory pain relievers in elderly adults because of the risk of peptic ulcer disease, renal disease, and aseptic meningitis.

The patient returns 1 month later. Her physical therapist reports her exercise tolerance has improved to 4 blocks and 2 flights of stairs.

What is the best next step in the management of this patient?

a. Electrocardiography (ECG)
b. Liver function tests
c. Complete blood count (CBC)
d. Prothrombin time (PT)
e. Basic metabolic profile

Answer a. Electrocardiography (ECG)

The correct answer is to obtain ECG. In the absence of history or physical findings indicating cardiac disease, ECG is recommended in men older than 40 years of age and women older than 50 years of age. Liver function tests are not indicated unless the patient has a history of chronic liver disease; albumin should be checked in patients with poor nutritional status. A CBC should only be checked when there is anticipation of major blood loss or if the patient has a history of anemia. The PT or partial thromboplastin time (PTT) should only be checked when the patient's history indicates chronic liver disease, history of bleeding diaphysis, or known coagulopathy. A basic metabolic profile to check for electrolytes is only indicated in patients who have renal disease, CHF, or are taking medications that affect electrolytes (e.g., diuretics).

PTT = PiTT—measures the intrinsic pathway
PT = PeT—measures the extrinsic pathway

Order: *ECG in the office*

Turn the clock forward 15 minutes to get the result.

All patients ≥40 years undergoing preoperative assessment require:
• Blood urea nitrogen/creatinine
• Chest radiography
• ECG

The ECG obtained in the office demonstrates a normal sinus rhythm with no abnormalities.

CCS TIP: *After ordering the appropriate tests in a preoperative assessment, change the location to the hospital for surgery and turn the clock forward. The case will end.*

CASE 2: Preoperative Assessment for High-Risk Patients

Setting: *Office*

CC: *"I need my hip fixed."*

VS: *BP, 185/60; HR, 95 beats/min; R, 20 breaths/min; T, 98.6°F*

HPI: *A 70-year-old man with a history of congestive heart failure (CHF) secondary to nonischemic cardiomyopathy presents to the office for preoperative evaluation for total hip replacement. The previous echocardiogram revealed an ejection fraction(EF) of 30%, and he occasionally has shortness of breath with exertion.*

PMHx: *Cirrhosis*

PSH:
- *60-pack-year smoking history*
- *1 pint of whiskey daily*

Medications: *Noncompliant with all medications*

ROS: *Unable to provide ROS*

Physical Exam:
- *Jugular venous distention (JVD)*
- *Lateral and inferior displacement of the apex of the heart*
- *Barrel chest*
- *Faint crackles in bilateral lung fields*
- *2+ pedal edema up to the mid calf*

Which of the following factors in this patient's history and physical examination puts him most at a high risk for perioperative mortality?

a. EF <35%
b. Current smoker
c. History of cirrhosis
d. JVD
e. Chronic alcohol use

Answer a. EF <35%

All of these factors raise this patient's perioperative mortality risk, but the one that raises it the most is the cardiac findings. The EF of less than 35%, the findings of JVD, and shortness of breath on exertion are all indicative of systolic dysfunction and CHF. His physical findings support a diagnosis of CHF as well. Being a smoker raises the mortality risk but not as much as being a heart failure patient; this patient's history of cirrhosis does raise the mortality rate up to 40%, but

remember that a person can live with very little liver but cannot live without a heart (Table 1-1).

Table 1-1 Perioperative Mortality Risk Factors

Organ	Risk Factor	Affect on Surgery	Intervention
Cardiac	EF <35% JVD = CHF	Prohibitive of noncardiac surgery	Optimize medications
Pulmonary	Smoking	FEV <1.5 raises pneumonia risk after surgery	Check PFTs before surgery Provide smoking cessation counseling
Hepatic	PT >16 sec Albumin <3.0 g/dL Bilirubin >2.0 g/dL	Indicative of poor synthetic function; thus, bleeding complications increase after surgery	Consider nutrition supplementation and close monitoring of bleeding parameters

CHF, congestive heart failure; EF, ejection fraction; FEV, forced expiratory volume; PFT, pulmonary function test; PT, prothrombin time.

Albumin and PT are surrogate markers of hepatic synthetic function. If their levels are abnormal, the liver is damaged.

Which of the following is the best next step in the management of this patient?

a. Optimize cardiac medications
b. Smoking cessation counseling
c. Hepatology consult

Answer a. Optimize cardiac medications

The correct answer is to begin with medical management of this patient's CHF. A combination of beta-blockers, angiotensin-converting enzyme (ACE) inhibitors, digoxin, and furosemide should be prescribed to optimize cardiac function. Beta-blockers and ACE inhibitors reduce mortality, and in advanced CHF (New York Heart class IV), spironolactone has been shown to reduce mortality rates. With regard to the patient's liver disease, a hepatology consult on the examination will not be helpful for the CCS; on the CCS, it is better to provide alcohol abstinence counseling.

Myocardial infarction = no surgery for a minimum of 6 months.

Orders:

- *Lisinopril*
- *Carvedilol*
- *Furosemide*
- *Digoxin*
- *Postpone surgery by not calling surgical consult*
- *Have patient return in 6 weeks*
- *Repeat examination upon return*
- *Order liver function tests*
- *Smoking counseling*
- *Alcohol cessation counseling*

CCS TIP: *Send the patient home and schedule a return to the office in 4 to 6 weeks. This is how you assess if your therapy was correct. If it was, the patient will feel a bit better. Always reexamine the patient.*

The patient returns to the office and says he feels less shortness of breath. On examination, he has fewer rales than previously and no pedal edema. The patient weighs less than before, has given up smoking, and has not consumed alcohol since his last visit. Liver function tests reveal bilirubin of 1.2 mg/dL, albumin of 3.2 mg/dL, and PT of 10 seconds.

Only on the CCS do patients actually do what the doctor says, so take advantage and counsel them. You will gain points.

Which is the best next step in the management of this patient?

a. Clear the patient for surgery
b. Repeat echocardiography
c. Cancel surgery forever

Answer b. Repeat echocardiography

This patient should have a repeat echocardiography to assess if he regained cardiac function (in other words, whether the EF improved). If the EF improves with medical therapy to above 35%, then the patient can safely have noncardiac surgery. Clearing the patient for surgery without ensuring the cardiac reserve has improved could kill the patient. Canceling the surgery forever would render the patient unable to walk because he does need a hip replacement.

Order:

- *Transthoracic echocardiography*

Turn the clock forward to obtain a result.

The echocardiography shows dilated cardiomyopathy with global hypokinesis and no regional wall motion abnormalities. The EF is 45%.

Order a surgical consult and turn the clock forward; the case will end.

CASE 3: Malignant Hyperthermia Syndrome

Setting: *ED*

CC: *Fever*

VS: *BP, 90/50 mm Hg; HR, 140 beats/min; R, 18 breaths/min; T, 105°F*

HPI: *A 26-year-old man is about to undergo an orchiectomy for testicular cancer. The anesthesiologist begins isoflurane and succinylcholine, and about 30 minutes later, the patient develops muscle rigidity, hyperthermia, an elevated heart rate, and abnormal ventilation patterns. There are numerous atrial premature complexes (APCs) and ventricular premature complexes (VPCs) noted on the monitor. The anesthesiologist is unable to open the patient's mouth because of masseter muscle rigidity.*

ROS: *Unable to provide*

Physical Exam:
- *Rigid muscles*
- *Very warm skin*

Which of the following is the most likely diagnosis?

a. Neuroleptic malignant syndrome
b. Serotonin syndrome
c. Malignant hyperthermia syndrome

Answer c. Malignant hyperthermia syndrome

Malignant hyperthermia is a life-threatening condition that includes tachycardia, muscle rigidity, hyperthermia, and arrhythmia. It is caused by exposure to triggering agents such as succinylcholine. Exposure to the triggering agent causes large quantities of calcium to be released from the sarcoplasmic reticulum of skeletal muscle. The sustained elevation of calcium allows excessive stimulation of aerobic and anaerobic metabolism, which yields respiratory and metabolic acidosis, rigidity, altered cell permeability, and hyperkalemia. Serotonin syndrome does have an elevated temperature but usually is in the presence of inadvertent interactions between various drugs such as selective serotonin reuptake inhibitors and monoamine oxidase inhibitors. Neuroleptic malignant syndrome is secondary to the use of antipsychotics rather than anesthetics.

Drugs that cause muscle rigidity: isoflurane, sevoflurane, desflurane, and succinylcholine

MHS is an autosomal dominant syndrome affecting the ryanodine receptor.

The most reliable sign of MHS is hypercapnia resistant to increasing ventilation. This is reflected in the arterial blood gas as a mixed metabolic and respiratory acidosis.

What is the best next step in the management of this patient?

a. Discontinue isoflurane and succinylcholine
b. Hyperventilate the patient
c. Check electrolytes
d. Administer calcium channel blockers
e. Provide intravenous (IV) hydration

Answer a. Discontinue isoflurane and succinylcholine

Immediately discontinue anesthetic agents and stop the surgical procedure. If the procedure cannot be aborted, the surgeon should "close up" with the use of IV sedation such as propofol. Hyperventilating the patient will not help unless the underlying agent is discontinued. After the anesthetic is stopped, increasing the minute ventilation with 100% oxygen or increasing the tidal volume will help reduce the hypercardia. Checking the electrolytes simply wastes time and offers nothing to save the patient's life because the abnormalities can be predicted without checking them. Calcium channel blockers are contraindicated because of the possibility that they can worsen hyperkalemia and hypotension when antidotes are given.

Which of the following is the most appropriate therapy?

a. Danazol
b. Dantrolene
c. Bromocriptine
d. Cooling blankets
e. IV fluids

Answer b. Dantrolene

The most appropriate therapy is to administer dantrolene to treat the underlying elevated calcium within the cells. Danazol is simply an androgen that offers no therapeutic aid in the treatment of MHS. Bromocriptine is used in the treatment of pituitary adenomas. Cooling blankets and IV fluids have not been shown to aid in treating MHS.

Dantrolene interferes with muscle contraction by inhibiting calcium ion release from the sarcoplasmic reticulum.

Orders:

- *Dantrolene*
- *IV fluids*
- *Transfer to the medical intensive care unit*

After the patient has been given dantrolene, it is then appropriate to check electrolytes, creatinine phosphokinase (CPK) levels, and the urine for myoglobinuria. CPK will be elevated because of the long-standing muscle rigidity, which in turn will also cause elevated hyperkalemia. The muscle breakdown can cause myoglobin to leak into the bloodstream, which can cause clogging of the renal tubules and lead to renal failure. IV fluid hydration with bicarbonate to alkalinize the urine will aid in clearance of the nephrotoxic myoglobin.

Orders:

- *Basic metabolic profile*
- *CPK*
- *Urine analysis*
- *Myoglobin in the urine*

CCS TIP: *Turn the clock forward, and the case will end.*

CPK levels generally peak on day 3 and then rapidly decrease by half every 24 to 48 hours.

HEMODYNAMIC INSTABILITY

CASE 1: Septic Shock

Setting: *ED*

CC: "*My dad is sick.*"

VS: *BP, 86/40 mm Hg; R, 32 beats/min; P, 121 breaths/min; T, 101.9°F; Tmax, 102.5°F*

HPI: *A 72-year-old retired banker is brought to the ED by his daughter for increasing confusion, lethargy, cough, and fever. You remember the patient because he was discharged just 3 days earlier after being treated for urinary retention secondary to benign prostatic hypertrophy (BPH). The patient's cough has been present since discharge and is accompanied by dark green sputum. He has not returned to work, and he has not been able to ambulate.*

PMHx: *Hypertension and BPH*

Medications: *Tamsulosin and lisinopril*

ROS:
- *Shortness of breath*
- *Chills and rigors*
- *No chest pain*

Physical Exam:
- *Rhonchi most pronounced at the left lung base*
- *Increased resonance of voice at the left lung base with E to A changes*
- The patient is confused
- Respiratory distress is noted

Egophony is caused by increased transmission of high-frequency noise across fluid with lower frequencies being unheard, resulting in a high-pitched nasal tone.

What is the most likely diagnosis?

a. Community-acquired pneumonia (CAP)
b. Healthcare-associated pneumonia (HCAP)
c. Chronic obstructive pulmonary disease (COPD) exacerbation
d. Asthma

e. Pulmonary embolus

Answer b. Healthcare-associated pneumonia (HCAP)

The most likely diagnosis is HCAP. HCAP = pneumonia + a risk factor. Four risk factors you need to know for the exam are that the patient (1) had intravenous therapy within the prior 30 days, (2) resides in a nursing home, (3) was in a hospital for 2 or more days in the last 90 days, and (4) attends regular hemodialysis. Any of these raises the risk of developing infections from highly virulent organisms. CAP is defined as an acute infection of the pulmonary parenchyma that develops outside of a hospital in the community. This patient developed his infection within 90 days of discharge from an acute care facility and therefore does not have CAP. COPD exacerbation only occurs in patients who have a history of COPD and would present with wheezing, both of which are absent in this patient. Similarly, for asthma, an absence of the disease or evidence of wheezing makes asthma diagnosis unlikely. Pulmonary embolus after discharge is an ideal fit after being in a hospital, but it would not be associated fever or cough. This patient is clearly infected and has sequela related to sepsis rather than from hypoxia.

Healthcare-associated pneumonia (HCAP) is the most common cause of death among nosocomial infections.

Initial Orders:

- *CMP*
- *Arterial blood gas*
- *CBC*
- *UA and urine culture*
- *Blood cultures ×2*
- *Lactic acid level*
- *Foley catheter*
- *Chest radiography*

What is the best next step in the management of this patient?

a. Normal saline (NS) bolus

b. Dextrose 5% water colloid bolus

c. Await blood culture results

d. Consult pulmonary

Answer a. Normal saline (NS) bolus

A NS bolus is the best next step in the management of this patient. This patient appears to be infected and is currently hypotensive with a compensatory tachycardia. The initial management of all unstable patients is to maintain ABCs (airway, breathing, and circulation). Although the patient's

tachypnea combined with confusion and lethargy is concerning, the choices are currently addressing the circulatory issues. Maintenance fluids do nothing in patients who are hypotensive because a fast infusion of a large volume of fluid is necessary to refill the intravascular space. The goal of resuscitative directed therapy is to achieve perfusion of organs such as the kidneys. Colloid bolus is no different than crystalloid, but we opt for crystalloids such as NS because it is easily accessible and can be infused in less than 15 minutes. Awaiting blood cultures is the same as letting the patient die, and although we consult on the CCS, it is not the next best step but rather a corollary step in addition to the more urgent needs of the patient.

CCS TIP: *Remember that intubation is also performed for protection of the airway in lethargic patients.*

Total body water is only ONE third, ECF. Of the ECF only one quarter is vascular.

CCS TIP: *Turn the clock forward to obtain laboratory test results and obtain interval updates on the patient's condition.*

Order:

- *Critical care consult*

CCS TIP: *Getting a critical care consult on the CCS component of the exam is only to show that you know when you need help. The consult will give you no useful information. All consultants on CCS say they have seen the patient but have no specific recommendations.*

The patient is intubated, given 2.5 L of NS and empiric antibiotics, and central venous access is obtained. Repeat vital signs show persistent tachycardia with a blood pressure of 85/48 mm Hg. The patient has no urine in the Foley catheter bag. CBC reveals a white blood cell (WBC) count of 16,500 cells/mm^3, a blood urea nitrogen/creatinine (BUN/Cr) of 63/2.1, and lactic acid of 3.9 units. Arterial blood gas shows a mixed respiratory alkalosis with metabolic acidosis. Chest radiography reveals a dense consolidation in the left lower lung base consistent with pneumonia (Figure 2-1).

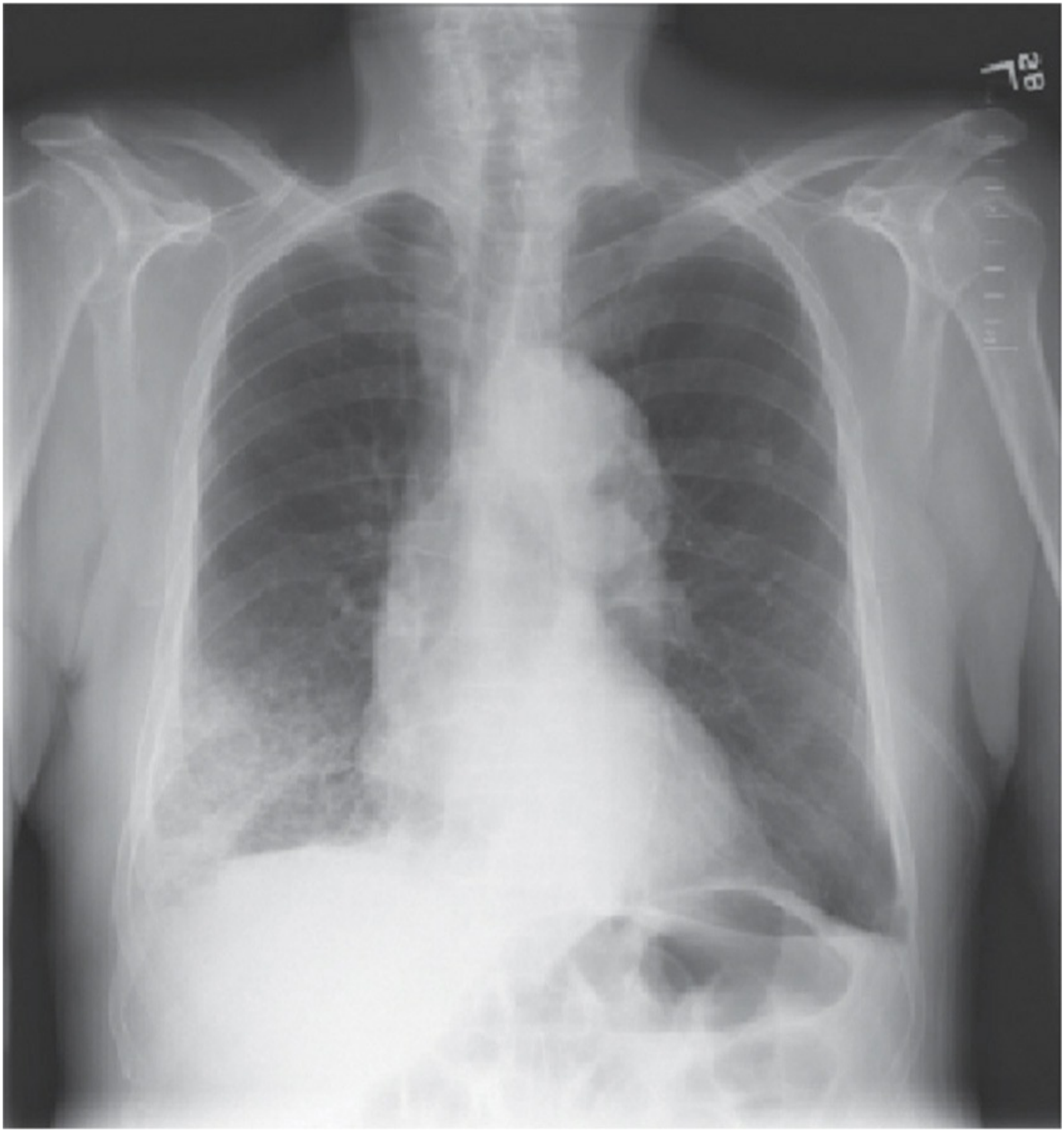


Figure 2-1. Pneumococcal lobar pneumonia. (Reproduced, with permission, from Musher DM. Community-acquired pneumonia. In: McKean SC, Ross JJ, Dressler DD, et al, eds. *Principles and Practice of Hospital Medicine*. New York: McGraw-Hill; 2012.)

Which of the following is the most likely additional diagnosis?

a. Systemic inflammatory response syndrome (SIRS)
b. Sepsis
c. Severe sepsis
d. Septic shock

Answer d. Septic shock

Systemic inflammatory response syndrome (SIRS) is a global inflammatory state that yields a particular set of symptoms and objective findings, and occurs prior to sepsis and shock. There are four components of the SIRS criteria:

1. Body temperature <36°C or >38°C
2. Heart rate >90 beats/min
3. Tachypnea >20 breaths/min; or PCO_2 <32 mm Hg
4. WBC count <4000 cells/mm^3 or >12,000 cells/mm^3

Two criteria = SIRS
Two criteria + Source of infection = Sepsis
Two criteria + Source of infection + Organ dysfunction = Severe sepsis
Two criteria + Source of infection + Organ dysfunction + Hypotension = Septic shock

This patient has four criteria: tachypnea, tachycardia, an elevated WBC count, and a fever. This combined the lungs as a source, confusion (brain dysfunction), and evidence of renal dysfunction yields severe sepsis. However, because the patient is also hypotensive and does not improve with fluid, he enters the category known as septic shock (Table 2-1).

Table 2-1 Septic Shock

	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	Pulmonary capillary wedge pressure	Cardiac output	Systemic vascular resistance	Mixed venous oxygen saturation
Septic shock	Decreased	Increased	Decreased	Increased

Which of the following is the most appropriate therapy at this time?

a. Start norepinephrine
b. Start dobutamine

c. Colloid bolus
d. Start dexamethasone
e. Provide intensive insulin therapy

Answer a. Start norepinephrine.

When the patient has refractory hypotension or a blood pressure that does not improve with fluids, vasopressors should be started. The best vasopressors for septic shock are norepinephrine or phenylephrine. Phenylephrine is used when patients have severe tachycardia or arrhythmia. Norepinephrine and dopamine should be avoided with fast heart rates or arrhythmias because of their β-adrenergic effect. Dobutamine does not raise blood pressure; it is an agent for cardiogenic shock.

Colloid bolus at this time will not help because this patient requires vascular tone; in septic shock, bacterial toxins cause massive vasodilation, yielding hypotension. Steroid use in shock is still controversial (some studies demonstrate benefit, but others show an increase in mortality rates) and therefore is not first-line therapy. Hyperglycemia resulting from sepsis is a common finding, but strict blood glucose control (<100 mg/dL) was found to increase mortality; therefore, a target of 140 to 180 mg/dL is currently the recommended glycemic goal.

Norepinephrine = β_1-Adrenergic receptors α-adrenergic receptors agonist = vasoconstriction, positive inotropy (contractility), and chronotropy (rate).

Which of the following is the most appropriate antibiotic regimen for a patient presenting with HCAP?

a. Vancomycin and ertapenem
b. Vancomycin alone
c. Vancomycin and doripenem
d. Ertapenem alone
e. Vancomycin, piperacillin–tazobactam, and fluoroquinolone

Answer e. Vancomycin, piperacillin–tazobactam, and fluoroquinolone

Antibiotic coverage directed against both gram-positive and gram-negative bacteria should be chosen. If *Pseudomonas* infection is unlikely, vancomycin combined with a third-generation cephalosporin, β-lactam/β-lactamase inhibitor, or a carbapenem is correct. However, if the patient has risk factors for *Pseudomonas* such as HCAP, neutropenia, or diabetes, then vancomycin with two of the following should be started:

- Antipseudomonal cephalosporin: cefepime, ceftazidime
- Carbapenem: imipenem, meropenem
- β-lactam/β-lactamase inhibitor: piperacillin, ticarcillin
- Fluoroquinolone

• Aminoglycoside or a monobactam (aztreonam)

Methicillin-resistant staphylococci and *Pseudomonas* spp. are resistant to ertapenem.

Daptomycin does not work in the lung and is inactivated by surfactant.

CCS TIP: *Transfer the patient to the intensive care unit, order repeat laboratory studies for the morning, and turn the clock forward to mimic morning rounds. The case will end.*

CASE 2: Hypovolemic Shock

Setting: *ER*

CC: "*My mother passed out.*"

VS: *BP, 70/40 mm Hg; R, 16 breaths/min; P, 135 beats/min; T, 98.6°F*

HPI: *A 69-year-old woman presents with profuse watery diarrhea of 4 days' duration. She was recently treated with antibiotics for sinusitis. She has had 1–15 bowel movements per day without blood and feels lightheaded. Her daughter brought her to the ER when she was found collapsed in the bathroom. The patient does not remember passing out and denies any postevent symptoms. Placement of Foley catheter in the ER yields no urine output.*

PMHx: *Osteoporosis*

Med: *Alendronate*

ROS:

- *Lightheadedness*
- *Confusion*
- *No chest pain*
- *No visual disturbance*
- *Dry oral mucous membranes*
- *Decreased skin turgor*
- Cold clammy extremities

Physical Exam:

The patient is lethargic but AAOx1.
Supine

BP: 115/77 mm Hg
Pulse: 132 beats/min

Standing

BP: 85/67 mm Hg
Pulse: 122 beats/min

Initial Orders:

- *CMP*
- *CBC*
- *Lactic acid level*
- *Normal saline (NS)*
- *Urine sodium and urine creatinine*

Which of the following is the most likely diagnosis?

a. Septic shock
b. Hypovolemic shock
c. Hemorrhagic shock
d. Anaphylactic shock
e. Cardiogenic shock

Answer b. Hypovolemic shock

This patient is in hypovolemic shock caused by intravascular volume loss. The lack of volume decreases the cardiac output (CO) because of lack of preload. The systemic vascular resistance (SVR) increases in an effort to compensate for the diminished cardiac output and maintain perfusion to the vital organs. You should expect to see organ dysfunction such as low urine output; cold, clammy extremities; and tachycardia. The finding of orthostatic hypotension on standing from a supine position further supports this diagnosis. Orthostasis is defined as a persistent 10-point increase in pulse on standing or a 20-point decrease in systolic blood pressure. Patients with septic shock are typically warm and have a history of fever with a source of infection. Hemorrhagic shock presents with signs of bleeding or in the postoperative period. Anaphylactic shock occurs after the introduction of an allergen such as a medication such as penicillin, sulfa drugs, or allopurinol. Cardiogenic shock occurs after myocardial infarction (Table 2-2).

Table 2-2 Hypovolemic Shock

	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	Pulmonary capillary wedge pressure	Cardiac output	Systemic vascular resistance	Mixed venous oxygen saturation
Hypovolemic shock	Decreased	Decreased	Increased	Decreased

Figure 2-2 shows the relationships between pressure and volume in hemorrhagic shock.

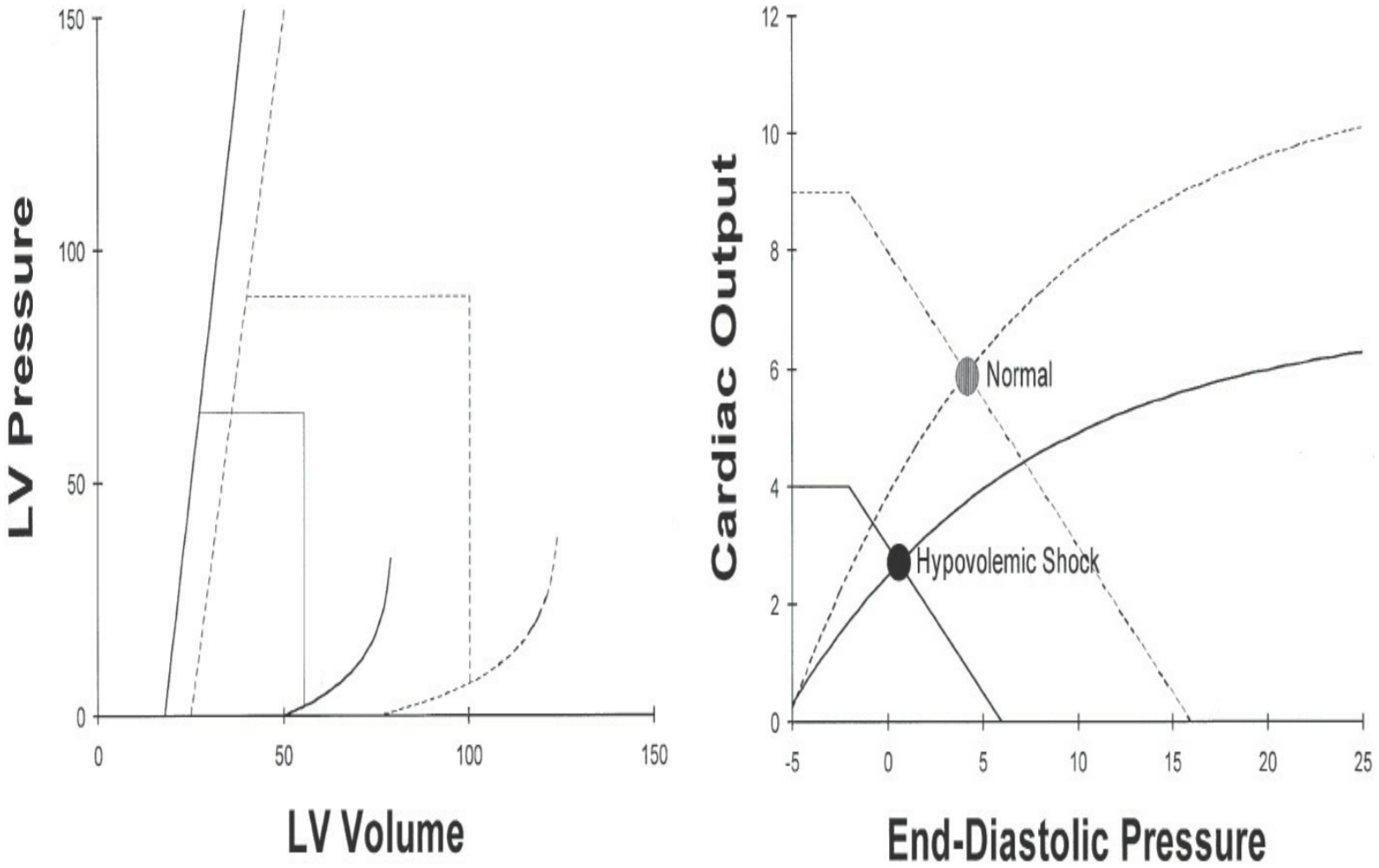


Figure 2-2. During hypovolemic shock, the primary abnormality is a decrease in the intravascular volume; therefore, mean systemic pressure decreases as illustrated by a shift of the venous return curves from the normal relation (*straight dashed line*) leftward (*straight continuous line*). This hypovolemic venous return curve now intersects the normal cardiac function curve (*dashed curvilinear relation*) at a much lower end-diastolic pressure so that cardiac output is greatly reduced. *Upper panel*: The increased sympathetic tone accompanying shock results in a slight increase in contractility, as illustrated by the slight left shift of the left ventricular end-systolic pressure–volume relation (from the *dashed straight line* to the *solid straight line*). However, because the slope of the end-systolic pressure–volume relation is normally quite steep, the increase in contractility cannot increase stroke volume or cardiac output much and is therefore an ineffective compensatory mechanism in patients with normal hearts. If volume resuscitation to correct the primary abnormality is delayed for several hours, the diastolic pressure–volume relation shifts from its normal position (*dashed curve, upper panel*), resulting in increased diastolic stiffness (*continuous curve, upper panel*). Increased diastolic stiffness results in a decreased stroke volume and therefore a depressed cardiac function curve (*continuous curve, lower panel*) compared with normal (*dashed curve, lower panel*). This decrease in cardiac function due to increased diastolic stiffness probably accounts for irreversibility of severe prolonged hypovolemic shock. LV, left ventricular. (Reproduced, with permission, from Walley KR. Shock. In: Hall JB, Schmidt GA, Wood LH, eds. *Principles of Critical Care*. 3rd ed. New York: McGraw-Hill; 2005.)

Cardiac output = Stroke volume × Heart rate
and
Stroke volume = End-diastolic volume – End-systolic volume
Thus:
Cardiac output = (End-diastolic volume – End-systolic volume) × Heart rate
and

Total peripheral resistance = Mean arterial pressure – Mean venous pressure
Therefore
Blood pressure = Cardiac output × Total peripheral resistance

CCS TIP: *After initial orders are entered turn the clock forward to see results.*

Cold and clammy = Tight arteries = High SVR
Warm and wet = Open arteries = Low SVR

The patient remains hypotensive. Labs reveal an elevated lactate of 2.5 (units), BUN/Cr of 35/1.8, and a hematocrit of 55. The Foley catheter has yielded 5 cc of urine in the last 2 hours. The patient's urine sodium is 10 mEq/L, and urine creatinine is 20 mg/dL.

Orders:
- *Central venous access*
- *Critical care consult on CCS*

CCS TIP: *On single best answer questions, never consult. On CCS, ask for a consultation.*

What is the best next step in the management of this patient?

a. Crystalloid bolus
b. Maintenance fluids
c. Colloid bolus
d. Consult critical care
e. Calculate a FeNa

Answer a. Crystalloid bolus

The best next step in any patient with hypovolemic shock is rapid volume repletion. Delays can lead to ischemic injury and multiorgan system failure. This patient already has evidence of organ dysfunction from elevated lactate and BUN/Cr. The best choice is to administer isotonic saline, which has a higher likelihood of staying in the vascular space compared with half NS or 5% dextrose in water. Your therapy will be working if objective measurements of end-organ function improve, such as blood pressure, lactic acid, and urine output. Giving maintenance fluids will not replete the intravascular space quickly enough and can lead to further organ damage. A colloid bolus is no different than crystalloid bolus; it takes longer to prepare but does have the benefit of not causing pulmonary edema. In this case, consulting anyone on the examination is useless, and calculating the FeNa in a patient in shock is academic and does not trump the findings of the clinical examination.

Order:

- *NS bolus ×. Turn the clock forward 30 to 60 minutes. Obtain interval urine output and new vital signs.*

Fractional excretion of sodium or FeNa directly evaluates sodium handling the kidney.
FENa
<1% = Hypovolemia
>1% = Acute tubular necrosis

Urine sodium gives the same information as FeNa.

The patient's blood pressure has improved to 95/55 mm Hg, and the heart rate is now 100 beats/min. The patient's urine output for the past hour has been 30 cc.

Orders:

- *Order maintenance fluids, intensive care unit transfer, and turn the clock forward to morning rounds.*
- *The case will end.*

CASE 3: Hemorrhagic Shock

Setting: *ED*

CC: "*My back hurts*."

VS: *BP, 80/40 mm Hg; R, 20 breaths/min; P, 119 beats/min; T, 99°F*

HPI: *A 78-year-old woman presents to the emergency department with back pain of 24 hours' duration. The pain began yesterday evening and has gotten worse in intensity since. There is also abdominal pain that is nonfocal, dull, and constant. She was recently treated for a urinary tract infection with trimethoprim–sulfamethoxazole for 3 days. The patient is known to you and appears confused and unable to answer all questions accurately.*

PMHx: *Mechanical heart valve for aortic stenosis*

Meds:
- *Warfarin*
- *Aspirin*
- *Daily vitamin*

ROS: *Unable to provide history*

Physical Exam:
- *The patient has a bruise over left flank and around the umbilicus*
- *Dry skin*
- *Dry axillae*
- *Cold, clammy extremities*

Which of the following is the most likely diagnosis?

a. Pancreatitis
b. Spontaneous retroperitoneal bleed (SRB)
c. Lumbar disc herniation
d. Herpes zoster

Answer b. Spontaneous retroperitoneal bleed (SRB)

The findings of back pain with evidence of flank or abdominal ecchymosis in a patient on anticoagulants are a classic presentation for SRB on the USMLE. Pancreatitis can lead to bruising on the flanks but presents with severe epigastric pain that radiates to the back. Lumbar disc herniation classically occurs after trauma or heavy lifting and is tender to palpation. Herpes zoster is only the diagnosis if you see crops of vesicles, no rash, and then no herpes.

Initial Orders:

- *CMP*
- *CBC*
- *Lactic acid level*
- *IV access*
- *Foley catheter*
- *ABG*
- *Prothrombin time (PT)/international normalized ratio (INR)*
- *Transfer to the intensive care unit*
- *Critical care consult*

CCS TIP: *After ordering laboratory studies, turn the clock forward 15 to 30 minutes to obtain results.*

BUN/Cr is 45/2.0, the complete blood count shows a hemoglobin of 9.5 d/dL, and a Foley catheter yields 100 cc of dark urine. Lactic acid is 2.2 mEq/L. Arterial blood gas analysis reveals metabolic acidosis. The PT is 110 seconds, and INR is 11.1.

Flank ecchymosis = Grey Turner sign (Figure 2-3)
Periumbilical ecchymosis = Cullen sign (Figure 2-4)

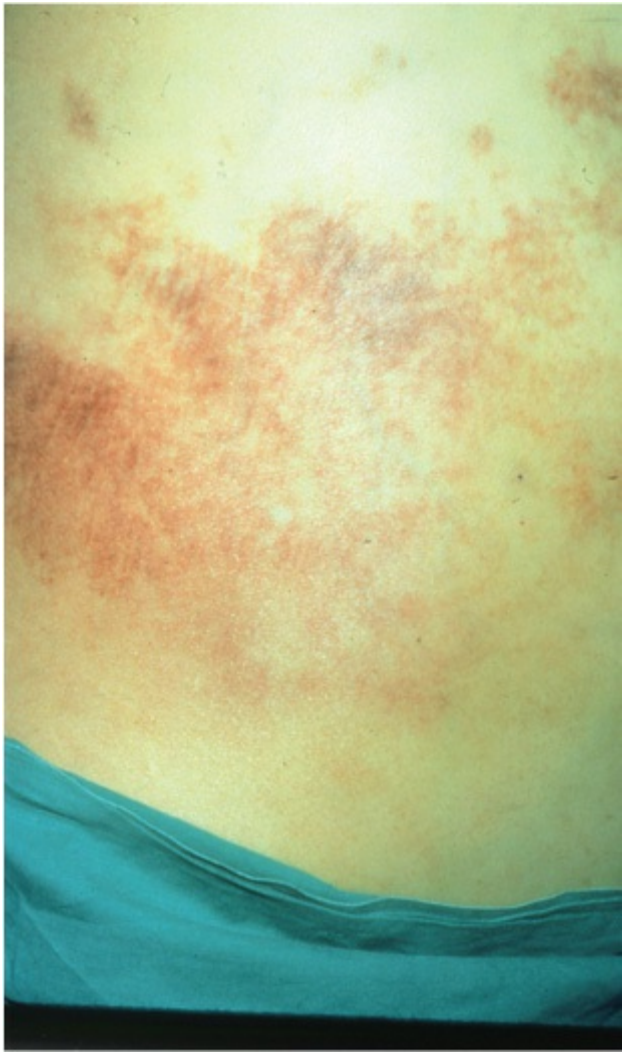


Figure 2-3. Grey Turner sign. Ecchymosis on the side of the abdomen. This is usually associated with intraperitoneal bleeding from hemorrhagic pancreatitis, a ruptured abdominal aorta, or a ruptured ectopic pregnancy. (Reproduced, with permission, from External manifestations. In: Lichtman MA, Shafer JA, Felgar RE, Wang N, eds. *Lichtman's Atlas of Hematology*. New York: McGraw-Hill; 2007.)

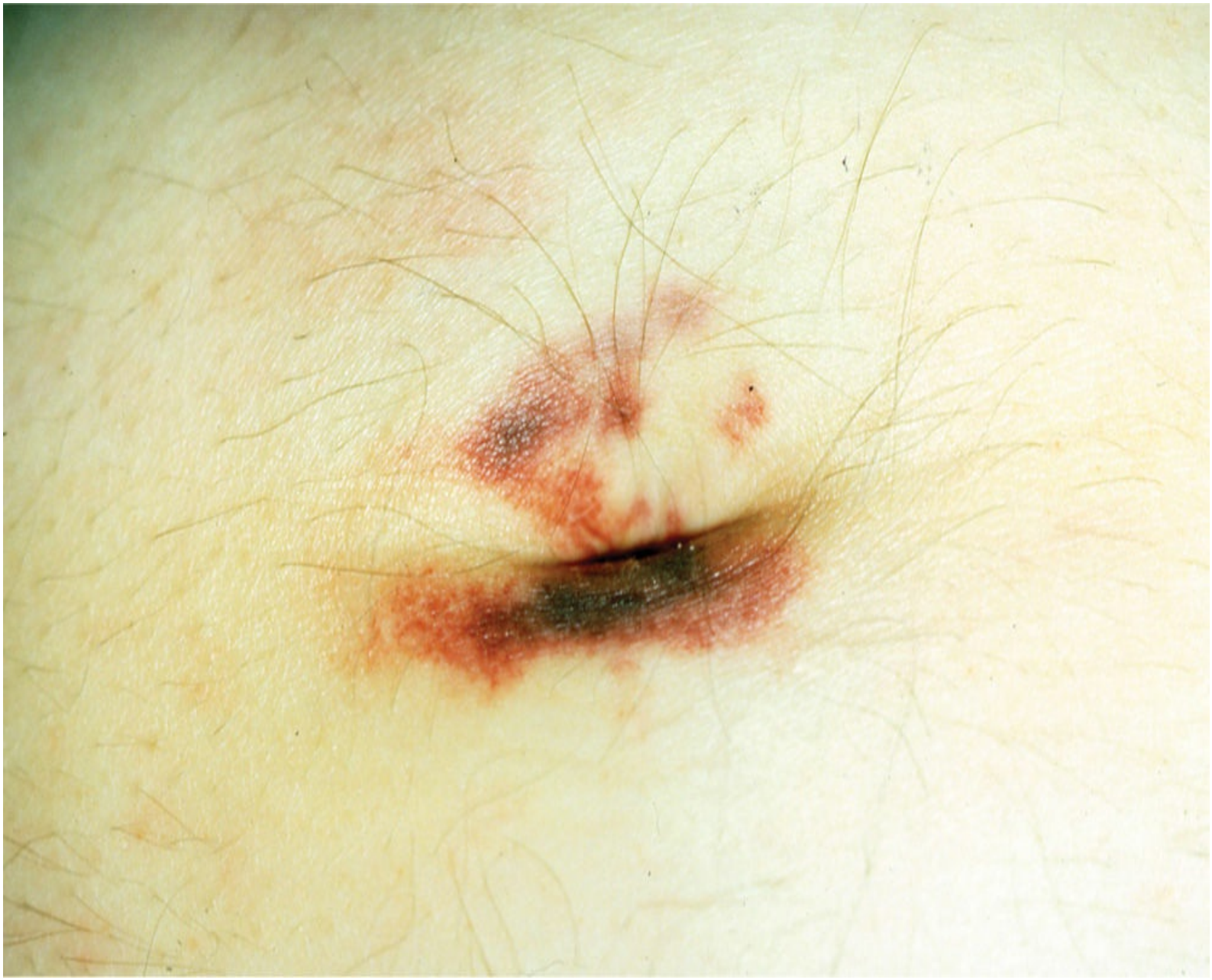


Figure 2-4. Cullen sign. Periumbilical ecchymoses indicating hemoperitoneum. This is seen in acute hemorrhagic pancreatitis. (Reproduced, with permission, from Lichtman MA, Shafer JA, Felgar RE, Wang N, eds. *Lichtman's Atlas of Hematology*. New York: McGraw-Hill; 2007.)

What is the best next step in the management of this patient?

a. Spiral computed tomography (CT)
b. Blood transfusion
c. Magnetic resonance imaging (MRI) of the abdomen
d. Antibiotics
e. Fresh-frozen plasma (FFP)

Answer b. Blood transfusion

The best next step would be to give is an immediate blood transfusion to resuscitate the patient because there is clear evidence of organ dysfunction caused by hemorrhage (i.e., change in mental status, acute kidney injury, and metabolic acidosis). Hemorrhagic shock presents similarly to hypovolemic shock except the underlying volume loss is pure blood. After the transfusion of packed

red blood cells (PRBC), the next step in this patient's management would be to reverse the anticoagulation because the patient is taking warfarin. The antidote to warfarin is FFP, vitamin K, and to withhold any further doses of the medication. There is no role for antibiotics in hemorrhagic shock because the nidus for dysfunction is a lack of circulating red blood cells leading to hypoperfusion (Table 2-3).

Table 2-3 Hemorrhagic Shock

	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	Pulmonary capillary wedge pressure	Cardiac output	Systemic vascular resistance	Mixed venous oxygen saturation
Hemorrhagic shock	Decreased	Decreased	Increased	Decreased

Warfarin inhibits vitamin K epoxide reductase; gamma carboxylates factors II, VII, IX, and X; and the regulatory factors protein C, protein S, and protein Z.

Orders:

- *2 units PRBC*
- *2 units FFP*
- *Intravenous (IV) vitamin K*

The patient receives 4 units of PRBCs, 4 units of FFP, and vitamin K. The patient's blood pressure improves to 95/70 mm Hg, and the heart rate is now 100 beats/min.

CCS TIP: *After a massive transfusion of blood products, order a pulmonary examination to ensure that the patient is not developing pulmonary edema. If rales are heard on the examination, then give the patient IV furosemide.*

What is the most accurate diagnostic test for this patient?

a. CT scan
b. Magnetic resonance angiography (MRA)
c. Angiography

Answer a. CT scan

CT scan of the abdomen allows for the rapid diagnosis of retroperitoneal bleeding and provides useful information on the type, site, and extent of the collection. MRA is also useful and provides further information regarding soft tissue; however, because of its lengthy procedure time and the emergent nature of SRB, the test is not often used. Angiography is the correct answer when the patient is hemodynamically stable and the bleed is attributable to iatrogenic causes rather than being of a spontaneous nature.

Orders:

- *CT scan of the abdomen*
- *Turn the clock forward 15 minutes to obtain a result.*

The CT scan reveals a large hematoma measuring 6 × 10.25 cm that extends slightly into the pelvis. The patient's repeat vital signs show a blood pressure of 102/65 mm Hg and a heart rate of 98 beats/min (Figure 2-5).

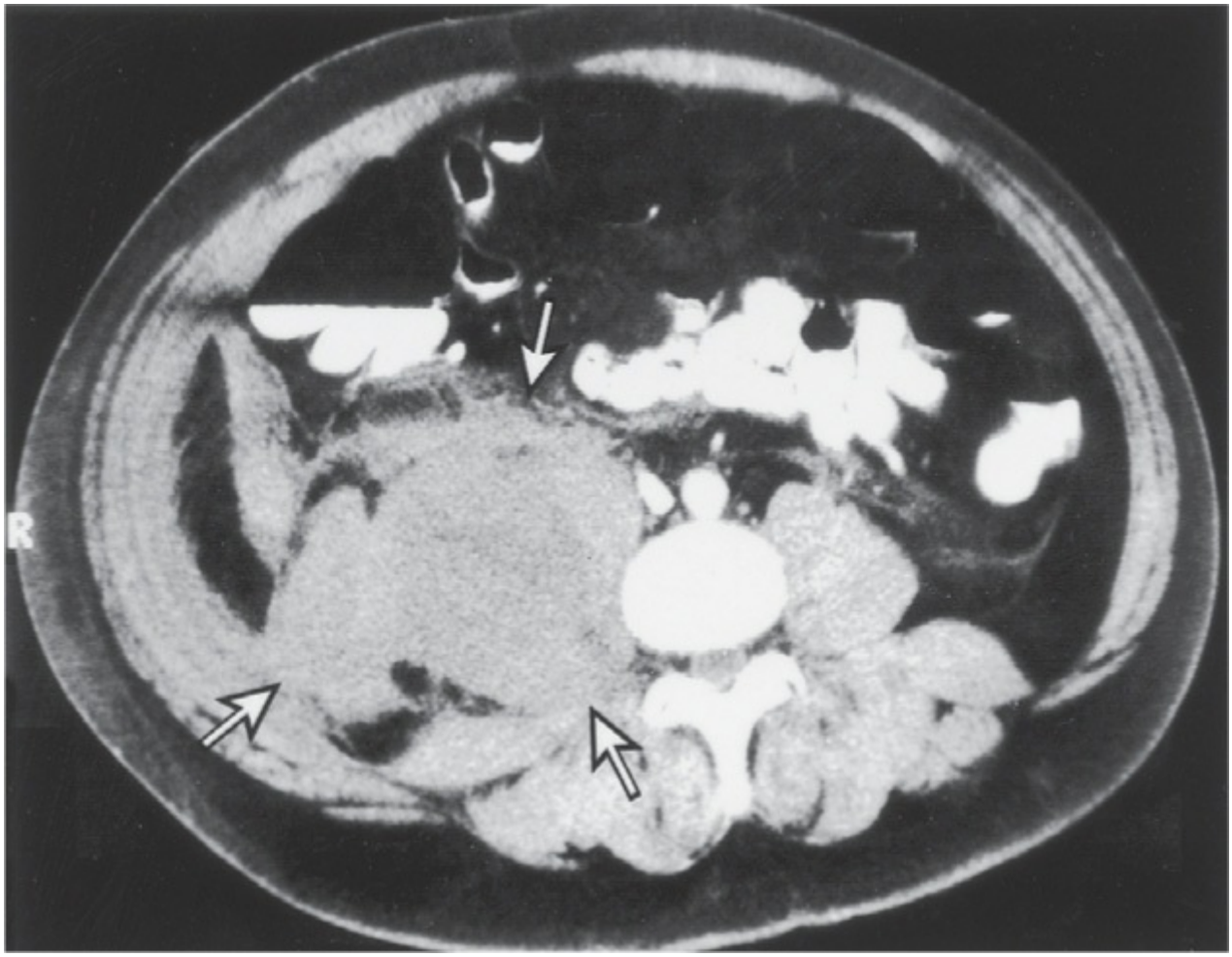


Figure 2-5. Computed tomography scan of a retroperitoneal hematoma in a patient with severe hemophilia A. Extent of the hematoma is indicated by the *arrows*. (Reproduced, with permission, from Roberts HR, Key NS, Escobar MA. Hemophilia A and hemophilia B. In: Lichtman MA, Kipps TJ, Seligsohn U, et al, eds. *Williams Hematology*. 8th ed. New York: McGraw-Hill; 2011.)

What is the most appropriate therapy in this patient?

a. Surgical repair

b. Embolization

c. Conservative management

Answer c. Conservative management

In the case of spontaneous retroperitoneal hemorrhage, the first-line treatment is conservative, consisting of withdrawal of anticoagulation therapy, correction of coagulopathy, volume resuscitation, and supportive measures. Embolization is the best treatment for retroperitoneal bleeds secondary to iatrogenic causes. Open surgery is indicated if the patient remains unstable despite adequate fluid and blood product resuscitation, or if interventional radiology is unavailable.

Orders:

- *Surgical consult*
- *Turn the clock forward, and the case will end.*

CASE 4: Anaphylaxis

Setting: *ED*

CC: *"I have a sore on my penis."*

VS: *BP, 118/64 mm Hg; R, 16 breaths/min; P, 68 beats/min; T, 98.6°F*

HPI: *A 22-year-old man presents to the emergency department after noticing a penny-sized painless lesion on his penis. He recently had unprotected sexual intercourse with a prostitute and is very scared about what is now "growing" on his penis. No previous lesions like this have ever been noticed and he says he occasionally wears condoms.*

PMH: *No past medical history*

ROS:

- *No fevers*
- *No headache*
- *No discharge from penis*

Physical Exam:

A small, red papule with superficial eroded non-ulcerated surface (Figure 2-6) and heaped-up borders that exude a serous fluid are seen. The lesion is 12 mm in diameter. There is also regional lymphadenopathy.

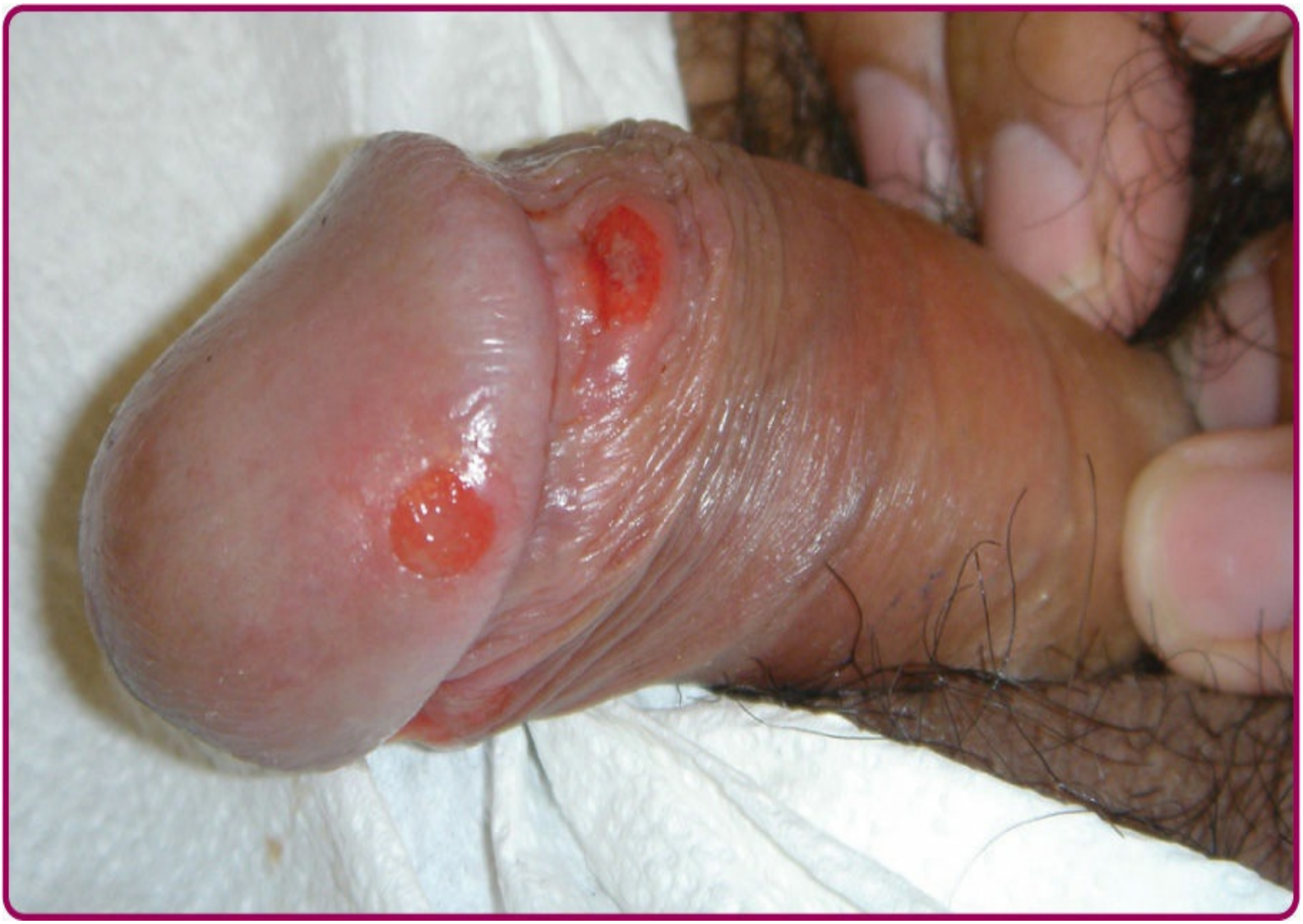


Figure 2-6. Multiple chancres on the glans and foreskin. (Reproduced, with permission, from Katz KA. Syphilis. In: Goldsmith LA, Katz SI, Gilchrest BA, et al, eds. *Fitzpatrick's Dermatology in General Medicine*. 8th ed. New York: McGraw-Hill; 2012.)

What is the most likely diagnosis?

a. Chancre
b. Chancroid
c. Herpes simplex
d. Warts
e. Balanitis

Answer a. Chancre

The most likely diagnosis is a chancre. The description of the lesion and the image seen is prototypic for primary syphilis, which is patho-mnemonically painless. A chancroid caused by *Haemophilus ducreyi* is painful can make the patient cry. Herpes simplex is classically a cluster of vesicles rather a single sore. Warts on the genitalia are caused by human papilloma virus (HPV) and appear like flesh-colored cauliflower-like lesions. Balanitis is an inflammation of the soft tissue of the glans of the penis secondary to *Staphylococcus aureus* infection.

Primary syphilis is diagnosed by darkfield microscopy or direct fluorescent antibody testing and confirmed with fluorescent treponemal antibody absorption (FTA-ABS). Venereal Disease

Research Laboratory (VDRL) test or rapid plasma reagin (RPR) is not used because there is a 25% false-negative rate.

Orders:
- *RPR*
- *Darkfield microscopy*
- *FTA-ABS*
- *Turn the clock forward, and a result will be generated.*

Syphilis is caused by the spirochete bacterium *Treponema pallidum*.
Chancroid is caused by gram-negative *Haemophilus ducreyi*.

The RPR result is negative, but a darkfield microscopy demonstrates a thin, delicate, corkscrew-shaped organism with rigid, tightly wound spirals. The FTA-ABS result is positive.

Treponema pallidum = Chancre = Painless
Haemophilus ducreyi = Chancroid = Painful

What is the most appropriate therapy for this patient?

a. Methicillin
b. Clindamycin
c. Rifampin
d. Penicillin G
e. Isoniazid

Answer d. Penicillin G

Intramuscular (IM) penicillin G is given to treat primary and secondary syphilis; tertiary syphilis is treated with 10 days of intravenous penicillin G. If there is an allergy to penicillin, then azithromycin or doxycycline can be used as alternatives. Resistance to clindamycin and rifampin has been documented, therefore they are no longer used for in the treatment of syphilis. Methicillin is only used for sensitive *S. aureus* and does not work against *T. pallidum*. Isoniazid is the treatment of choice for latent tuberculosis infections.

Penicillin inhibits the formation of peptidoglycan cross-links in the bacterial cell wall.

Orders:

- *Intramuscular penicillin G*
- *Interval check*

CCS TIP: *After the administration of any drug, the CCS should always order an interval check to see how the patient is doing.*

The patient receives one dose of penicillin G. The patient is complaining of difficulty breathing and swallowing. His blood pressure is 88/40 mm Hg, and his heart rate is now 120 beats/min.

CCS TIP: *If there is ever a clinical change in a patient's condition, immediately do a physical examination.*

Orders:

- *Physical examination of relevant organ systems (i.e., lung, skin, and heart examination).*
- *Continuous pulse oximetry*

Examination reveals respiratory distress with a rate of 28 breaths/min. Auscultation of the lungs reveals wheezing at the bases. Tachycardia is present. The patient is unable to speak, feels lightheaded, and has shortness of breath. There are generalized hives present, and the patient's lips are swollen.

What is the most likely diagnosis?

a. Anaphylactic shock
b. Sepsis
c. Pulmonary embolus
d. Myocardial infarction

Answer a. Anaphylactic shock

The acute onset of an illness involving the skin and mucosa combined with respiratory compromise and reduced blood pressure and subsequent end-organ dysfunction is anaphylactic shock. Anaphylaxis is a distributive form or vasodilatory form of shock in which there is massive drop in the systemic vascular resistance (SVR). The cardiac output is increased through an increase in heart rate as a compensatory mechanism. Sepsis is also a distributive form of shock but without evidence of systemic inflammatory response syndrome criteria or a source of infection, this is highly unlikely. A pulmonary embolus will not present with a high cardiac output state but will rather have a low CO. Furthermore, the absence of chest pain makes a diagnosis of emboli or myocardial infarction much more difficult (Table 2-4).

Table 2-4 Anaphylactic Shock

Type of Shock	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	Pulmonary capillary wedge pressure	Cardiac output	Systemic vascular resistance	Mixed venous oxygen saturation
Anaphylactic shock	Decreased	Increased	Decreased	Increased

Antigen + IgE activates mast cells and basophils to release cytokines, inflammatory mediators, and histamine.

Cold and clammy = Tight arteries = High SVR
Warm and wet = Open arteries = Low SVR

What is the best next step in the management of this patient?

a. Steroids
b. H1 blockers
c. H2 blockers
d. Intramuscular (IM) epinephrine
e. Subcutaneous (SC) epinephrine

Answer d. Intramuscular (IM) epinephrine

The patient should immediately be given IM epinephrine, which is the drug of choice and the most appropriate therapy for anaphylaxis. This is in addition to management of the patient's airway, breathing, and circulation. IM epinephrine decreases the total mediator release from mast cells and is the only medication that reverses the obstructive state of the upper and lower airways. H1 and H2 blockers relieve itching and hives but do nothing for the airway constriction, hypotension, and

shock. Steroids take several hours to take effect, and by that point, the patient will have already died from shock. SC epinephrine is simply the wrong route, and extravasation of epinephrine into the local skin can actually cause localized necrotic areas from microvascular constriction.

Epinephrine does what?
α_1-Agonist effects: Increased vasoconstriction and vascular resistance.
β_1-Agonist effects: Increased inotropy and increased chronotropy.
β_2-Agonist effects: Increased bronchodilation and decreased release of inflammatory mediators.

Orders:
- *IM epinephrine*
- *Central venous access*
- *Intubate the patient*
- *Transfer to the intensive care unit*

CCS TIP: *Turn the clock forward, and the case will end.*

CASE 5: Cardiogenic Shock

Setting: *CCU*

CC: *Chest pain*

HPI: *A 71-year-old man is transferred to the cardiac care unit after having an anterior wall myocardial infarction. The patient underwent coronary catheterization, and two drug-eluting stents were placed in the left anterior descending artery. Twelve hours later, the patient is confused and is unable to remember where he is.*

VS: *BP, 74/68 mm Hg; R, 28 breaths/min; P, 99 beats/min; T, 98.6°F*

ROS: *Shortness of breath*

Physical Exam:

- *Altered mental status AAOx1 without focal neurologic deficit*
- *Distended neck veins*
- *Cool skin*
- *Rales bilaterally*
- *Gallop rhythm is noted*
- *Decreased intensity of peripheral pulses*
- *Decreased urinary output for the past 6 hours*

What is the most likely diagnosis?

a. Septic shock
b. Hypovolemic shock
c. Hemorrhagic shock
d. Anaphylactic shock
e. Cardiogenic shock

Answer e. Cardiogenic shock

Cardiogenic shock is the most likely diagnosis because of the inability of the heart to pump an adequate amount of blood to perfuse peripheral tissues. Left or right ventricular failure is the underlying primary cause of the "pump failure." This then leads to tissue hypoperfusion, pulmonary congestion, and ultimately venous congestion. The drop in blood pressure from pump failure leads to a compensatory elevation in the systemic vascular resistance (SVR). This increase in SVR causes tissue hypoperfusion through catecholamines and eventual coronary hypoperfusion, which leads to a downward cycle of ischemia that leads to death. The inability of the heart to move preload forward yields the classic physical findings of distended neck veins, rales, and oliguria (Table 2-5).

Table 2-5 Cardiogenic Shock

Type of Shock	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	Pulmonary capillary wedge pressure	Cardiac output	Systemic vascular resistance	Mixed venous oxygen saturation
Cardiogenic shock	Increased	Decreased	Increased	Decreased

Acute myocardial infarction (MI) is the most common cause of cardiogenic shock.

Initial Orders:

- *Intubate*
- *Continuous cardiac monitoring*
- *Complete blood count*
- *Troponin*
- *Creatinine kinase MB (CK-MB)*
- *Electrocardiography (ECG)*
- *Comprehensive metabolic profile (CMP)*
- *Lactic acid level*
- *Transthoracic echocardiography*
- *Cardiology consult*

CCS TIP: *After ordering the above tests, transfer the patient to the CCU if he is not already there. Turn the clock forward and await the results.*

ECG demonstrates normal sinus rhythm with left axis deviation at a rate of 92 mg/dL. Blood urea nitrogen/creatinine (BUN/Cr) are increased from their baseline to 54/2.5 mg/dL. Lactic acid 4.5 mEq/L. Troponin and CK-MB are unchanged from previous values.
Echocardiography reveals global left ventricular systolic dysfunction, with decreased stroke

volume and elevated filling pressures.

Further Orders:

- *Aspirin*
- *Clopidogrel*
- *Heparin*
- *Norepinephrine*

β-Blockers are contraindicated in cardiogenic shock because of negative inotropic activity.

What is the best next step in the management of this patient?

a. Intraaortic balloon pump (IABP)
b. Repeat coronary angiography
c. Thrombolytics

Answer a. Intraaortic balloon pump (IABP)

The next step in the management of this patient is placement of an IABP, which increases myocardial oxygen perfusion while at the same time increasing cardiac output. The balloon inflates in diastole, increasing blood flow to the coronary arteries, and deflates in systole, increasing forward flow through a vacuum effect. Repeat coronary angiography is only indicated in patients in whom reperfusion of the coronary vessel failed or further reperfusion is necessary. Based on this patient's laboratory test results and ECG, a repeat MI has not occurred. Thrombolytics are the therapy of choice in a patient who has a massive pulmonary embolus causing cardiogenic shock.

The ultimate treatment for a patient who is not improving after placement of IABP is cardiac transplantation.

CCS TIP: *Order an IABP and turn the clock forward. The case will end.*

NEUROLOGIC EMERGENCIES AND HEAD TRAUMA

CASE 1: Epidural Hematoma

Setting: *ED*

CC: *"Patient is unconscious; unable to provide chief complaint."*

VS: *BP, 151/67 mm Hg; R, 16 breaths/min; P, 59 beats/min; T, 98°F*

HPI: *A 27-year-old convenience store worker was found unconscious after a robbery took place in his shop. A patron in the store recounts that the robbers hit the man on the side of the head with a baseball bat. Witnesses state the patient was unconscious for about 5 minutes before regaining consciousness in the ambulance. After a brief period of time, he became somnolent.*

ROS: *Unable to provide ROS*

Physical Exam:

- *Large 1-cm laceration over temporoparietal region of scalp*
- *No battle sign*
- *No raccoon eyes*
- *Right pupil, 8 mm; sluggish reactivity to light*
- *Left pupil, 4 mm; normal reaction to light*
- *The patient only opens his eye to painful stimuli, makes incomprehensible sounds, and withdraws from painful stimuli.*
- *Cervical collar in place covered in blood on the right side*
- *No evidence of respiratory distress*

Fixed and dilated pupil:

- Third cranial nerve compressed against tentorium
- Temporal lobe herniation
- Parasympathetic fibers on outside of third nerve
- Crushing parasympathetics first
- Parasympathetic nerves normally *constrict* pupil

Crushing CONSTRICTORS = DILATION!

What is the "Cushing reflex?"

a. Hypoadrenalism
b. Transection of pituitary stalk from trauma
c. Bradycardia and hypertension
d. Sudden onset of cortisol excess

Answer c. Bradycardia and hypertension

Cushing reflex = Bradycardia and hypertension. Increased intracranial pressure (ICP) causes increased sympathetic outflow, activating α_1-adrenergic receptors, causing an increase in blood pressure. Subsequently the increase in blood pressure triggers a parasympathetic response via the vagus nerve, causing bradycardia.

What is the best next step in the management of this patient?

a. Bolus of intravenous (IV) fluids
b. Steroids
c. Intubation
d. Start antibiotics
e. Suture the laceration

Answer c. Intubation

Patients with a Glasgow Coma Scale (GCS) score of 8 or less who were intubated were shown to have better outcomes at 6 months. Early intubation is the best next step in management of this patient because there is an urgent need to control ventilation and oxygenation. Through intubation, hyperventilation can be performed, which will allow for adequate long-term control of ICP. The patient at this point would not benefit from IV fluids or antibiotics, and in the time it takes to suture the laceration, the patient will herniate. Last, steroids have no role in treatment of traumatic brain injury (TBI) and do not reduce mortality.

The patient is moved to the resuscitation room, where he is intubated, the head of the bed is elevated, and hyperventilation is performed. The patient is being readied for transfer to the intensive care unit (ICU).

CCS TIP: *Any patient who is intubated must be transferred to the ICU.*

Which is the best way to reduce deep venous thrombosis (DVT) in patients with intracranial hemorrhages?

a. Low-molecular-weight heparin
b. Subcutaneous unfractionated heparin
c. Pneumatic compression devices

Answer c. Pneumatic compression devices

Pneumatic compression devices or thigh-high stockings are the best way to prevent DVT in patients with intracranial hemorrhage. Using anticoagulants such as heparin subcutaneously may make the bleeding worse and is therefore contraindicated.

Intubation = Proton pump inhibitor (PPI) therapy to reduce Cushing's ulcers
Cushing's ulcers = Stress ulcers = Curling's ulcers → All get PPI

What is the best next step in the management of this patient?

a. Suture the wound
b. Computed tomography (CT) scan of the head without contrast
c. CT scan of the head with contrast
d. Give steroids
e. Start antibiotics

Answer b. Computed tomography (CT) scan of the head without contrast

After initial resuscitation efforts, the best next step in management is a CT scan of the head. The CT scan of the head must be without contrast in an effort to ensure proper identification of blood. Remember both blood and contrast appear white; therefore, using contrast would give a false-positive result. It is paramount to identify herniation, mass effect, and large areas of bleeding because these will change management. Giving steroids and antibiotics does not have any effect on outcomes of epidural bleeds.

Hyperventilation = Decreased CO_2 = Vasoconstriction
- Decreases volume in brain
- Less pressure compressing brain

GCS score of 8 or lower = Severe TBI

Loss of consciousness = CT scan of the head
Loss of consciousness = CT!

A CT scan is obtained and is seen below (Figure 3-1). What is the most likely

diagnosis?

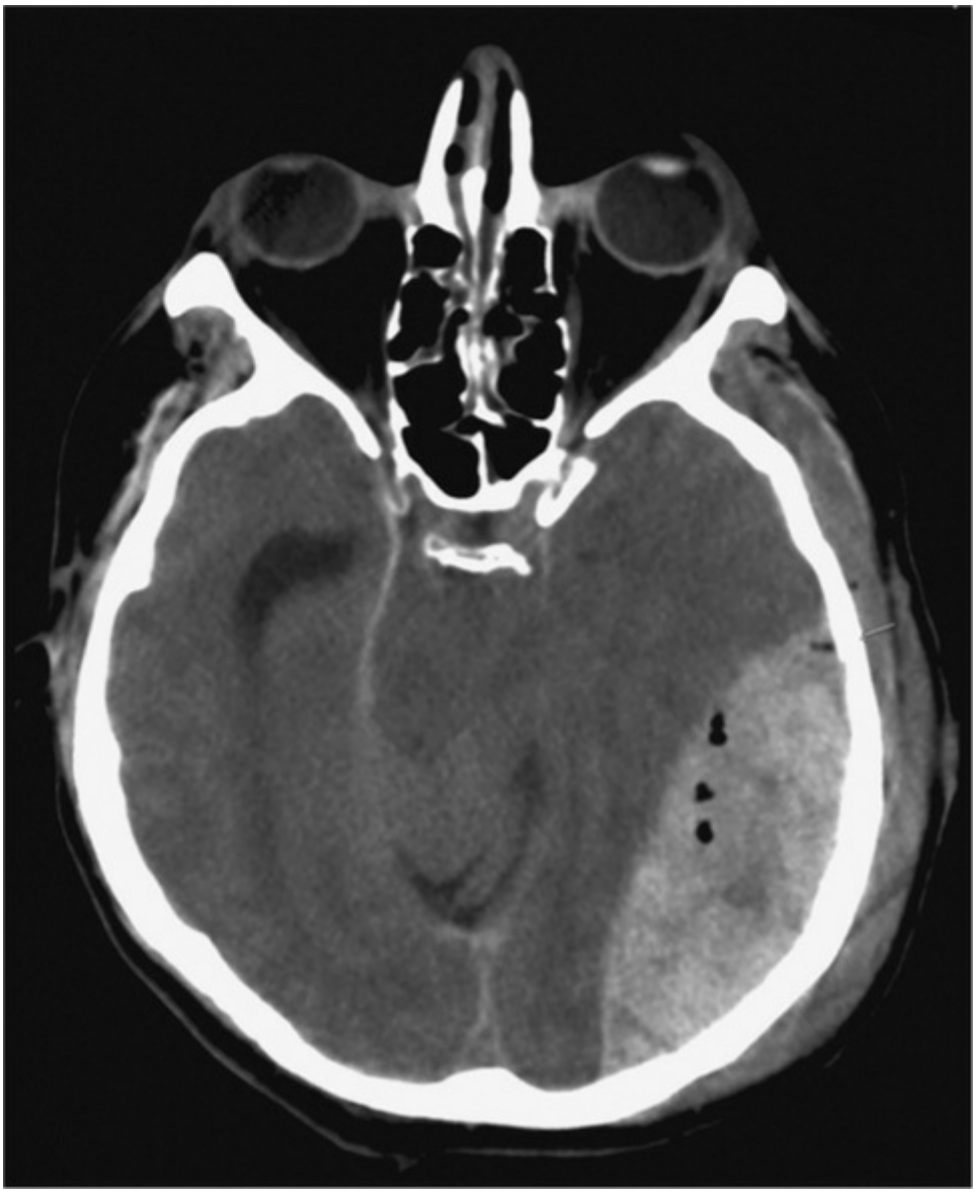


Figure 3-1. Acute epidural hematoma produced by laceration of the middle meningeal artery. (Reproduced, with permission, from Knoop KJ, et al. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010, Photo contributor: Lawrence B. Stack, MD.)

a. Epidural hematoma
b. Subdural hematoma
c. Subarachnoid hemorrhage

Answer a. Epidural hematoma

The image shows a biconvex bleed characteristic of an epidural hematoma, which carries a mortality rate of approximately 15% to 20%. Remember that epidural hematomas are classically seen in patients with high-velocity trauma. Both epidural and subdural hematoma can have a "lucid interval." The "lucid interval" is the time between initially passing out from a concussion and then waking up until blood accumulates again, resulting in another loss of consciousness. The most commonly affected vessel in epidural hematomas is the middle meningeal artery (Figure 3-2). The rest of the answer options do not fit the image as seen.

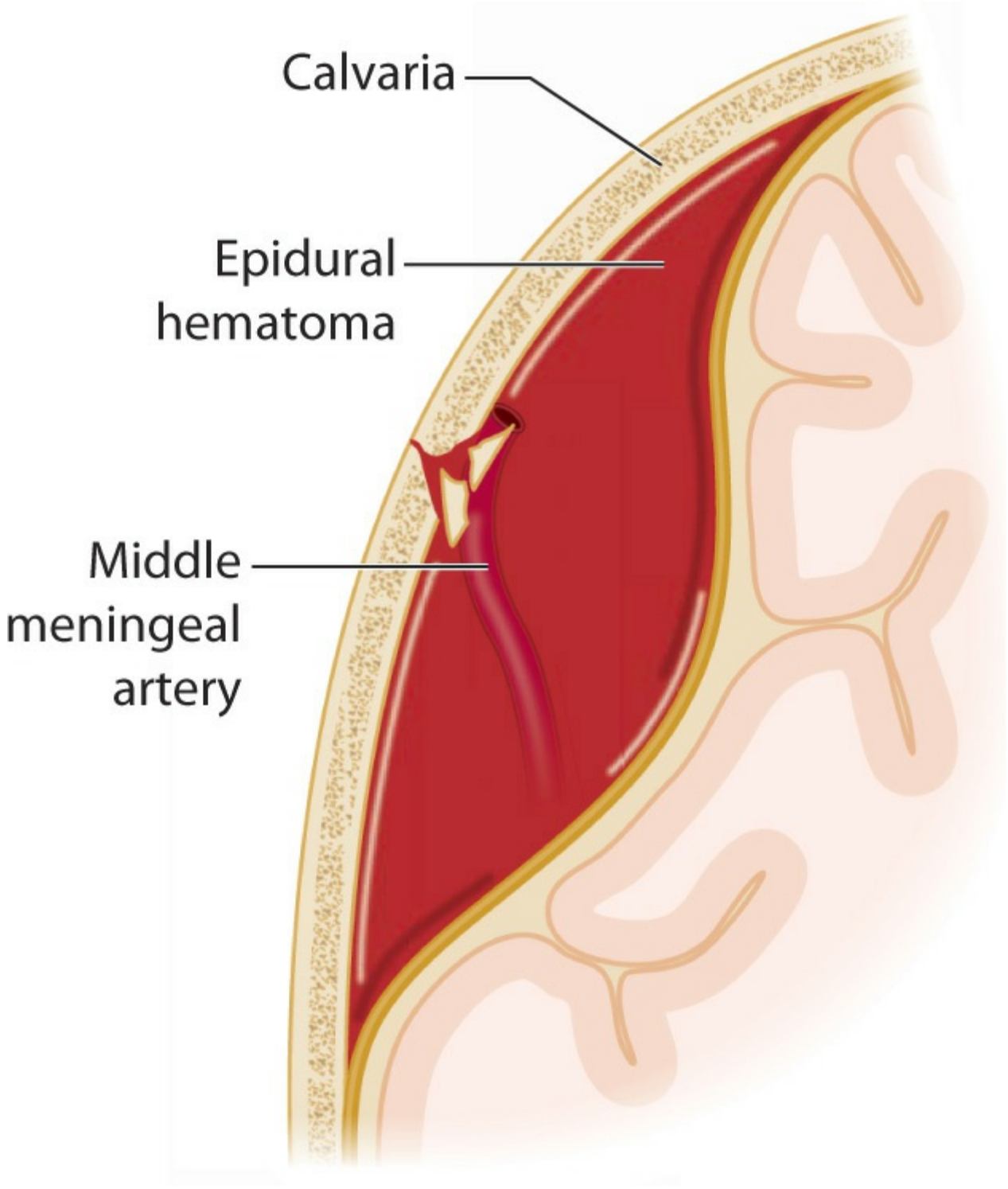


Figure 3-2. Schematic illustration of an epidural hemorrhage. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine, A Comprehensive Study Guide*. 7th ed. New York: McGraw-Hill; 2011.)

Lucid interval = epidural or subdural hematoma

Middle meningeal artery:
- Third branch of maxillary artery
- Maxillary is a branch of external carotid artery.

USMLE Step 3 will require you to be able to recognize specific imaging such as the head CT scan in Figure 3-1.

CCS TIP: *After you order the CT scan, move the clock forward to obtain the report. CCS always tells you when the report is available as soon as you order a test. You do not have to speculate on when any test report is available.*

The epidural space is between the skull and the dura.
The dura, arachnoid, and pia maters also surround the brain and as shown in Figure 3-3.

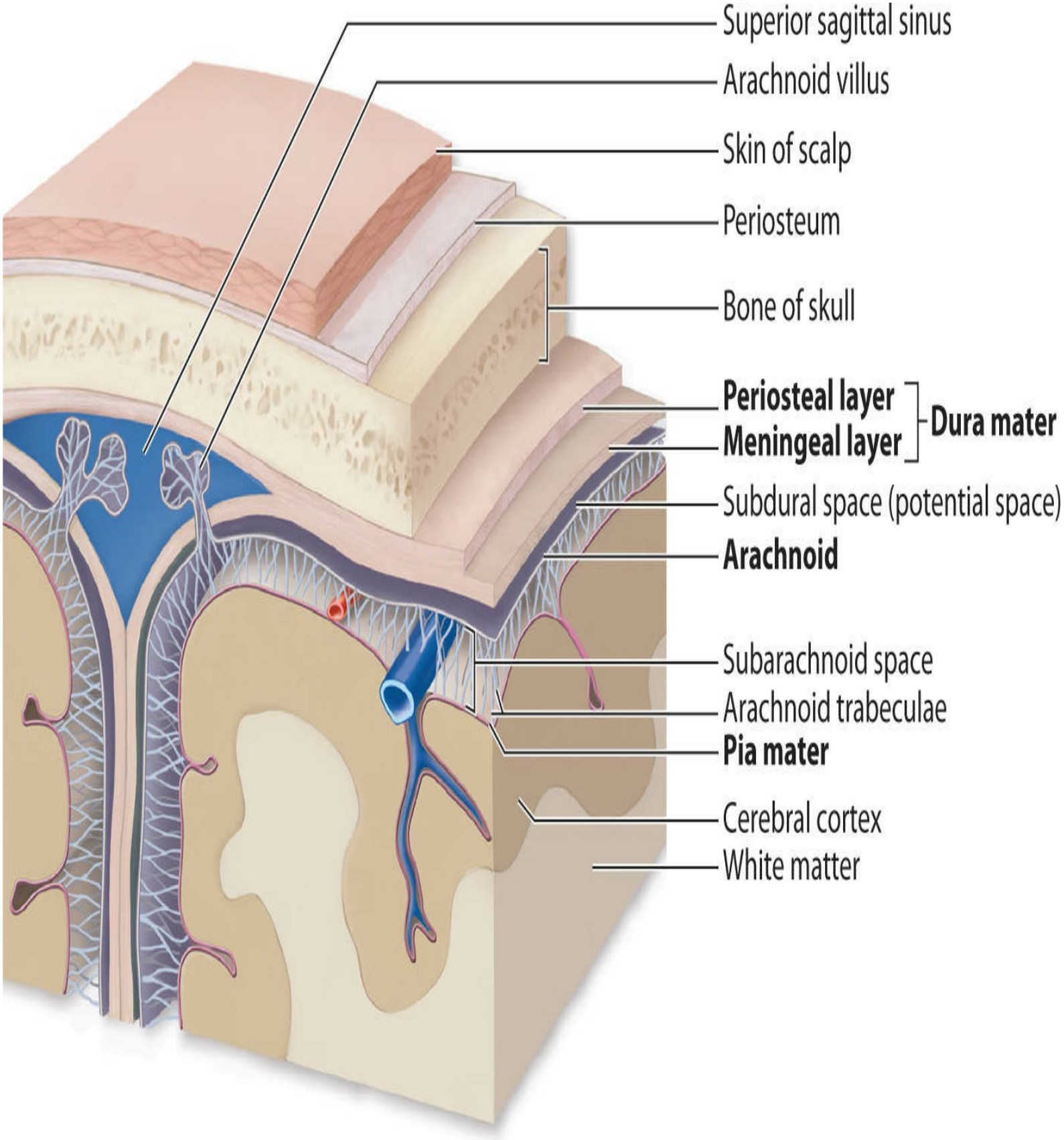


Figure 3-3. The dura, arachnoid, and pia maters also surround the brain. As shown here, the relationships among the cranial meninges are similar to those of the spinal cord. (Reproduced, with permission, from Mescher AL. *Junqueira's Basic Histology: Text & Atlas*. 13th ed. New York: McGraw-Hill; 2013.)

The CT scan of the head reports an epidural hematoma, biconvex in shape, that is 45 mL in volume.

CCS TIP: *CCS does not itself show images such as radiographs, CT scans, magnetic*

resonance images (MRIs), or electrocardiograms. You are given the report. The single best answer questions will show you the actual image.

Which of the following is the most effective therapy for this patient?

a. CT-guided drainage
b. MRI-guided drainage
c. Intraoperative drainage
d. Endovascular (going through a catheter) drainage

Answer c. Intraoperative drainage

The most effective therapy in this patient is immediate surgical evaluation and hematoma evacuation through either a burr hole or craniotomy.

Order a neurosurgical evaluation and burr hole or craniotomy as the next steps for therapy.
Urgent surgical evacuation is the most effective therapy for:

- *Patients with acute epidural hematoma and coma (GCS score ≤8) and combined pupillary abnormalities (anisocoria)*
- *In patients who are found to have a bleed greater than 30 mL in size. The time frame to operating room time for epidural hematomas that require surgery should be less than 2 hours.*

Turn the clock forward after ordering the neurosurgical evaluation and intervention. The case will then end.

CASE 2: Subdural Hematoma

Setting: *ED*

CC: *"My father isn't himself."*

VS: *BP, 161/77 mm; R, 16 breaths/min; P, 60 beats/min; T, 99.1°F*

HPI: *A 69-year-old man is brought to the emergency department by his daughter, who says her father has been complaining of a headache for the past few days. He has been sleeping more than usual and is inattentive. Two weeks ago he tripped and fell off the stoop in the front of their house. He had a small scrape to his forehead but that has since healed. Her father is nauseated and vomited once in the holding area of the ED. The patient has been walking oddly as well.*

PMH: *Hypertension and osteoporosis*

ROS:

- *No fever*
- *No neck pain*
- *No chest pain*
- *No shortness of breath*

Physical Exam:

- *Right pupil, 6 mm; sluggish reactivity to light*
- *Left pupil, 4 mm; normal reaction to light*
- *The patient is confused and AAOx1. Localizes pain to his head and opens his eyes in response to painful stimuli.*
- *Decreased strength 3/5 left upper extremity and 4/5 left lower extremity*
- *No respiratory distress noted*

What is the most likely diagnosis?

a. Epidural hematoma
b. Subdural hematoma
c. Subarachnoid hemorrhage
d. Meningitis
e. Guillain-Barré syndrome

Answer b. Subdural hematoma

Given this patient's presentation, the most likely diagnosis is subdural hematoma (SDH). The classic presentation is patients who have experienced low-velocity trauma without a lucid interval and develop increasing neurologic abnormalities such as headache, weakness, anisocoria, hypersomnolence, and disorientation. These bleeds are classically very slow and take time to

accumulate. Their presentation can be anywhere from 24 hours to up to several weeks. Epidural hematoma is unlikely because an epidural is an acute event, whereas can be more chronic or over several days. Subarachnoid hemorrhage is unlikely given the lack of neck stiffness, photophobia, and the "worst headache of my life." Furthermore, the timing of presentation in epidural hematoma and subarachnoid hemorrhages would not be 2 weeks; these patients would be dead at 2 weeks. Meningitis does not fit because this patient has no meningeal signs and no fever, and the case is in the setting of posttrauma, making it a far less likely diagnosis. Guillain-Barré syndrome does not fit with unilateral weakness. Guillain-Barré has ascending weakness bilaterally.

All clots and hematomas can give a fever.

What is this patient's Glasgow Coma Scale (GCS) score?

The patient's physical examination reveals that he is confused and AAOx1. He localizes pain to his head and opens his eyes in response to painful stimuli. The total GCS score is 11.

Mild head injury = GCS score of 13 to 15
Moderate head injury = GCS score of 9 to 12
Severe head injury = GCS score <8

Timing is key; the USMLE may require you to differentiate SDHs based on timing.

Acute SDH presents 1 to 2 days after onset.
Subacute SDH presents 3 to 14 days after onset.
Chronic SDH presents 15 or more days after onset.

What is the best initial test for the management of this patient?

a. Magnetic resonance imaging (MRI)
b. Computed tomography (CT) scan of the head
c. Steroids
d. Ceftriaxone and vancomycin

Answer b. Computed tomography (CT) scan of the head

The best next step in management and the best initial test for diagnosing a subdural hematoma is to order a head CT scan without contrast. The classic finding on a head CT is crescent-shaped hematoma. Remember evaluating for ABCs (airway, breathing, and circulation) is always the next

step in the evaluation of any patient; however, in this case it was not an option. Therefore, you can safely assume those components are taken care of. Contrast is not to be given because it appears the same as blood on CT scans. MRI is not the best initial test because it takes too long, and with intracranial hemorrhage, time is tissue. MRI is the most accurate test for everything except blood. It is not done with head trauma unless the CT scan is nondiagnostic. Steroids are not helpful in bleeding. Ceftriaxone and vancomycin are the best initial therapy for meningitis, however in this case is no infectious process going on in which antibiotics are needed.

The subdural space is between the dura and the arachnoid space.

A CT scan is obtained and shows a lens-shaped epidural hematoma (see Figure 3-1).

Epidural → Biconvex hematoma
Subdural → Crescent shaped

Which of the following structures is responsible for the underlying pathophysiology of this condition?

a. Bridging veins
b. Middle meningeal artery
c. Anterior ethmoidal artery

Answer a. Bridging veins

The bridging veins are the anatomic structure that is torn because of shearing forces that occur with trauma. These bridging veins drain the underlying neural tissue and puncture the dura mater and empty into the dural sinuses. The middle meningeal artery and anterior ethmoidal artery are both vessels that are involved with epidural hematomas, with the middle meningeal artery being the most common cause (Figure 3-4).

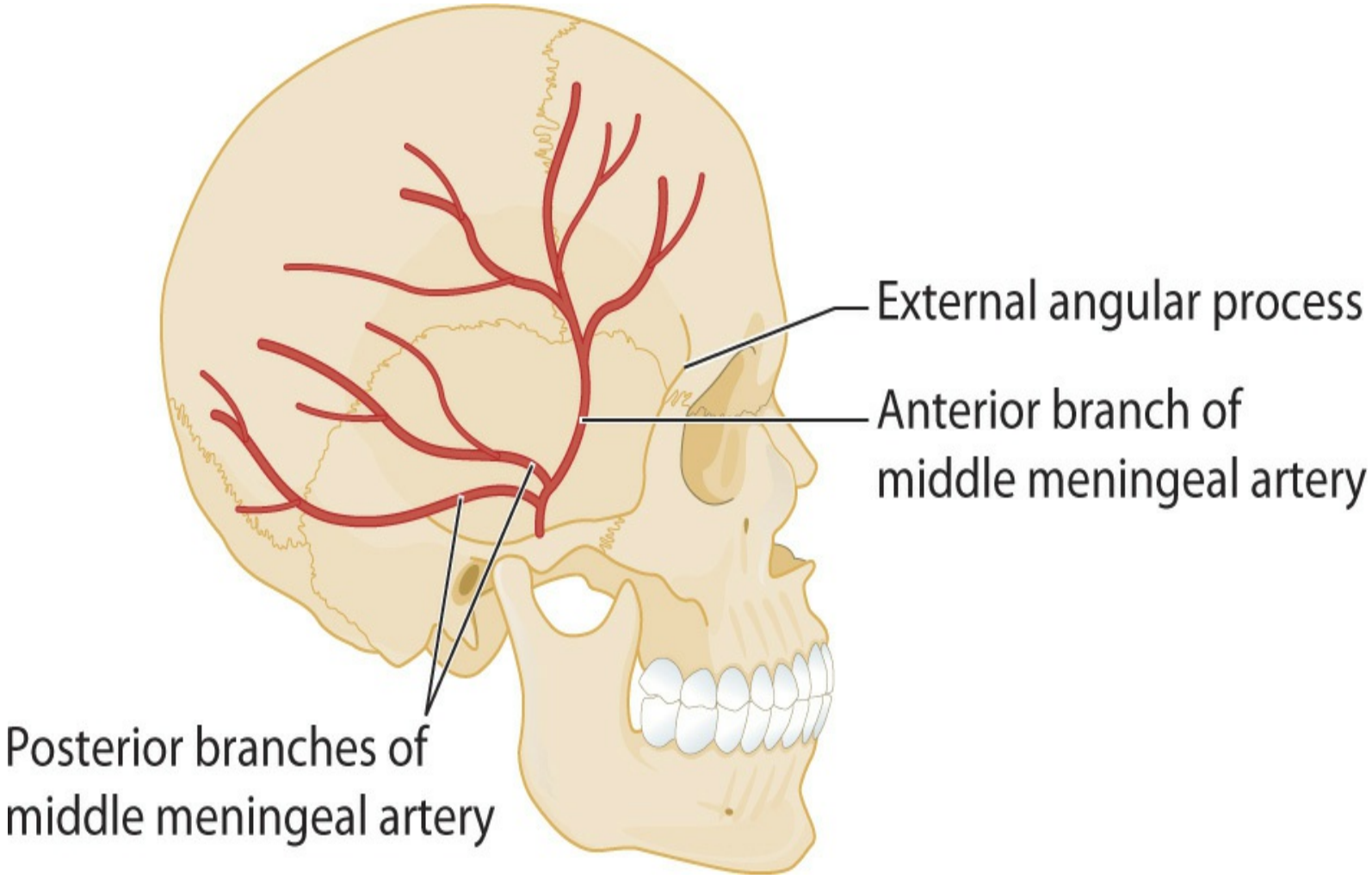


Figure 3-4. Anatomic relationships of the branches of the middle meningeal artery. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York: McGraw-Hill; 2011.)

The six layers of the skull and meninges are:

1. Skin
2. Periosteum
3. Bone
4. Dura mater
5. Arachnoid
6. Pia mater

Move the clock forward 15 minutes at a time for two to three intervals. Order "interval history" and new vital signs.

The patient is fully stabilized and transferred to the intensive care unit (ICU). The CT scan report returns and shows a hematoma 11 mm in size and accompanying midline shift.

CCS TIP: *Move all patients with intracranial hemorrhage to the ICU.*

What is the best next step in the management of this patient?

Answer. The most accurate therapy in this patient is immediate surgical evaluation and hematoma

evacuation through either a burr hole or craniotomy. Surgical evaluation is indicated on any subdural hematomas with:

1. Hematomas >10 mm in thickness
2. Midline shift >5 mm on CT
3. GCS score ≤8 or if the GCS score has decreased by ≥2 points from the time of injury to hospital admission
4. Patient presents with asymmetric or fixed and dilated pupils

CASE 3: Subarachnoid Hemorrhage

Setting: *ED*

CC: *"My head hurts bad, and I passed out."*

VS: *BP, 161/97 mm; R, 16 breaths/min; P, 99 beats/min; T, 101°F*

HPI: *A 39-year-old man presents with a very severe headache that began about 2 hours ago while at work. He awoke after the headache on the floor surrounded by his colleagues. Witnesses say he lost consciousness for about 3 minutes. The pain is severe, constant, and located over his forehead. He feels dizzy and nauseated since the onset of his headaches. He recently has been having severe headaches that resolved after a few hours for the past few days that were not alleviated by taking sumatriptan. He is having difficulty answering your questions.*

PMH: *Migraine headaches*

Medications: *Sumatriptan*

ROS:
- *Photophobia*
- *Orbital pain*
- *No diplopia*
- *No visual loss*
- *No seizures*
- *No dysphasia*

Physical Exam:
- *Funduscopy demonstrates blurring of optic disc margins*
- *Brudzinski's sign present*
- *Right pupil, 6 mm; sluggish reactivity to light*
- *Left pupil, 4 mm; normal reaction to light*
- *Equal strength 5/5 left upper extremity and 5/5 left lower extremities*
- *No respiratory distress is noted*

Neck stiffness or pain on flexion of the neck is caused by blood irritating the meninges.

What is the most likely diagnosis?

a. Epidural hematoma
b. Subdural hematoma

c. Subarachnoid hemorrhage (SAH)
d. Meningitis

Answer c. Subarachnoid hemorrhage (SAH)

SAH presents with the sudden onset of headache described as "thunderclap" or the "worst headache of my life" combined with loss of consciousness (LOC) and meningeal signs. SAH can be thought of as the sudden onset of meningitis with LOC but without a fever. The lack of trauma makes epidural and subdural hematoma unlikely, and the answer meningitis is meant to trick you. Remember that meningitis is not as sudden as a SAH and is more gradual. SAH can have a fever because it is a collection of blood.

Any clot or collection of blood can give a fever.

Patients with SAH have a minor hemorrhage or "warning leak," causing the "sentinel headache" that precedes the SAH by several days.
SAH = Sudden onset of meningitis + LOC

What is the most common etiology of SAH?

a. Rupture of a berry aneurysm
b. Rupture of an arteriovenous malformations (AVMs)
c. Trauma
d. Neoplasm

Answer a. Rupture of a berry aneurysm

Rupture of a berry aneurysm accounts for up to 80% of SAHs and is the most common underlying etiology; AVMs are the second most common cause. These aneurysms are the result of weakness in the walls of the vessels that make up the circle of Willis (Figure 3-5). The most common location of this aneurysm on the circle of Willis is at the anterior communicating artery. Rupture of major vessels is not a common finding, and neoplasms are far less common. The rupture of the aneurysm is directly proportional to the tension across the wall of the aneurysm. Trauma is not what makes the aneurysm rupture. The law of La Place states that the radius of the aneurysm and the pressure gradient determine tension across the wall of the aneurysm. Therefore, the rate of rupture is directly related to the size of the aneurysm.

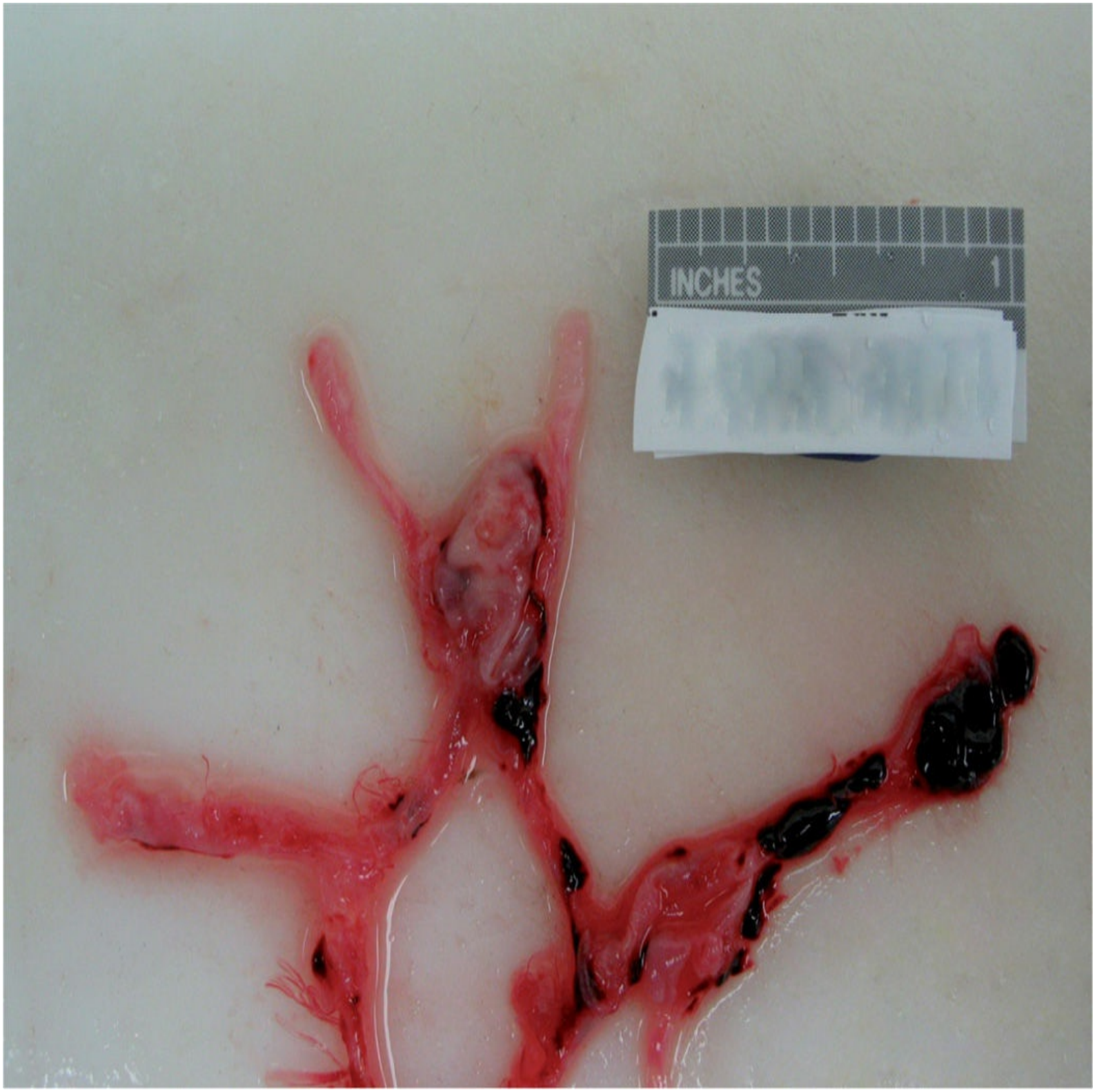


Figure 3-5. Berry (saccular) aneurysm. Arising from the junction of the anterior communicating cerebral artery and the left anterior cerebral artery is an approximately 1.0-cm aneurysm. Most berry aneurysms occur within the cerebral vessels derived from the internal carotid system and most commonly arise at arterial branch points. (Reproduced, with permission, from Kemp, WL, et al. *Pathology: The Big Picture*. New York: McGraw-Hill; 2008.)

Cigarette smoking is the most important preventable risk factor for SAH.
Hypertension is the single most treatable risk factor for SAH.

The patient is brought into the resuscitation room, where airway and breathing are secured and intravenous (IV) access is obtained. The patient's examination results have not changed, but his pain is still 10 of 10. SAH is seen on head computed tomography (CT) scan (Figure 3-6).

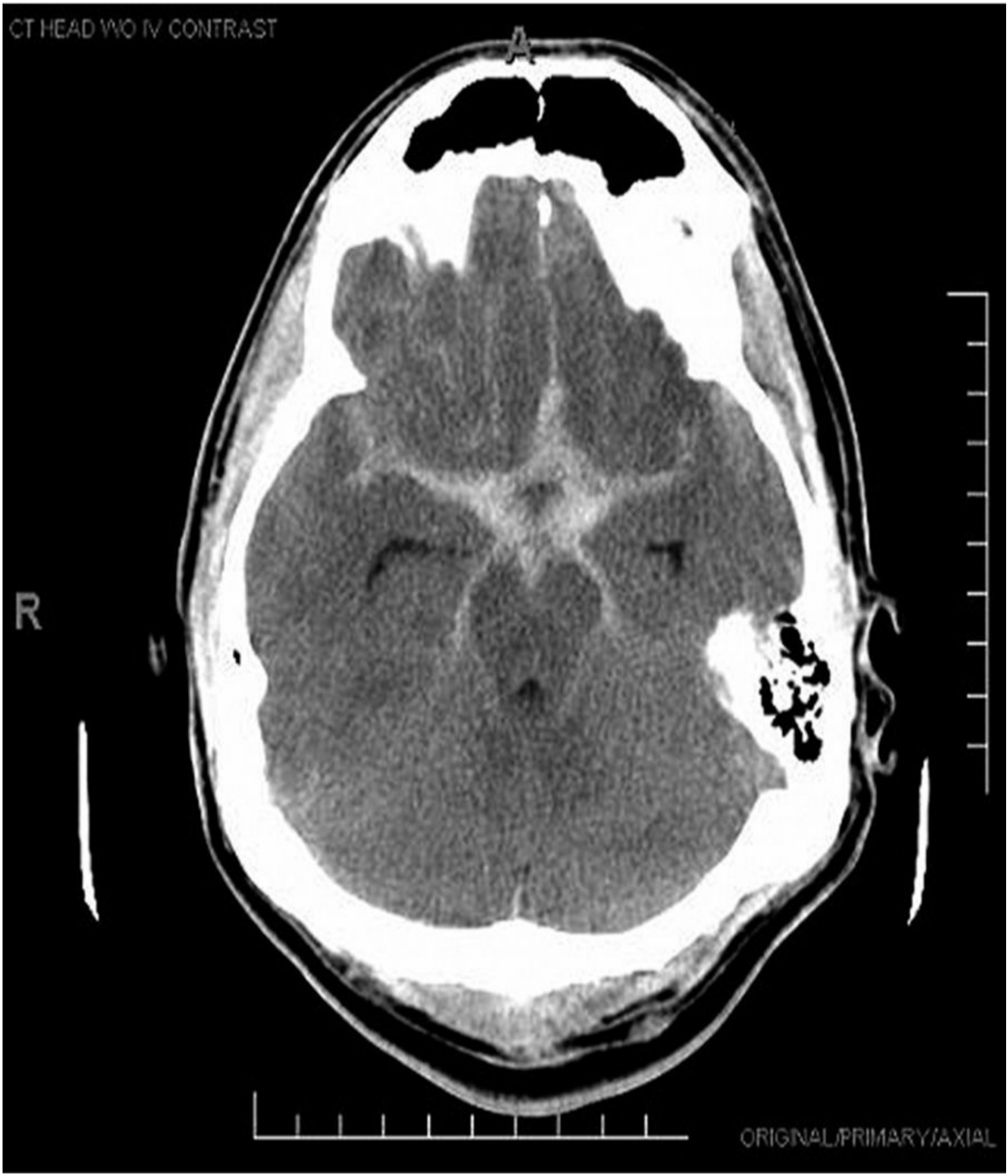


Figure 3-6. Classic appearance of a large subarachnoid hemorrhage. Notice that the hemorrhage pattern fills the cerebrospinal fluid spaces at the base of the brain and around the brainstem. (Reproduced, with permission, from Doherty GM. *Current Diagnosis & Treatment: Surgery*. 13th ed. New York: McGraw-Hill; 2010.)

What is best next step in the management of this patient?

a. CT angiography of the brain
b. Lumbar puncture
c. Magnetic resonance angiography of the neck vessel

Answer a. CT angiography of the brain

The best next step in management of this patient is a CT angiography of the brain to determine the site of bleeding. Magnetic resonance imaging (MRI) is not needed if the CT scan shows the SAH. MRI is not as sensitive for SAH within the first 48 hours. It is important to know that if no lesion is found on head CT, then a lumbar puncture (LP) is performed. The most accurate test for SAH is an LP, but if the CT shows bleeding, then the LP is not necessary.

To tell if an increased number of white blood cells (WBCs) in cerebrospinal fluid (CSF) is caused by infection or from blood, look at the ratio of the cell count on the LP.
Normal WBC count: Red blood cells (RBC) count → 1 WBC: 500 RBC

Xanthochromia is the yellowish appearance of CSF secondary to SAH.

The CT angiogram scan shows a large intracranial hemorrhage consistent with SAH resulting from an aneurysmal rupture.

Which of the following therapies has been shown to reduce mortality in SAH?

a. Nimodipine
b. Enalapril
c. Labetalol
d. Heparin
e. Aspirin

Answer a. Nimodipine

Nimodipine is a calcium channel blocker that prevents surrounding vasospasm and subsequent vasospasm. This vasospasm is detrimental because it causes surrounding ischemia and stroke. Enalapril and labetalol are antihypertensives and are only to be used if the patient has elevated blood pressures (BP). The goal BP in SAH is 130 to 140 mm Hg, which should be maintained either by BP medications or by intravenous normal saline. Heparin and aspirin are the answers for deep venous thrombosis and ischemic stroke and would cause exacerbation of bleeding in SAH.

Nimodipine must be given orally. IV administration has been associated with serious adverse

events, including death.

Prophylactic antiepileptic drug therapy is never the right answer for SAH.

Which of the following is best next step in management of this patient?

a. Surgical clipping
b. Embolization
c. Ventriculoperitoneal (VP) shunt
d. Observation
e. Consult palliative care

Answer b. Embolization

Embolization through endovascular repair has been found to be superior to surgical clipping. Surgical clipping was the mainstay of therapy but is not superior to coil embolization, and VP shunt placement is only if hydrocephalus develops. To opt for observation would be detrimental, and palliative care is only done if all possible management considerations have been attempted and the patient's prognosis still seems quite poor.

SAH + Hydrocephalus = VP shunt

CASE 4: Idiopathic Intracranial Hypertension

Setting: *Office*

CC: *"I can't see straight."*

VS: *BP, 121/67 mm; R, 14 breaths/min; P, beats/min; T, 99.1°F*

HPI: *A 28-year-old woman presents to the emergency department for daily headaches and a recent onset of visual disturbance. She has had these headaches for more than 1 month, and they are bandlike, associated with nausea and vomiting, and worse in the morning. In the past week, she has been having trouble seeing and says she currently can see two doctors in front of her. The patient also complains of pulsatile ringing in her ears worsened by lying flat or in the bending position. The patient has recently started new multivitamins and vitamin A to aid in weight loss and is taking tetracycline for her acne.*

PMH: *Morbid obesity, acne*

Meds: *Daily multivitamins, vitamin A supplements, tetracycline, and oral contraceptive pills (OCPs)*

ROS:

- *No neck stiffness*
- *No fevers*
- *No dizziness*

Physical Exam:

- *Funduscopy demonstrates blurring of optic disc margins and peripapillary flame hemorrhages*
- *Visual field testing reveals loss of peripheral visual fields and mild impairment of central visual fields.*
- *Visual acuity testing reveals diplopia*
- *Oculomotor testing demonstrates cranial nerve VI palsy*

What is the most likely diagnosis?

a. Abducens nerve palsy
b. Idiopathic intracranial hypertension (IIH)
c. Malignant hypertension
d. Migraine
e. Normal-pressure hydrocephalus (NPH)

Answer b. Idiopathic intracranial hypertension (IIH)

IIH, also known as pseudotumor cerebri, is a disease characterized by increased intracranial

pressure (ICP) in the absence of a tumor or other diseases. The classic presentations are diplopia, papilledema, pulsatile tinnitus, nausea, and vomiting in an obese patient. Patients also classically have findings of abducens nerve palsy and have vision loss in the periphery that progresses to central vision loss. Abducens nerve palsy is a result of the increased ICP. Although malignant hypertension does have headaches with nausea and vomiting, this patient's blood pressure is normal. Migraine does not have findings of increased ICP on examination, and NPH would present with incontinence, ataxia, and dementia.

Papilledema = Blurring of the optic disc margin

CCS TIP: *Remember buzzwords are OUT! You have to know the meanings of the terms.*

Idiopathic intracranial hypertension is the disease formerly known as pseudotumor cerebri.

Medications known to cause IIH are vitamin A, tetracycline, OCPs, and steroids.

What is the best initial test for this patient?

a. Computed tomography (CT) scan of the head
b. Lumbar puncture (LP)

Answer a. Computed tomography (CT) scan of the head

The best initial test to diagnose IIH is a CT scan of the head; results will be normal and will show no evidence of tumors. LP is the most accurate test and is the next step in therapy after CT. If the CT is done second, there is a chance for herniation if there is a tumor.

LP with opening pressure is the most accurate test and will show markedly elevated opening pressures.

Vitamin A is a cofactor for cerebrospinal fluid (CSF) production and is fat soluble. Overdose will yield excessive amounts deposited, and slow release from adipose will yield increased CSF production in the choroid plexus.

The patient is advised to lose weight, discontinue vitamin supplements, and start a new OCP medication. She has a CT scan, which is normal, and an LP, after which she says her symptoms have resolved.

Which medication is the most appropriate choice in this patient with IIH?

a. Furosemide
b. Serial lumbar punctures
c. Acetazolamide

Answer c. Acetazolamide

Acetazolamide is a carbonic anhydrase inhibitor and reduces the amount of CSF production by up to 50%. It can cause potassium wasting, and patients must have their levels watched closely because hypokalemia is a significant side effect. Serial LPs, although they will alleviate symptoms, are temporary and carry the inherent risk of infection. Additionally, patients do not enjoy having needles inserted into their spines on a semiregular basis. Furosemide has no effect on increased ICP and has not been shown to change outcomes.

CSF is produced from arterial blood by the choroid plexuses of the lateral and fourth ventricles.

Give the patient acetazolamide and schedule her for a return appointment. Turn the clock forward, and the case should end.

The patient returns to the office 8 weeks later and still has headaches and visual difficulty.

What is the best next step in management of this patient?

In patients where medical therapy has failed and continued visual compromise is a predominant problem, surgical intervention is the best next step in management. The two main surgical procedures in IIH are CSF shunting procedures and optic nerve sheath fenestration. On the USMLE Step 3 either answer choice will be ok as deciding which procedure is beyond the scope of the test.

Embolization must be done before the aneurysm can rebleed. Rebleeding is associated with a 50% mortality rate.

CASE 5: Normal-Pressure Hydrocephalus

Setting: *Office*

CC: *"My father is peeing all over himself."*

VS: *BP, 121/67 mm Hg; R, 14 breaths/min; P, 78 beats/min; T, 99.1°F*

HPI: *An 84-year-old man is brought in by his daughter with the complaint that her father has recently lost control of his urine. Up until the past few months, her father has been able to take care of himself and plays chess daily with his friends. He has been unable to control his urine for the past 2 weeks. She denies any recent falls or trauma and admits that her father has wandered off a few times recently while at the mall. He is very studious and takes great pride in his image but recently has stopped shaving and refuses to shower.*

PMH:

- *Hypertension*
- *Osteoarthritis of both knees*
- *Meningitis 2 years ago*

ROS:

- *No headache*
- *No dizziness*
- *No fever*

Physical Exam:

- *Elderly man of stated age; smells of urine. Disheveled in appearance.*
- *AAOx2*
- *Mini Mental Status Exam score of 22 of 30*
- *Wide-based magnetic gait without tremors. Romberg sign negative.*

What is the most likely diagnosis?

a. Alzheimer's disease
b. Vascular dementia
c. Creutzfeldt-Jakob disease
d. Huntington's disease
e. Normal-pressure hydrocephalus (NPH)

Answer e. Normal-pressure hydrocephalus (NPH)

NPH is the triad of urinary incontinence, dementia, and ataxia. It is more common in older men but can affect women as well. This patient has recently become confused and incontinent. He has personality changes consistent with dementia, specifically apathy in self-care and decreased

cognition as demonstrated by the Mini-Mental Status Exam score. Last, he has the classic magnetic wide-based gait of those with NPH. His risk factor is a remote history of meningitis that may be the underlying cause. Vascular dementia is not correct because there is no history of stroke or stepwise decline in cognition. Huntington's disease presents earlier in life and is characterized by choreiform movements. Creutzfeldt-Jakob disease is characterized by rapidly progressive dementia and the presence of myoclonus. Alzheimer's disease is a progressively worsening condition over years and is not associated with ataxia or incontinence.

Wet – Wacky – Wobbly → Urinary incontinence – Dementia – Ataxia

Risk factors for NPH:
- History of intraventricular hemorrhage
- History of subarachnoid hemorrhage
- Prior acute or ongoing chronic meningitis

What is the best next step in the management of this patient?

a. Computed tomography (CT) scan of the brain
b. Magnetic resonance imaging (MRI) of the brain
c. Ultrasonography of the brain

Answer b. Magnetic resonance imaging (MRI) of the brain

CT and MRI are both excellent to evaluate ventricular dilation and sulcus size, but MRI allows for visualization of other findings seen in NPH (Figure 3-7). CT is the best test to screen for NPH, but MRI is the most accurate imaging test. Ultrasonography has no role as the skull impairs adequate visualization.

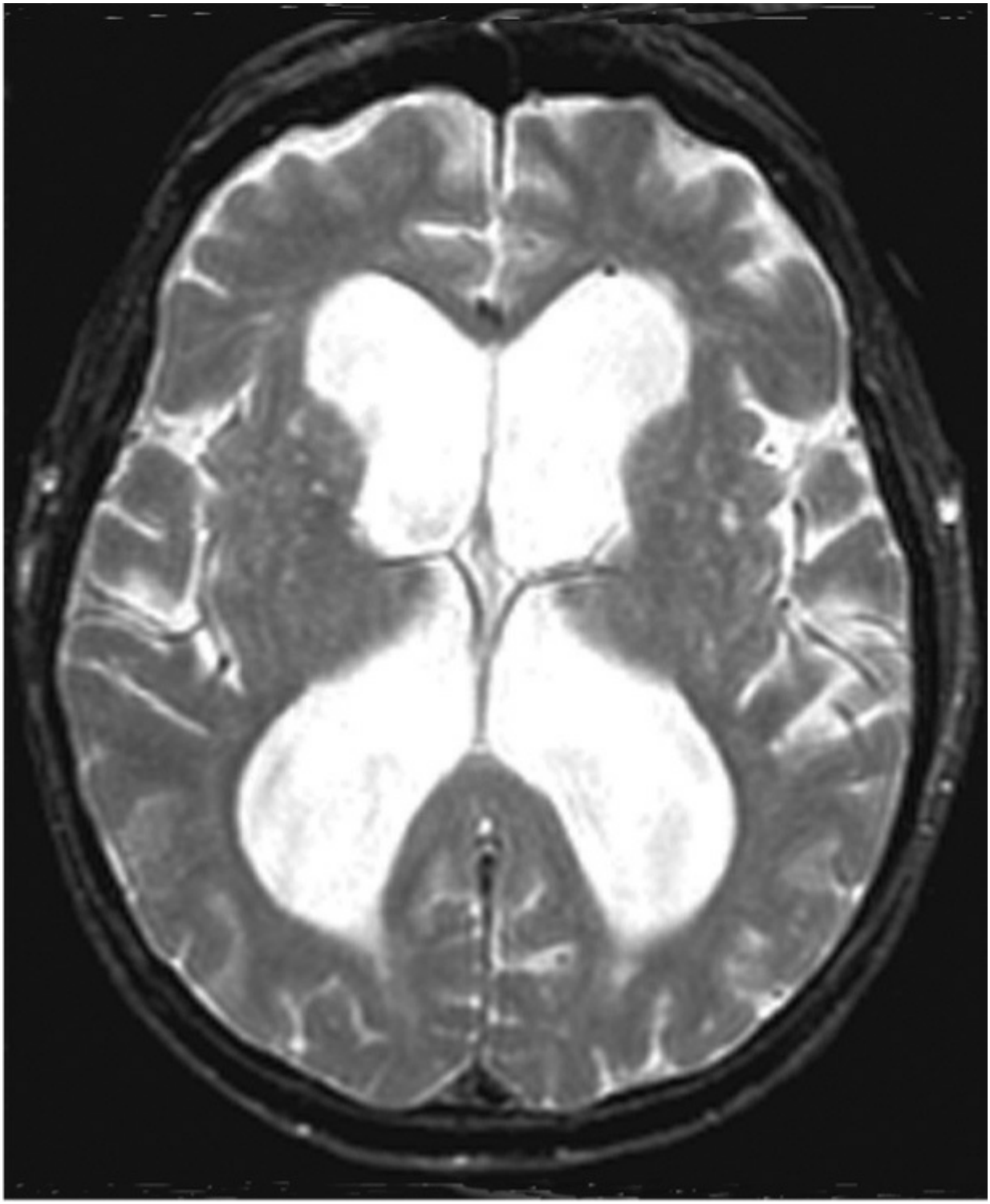


Figure 3-7. Normal-pressure hydrocephalus magnetic resonance image (MRI). Axial T2-weighted MRIs demonstrate dilation of the lateral ventricles. This patient underwent successful ventriculoperitoneal shunting. (Reproduced, with permission, from Longo et al. *Harrison's Principles and Practice of Internal Medicine*. Vol 2, 18th ed. New York: McGraw-Hill; 2012.)

Cerebrospinal fluid is produced by the choroid plexus in the lateral ventricles → third and fourth ventricles → the basal cisterns, tentorium → subarachnoid space → venous channels sagittal sinus.

What is the most accurate test to confirm the diagnosis of NPH?

Lumbar puncture is the most accurate test to confirm NPH. The hallmark finding in NPH is normal

opening pressure. Documentation of improvement in the patient's gait and cognitive function 60 minutes after the procedure is diagnostic.

Improvement in gait after lumbar puncture (LP) is diagnostic for NPH.

After the imaging tests, you must still order LP on the CCS.

The patient undergoes an MRI, which shows ventricular enlargement and sulcal enlargement. An LP is performed, and the patient is able to walk with a normal gait 1 hour later.

What is the best next step in the management of this patient?

The treatment for NPH is ventriculoperitoneal (VP) shunting. Medical therapies such as acetazolamide or osmotic diuretics are not superior. Serial high-volume LOP have not been shown to be superior to VP shunting.

Consult neurosurgery, order a VP shunt, and after the surgery move the patient into the neurosurgical intensive care unit. Turn the clock forward, and the case will end.

Serial LP is always the wrong answer in NPH.

CASE 6: Syringomyelia

Setting: *Clinic*

CC: *"My arms feel numb."*

VS: *All within normal limits*

HPI: *A 39-year-old man who was recently in a car accident presents with strange sensations in his arms. The patient states that he has noticed his ability to perceive pain in his upper extremities has been diminishing since his release from the hospital 6 months ago. He also states he recently burned his hands but did not experience the pain.*

ROS:

- *No headache*
- *No weight loss*
- *No loss of bowel or bladder continence*

Physical Exam:

- *Decreased sensation to pinprick in the bilateral upper extremities*
- *Decreased sensation to cold sensations along both arms*
- *Lower extremity sensation intact*
- *Motor sensation in the upper and lower extremities intact*

What is the most likely diagnosis?

a. Syringomyelia
b. Lumbosacral strain
c. Cord compression
d. Epidural abscess
e. Spinal stenosis

Answer a. Syringomyelia

Syringomyelia classically presents as a patient with bilateral loss of sensation and pain over the upper extremities, neck, and shoulders, also described as a capelike distribution. Lumbosacral strain is nontender to palpation and has no neurologic findings, and cord compression is tender and has loss bowel or bladder continence. Epidural abscess classically has a fever with neurologic change, and spinal stenosis presents with pain walking down a hill.

Syringomyelia commonly occurs with Arnold Chiari malformation type 1, which is characterized by cerebellar tonsils that are displaced below the level of the foramen magnum.

Trauma is the second most common cause and is called posttraumatic syringomyelia.

Dorsal columns are always spared. Proprioception, two-point discrimination, and vibration senses are always intact.

Syringomyelia is similar to an aortic dissection of the spinal cord with cerebrospinal fluid instead of blood.

Which is the most accurate diagnostic test for syringomyelia?

a. Computed tomography (CT) scan of the spine
b. Magnetic resonance imaging (MRI)

Answer b. Magnetic resonance imaging (MRI)

MRI is the most accurate diagnostic test and will reveal the fluid-filled cyst called a syrinx. Remember that CT scans are excellent for bone, blood, and soft tissue, but for accurate details of the parenchymal tissues, MRI is always superior.

The fluid-filled cyst is called a syrinx.

Remember to order a cervical and thoracic MRI; then turn the clock forward to get the results.

Most common locations for a syrinx are between C2 and T9.

The patient undergoes an MRI, which demonstrates a fluid-filled cyst that is between C6 and T2. The patient's examination results are unchanged.

What is the next step in the management of this patient?

Surgical decompression with fenestration or shunt placement is the best therapy for patients with syringomyelia accompanied by neurologic deterioration. Neurologic deficits usually stabilize after surgery and sometimes improve.

After ordering surgical consult, turn the clock forward, and the case will end.

CASE 7: Epidural Abscess

Setting: *ED*

CC: *"I have severe back pain."*

VS: *BP, 100/67 mm; R, 20 breaths/min; P, 104 beats/min; T, 101.1°F*

HPI: *A 27-year-old man presents to the emergency department with severe neck and back pain that has progressively worsened over the past 14 days. The patient states that he has fevers and chills and woke up this morning in a drenching sweat. He describes progressively feeling weak, being unable to rise from a seated position without help, and decreased grip strength in both his hands. He says he also feels shooting electric shocks in his arms. He said this morning he dropped a cup of coffee that his girlfriend had given him. He denies any recent trauma, illness, and medical procedures.*

PMH: *Seasonal allergies, cellulitis of the arm 1 year ago*

SH: *Alcoholism and IV drug abuse*

ROS:
- *Chills*
- *No photophobia*
- *Rigors*
- *No heart murmurs noted*
- *No shortness of breath*

Physical Exam:
- *Limited flexion of the neck because of pain; negative Brudzinski sign*
- *Tenderness to palpation over the cervical and thoracolumbar spine*
- *Distal weakness of bilateral upper extremities, 2 of 5*
- *Decreased strength, 3 of 5 in the bilateral lower extremities*

What is the most likely diagnosis?

a. Syringomyelia
b. Lumbosacral strain
c. Cord compression
d. Epidural abscess
e. Spinal stenosis

Answer d. Epidural abscess

Epidural abscess classically presents with back and neck pain, fever, and tenderness over the spinal canal. This patient's risk factors include IDUU and alcoholism. Syringomyelia classically presents

as a patient with bilateral loss of sensation and pain over the upper extremities, neck, and shoulders, also described as a capelike distribution. Lumbosacral strain is nontender to palpation and has no neurologic findings, cord compression is tender and has loss bowel or bladder continence, and spinal stenosis presents with pain walking down a hill.

What is the most urgent step?

a. Dexamethasone
b. Surgical consultation
c. Magnetic resonance imaging (MRI)
d. Radiography
e. Radiation of spine

Answer a. Dexamethasone

The most important take-home message you can get is that patients with spinal cord compression need steroids to decompress the mass effect on the spine. Short-term steroids, even in an infection, are not dangerous. Mass effect leading to permanent paralysis is more dangerous than possible immunosuppression.

The most common risk factors for spinal epidural abscesses are injection drug use, alcoholism, bacteremia caused by distal infection, trauma, and contiguous osteomyelitis.

What is the best next step in the management of this patient?

a. Intravenous fluids and antibiotics
b. MRI of the spine
c. Surgical consult
d. Blood cultures
e. a and d

Answer e. a and d

This patient presents with findings of fever, tachycardia, and neurologic deficits. Fever and tachycardia are two systemic inflammatory response syndrome (SIRS) criteria and are precursors of sepsis. Even though initial instincts are to scan the spine, you must keep systolic blood pressure above 90 to 100 mm Hg with normal saline or Ringer's lactate and obtain blood cultures. Give broad-spectrum antibiotics at the same time. Obtaining an MRI is important but not as important as getting blood cultures and giving antibiotics when the patient is unstable. Surgical consultation on the CCS does not offer any helpful suggestions. Consultants on CCS will see the patient quickly but will not actually say anything.

Initial Orders:

- *Normal saline*
- *Complete blood count (CBC)*
- *Comprehensive metabolic profile (CMP)*
- *Blood cultures ×2*
- *Urine analysis (UA)*
- *Urine culture*

CCS TIP: *On CCS, the only way to get two blood cultures is to order one and then move the clock forward to order another one. There is no way to order both of them at the same time. Move the clock forward so that the UA and blood cultures are obtained and normal saline is started with analgesics. If there are white blood cells (WBCs) on the UA, then send the urine culture.*

How far should you go in terms of ordering an initial evaluation of fever?

a. UA, blood culture, and CBC
b. Chest radiography and UA
c. Chest radiography, blood culture, and UA
d. Chest radiography, blood culture, UA, and urine culture

Answer c. Chest radiography, blood culture, and UA

Do *not* do a urine culture unless there are WBCs in the urine; ordering routine urine culture on every patient with a fever simply creates extra false-positive cultures. For example, there is no meaning to *Escherichia coli* in a urine culture if there are no WBCs and no symptoms of dysuria. This would simply be "asymptomatic bacteriuria." Asymptomatic bacteriuria is only significant in a pregnant woman. A CBC does not change management just because of a fever evaluation. If leukocytosis is present, this tells the same information at the presence of fever. You may be getting a CBC for other reasons but do not do it just because of fever.

CCS TIP: *You cannot order "ABCs" on CCS. You must order the management by the specifics of what you want. Do you want to give oxygen? Intubate? Bolus normal saline? Study with these specific terms in your mind.*

What is the most common organism found in spinal epidural abscesses?

a. *Staphylococcus aureus*
b. Diphtheroids
c. *E. coli*
d. Bacteroides

Answer a. *Staphylococcus aureus*

For unclear reasons, the most common organisms are gram-positive cocci such as *S. aureus* and epidermidis. Both choices are not present in this question because you would not be able to choose between them. Although gram-negative bacilli such as *E. coli* do occur, they are not as common as staphylococci. Anaerobes are a very uncommon cause of spinal epidural abscess. It is not clear where the staphylococcus comes from that invades the epidural space.

S. aureus
- Facultative aerobic gram-positive cocci
- Appear in grapelike clusters
- Coagulase in cell surface allows tissue penetration

"Coagulase" enzyme
- In cell surface of *S. aureus*
- "Eats" through tissue such as blood vessel lining
- Direct cause of endocarditis, abscess, and aneurysm

Which antibiotics should be started empirically?

a. Vancomycin and cefepime
b. Oxacillin
c. Metronidazole and aztreonam
d. Levofloxacin
e. Ceftriaxone and azithromycin

Answer a. Vancomycin and cefepime

You should combine agents active against sensitive staphylococci, methicillin-resistant *S. aureus* (MRSA), and gram-negative bacilli until you have the results of either blood culture or biopsy. Terms such as "broad spectrum" are very difficult because they lack precision. MRSA is covered by vancomycin, linezolid, daptomycin, ceftaroline, and tigecycline. These agents are generally not as effective against sensitive staphylococci. β-Lactam agents such as penicillins, cephalosporins, and carbapenems are the best against cephalosporins. Oxacillin is not right because it only covers sensitive staphylococci. Levofloxacin will not cover MRSA. Aztreonam will cover no gram-positive organisms.

β-Lactam antibiotics work by breaking down the cell wall.

What is the best next step in the management of this patient?

a. MRI of the spine
b. Surgical consult
c. Await blood cultures
d. Positron emission tomography scan

Answer b. Surgical consult

MRI of the spine is the next step in managing patients presenting with back pain, fever, and spinal tenderness (Figure 3-8). These symptoms, compounded by evidence of neurologic compromise, raises the suspicion of epidural abscess or cord compression. Therefore, it is paramount that the source of the lesion is found. Without knowing where the lesion is, you cannot remove it, and therefore imaging *changes* management. Blood cultures take 2 or 3 days to grow. This delay may result in permanent neurologic damage if you wait.

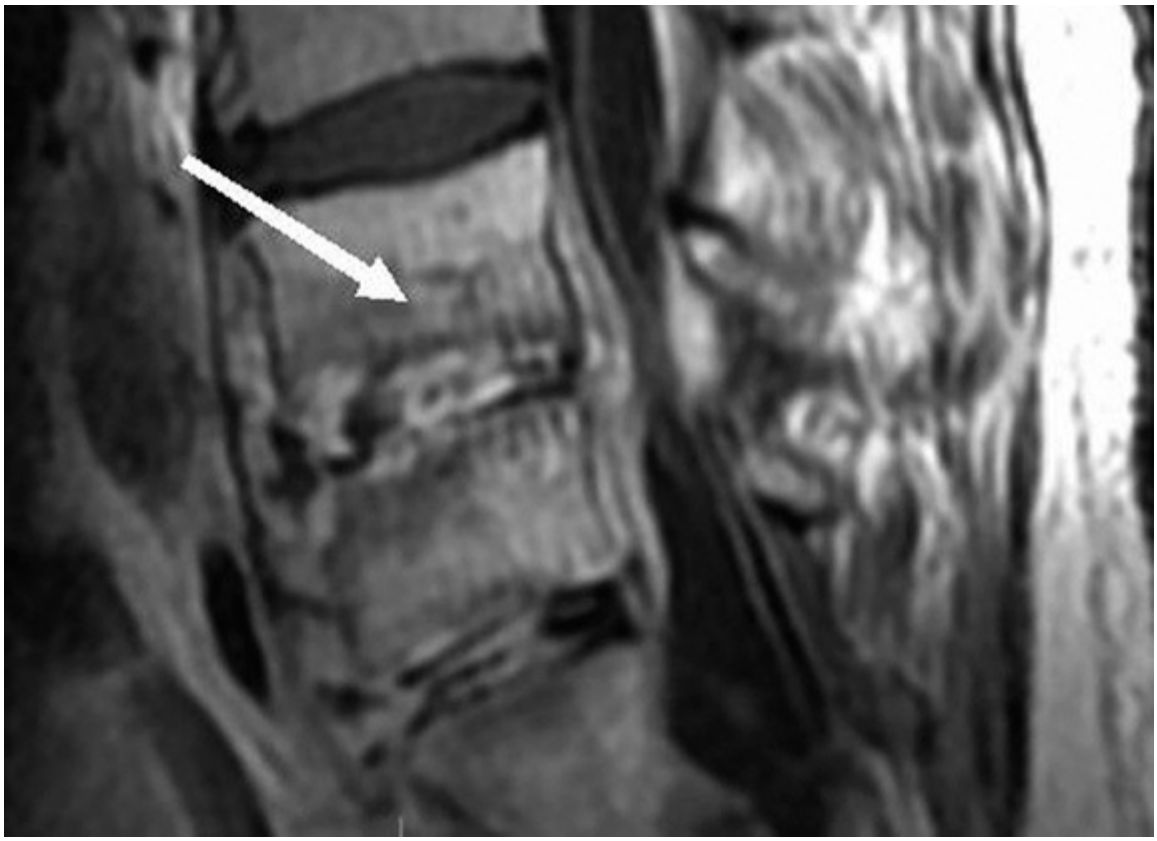


Figure 3-8. Sagittal magnetic resonance T1-weighted image with contrast of the lumbar spine demonstrating diskitis or osteomyelitis associated with a spinal epidural abscess. (Reproduced, with permission, from Doherty GM. *Current Diagnosis & Treatment: Surgery*. 13th ed. New York: McGraw-Hill; 2010.)

Transfer the patient to the intensive care unit and concurrently order laboratory studies and imaging. Move the clock forward, and results will return.

CCS TIP: *You do not have to do anything to get results of tests on CCS. As you pass the time that it says "Report available," the results will pop up automatically. In addition, all written reports stay stored in the medical record on your case. You can review them as many times as you want.*

Move the clock forward 30 to 60 minutes or to the time the MRI is listed as "Report available."

Results:

- *CBC: WBC 18.6 × 10^9/L with 15% bands.*
- *MRI report: Large anterior epidural mass compressing the spinal cord at the level of C4 to C5*

Interval History: *The patient says his legs weakness has worsened*

What is the best therapy to treat this patient's epidural abscess?

a. Continue antibiotics and await cultures.

b. Surgical drainage and decompression.

Answer b. Surgical drainage and decompression.

Surgical drainage and decompression is the most effective therapy, preferably within the first 24 hours, because this is the critical factor that will improve the ultimate prognosis. Antibiotics and awaiting culture sensitivity is not the most effective therapy but must be done concurrent to surgical drainage. The usual duration of therapy is 6 to 8 weeks or until resolution of the abscess is seen on MRI. The first MRI is to be completed 6 weeks after discharge. Epidural abscess and signs of cord compression are a neurosurgical emergency.

After surgical drainage, discharge the patient on intravenous antibiotics and schedule him for a return office visit and MRI in 6 weeks. Turn the clock forward, and the case will end.

CASE 8: Posterior Communicating Artery Aneurysm

Setting: *ED*

CC: *"My husband says my eyelids are droopy."*

VS: *Normal*

HPI: *A 48-year-old woman presents with a droopy eyelid on in her right eye. She states that she noticed this about a month ago, but now it has become bothersome and she feels embarrassed by the asymmetry. She recently fell because she could not see properly while going down a set of stairs in her home because she was seeing double. A head computed tomography (CT) scan without contrast is performed and does not show a bleed.*

ROS:

- *Occasional headaches in the occipital region*
- *No fever*
- *No neck pain*
- *No visual change*

Physical Exam:

- *Pupils of the right eye are 6 mm and left eye are 4 mm*
- *Ptosis of the right eye*
- *Extraocular motion was hindered because the patient was unable to look down, or inward*
- *No facial palsy*

This patient has obvious neurologic compromise. Admit the patient to the intensive care unit (ICU) because you do not know if there is a bleed or not.

What is the most likely diagnosis?

a. Diabetic neuropathy
b. Normal variant
c. Third cranial nerve palsy
d. Myasthenia gravis

Answer c. Third cranial nerve palsy

Isolated third cranial nerve palsy presents with:

- Anisocoria
- Palsy of most of the muscles controlling eye movements
- Weakness of levator palpebrae superioris.

It is called "isolated" because no other neurologic deficits are seen. Diabetic neuropathy is unlikely to cause an effect on the third cranial nerve and presents with paresthesias in a glove and

stocking distribution. Myasthenia gravis has ptosis, but weakness is exacerbated by repetitive movement, which this patient does not have in the history.

The oculomotor nerve arises from the anterior aspect of mesencephalon.

What is the reason for ptosis and mydriasis without evidence of oculomotor palsy?

Answer. Compressive oculomotor nerve damage could result in compression of the parasympathetic fibers before any disruption of the motor fibers. This is because the parasympathetic fibers run on the outside of the nerve, and motor fibers run more interiorly. So a patient can have eyelid ptosis and mydriasis before the "down and out" position is seen.

Cranial nerve = three subnuclei you need to know:
- Superior rectus subnucleus → Contralateral superior rectus muscle
- Levator subnucleus → Both levator palpebrae superioris
- Edinger-Westphal nuclei → Controls pupil constriction

What is the best next step in management?

a. Magnetic resonance imaging (MRI) of the brain
b. CT scan of the brain
c. Angiography of the brain

Answer a. Magnetic resonance imaging (MRI) of the brain
MRI is the best initial test in a patient who presents with isolated third cranial nerve findings. If the patient had other neurologic findings, then a CT of the brain is best initial test because it is paramount to quickly detect blood.

An MRI is performed and shows a large space-occupying lesion in the extraaxial location compressing the right side of the midbrain.

What is the most likely cause of this patient's third cranial nerve palsy?

a. Trauma
b. Mass lesion
c. Aneurysm

Answer c. Aneurysm

Intracranial aneurysm must be ruled out immediately because of the potential risk of imminent subarachnoid hemorrhage. The most common cause of third cranial nerve palsy is an aneurysm. Trauma and mass lesions are also causes of third nerve palsy but would not appear as such on the MRI. Aneurysms of the posterior communicating artery are the third most common circle of Willis aneurysm and classically can lead to oculomotor nerve palsy.

The most common aneurysm of the circle of Willis is of the anterior communicating artery.

What is the best next step in the management of this patient?

Cerebral angiography is the most accurate test to delineate the location of the aneurysm.

Order cerebral angiography, complete blood count, prothrombin time, partial thromboplastin time, and a neurosurgical consult. If all laboratory results are within normal limits, you can proceed to surgery.

A cerebral angiogram demonstrates the aneurysm arising from the posterior communicating artery.

What is the most accurate therapy for this aneurysm?

Embolization through endovascular repair has been found to be superior to surgical clipping. Surgical clipping is inferior to coil embolization. Embolization does not require craniotomy. Embolization takes one tenth as much time and has the same result. A platinum wire is placed into the blood vessel to clog off the site of the bleeding so it cannot rebleed.

After the procedure, transfer the patient to ICU and turn the clock forward, and the case will then end.

TRAUMA

CASE 1: Pneumothorax

Setting: *ED*

CC: "*Chest pain.*"

VS: *BP, 150/90; P, 110 beats/min; R, 25 breaths/min; afebrile*

HPI: *A 25-year-old woman presents to the emergency department with an acute onset of chest pain and shortness of breath while walking to work. The pain is on the right side of her chest, sharp, worsened by deep breathing, and constant. The patient points with one finger to the pain. Nothing makes it better. The pain is similar to the pain she felt while scuba diving 3 years previously in the Galapagos Islands.*

PMH: *History of barotrauma from scuba diving*

ROS:
- *No recent travel*
- *SH*
- *Smoker*

Meds: *Oral contraceptive pills (OCPs)*

Physical Exam:
- *Tachypnea*
- *Distant breath sounds over the right*
- *Hyperresonance on the right with percussion*
- *Decreased tactile fremitus*
- *No pain to palpation*

Which of the following is the most likely diagnosis?

a. Pneumothorax
b. Pulmonary embolism (PE)
c. Costochondritis
d. Myocardial infarction
e. Pneumonia

Answer a. Pneumothorax

Primary spontaneous pneumothorax presents with the acute onset of chest pain and shortness of breath in a young woman who is a smoker or using OCPs. PE is the next most likely diagnosis;

however, because of the abnormal lung examination findings, the patient is unlikely to have had a PE. The classic presentation of PE is a patient who has chest pain and shortness of breath but has normal lung examination results. Costochondritis is pain to palpation of the rib cage after a recent upper respiratory illness. Pneumonia is pain with deep breathing but must have a cough and fever, which this patient does not have. Last, myocardial infarction is substernal chest pain, but this patient's pain is over the right side of the chest.

The surface of the lung is covered by visceral pleura, and the lining inside the chest is called the parietal pleura.

Catamenial pneumothorax is related to a menstrual cycle and finding of endometriosis in the chest.

Which of the following are risk factors for the development of the primary spontaneous pneumothorax?

a. Smoking
b. Marfan's syndrome
c. Pregnancy
d. Family history
e. All of the above

Answer e. All of the above

Risk factors that predispose patients to primary spontaneous pneumothorax include smoking, Marfan's syndrome, family history, and pregnancy.

Which of the following is the best diagnostic test for this patient?

a. Computed tomography (CT) scan of the chest
b. Radiography of the chest
c. Barium swallow
d. Ultrasonography
e. Arterial blood gas analysis (ABG)

Answer b. Radiography of the chest

Radiography of the chest is the best initial test and often the only test needed for the evaluation of a patient with suspected pneumothorax. CT scanning is used in a patient with severe trauma or a history of bullae as in emphysema. Barium swallow is used for a viscous tear of the esophagus, not the lung tissue. Ultrasonography may be more sensitive than chest radiography in the identification

of pneumothorax after blunt trauma to the chest; however, in patients who are stable, we opt for chest radiography. An ABG analysis may reveal the amount of acidemia, hypercarbia, and hypoxia but does not confirm the diagnosis.

Orders:

- *Chest radiography*
- *Turn the clock forward to obtain results*

Chest radiography reveals a right-sided pneumothorax without tracheal deviation (Figure 4-1).

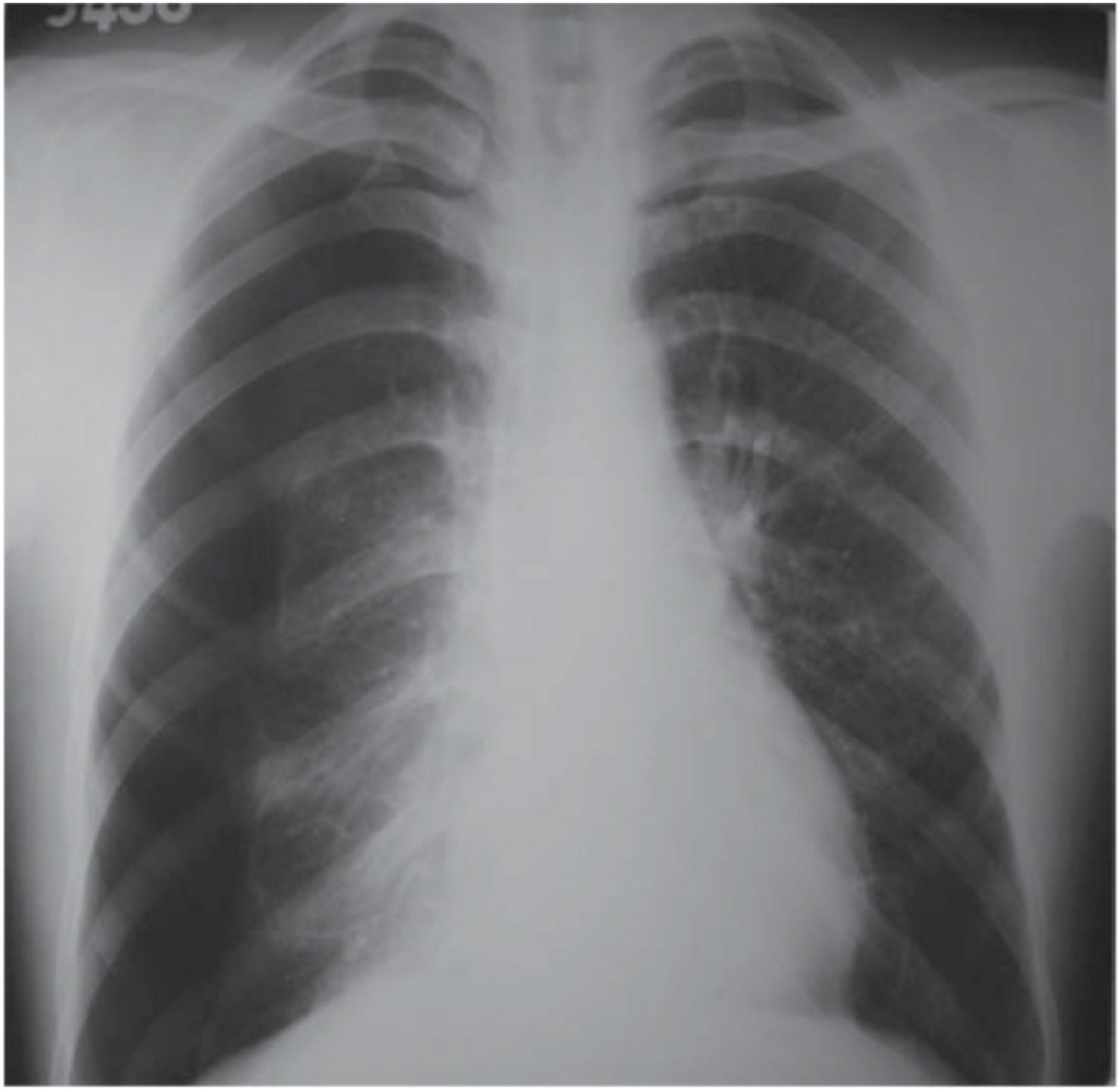


Figure 4-1. Pneumothorax. This right-sided pneumothorax can be diagnosed by the absence of lung markings and increased (air density) lucency lateral to the pleural line. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York: McGraw-Hill; 2011.)

What is the best next step in the management of this patient?

a. Oxygen therapy
b. Chest tube placement
c. Needle aspiration
d. Conservative management
e. Pleurodesis

Answer b. Chest tube placement

Chest tube placement is the correct answer for a patient with a pneumothorax (Figure 4-2). Oxygen therapy and conservative management should be started in all patients and will aid in absorption of very small apical pneumothoraces. Needle aspiration is for a patient who has a tension pneumothorax and needs immediate decompression of the pleural space because of hemodynamic compromise. Pleurodesis with video-assisted thoracic surgery (VATS) with chemical or talc is a surgical procedure indicated only for patients with persistent air leak after placement of a chest tube or recurrent pneumothorax.

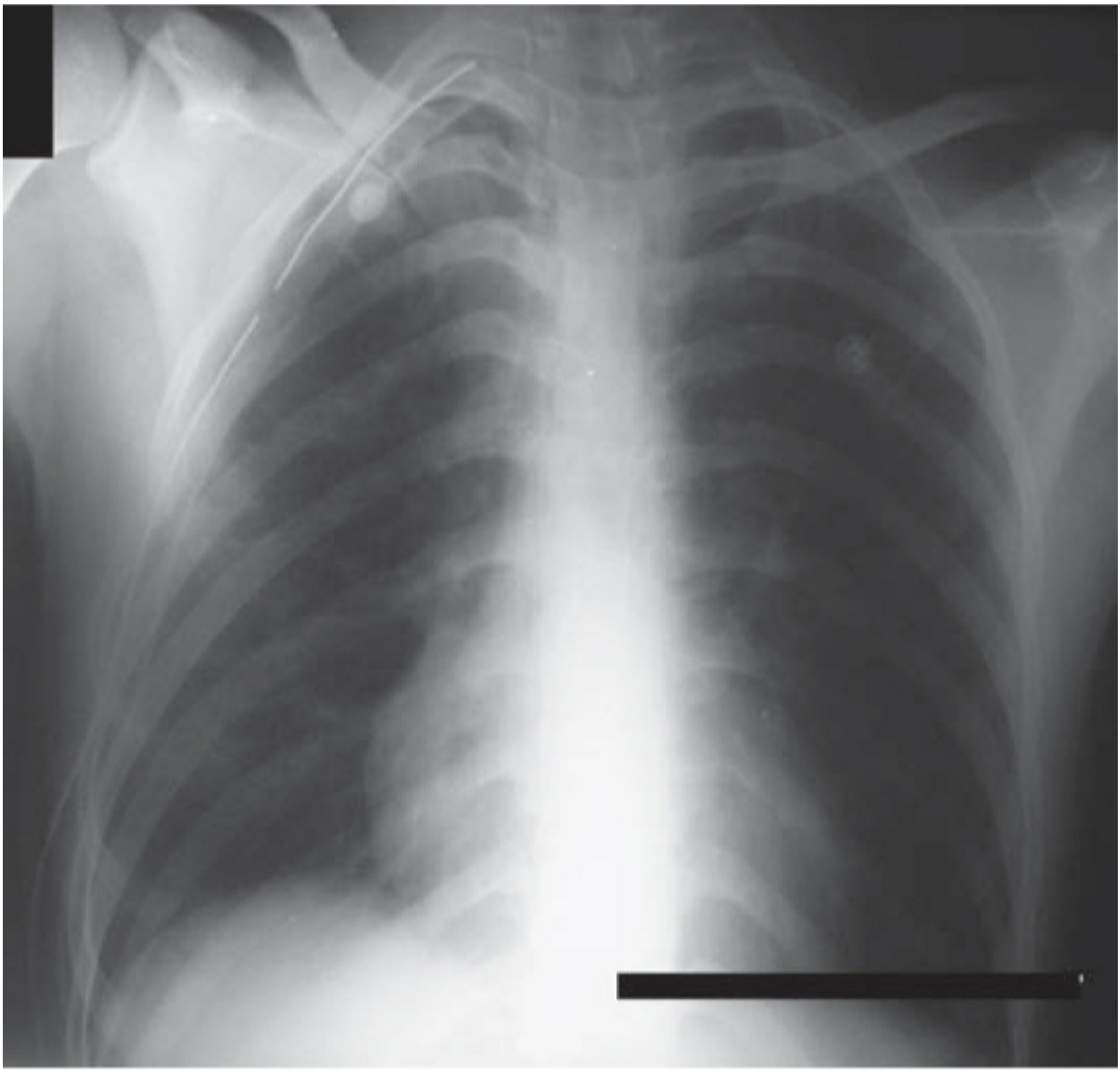


Figure 4-2. Chest tube insertion—placement of catheter. Right chest tube is inserted for a pneumothorax. All holes of chest tube should be inside the hemithorax cavity, and the tip of the tube should be directed toward the apex. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York:

McGraw-Hill; 2011.)

Pleurodesis uses doxycycline or talc to fibrose the pleural space and prevent the lung from collapsing.

Chest tubes are placed in the safe triangle made up of the horizontal line of the nipple and latissimus dorsi and pectoralis major making up the two diagonals.

Orders:
- *Surgical consult*
- *Chest tube*
- *Turn the clock forward 48 hours*

A chest tube is successfully placed, and the patient feels better. On rounds, it is noted that an air leak is still present.

Tension pneumothorax pushes the trachea to the contralateral side, and bronchiectasis pulls it to the affected side.

Orders:
- *Surgical consult*
- *VATS*
- *Pleurodesis*
- *Turn the clock forward, and the case will end.*

Smoking cessation can help prevent recurrent pneumothoraces.

CASE 2: Pericardial Tamponade

Setting: *ED*

CC: *"Post motor vehicle accident."*

VS: *BP, 80 mm Hg over palpation; P, 130 beats/min; R, 24 breaths/min; T, 96.5°F*

HPI: *A 24-year-old man is brought into the emergency department after a motor vehicle accident. He is unable to provide his history because of being unconscious.*

Physical Exam:
- *Distant and muffled heart sounds*
- *Jugular venous distension (JVD)*
- *Blood pressure drops by 10 mm Hg on each respiration*

Which of the following is the most likely diagnosis?

a. Constrictive pericarditis
b. Cardiac tamponade
c. Tension pneumothorax
d. Massive embolism

Answer b. Cardiac tamponade

Cardiac tamponade is an acute condition in which fluid accumulates in the pericardial space, causing compromised ventricular filling and contractions, resulting in diminished cardiac output. Hallmark features are distant heart sounds—heartbeats are difficult to hear as they travel through fluid—and pulsus paradoxus. Pulsus paradoxus is when the blood pressure drops by more than 10 mm Hg on each respiration. This ultimately causes flow back into the venous system and JVD. Constrictive pericarditis would present similarly but would have a friction rub, and tension pneumothorax would have absent breath sounds and a deviated trachea. The most common causes of pericardial fluid not in the acute setting include malignancy, tuberculosis, and autoimmune disease. These diseases cause chronic effusions over a long period of time.

Kussmaul's sign is a paradoxical rise in jugular venous pressure with inspiration.
Pulsus paradoxus is a drop greater than 10 mm Hg with inspiration.

What are the electrocardiographic (ECG) findings in cardiac tamponade?

a. Electrical alternans
b. Delta waves

c. J waves
d. PR depressions
e. Diffuse ST elevation

Answer a. Electrical alternans

Electrical alternans is a QRS complex that changes in size with each beat of the heart (Figure 4-3). There is alteration of the axis with wandering baseline (isoelectric line). It is caused by the electric currents being measured differently in each beat because of the movement of fluid dynamically in the pericardial space. Delta waves are seen in Wolff-Parkinson-White syndrome. J waves are seen in patients with hypothermia. PR depressions can be seen in pericarditis along with diffuse ST elevations.

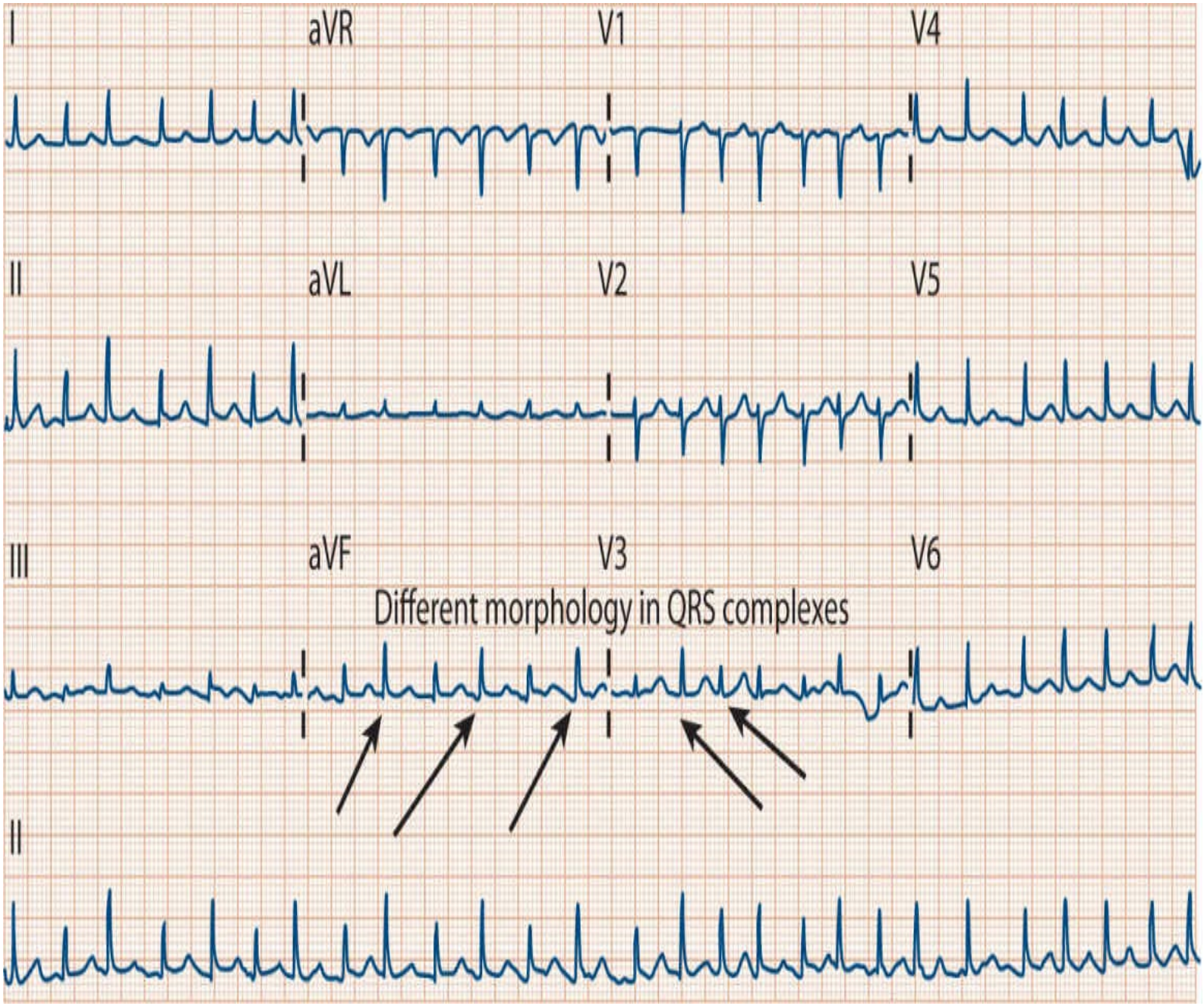


Figure 4-3. Electrocardiogram demonstrating variability in the QRS complexes.

Cardiac tamponade = Beck's triad = Hypotension + JVD + muffled heart sounds

Pulse power (Figure 4-4)

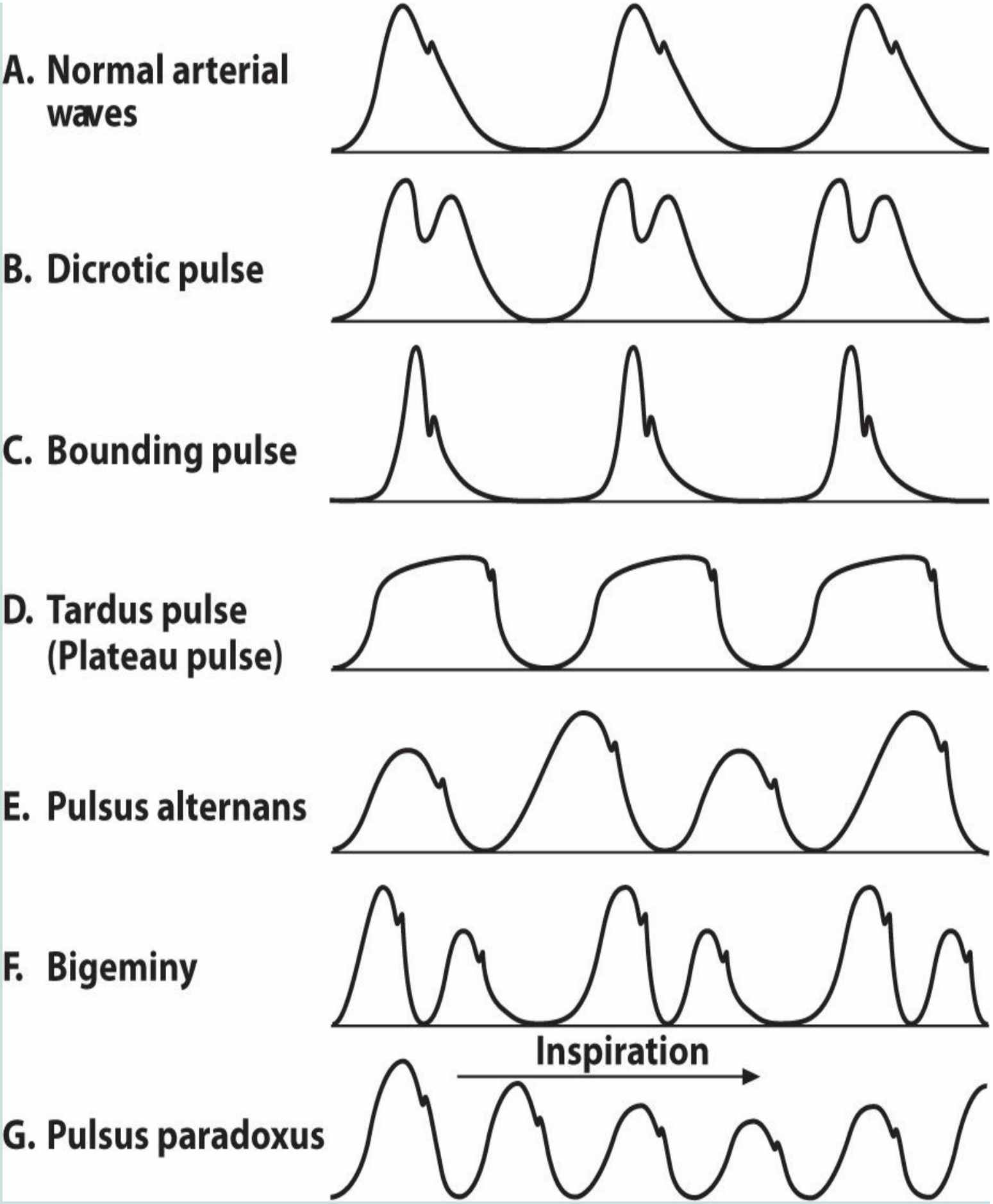


Figure 4-4. Arterial pulse contour. **A.** Normal pulse contour. **B.** Dicrotic pulse. **C.** Bounding or collapsing pulse. **D.** Plateau pulse. **E.** Pulsus alternans. **F.** Pulsus bigeminus. **G.** Pulsus paradoxus. (Reproduced, with permission, from LeBlond RF, Brown DD, DeGowin RL, eds. *DeGowin's Diagnostic Examination*. 9th ed. New York: McGraw-Hill; 2009.)

• Pulsus alternans: sign of left ventricular systolic dysfunction

- Pulsus bigeminus: sign of hypertrophic obstructive cardiomyopathy (HOCM)
- Pulsus bisferiens: in aortic regurgitation
- Pulsus tardus et parvus: aortic stenosis
- Pulsus paradoxus: cardiac tamponade and tension pneumothorax
- Pulse irregularly irregular: atrial fibrillation

What is the best next step in the management of this patient?

a. Chest radiography
b. Computed tomography (CT) scan
c. Echocardiography
d. Pericardiocentesis

Answer d. Pericardiocentesis

Pericardiocentesis (Figure 4-5) or emergent subxiphoid percutaneous drainage should be done. Removal of pericardial fluid is the definitive therapy for tamponade. Furthermore, history and physical examination alone is enough because waiting for imaging will cost time and could be fatal for the patient. The most common complications of pericardiocentesis are myocardial puncture and arrhythmia.

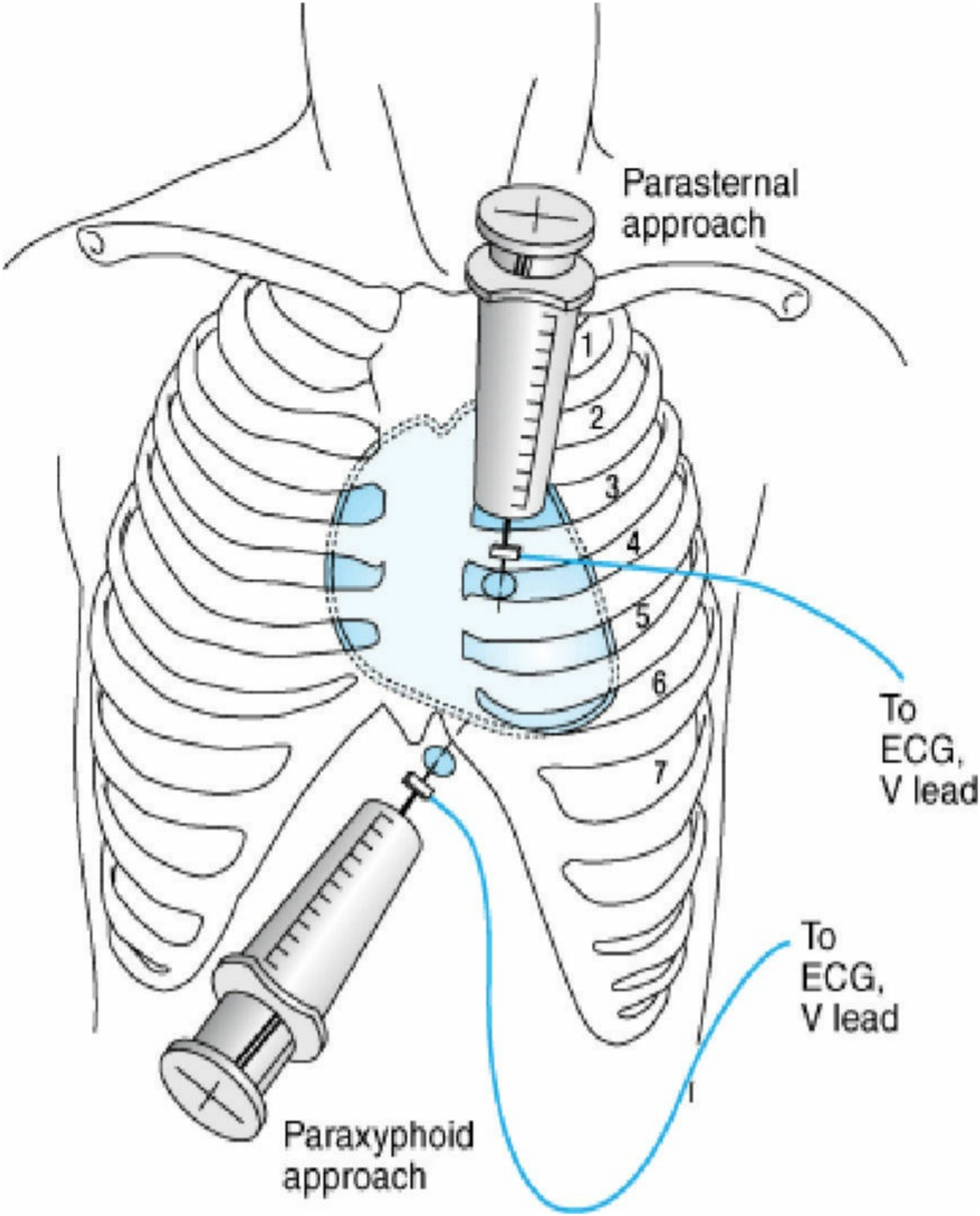


Figure 4-5. Techniques for pericardiocentesis. ECG, electrocardiography. (Reproduced, with permission, from Gomella LG, Haist SA, eds. *Clinician's Pocket Reference: The Scut Monkey*. 11th ed. New York: McGraw-Hill; 2007.)

Chest radiography will show a “water bottle–shaped heart” in cardiac tamponade (Figure 4-6)

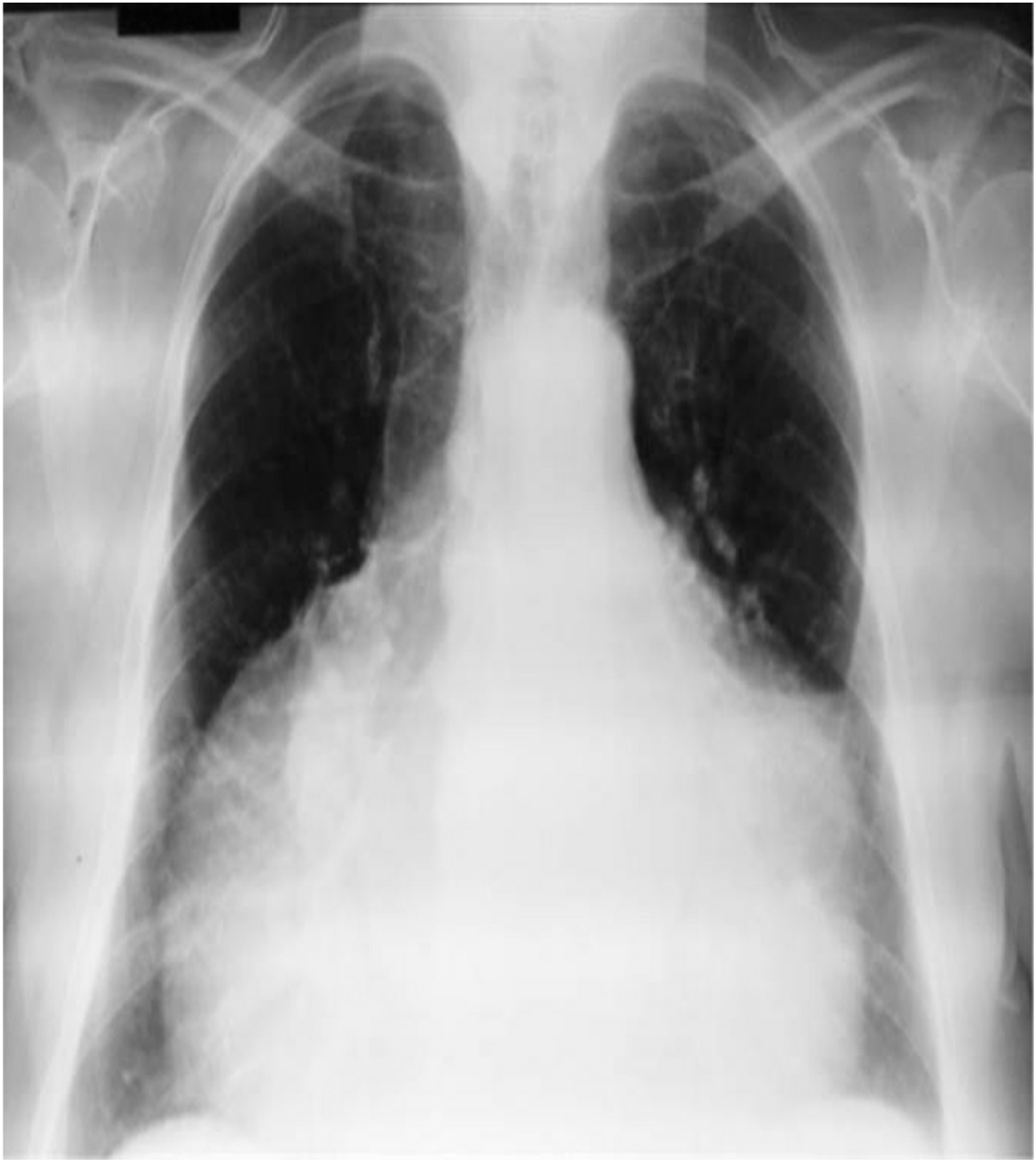


Figure 4-6. Large pericardial effusion on chest radiography with water bottle heart shape. (Reproduced, with permission, from Crawford MH. *Current Diagnosis & Treatment: Cardiology*. 4th ed. New York: McGraw-Hill; 2014.)

Know thy heart on radiology:
- Pear-shaped heart: pericardial effusion
- Boot-shaped heart: tetralogy of Fallot
- Jug handle appearance: primary pulmonary artery hypertension
- "3"-like appearance: coarctation of the aorta
- Rib notching: coarctation of the aorta

Orders:
- *Pericardiocentesis*
- *Turn the clock forward.*

The patient's blood pressure begins to improve, and the heart rate has decreased. He is beginning to regain consciousness.

Orders:
- *Cardiology consult*
- *Transfer to the cardiac care unit.*
- *Turn the clock forward, and the case will end.*

A pericardial window is the best next step in management after pericardiocentesis is attempted but the patient effusions have reaccumulated.

CASE 3: Penetrating Abdominal Trauma

Setting: *ED*

CC: *"Stabbing."*

VS: *BP, 80 mm Hg palpation; R, 24 breaths/min; afebrile*

HPI: *A 24-year-old up-and-coming rap star gets shot in the abdomen after his first concert. He is in severe pain, is unable to provide his history, and is covered in blood. As per the patient's manager, he has no past medical history.*

SH:
- *Daily marijuana use*
- *Daily alcohol use*

Physical Exam:
- *Awake but not alert or oriented*
- *A large 1-cm puncture wound is seen in the left upper quadrant*
- *Pulse pressure is narrow*
- *Guarding rebound and rigid abdomen*

Which of the following is the best next step in the management of this patient?

a. Intravenous (IV) normal saline
b. Packed red blood cells
c. Surgical consult
d. Urgent transfer to the operating room
e. Type and screen
f. Intubation
g. Antibiotics
h. All of the above

Answer h. All of the above

All of the above are correct, with urgent transfer to the operating room for exploratory laparotomy being the end goal. Given the patient's hemodynamic instability, intubation for airway management and immediate infusion of normal saline followed by packed red blood cells is paramount. These steps are done within minutes in the emergency room while the patient is being readied for the operating room. Laboratory tests, type and screen, and antibiotics can all be done perioperatively.

The most commonly injured organ from gunshot wounds is the small bowel followed by the colon.

The most commonly injured organ after stab wounds is the liver followed by the small bowel.

Orders:

- *Surgical consult*
- *Urgent transfer to the operating room*
- *IV normal saline*
- *Packed red blood cells*
- *Piperacillin tazobactam*
- *Type and screen*
- *Complete blood count*
- *Comprehensive metabolic profile (CMP)*
- *International normalized ratio*
- *Intubation*

CCS TIP: *Turn the clock forward, transfer the patient to the surgical intensive care unit (SICU), and the case will end.*

All patients who require splenectomy will need a vaccination against encapsulated bacteria (streptococcus, meningococcus, and *Hemophilus influenza* type B).

GENERAL ABDOMINAL SURGERY

CASE 1: Splenic Flexure Syndrome

Setting: *Office*

CC: *"My stomach hurts."*

VS: *Stable*

HPI: *A 27-year-old woman corporate executive presents with severe abdominal pain of 6 months' duration. The pain is located in the left upper quadrant, is sharp in quality, 8 of 10 in intensity, and does not radiate. The pain is associated with flatulence and constipation several times per week and at times with diarrhea on weekends. The pain improves after bowel movements, but she never feels fully evacuated. She has lots of stress in her life and has had upper and lower endoscopies which were negative.*

PMH: *Anxiety disorder*

Meds: *Lorazepam*

ROS:
- *Constipation*
- *Diarrhea on weekends*

Physical Exam: *Tenderness of the left upper quadrant*

What is the most likely diagnosis?

a. Inflammatory bowel disease
b. Irritable bowel syndrome (IBS)
c. Intussusception
d. Peptic ulcer disease
e. Biliary colic

Answer b. Irritable bowel syndrome (IBS)

This patient presents with all 3 Rome II diagnostic criteria for IBS, which are pain associated with:
- Improvement with defecation
- Association with change in frequency of stool
- Change in form of stool

The patient is experiencing splenic flexure syndrome. Splenic flexure syndrome is caused by gas collecting in splenic flexure, leading to distension of the capsule, causing pain. Furthermore,

young women with a history of depression, anxiety, and other mood disorders are more predisposed to developing IBS. IBS presents with diarrhea, tenesmus, and fistulas in the case of Crohn's disease. Intussusception is more common in children and presents with "currant jelly" stool, which is grossly bloody stool in clots. Peptic ulcer disease is less likely in the left upper quadrant and is mostly epigastric pain. Biliary colic is postprandial pain that is in the right upper quadrant.

Two major forms of IBS:
- Diarrhea-predominant IBS
- Constipation-predominant IBS

Screen for IgA antibody to tissue transglutaminase. Ten percent of patients with IBS have celiac disease.

IgA protects mucosal surfaces such as the mouth and gastrointestinal tract.

IBS is a diagnosis of exclusion; patients must have an upper and lower colonoscopy and testing for celiac disease.

What is the best initial management of this patient?

a. Fiber supplementation
b. Antispasmodics (dicyclomine, hyoscyamine)
c. Imipramine
d. Probiotics
e. Lactose avoidance

Answer a. Fiber supplementation

Fiber acts as a bulking agents that aids in improving symptoms. Fiber actually helps all forms of IBS. Fiber bulks stool in diarrhea and makes it softer in constipation and adds bulk to prevent spasms. Antispasmodics such as hyoscyamine or dicyclomine are added if symptoms are not controlled with fiber, diet modification, and stress reduction. Tricyclic antidepressants are used when the patient is not helped by all of these other modalities of therapy. Probiotics have no proven benefit. Lactose avoidance is correct only for someone who presents with gas, bloating, and explosive diarrhea after ingesting dairy products.

Initial IBS therapy consists of:
• Fiber supplementation
• Dietary modification
• Stress reduction

Dicyclomine and hyoscyamine
• Block muscarinic receptors, leading to an anticholinergic effects
• Slow the bowel

Acetylcholine receptors:
• Nicotinic Receptor: Neuromuscular junction
• Muscarinic receptor: Saliva, lung, bladder, gut, heart

Orders:
• *Fiber supplementation*
• *Stress reduction counseling*
• *Nutrition counseling*
• *Send the patient home and bring her back in 2 weeks.*

The patient returns 2 weeks later with minimum improvement. She continues to have 6 or 7 days of constipation followed by 1 day of diarrhea. Her cramping and bloating still persist, and she is very distraught because her constant need to use the bathroom is affecting her work.

IBS-C manifests as constipation from days to months with infrequent periods of diarrhea or normal bowel function. Stool is described as hard or pellet-like.

What is the most appropriate therapy if the patient has IBS-C?

a. Polyethylene glycol (PEG)
b. Docusate sodium
c. Yoga
d. Linaclotide

Answer d. Linaclotide

In patients with IBS with constipation who have failed a trial of soluble fiber, the next step is PEG as a laxative. PEG does not help patients with abdominal pain or cramping and is, therefore, incorrect in this patient. Patients with persistent constipation despite treatment with PEG or unable to take PEG because of cramping or abdominal pain should be treated with lubiprostone or linaclotide.

Linaclotide: guanylate cyclase agonist that stimulates intestinal fluid secretion
Lubiprostone: chloride channel activator that stimulates chloride-rich fluid secretion

Orders:

- *Linaclotide*
- *Turn the clock forward, and the case will end.*

CASE 2: Appendicitis

Setting: *ED*

CC: *"My stomach is killing me."*

VS: *BP, 130/90 mm Hg; P, 101 beats/min; R, 20 breaths/min; T, 100.4°F*

HPI: *A 19-year-old woman presents with severe right lower quadrant pain of 12 hours' duration. It began earlier in the morning and has now become unbearable. The pain is sharp, 8 of 10 in intensity, but is becoming progressively worse and is associated with nausea and vomiting.*

PMH: *Constipation*

ROS: *Chills*

Physical Exam:

- *Pain 2 inches from the anterior superior iliac spine*
- *Pain in the right lower quadrant when palpating the left lower quadrant*
- *Pregnancy test is negative*

What is the most likely diagnosis?

a. Appendicitis
b. Diverticulitis
c. Cholecystitis
d. Ectopic pregnancy
e. Ovarian torsion

Answer a. Appendicitis

The presentation of right lower quadrant (RLQ) pain in a man with anorexia, nausea, and vomiting combined with pain to palpation at McBurney's point or displaying Rovsing's sign is appendicitis. However in females, who present with RLQ pain, the first step in management is to check a urine pregnancy test. If the result is negative, think appendix. In this case, the pregnancy test has already been done for you. Diverticulitis is more common in older patients and presents with left lower quadrant pain. Cholecystitis is usually in middle-aged obese women with right upper quadrant pain. Ectopic pregnancy and ovarian torsion can both present with fever and right lower quadrant pain. Ectopic pregnancy is why every woman with lower abdominal pain younger than age 50 years should have a pregnancy test ordered on CCS. Do not rely on sexual history. Ovarian torsion is acute, sharp, unilateral pain.

Women + Lower abdominal pain = Pregnancy test

The vermiform appendix is located at the base of the cecum near the ileocecal valve where the taenia coli converge on the cecum

Rovsing's sign: Pain in RLQ with palpation of the LLQ

Press left + Pain right = Rovsing's sign

Psoas sign is associated with a retrocecal appendix. This is manifested by right lower quadrant pain with right hip extension.

What is the most accurate diagnostic test for this patient?

a. Ultrasonography
b. Computed tomography (CT) scan of the abdomen and pelvis
c. Magnetic resonance imaging (MRI) of the abdomen
d. Radiography of the abdomen

Answer b. Computed tomography (CT) scan of the abdomen and pelvis

A CT scan of the abdomen is the most accurate diagnostic test for a patient with clinical evidence of appendicitis. Ultrasonography is only useful to rule in a diagnosis of appendicitis but cannot be used to reliably exclude the diagnosis. Furthermore, the sensitivity of ultrasonography diminishes with increasing abdominal girth. MRI of the abdomen is always the wrong answer for any acute abdominal inflammatory process because it takes too long. Radiography of the abdomen lacks the resolution and sensitivity to localize an acute process in the RLQ. Radiography can only be used to aid in excluding free air in the case of perforated appendix. Exploratory laparotomy is far too invasive as a diagnostic test of choice because the negative appendectomy rate can approach to 20% but as a therapeutic option is the next step in management.

Blood supply of the appendix is from the appendiceal artery, which is a branch of the ileocolic artery.

Orders:
- *Nothing by mouth (NPO)*
- *Complete blood count (CBC)*
- *Normal saline*
- *Intravenous morphine*

• *CT scan of the abdomen and pelvis with contrast*

CBC: *White blood cell count, 14,500 cells/mm^3 CT scan of abdomen: Enlarged nonperforated appendiceal diameter of 7 mm; appendiceal wall thickening with fat stranding and evidence of appendicolith (Figure 5-1).*

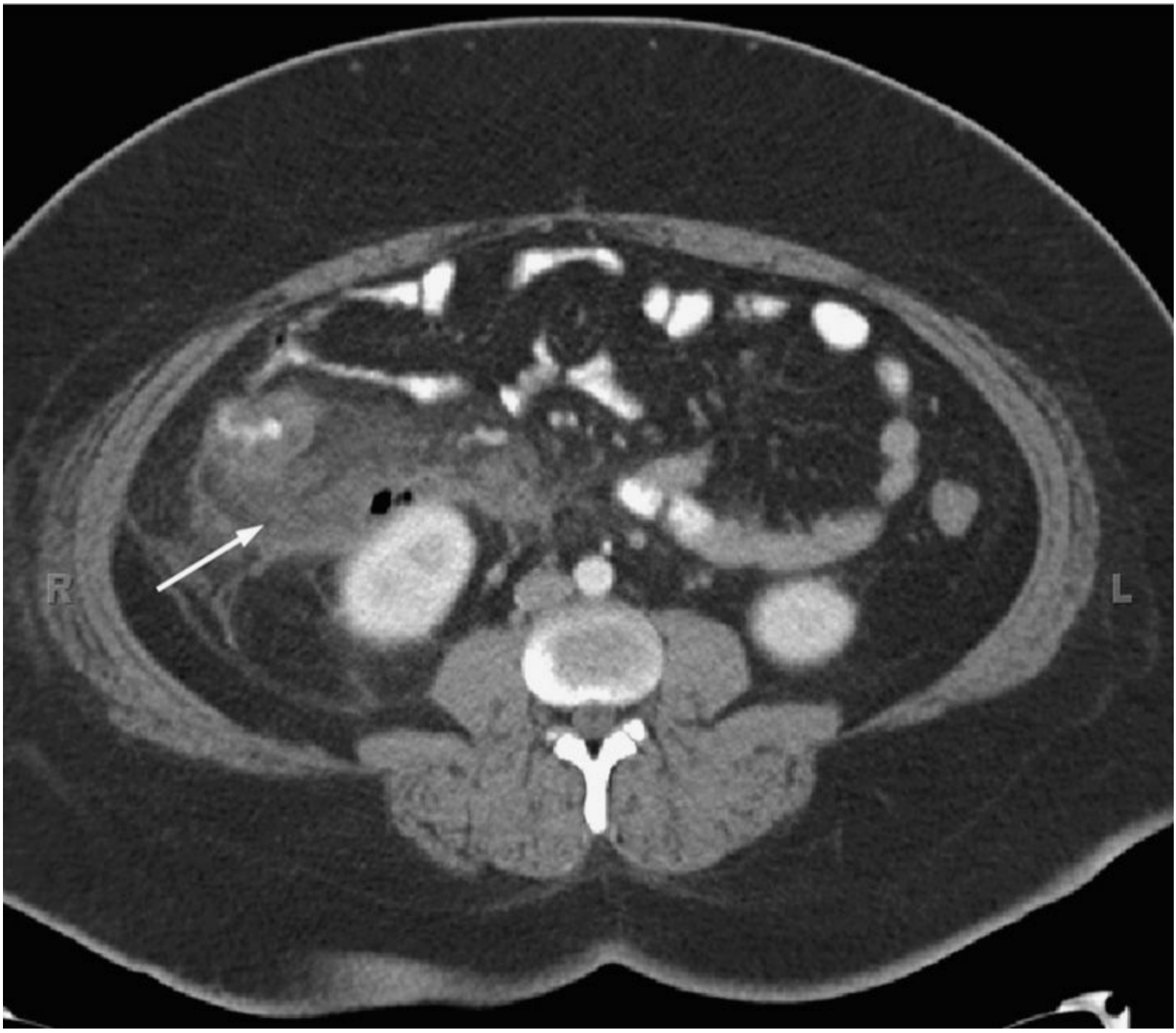


Figure 5-1. Computed tomography scan with oral and intravenous contrast of acute appendicitis. There are thickening of the wall of the appendix and periappendiceal stranding (*arrow*). (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

An appendiceal diameter larger than 6 mm has a higher sensitivity than an appendicolith, which is seen less than 25% of the time.

What is the most appropriate therapy?

Patients with appendicitis need surgical appendectomy. Without urgent removal of the inflamed appendix, it will perforate, which leads to right hemicolectomy or postoperative complications such as abscess formation.

Antibiotics in appendicitis are only adjunctive.
Surgery is mandatory.

Orders:

- *Surgical consult*
- *Turn the clock forward, and the case will end.*

Flora of the appendix includes gram-negative aerobes and anaerobes.

CCS TIP: *You cannot physically move the patient to a location called the operating room (OR). Order the procedure, and it is implied that the patient goes to the OR.*

Nonperforated appendicitis = Single preoperative dose of antibiotic such as cefoxitin or ampicillin–sulbactam. No postoperative dose is needed.

Perforated appendicitis = Antibiotics before surgery and for 5 to 7 days afterward.

CASE 3: Diverticulitis

Setting: *ED*

CC: *"My belly hurts again"*

VS: *BP, 130/90; P, 121 beats/min; R, 18 breaths/min; T, 101.4°F*

HPI: *A 71-year-old man presents with dull abdominal pain, worsening in intensity over the past 2 hours. The pain is dull and localized over his left lower abdomen without radiation. It is associated with nausea, vomiting, and a few bouts of diarrhea. He has not recent traveled and has had no exposure to antibiotics or sick contacts.*

PMH: *Colonoscopy showing diverticular disease 2 years ago*

ROS:
- *Nausea*
- *Chills*

Physical Exam:
- *Abdomen is soft*
- *Pain to palpation at the left lower quadrant (LLQ)*
- *Guarding and mild rigidity are noted*

What is the most likely diagnosis?

a. Appendicitis
b. Diverticulitis
c. Cholecystitis
d. Ischemic colitis
e. Infectious colitis

Answer b. Diverticulitis

Diverticulitis is an inflammatory condition in which a diverticulum becomes obstructed and a microperforation occurs. The presentation is in a person older than 60 years of age presenting with LLQ pain and fever accompanied by nausea and vomiting. Pain is most common in the LLQ because the sigmoid colon is most commonly affected, yet the entire colon is susceptible.

Appendicitis gives right lower quadrant (RLQ) pain, while cholecystitis leads to right upper quadrant (RUQ) pain. Ischemic colitis is a transient state of hypoperfusion to the bowel in which the mucosa sloughs off from lack of oxygen. Although it presents with LLQ pain, the lack of bloody diarrhea and history of vascular disease make it less likely in this patient. Infectious colitis is most often after exposure to an antibiotic from *Clostridium difficile*.

Colonic diverticula “false”: “False” means they do not contain all layers of the colon. They contain mucosa and submucosa, which push through the muscularis covered only by serosa.

What is the most accurate diagnostic test?

a. Ultrasonography
b. Computed tomography (CT) scan of the abdomen and pelvis
c. Magnetic resonance imaging (MRI) of the abdomen
d. Radiography of the abdomen

Answer b. Computed tomography (CT) scan of the abdomen and pelvis

Findings on CT scan consistent with diverticulitis are localized bowel wall thickening, pericolonic fat stranding, and the presence of colonic diverticula (Figure 5-2). Ultrasonography of the abdomen can be used for diagnosis of diverticulitis but is operator dependent and cannot exclude other diagnoses. Sonography lacks sensitivity in diverticular diseases. MRI of the abdomen takes too long to make a diagnosis, and radiography of the abdomen will not able to provide information of the colon because it is a soft tissue organ, which is not radiopaque. MRI is not good for the abdomen in general.

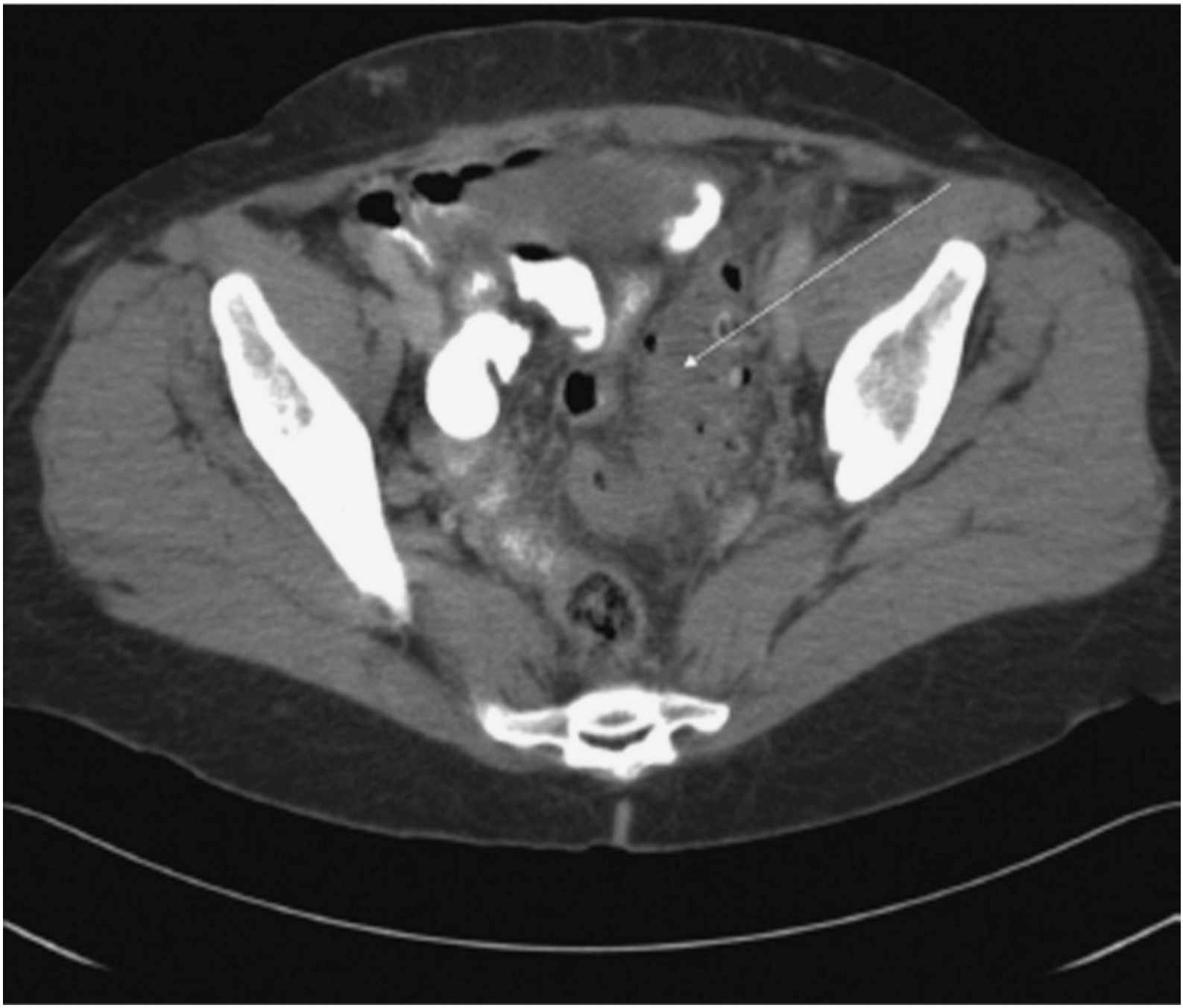


Figure 5-2. Computed tomography scan of the abdomen with left lower quadrant abdominal pain showing sigmoid colon mural thickening, several colonic diverticula, and associated mesocolic fat infiltration, which are findings consistent with acute diverticulitis. (Reproduced, with permission, from McKean SC, Ross JJ, Dressler DD, et al, eds. *Principles and Practice of Hospital Medicine*. New York: McGraw-Hill; 2012.)

MRI
- Based on water content of tissues
- Central nervous system: Each tissue (neural, cerebrospinal fluid, bone) has very different water content MRI is great!
- Gastrointestinal: Each tissue in abdomen has similar water content MRI not so great

CT with contrast with air in other organs suggests a fistula.

Orders:

- *Nothing by mouth (NPO)*
- *Complete blood count*
- *Normal saline*
- *Intravenous morphine*
- *CT scan of the abdomen and pelvis with contrast*

A CT scan of abdomen reveals bowel thickening and colonic fat stranding along the sigmoid colon with evidence free air and perforation. The patient is currently in more pain and has a fever of 102°F.

Diverticula develop at points where the vasa recta penetrate the circular muscle layer of the colon.

Diverticulitis + Abscess or perforation = Complicated diverticulitis → Surgery

What is the best next step in management?

a. Antibiotics and observation
b. Percutaneous drainage
c. Surgery

Answer c. Surgery

Surgery is the only way to close a hole. Antibiotics are only supportive for a perforated viscous secondary to any inflammatory condition, including diverticulitis. Antibiotics try to keep the infection local; surgery solves the problem. Surgery removes the perforated focus by resection of the colon restores the alimentary canal. Whereas percutaneous drainage is correct therapy for a patient with abscess formation secondary to diverticulitis, antibiotics and observation are done for a patient who has uncomplicated diverticulitis.

CCS TIP: *You cannot order medications on CCS by class. You cannot just say, "Cephalosporin." You have to order them on CCS by individual name.*

Antibiotics for Diverticulitis

- Ciprofloxacin and metronidazole
- Ampicillin–sulbactam

• Ertapenem

β-Lactam antibiotics: penicillins, cephalosporins, carbapenems, aztreonam.
All work by inhibiting the cell wall.

Multiple occurrences of diverticulitis require elective surgery to remove the segment of bowel causing recurrence.

Orders:
• *Surgical consult*
• *Ciprofloxacin*
• *Metronidazole*
• *Turn the clock forward, and the case will end.*

Penicillin allergy:
• If rash only, cephalosporins are safe
• If anaphylaxis, use aztreonam for gram-negative rods in bowel
• No cross-reaction between penicillin and aztreonam

CASE 4: Small Bowel Obstruction

Setting: *ED*

CC: *"I have not passed stool in 3 days."*

VS: *BP, 100/60 mm Hg; P, 101 beats/min; R, 24 breaths/min; afebrile*

HPI: *A 39-year-old woman presents with an abrupt onset of abdominal pain, severe nausea, and multiple episodes of bilious vomiting over the past night. The pain is intense and comes in waves. It is located in the periumbilical region. She has not had a bowel movement in 3 days and denies any abnormal food exposures, travel, or sick contacts.*

PMH:
- *History of open appendectomy*
- *History of cesarean section*

ROS:
- *Nausea*
- *Vomiting*
- *Obstipation*

Physical Exam:
- *Soft but distended abdomen*
- *Hypoactive bowel sounds*
- *High-pitched tinkling sounds when pain is worst*
- *Tenderness diffusely*
- *Digital rectal examination demonstrates an empty rectal vault*

What is the most likely diagnosis?

a. Appendicitis
b. Small bowel obstruction (SBO)
c. Gastroenteritis
d. Infectious colitis

Answer b. Small bowel obstruction (SBO)

SBO is the most likely diagnosis when a patient presents with nausea, vomiting, constipation, and obstipation in the setting with a history of abdominal surgeries. In a bowel obstruction, the alimentary canal's normal flow becomes interrupted because of a mechanical obstruction. This prevents passage of bowel fluid through the small bowel and causes a proximal dilation. If the obstruction becomes strangulated, then bowel necrosis and perforation can occur.

The pain in this patient is not located in the right lower quadrant and, therefore, is not likely

appendicitis. A patient with gastroenteritis would have nausea and vomiting likely also diarrhea, but definitely not obstipation. Infectious colitis would occur after a patient is exposed to antibiotics. Patients with SBO become hypovolemic because of vomiting, so findings of orthostasis, hypotension, and tachycardia are common physical findings.

Number one risk for SBO: prior abdominal surgery causing adhesions

The most common physical finding in SBO is distension.

What is the most accurate diagnostic test for diagnosis of SBO?

a. Plain abdominal radiography
b. CT scan of the abdomen
c. Small bowel follow-through series
d. Small bowel enteroclysis

Answer b. CT scan of the abdomen

CT scanning allows for the identification of the transition point, or the area of the small bowel that has the mechanical obstruction. Radiography is the best initial test and is sensitive for dilated loops of bowel and air fluid levels but not specific to SBO as other conditions can cause these findings (Figure 5-3). Small bowel follow-through and enteroclysis are no longer done because the test is long, expensive, and adds little or nothing to CT scan. Enteroclysis has been used for Crohn's disease but never for bowel obstruction.

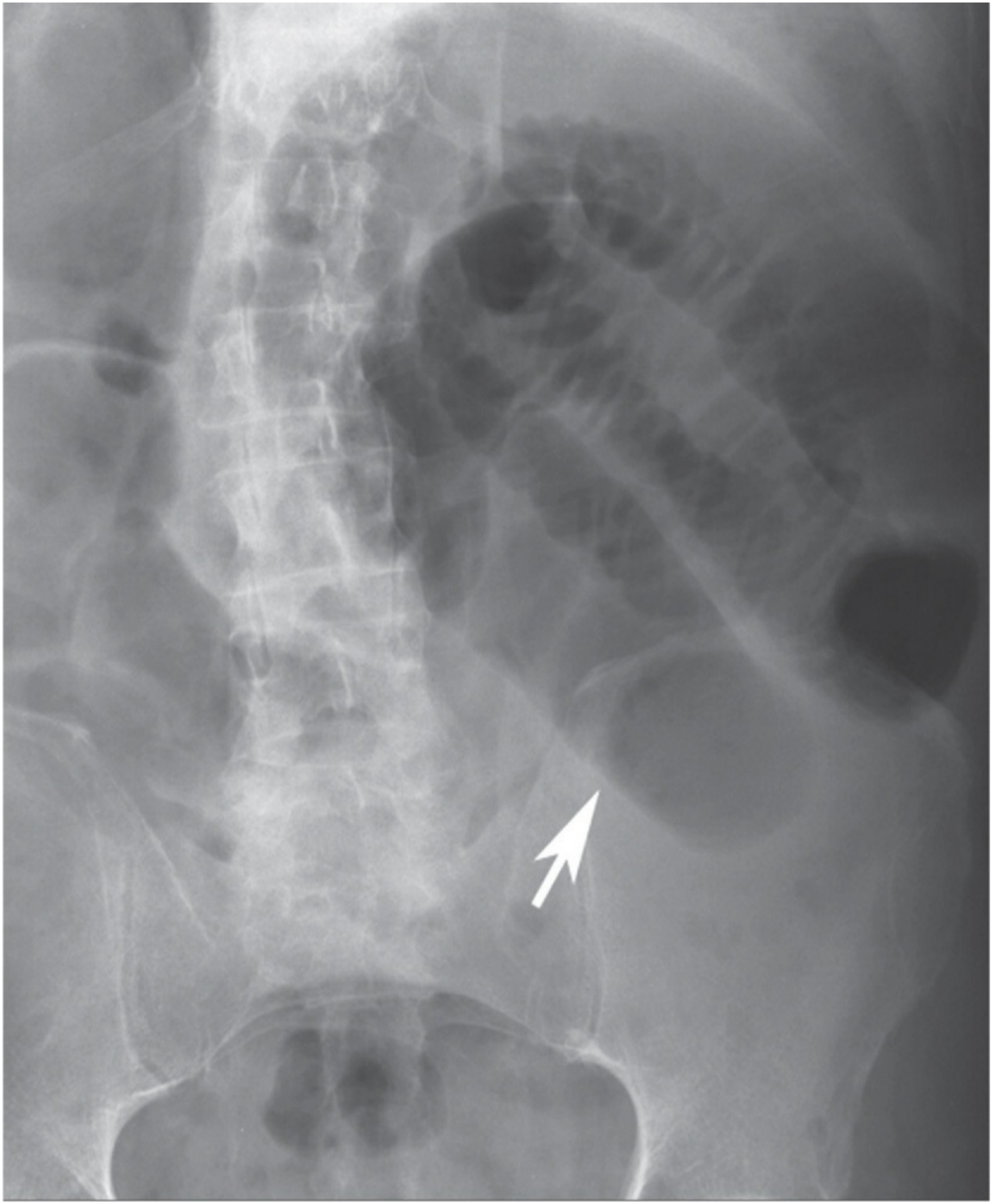


Figure 5-3. Small bowel obstruction. Abdominal radiograph image shows severe dilation of jejunal small bowel loops with acute transition (*arrow*). (Reproduced, with permission, from Mortele KJ. State-of-the-art imaging of the gastrointestinal system. In: Greenberger NJ, Blumberg RS, Burakoff R, eds. *Current Diagnosis & Treatment: Gastroenterology, Hepatology, & Endoscopy*. 2nd ed. New York: McGraw-Hill; 2012.)

Best initial test: abdominal radiography
Most accurate test: CT scan

Hyponatremic, hypokalemic, hypochloremic metabolic alkalosis occur from ongoing vomiting in SBO.

Orders:
- *Nothing by mouth (NPO)*
- *Normal saline*
- *Lactic acid*
- *CT scan of the abdomen*

CT scans do not need oral contrast because the intraluminal fluid serves as a natural contrast agent.
Mechanism of Hypokalemia in Vomiting
- Loss of acid creates alkalosis.
- Alkalosis drives potassium into cells.
- Volume depletion increases aldosterone.
- Aldosterone increases potassium excretion at the kidney.

A CT scan demonstrates a partial small bowel obstruction in the mid jejunum. The patient's vital signs have not changed. The lactic acid level is 1.8 meq/L (elevated) (Figure 5-4).

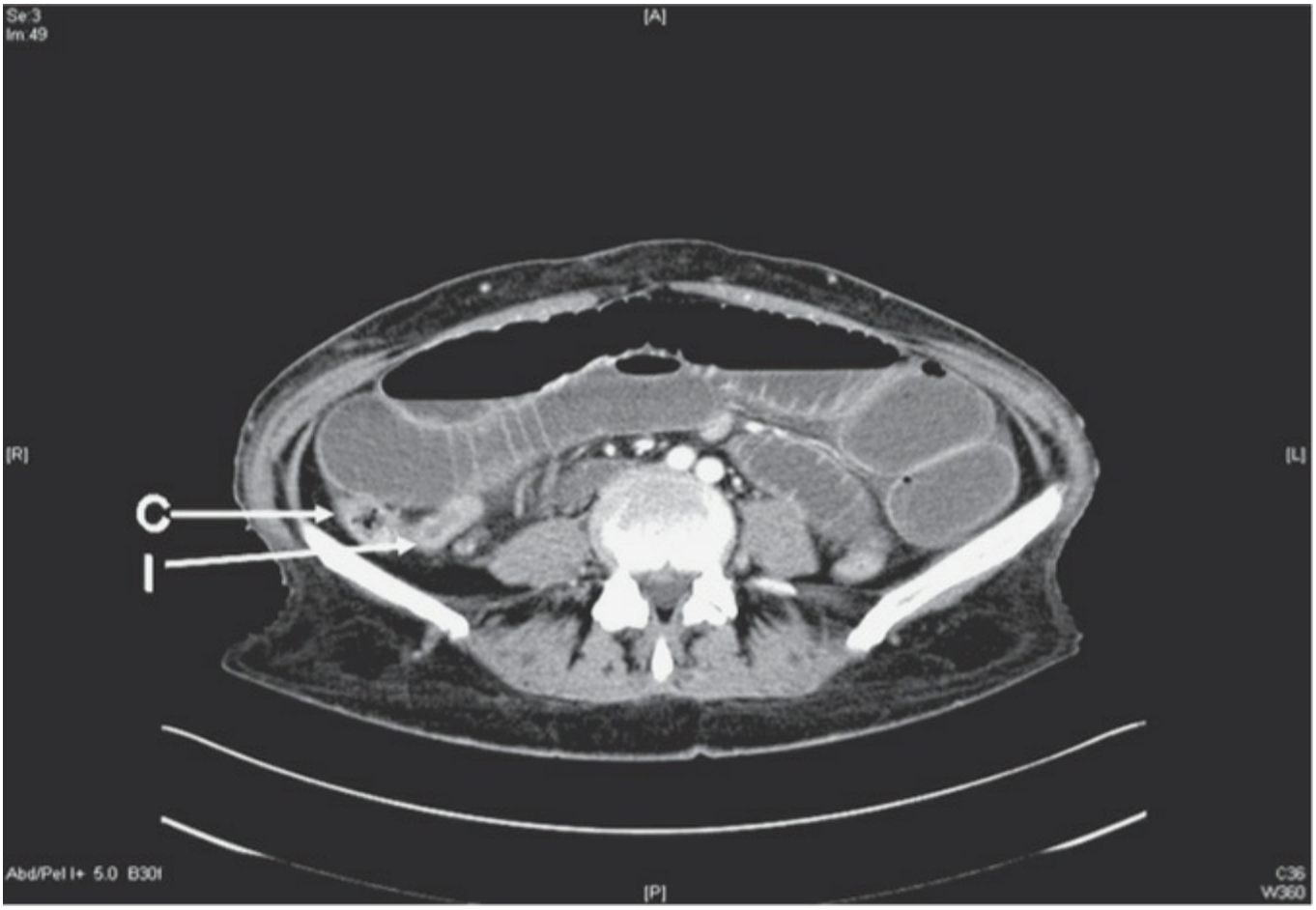


Figure 5-4. Small bowel obstruction. A computed tomography scan of a patient presenting with signs and symptoms of bowel obstruction. The image shows grossly dilated loops of small bowel, with decompressed terminal ileum (I) and ascending colon (C), suggesting a complete distal small bowel obstruction. (Reproduced, with permission, from Brunicardi F, Andersen DK, Billiar TR, et al, eds. *Schwartz's Principles of Surgery*. 9th ed. New York: McGraw-Hill; 2010.)

What is the best next step in management?

a. Surgical intervention

b. Antibiotics

c. Nasogastric (NG) tube decompression

Answer c. Nasogastric (NG) tube decompression

The mainstay of therapy for a patient with SBO is NG tube decompression of the proximal bowel that is before the transition zone. Antibiotics and surgical intervention is the best next step in the management of a patient with strangulated small bowel. Strangulated small bowel is a surgical emergency, and the earlier a patient is taken for laparoscopy, the less likely bowel necrosis will set in.

SBO is the only truly clear indication for an NG tube. Gastrointestinal secretions continue to be made, but the bowel does not move forward. You must remove them.

Orders:

- *Nothing by mouth (NPO)*
- *Normal saline*
- *CT scan of the abdomen*

• *Turn the clock forward, and the case will end.*

Signs of strangulated SBO are fever, elevated lactic acid level, and evidence of septic shock.

Why we need NG suction in SBO
Gastrointestinal secretion rates:
• Saliva: 1-2 L/day
• Gastric: 2 L/day
• Pancreatic: 2-3 L/day

ENDOCRINE

CASE 1: Pituitary Disease

Setting: *Office*

CC: *"I am having trouble in bed."*

VS: *Stable*

HPI: *A 42-year-old man presents with difficulty seeing and a recent onset of erectile dysfunction (ED). He is married and says his sex life with his wife for the past 6 months has been troubled. Also, his shirts have become tighter in the chest area.*

ROS: *Frequent headaches*

Physical Exam:
- *Bilateral gynecomastia*
- *Testicles decreased in size and soft to palpation*

What is the most likely diagnosis?

a. Pituitary adenoma
b. Intracranial hemorrhage
c. Meningioma
d. Cavernous venous thrombosis
e. Testicular cancer

Answer a. Pituitary adenoma

Pituitary adenoma most often presents with symptoms of hormonal excess. The most common pituitary lesion is a microadenoma. In this patient, decreased libido, gynecomastia, and ED are consistent with prolactinoma. Intracranial hemorrhage, cavernous thrombosis, and meningioma would present with focal neurologic deficits in addition to the visual deficits. Testicular cancer presents with enlarged testicle, and there is no functional abnormality. Testicular cancer does not interfere with hormone function.

Bitemporal visual field defects are caused by compression of the optic chiasm.

The most common pituitary adenoma is a prolactinoma (Table 6-1).

Table 6-1 Types of Adenomas

Type of Adenoma	Hormone Secreted	Type	Pathology
Lactotroph	Prolactin	Acidophilic	Galactorrhea, hypogonadism, amenorrhea, infertility, and impotence
Somatotroph	Growth hormone	Acidophilic	Acromegaly
Corticotroph	Adrenocorticotropic hormone	Basophilic	Cushing's disease
Gonadotroph	Luteinizing hormone, follicle-stimulating hormone	Basophilic	
Thyrotroph	Thyroid-stimulating hormone	Basophilic	Hyperthyroidism

Prolactin inhibits follicle-stimulating hormone, luteinizing hormone, and gonadotropin-releasing hormone.

What is the best next step in the management of this patient?

a. Serum thyroid-stimulating hormone (TSH) level
b. Serum prolactin level
c. Magnetic resonance imaging (MRI)
d. Serum testosterone level
e. Serum insulin-like growth factor-(IGF)1

Answer b. Prolactin level

The best initial test to diagnose a patient with signs and symptoms of prolactinoma is to check the serum prolactin level. Serum TSH would be used to confirm if a patient has a rare TSH-secreting tumor. Serum testosterone can be measured because hypogonadism presents with ED and decreased libido. Because of gynecomastia, a pituitary source must be given first consideration. Serum IGF-1 level is used in patients who present with acromegaly. MRI is never the first step in an endocrinologic disorder. MRI is used to confirm a mass lesion if serum levels of a particular hormone are elevated. If prolactin levels are elevated, then the most accurate test is an MRI of the brain to look for a mass lesion in the hypothalamic–pituitary region.

Do not measure prolactin levels after a breast examination because manipulation causes a modest rise in prolactin levels.

Prolactinoma presents with amenorrhea and galactorrhea in women. Check a pregnancy test first before proceeding.

Orders:
• *Prolactin level*
• *Send the patient home and bring him back in 24 hours*

Prolactin levels return at 350 ng/mL (markedly elevated). The patient's symptoms have not changed, and his vital signs are stable.

If a patient is taking one of these drugs that cause hyperprolactinemia, it must be discontinued:
• Haloperidol

- Risperidone
- Olanzapine
- Desipramine
- Metoclopramide
- Verapamil
- Morphine

Antipsychotic medications inhibit prolactin.

During pregnancy, the pituitary gland doubles in size and prolactin levels increase by 10-fold during this period.

Order:

- *MRI of the brain*

MRI of the pituitary demonstrates a 1-cm mass in the left pituitary gland. There is displacement of the infundibulum and normal pituitary tissue to the right. There is significant chiasmal contact with compression (Figure 6-1).

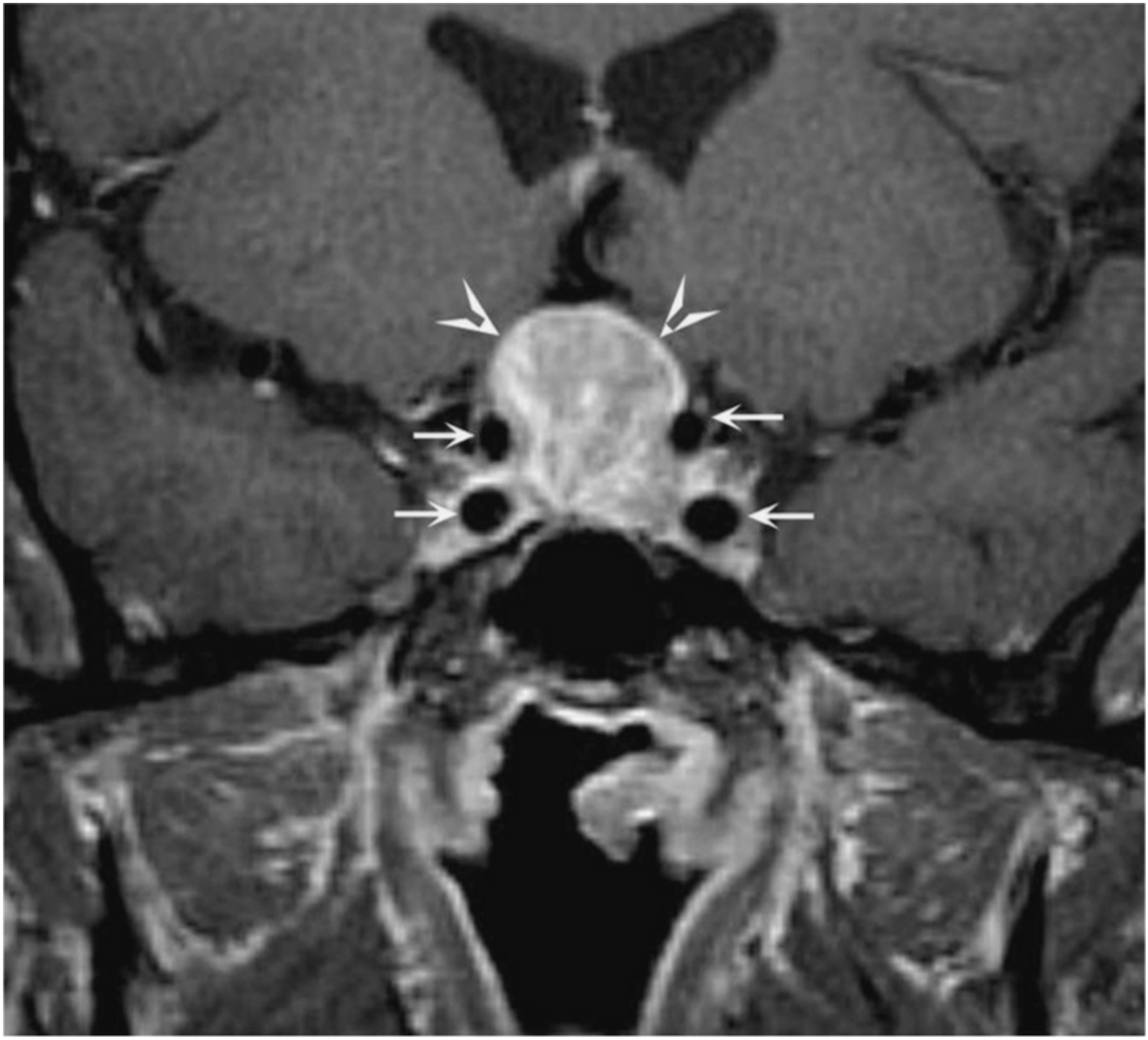


Figure 6-1. Coronal T1-weighted postcontrast magnetic resonance image shows a homogeneously enhancing mass *(arrowheads)* in the sella turcica and suprasellar region compatible with a pituitary adenoma; the *small arrows* outline the carotid arteries. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

What is the best next step in the management of this patient?

a. Cabergoline
b. Benztropine
c. Baclofen
d. Beclomethasone

Answer a. Cabergoline

Cabergoline and bromocriptine are dopamine agonists that are first-line therapy to shrink the size

and secretory potential of prolactinomas. Benztropine (an anticholinergic), baclofen, and steroids have no role in the treatment of prolactinoma. Many patients cannot tolerate bromocriptine because of nausea. This is why cabergoline is indicated.

Serum prolactin levels and adenoma size typically improve within 2 to 4 weeks of therapy with a dopamine agonist.

Dopamine inhibits prolactin release.

Orders:

- *Cabergoline*
- *Send the patient home and bring him back in 4 weeks.*
- *Repeat prolactin level on return.*

The patient returns in 4 weeks and reports a mild improvement in his symptoms but still has visual defects. He also reports nausea and vomiting with cabergoline. His prolactin level is 250 ng/mL (elevated).

Surgery is used when dopamine agonist therapy does not work. Women who wish to become pregnant and have a prolactin-secreting tumor larger than 3 cm should have surgery.

The type of intervention is transsphenoidal surgery, which occurs via an incision in the upper lip into the brain.

Orders:

- *Neurosurgical consult.*
- *Turn the clock forward, and the case will end.*

CASE 2: Hyperparathyroidism

Setting: *Office*

CC: *"I have too much calcium."*

VS: *Stable*

HPI: *A 49-year-old man is referred after a community health screening found him to have an elevated calcium level. He does not take vitamin supplements. His has peptic ulcer disease (PUD) that causes pain off and on lately. He denies joint pain, has no history of kidney stones, and reports no change in his ability to concentrate or think.*

High calcium inhibits neural depolarization.

PMH:
- *Peptic ulcer disease (PUD)*
- *Nephrolithiasis 2 years ago*

Meds:
- *Omeprazole*
- *Glucosamine*

Calcium increases gastrin release. Gastrin produces acid from parietal cells.

ROS:
- *Polyuria*
- *No nausea or vomiting*
- *No abdominal pain*
- *No dark stools*

Physical Exam:
- *Abdomen is soft*
- *Epigastric tenderness to deep palpation*

Initial Orders:
- *Basic metabolic profile (BMP)*

- *Albumin level*
- *Ionized levels*
- *Vitamin D level*
- *Parathyroid hormone (PTH) level*
- *24-hour urine calcium*

Results:

- *BMP: Calcium level: 14.0 mg/dL (normal, 8.5–10.5 mg/dL)*
- *Phosphorus level: 1.5 mg/dL (low)*
- *Blood urea nitrogen/creatinine (BUN/Cr): 10/1.0 mg/DL*
- *Vitamin D level: 31 ng/mL*
- *Albumin level: 4.0 g/dL*
- *PTH level: 150 pg/mL (elevated)*

PTH lowers phosphorus level by increasing proximal tubule excretion.

What is the most likely diagnosis?

a. Primary hyperparathyroidism
b. Secondary hyperparathyroidism
c. Tertiary hyperparathyroidism
d. Vitamin D toxicity

Answer a. Primary hyperparathyroidism

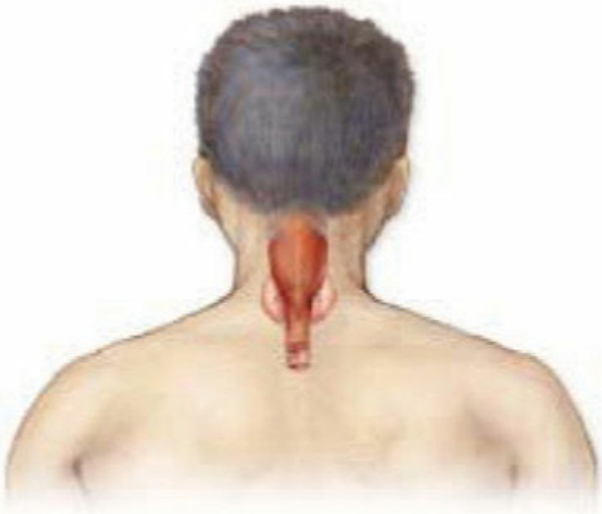
Primary hyperparathyroidism usually presents as asymptomatic hypercalcemia in a patient without renal disease. However, clinical signs that are subtle and suggest hypercalcemia in this patient outside of the elevation in the ion are normal vitamin D level, elevated PTH level, and normal albumin level. PUD may be caused by calcium being the second messenger for gastrin, causing an elevation of HCl release from parietal cells. Secondary hyperparathyroidism is from low calcium. This increases PTH from loss of negative feedback. Secondary hyperthyroidism can be caused by vitamin D deficiency causing low serum calcium levels. Tertiary hyperparathyroidism is seen in patients with long-standing secondary hyperparathyroidism, causing hyperplasia of the parathyroid glands. This is caused by chronic renal failure (Table 6-2).

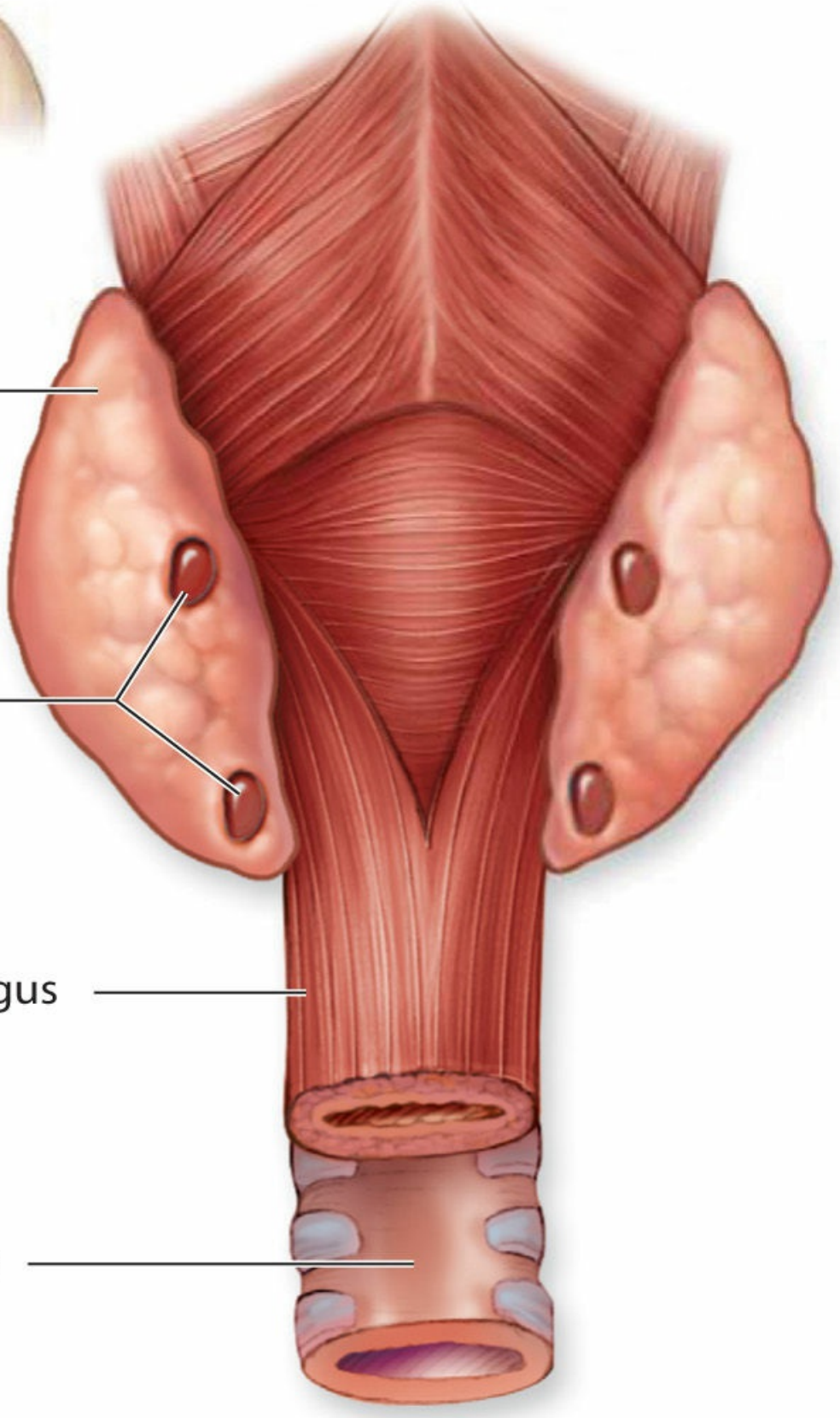
Table 6-2 Differences in Serum Parathyroid Hormone, Calcium, and Phosphorus Levels in Primary, Secondary, and Tertiary Hyperparathyroidism

Parathyroid Hormone Level	Calcium Level	Phos-phorus	Diagnosis	Cause
High	High	Low	Primary hyperparathyroidism	Oversecretion of parathyroid hormone
High	Low	High	Secondary hyperparathyroidism	Vitamin D deficiency
Very high	High	High	Tertiary hyperparathyroidism	Chronic renal failure

About 80% of patients with primary hyperparathyroidism will be asymptomatic. The remaining 20% present with "stones, bones, abdominal groans, and psychiatric moans."

There are four parathyroid glands: right and left, and superior and inferior. The inferior glands are derived from the third pharyngeal pouch, and the superior are from the fourth pharyngeal pouch (Figure 6-2).





Posterior view

Figure 6-2. The parathyroid glands are four small nodules normally embedded in the capsule on the posterior surface of the thyroid gland. (Reproduced, with permission, from Mescher AL, ed. *Junqueira's Basic Histology: Text & Atlas*. 13th ed. New York: McGraw-Hill; 2013.)

Multiple endocrine neoplasia (MEN) type I → 3 Ps
1. Pancreatic tumor (e.g., gastrinoma)
2. Pituitary adenoma
3. Parathyroid adenoma

Alkaline phosphatase levels are elevated in primary hyperparathyroidism.

What is the best next step in the management of this patient?

a. Thiazide therapy
b. Vitamin D supplementation
c. Surgical parathyroidectomy
d. Bisphosphonates

Answer c. Surgical parathyroidectomy

Surgical parathyroidectomy is indicated in patients with symptomatic hypercalcemia such as PUD, nephrolithiasis, abdominal pain, or altered mental status. Parathyroidectomy is the answer for asymptomatic patients with a serum calcium concentration of 1.0 mg/dL or above the upper limit of normal in those younger than 50 years of age, creatinine clearance reduced to less than 60 mL/min, and bone density with a T score less than –2.5. Thiazide therapy would make the calcium levels worsen and increase. Vitamin D supplementation is for patients with secondary hyperparathyroidism. Bisphosphonates are used in patients with concomitant osteoporosis.

Bisphosphonates inhibit osteoclastic bone resorption.

Thiazides cause hyperGLUC:
• HyperGlycemia
• HyperLipidemia
• HyperUricemia
• HyperCalcemia

Thiazides increase calcium uptake at the distal tubule.

Orders:
- *Endocrine consult*
- *Surgical consult*
- *Turn the clock forward, and the case will end.*

A sestamibi nuclear scan identifies the parathyroid adenoma to make surgical resection easier.

The most common location for ectopic parathyroid adenomas is in the anterior mediastinum.

CASE 3: Pheochromocytoma

Setting: *ED*

CC: *"I'm having palpations."*

VS: *BP, 200/90 mm Hg; P, 20 beats/min; R, 18 breaths/min; afebrile*

HPI: *A 30-year-old woman presents with an acute onset of headaches, palpitations, and sweating. Symptoms are intermittent and last for about 15 minutes and slowly dissipate. They are not related to exertion. This has occurred several times in the past 3 months, and this time she was scared and came to the emergency department. The patient denies cocaine use and caffeine consumption.*

PMH: *Oral contraceptive pills for 10 years*

ROS:
- *Nausea*
- *Weakness*
- *Anxiety and a sense of doom*
- *Weight loss*

Physical Exam:
- *Tremor bilaterally with warm, moist skin*
- *Blood pressure decreases by 20 points, and pulse increases by 15/minute when going from lying down to standing.*

Orthostatic hypotension:
- Decrease in systolic blood pressure >20 mm Hg
- Increase in pulse >10 beats/min

What is the most likely diagnosis?

a. Pheochromocytoma
b. Gastrinoma
c. Glucagonoma
d. Insulinoma

Answer a. Pheochromocytoma

A history suggestive of a pheochromocytoma includes episodic spells characterized by headaches, palpitations, and diaphoresis in association with severe hypertension. This is caused by a massive release of catecholamines, leading to various adrenergic effects. In between episodes of

hypertension, blood pressure drops precipitously. Whereas gastrinoma presents with multiple large ulcers past the second portion of duodenum, glucagonoma presents with elevated blood sugars that are difficult to control and necrolytic migratory erythema. Insulinoma presents with episodes of severe hypoglycemia and high C-peptide levels.

Pheochromocytoma
- Most common symptom: headache
- Most common electrocardiographic finding: sinus tachycardia
- Most common location: the medulla of the adrenal glands
- Most common ectopic site: the most common extra-adrenal site is in the superior para-aortic region between the diaphragm and lower renal poles

Pheochromocytoma is chromaffin cell adenoma.

What is the best next step in the management of this patient?

a. Computed tomography (CT) scan of the abdomen and pelvis
b. Urinary metanephrines
c. Observation
d. Meta-iodobenzylguanidine (MIBG) scan
e. Dexamethasone suppression test

Answer b. Urinary metanephrines

Urinary metanephrines measure catecholamines metabolites. This is much more accurate than a random catecholamine level, which can easily be up and down very quickly. Epinephrine is changed into urinary metanephrine, which is subsequently metabolized into vanillylmandelic acid (VMA).

Never start with a scan in endocrinology. CT scan of the abdomen and pelvis is done after the biochemical test confirms pheochromocytoma. MIBG scan is a nuclear scan that detects the 10% of cases that are outside the adrenal gland. You cannot just "observe" uncontrolled hypertension; you will then observe a stroke, myocardial ischemia, or renal failure.

Adrenal lesions are found in 4% of the general population.
Pituitary lesions in 10%.
Never start with a scan in endocrinology!

Medications which cause false elevations in catecholamine level:
- Tricyclic antidepressants
- Phenoxybenzamine
- Levodopa

Contrast used in CT scans inhibits tyrosine hydroxylase, the rate-limiting enzyme in catecholamine synthesis, and causes decreased levels of urinary metanephrines.

Orders:
- *24-hour urine for metanephrines and catecholamines*
- *Admit the patient to the hospital and turn the clock forward to the next day.*

Result: *Twenty-four-hour urine collection yields 9.3 mg of metanephrine and elevated catecholamines.*

Dopamine becomes homovanillic acid (HVA).
Epinephrine becomes metanephrine and VMA.
Norepinephrine becomes normetanephrine.
Normetanephrine becomes VMA.

If catecholamine and metanephrine are elevated but abdominal CT shows no lesion, what should you do? In other words, what is the most accurate test for pheochromocytoma?

a. Surgical removal of the adrenal glands
b. MIBG scan
c. CT scan of the brain
d. Magnetic resonance imaging (MRI) of the abdomen and pelvis

Answer b. MIBG scan

CT or MRI scan will reveal a mass in the adrenal glands in 90% of those with clinical findings and elevated catecholamines, suggesting pheochromocytoma. MIBG scan has a sensitivity and specificity of 92% and 94%, respectively, in detecting lesions outside the adrenal. Surgical removal is not indicated until we actually know where the mass itself is.

Orders:

- *MIBG*
- *Turn the clock forward to obtain results.*

Result: *MIBG scans: mass in left adrenal gland with radioactive uptake consistent with pheochromocytoma (Figure 6-3).*

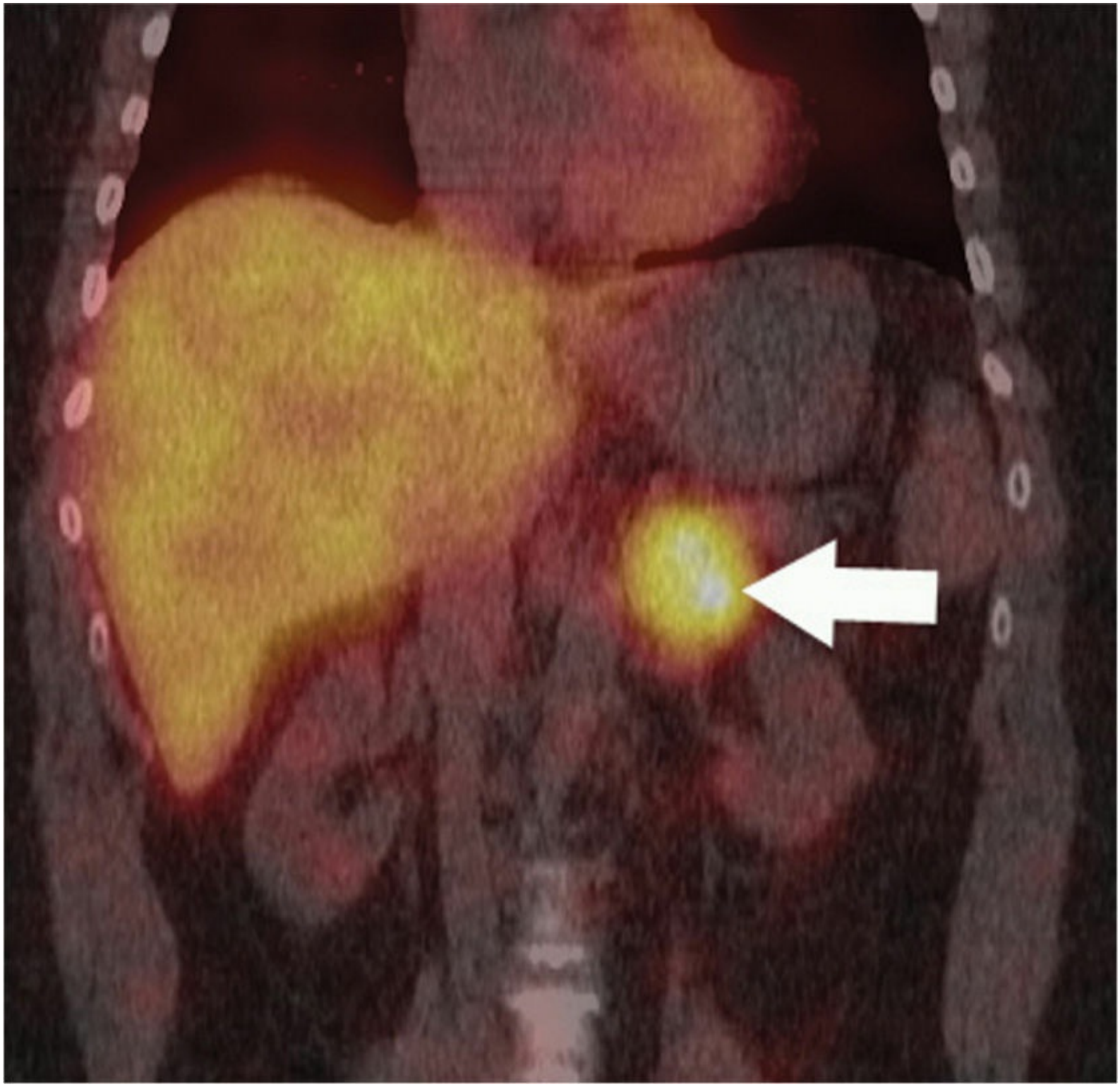


Figure 6-3. Meta-iodobenzylguanidine scan (coronal view) illustrates increased uptake in left-sided pheochromocytoma *(white arrow)*. (Reproduced, with permission, from Kantarjian HM, Wolff RA, Koller CA, eds. *The MD Anderson Manual of Medical Oncology*. 2nd ed. New York: McGraw-Hill; 2011.)

Neuroblastoma is pheochromocytoma in children. It is the most common extracranial solid cancer in childhood and the most common cancer in infancy.

What is the best next step in the management of this patient?

a. α Blockade and surgical excision
b. β Blockade and surgical excision
c. α followed by β blockade and surgical excision
d. α Blockade alone

Answer c. α followed by β blockade and surgical excision

Before surgical excision, there is an absolute need to block α receptors with phenoxybenzamine followed by β blockade. If the patient receives β blockade before α blockade, there will unopposed α, which will cause malignant uncontrolled hypertension leading to stroke.

For surgical follow-up, obtain plasma metanephrine levels yearly for 10 years and then test for multiple endocrine neoplasia (MEN) 2A and 2B.

Epinephrine: agonist at α1 and α2 and β1 and β2 receptors
Norepinephrine: agonist at α1 and α2 and β1 only.
Norepinephrine does not stimulate β2 receptors; it is mostly α1.

Normal adrenals make 80% epinephrine and 20% norepinephrine.
Pheochromocytoma makes 20% epinephrine and 80% norepinephrine.

Orders:
- *Phenoxybenzamine*
- *Labetalol*
- *Surgical consult*
- *Turn the clock forward, and the case will end.*

10% of pheochromocytomas present bilaterally.

MEN 2A
- Medullary thyroid carcinoma
- Parathyroid adenoma
- Pheochromocytomas
- Hirschsprung disease

MEN 2B
- Medullary thyroid carcinoma
- Pheochromocytoma
- Mucosal neurofibromatosis
- Intestinal ganglioneuromatosis

CASE 4: Gastrinoma

Setting: *Office*

CC: *"My stomach still hurts."*

VS: *Stable*

HPI: *A 35-year-old man presents with continued abdominal pain. He is planned for a repeat esophagogastroduodenoscopy today. He was recently started on omeprazole for an ulcer in his gastric antrum found 2 months ago. He returns with increasing abdominal pain that is dull and gnawing in nature, 7 of 10 in intensity. It is worse, especially after eating, and is nonradiating. A repeat endoscopy performed now shows multiple large ulcers greater than 1 cm in size. Upon passage of the scope into the duodenum, three ulcers are seen in the second and third portions of the duodenum. He has had dark stools and diarrhea for 6 weeks.*

Physical Exam:

- *Epigastric tenderness upon palpation*
- *Melena on rectal examination*
- *Guaiac-positive stools*

What is the most likely diagnosis?

a. Pancreatitis
B. Pernicious anemia
c. Zollinger-Ellison syndrome (ZES)
d. Gastric outlet obstruction

Answer c. Zollinger-Ellison syndrome (ZES)

ZES is characterized by a patient who has symptoms of peptic ulcer disease (PUD) with persistent abdominal pain despite medical treatment. Tumor cells release gastrin, which causes parietal cells to release massive amounts of acid. This results in severe ulcer disease that extends into the small intestine past the first portion of the duodenum and sometimes into the jejunum.

Acid in the small intestine causes bicarbonate release from the pancreas and small intestine, caused by secretin stimulated by the acidic environment, which leads to constant diarrhea. Pancreatitis would present with epigastric pain that radiates into the back, and a history of gallstones or alcoholic binge. Pancreatitis is not associated with bleeding. Although chronic pancreatitis can lead to vitamin B12 deficiency and megaloblastic anemia, it would not cause bleeding or abdominal pain. Gastric outlet obstruction gives early satiety and nausea after eating.

Acid inactivates lipase.
Lipase inactivation causes steatorrhea.

Gastrin causes parietal cell hyperplasia and increased hydrogen ion secretion, leading to a much larger volume of acid secretion.

What is the best next step in the management of this patient?

a. Gastrin level
b. Secretin level
c. Computed tomography (CT) scan of the abdomen
d. Endoscopic ultrasonography (EUS)

Answer a. Gastrin level

The best initial test for ZES is to obtain a gastrin level while the patient is off proton pump inhibitors (PPIs) and H2 blockers. A gastrin level greater than 1000 pg/mL is suggestive of ZES. A high gastrin level and increased gastric acid output are diagnostic of gastrinoma. Secretin level may be elevated, but this does not diagnose gastrinoma. CT scan may not show a mass because neuroendocrine tumors are very small. As with all endocrine lesions, the content of the lesion should be confirmed before imaging. An octreotide scan combined with EUS is the most accurate way to localize the site of gastrinoma. EUS and octreotide scan are done after the presence of the lesion is confirmed.

High gastric acid + High gastrin = Gastrinoma

PPIs elevate gastrin levels from loss of negative feedback from hydrogen ions.

Orders:
• *Gastrin level*
• *Turn the clock forward to obtain the result.*

Result: *Gastrin level: elevated at 1500 pg/mL*

Order:
• *Restart PPIs after the gastrin level is obtained.*

Most accurate tests for gastrinoma location:

- Octreotide scan (somatostatin receptor scintigraphy)
- EUS fine-needle aspiration (FNA) obtains tissue for final pathologic diagnosis.

Orders:

- *Octreotide scan*
- *Endoscopy ultrasound with FNA*
- *Restart omeprazole*

Octreotide scan shows enhancement of somatostatin localized solely to the head of the pancreas (Figure 6-4). EUS-guided FNA on pathology demonstrates a positive immunohistochemical staining for chromogranin A and G cells of neuroendocrine origin consistent with gastrinoma.

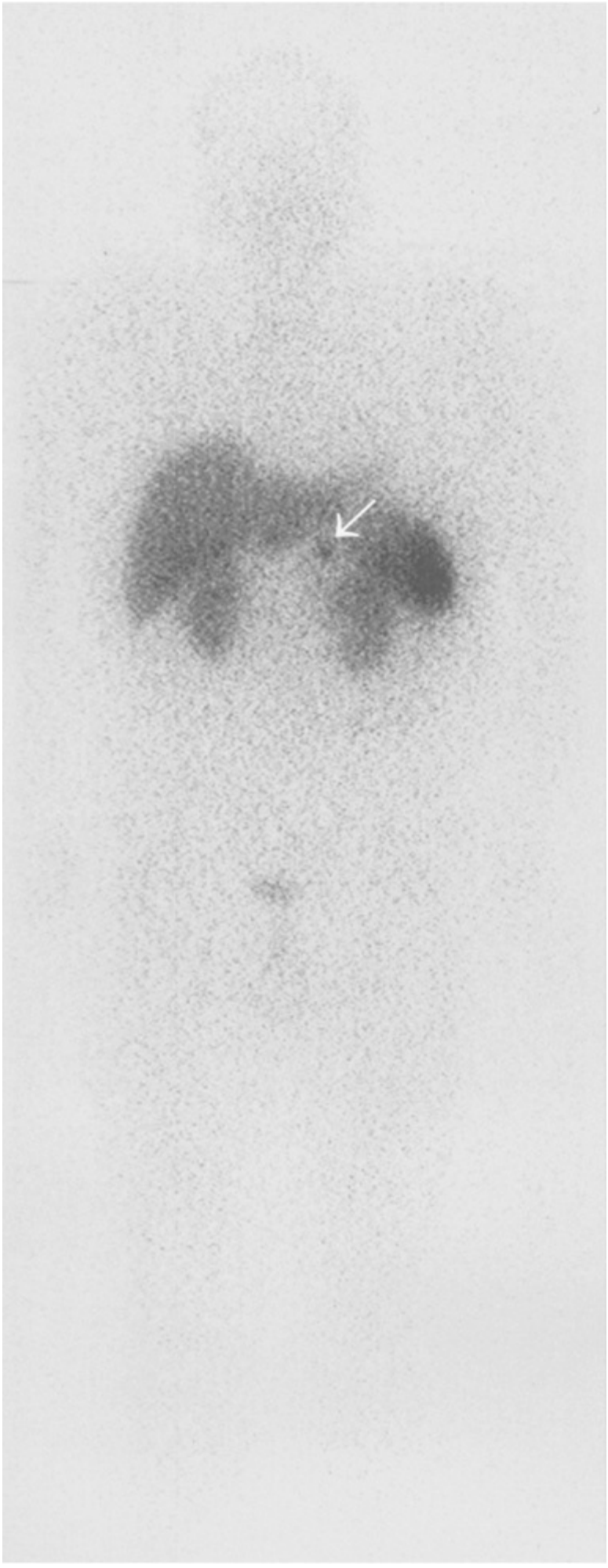


Figure 6-4. Positive octreotide scan in patient with gastrinoma. (Used with permission, from Alan Maurer, MD.)

What is the therapy of choice for localized gastrinoma?

a. Surgery
b. PPIs
c. Radiation
d. H2 receptor blockers

Answer a. Surgery

Surgery is the only cure for a patient with gastrinoma. You can only resect a localized gastrinoma. PPI therapy is only a medical therapy that treats symptoms; PPIs cannot cure the underlying cause. H2 receptor blockers are far less effective and are never the right answer for gastrinoma. Radiation therapy has no role in gastrinoma. It is too far inside the body to be effective, and as with pituitary lesions, it is highly unlikely there will ever be a cure.

What is the therapy for metastatic or widespread gastrinoma?

a. Chemotherapy
b. Surgical resection
c. Lifelong PPIs
d. Combine PPI and H2 blocker
e. Continuous gastric acid aspiration

Answer c. Lifelong PPIs

For patients with metastatic gastrinoma, lifelong PPIs will block the acid output of the parietal cells. You cannot surgically resect metastatic disease. Chemotherapy is not as important as blocking the source of symptoms from gastrinoma.

CASE 5: Glucagonoma

Setting: *Office*

CC: *"My rash is not getting better."*

VS: *Stable*

HPI: *A 45-year-old man with uncontrolled diabetes presents with a worsening pruritic rash of several months' duration. The rash begins as blisters and then moves to another location shortly thereafter, leaving a dark patch. He also has been drinking a lot more water lately, urinating more frequently, and has some weight loss.*

PMH:

- *Deep venous thrombosis (DVT) 2 years ago treated with warfarin*
- *Diabetes mellitus*

Meds:

- *Metformin*

ROS:

- *Lack of interest in activities*
- *Feelings of sadness and guilt*
- *Anhedonia*

Physical Exam: *Maculopapular rash with ringed lesions and blisters that are in various stages of healing most notable in areas of friction, including the buttocks and groin. The lesions are confluent strongly pruritic and painful. Healed areas are hyperpigmented (Figure 6-5).*

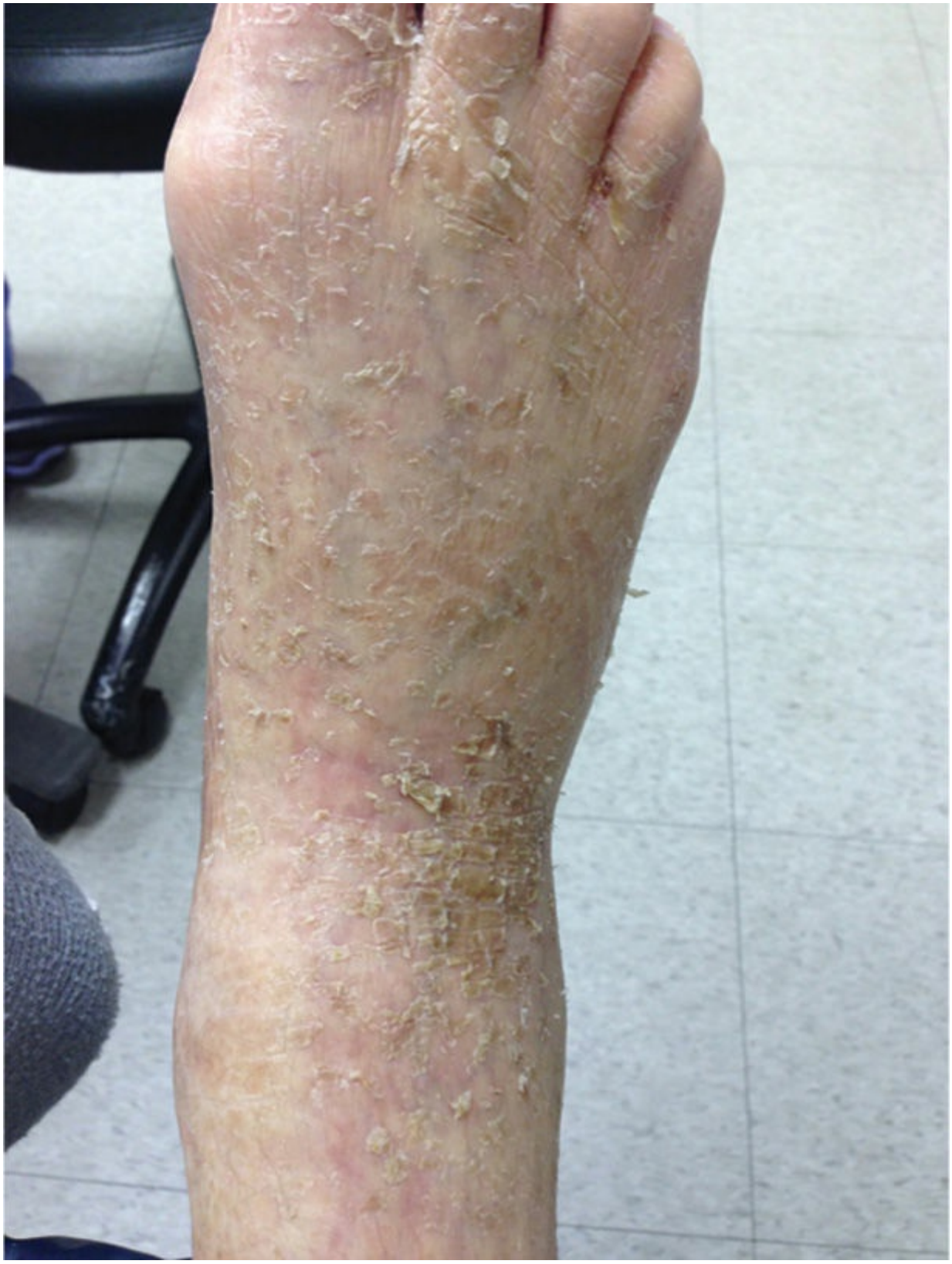


Figure 6-5. Migratory necrolytic erythema.

What is the most likely diagnosis?

a. Pheochromocytoma
b. Gastrinoma
c. Glucagonoma
d. Insulinoma

Answer c. Glucagonoma

Glucagonoma presents with weight loss, depression, diabetes mellitus, DVT, and necrolytic migratory erythema. It is a rare neuroendocrine tumor that is made up of islet cells, specifically the α cells that resemble those seen in the pancreas. Large amounts of glucagon are secreted, which causes an increase in serum blood glucose levels, which then leads to symptoms of diabetes mellitus. Necrolytic migratory erythema is characterized as a rash that begins as a maculopapular eruption that later blisters, and occurs most frequently in areas of high friction. Healed areas become hyperpigmented. Patients with ecrolytic migratory erythema describe the rash as pruritic and painful at the same time. Gastrinomas present with multiple large ulcers that extend into the jejunum and ileum, and insulinomas present with episodic hypoglycemia and high C-peptide levels. Pheochromocytomas cause episodic palpitations, tachycardia, and hypertension.

The 4 Ds of glucagonoma are diabetes, dermatitis, DVT, and depression.

α cells release glucagon, β cells release insulin.

What is the best next step in the management of this patient?

a. Zinc level
b. Glucagon level
c. Insulin level
d. C-peptide level

Answer b. Glucagon level

A positive test result should give a glucagon level exceeding 1000 pg/mL. Zinc deficiency has been associated with diabetes mellitus but would not cause dermatitis, DVT, or depression. Insulin and C-peptide levels are indicated in patients who have insulinoma. Insulinoma presents with a high insulin level and low glucose level. A new diagnosis of diabetes mellitus is diagnosed with a fasting blood glucose greater than 125 mg/dL or hemoglobin A1C greater than 6.5%.

Orders:
- *Glucagon level*
- *Turn the clock forward to obtain the result.*

Result: *A glucagon level of 1521 pg/mL (elevated)*

The most accurate test to localize neuroendocrine tumor of glucagon secreting cells is an MRI

of the abdomen. 95% are in the pancreas.

Order:
• *MRI of abdomen with gadolinium*

Result: *T2-weighted images demonstrate a localized enhancement in the body of the pancreas. No other lesions are noted.*

What is the most effective therapy for glucagonoma?

a. Chemotherapy
b. PPIs
c. Insulin
d. Surgery

Answer d. Surgery

The most effective therapy for glucagonoma is surgical resection. PPIs, chemotherapy, and insulin have no meaningful effect.

Orders:
• *Surgical consult*
• *Turn the clock forward, and the case will end.*

Everolimus is the treatment of choice for metastatic neuroendocrine tumors that secrete glucagon and are not surgically resectable.

CASE 6: Insulinoma

Setting: *ED*

CC: *"I got really dizzy on the subway."*

VS: *Stable*

HPI: *A 25-year-old woman presents to the emergency department after having a near syncopal episode on the subway. She was coming home from dinner with her new boyfriend. The episode began with diplopia, blurred vision, palpitations, and feeling very weak. She also states that she felt palpitations and tremulousness and was sweating profusely. After feeling better in the ambulance, she remembers being incredibly hungry. She has been in the ED for 1 hour getting intravenous fluids and feels fine. This is her third such episode of feeling dizzy, and she notes it always happens after eating.*

ROS: *Weight gain of 15 lb*

Physical Exam: *No abnormal physical findings*

What is the most likely diagnosis?

a. Pheochromocytoma
b. Gastrinoma
c. Glucagonoma
d. Insulinoma

Answer d. Insulinoma

An insulinoma presents with symptoms of profound hypoglycemia, including diplopia, blurred vision, palpitations, or weakness. Patients can even experience a seizure. Symptoms, including weakness, sweating, tachycardia, palpitations, and hunger, are all caused by adrenergic symptoms triggered by adrenalin release. Whereas gastrinomas present with multiple large ulcers that extend into the jejunum and ileum, insulinomas present with episodic hypoglycemia and high C-peptide levels. Pheochromocytomas cause patients to experience episodic palpitations, tachycardia, and hypertension.

Postprandial attacks are from food triggering extra insulin release. This is endogenous signaling for insulin release after a rise in blood sugar.

Whipple's triad

- Symptoms of hypoglycemia
- Documented low blood sugar at the time of symptoms
- Reversal of symptoms by glucose administration

What is the most appropriate next step in the management of this patient?

a. Fasting insulin levels
b. Fasting C-peptide levels
c. Fasting glucose levels
d. All of the above

Answer d. All of the above

The diagnosis of insulinoma is established by checking one of the following during a fasting period:
- Serum insulin levels >10 µU/mL
- Glucose levels of <40 mg/dL
- C-peptide levels >2.5 ng/mL

All patients with hypoglycemic episodes must be screened for sulfonylurea through urinary or plasma testing.

Orders:
- *Admit to the intensive care unit*
- *Intravenous access*
- *Normal saline*
- *Nothing by mouth (NPO)*
- *Serum insulin levels*
- *Glucose levels*
- *C-peptide levels*
- *Proinsulin levels*

Results:
- *Serum insulin level: 25 µU/mL (elevated)*
- *Glucose level: 39 mg/dL (low)*
- *C-peptide level: 3.0 ng/mL (elevated)*

C-peptide elevates with pancreatic insulin.
C-peptide is low in exogenous insulin use (injection).

What is the most accurate test to localize the tumor in this patient?

a. Computed tomography (CT) scan of the abdomen
b. Ultrasonography of the abdomen
c. Endoscopic ultrasonography (EUS)
d. Hepatic venous sampling

Answer c. Endoscopic ultrasonography (EUS)

Imaging techniques are used to localize the tumor. CT scan of the abdomen is the most accurate test to localize the tumor, followed by EUS or arterial stimulation with hepatic venous sampling when an insulinoma has not been localized by scan. Ultrasonography of the abdomen does not have the resolution or sensitivity and therefore is not used in comparison to CT scan. If the choice of magnetic resonance imaging is given, it has similar sensitivity as CT scans; therefore, they are interchangeable for imaging the pancreas.

EUS and hepatic vein sampling are done if CT scan fails to identify a tumor.

Order: *CT scan of the abdomen with contrast*

Contrast inhibits tyrosine hydroxylase, the rate-limiting enzyme in catecholamine synthesis, and causes decreased urinary metanephrines. This may blunt adrenergic hypoglycemic symptoms.

Result: *A solid mass 2 cm in size is seen adjacent to the pancreatic duct in the head of the pancreas. No other lesions are identified.*

What is the most appropriate therapy in this patient?

a. Everolimus
b. Diazoxide and hydrochlorothiazide
c. Surgical resection
d. Octreotide

Answer c. Surgical resection

Surgical resection is the treatment of choice and achieves cure in 90% of patients with insulinoma. Medical therapy with diazoxide and hydrochlorothiazide or octreotide is only used in patients who are not candidates for surgery because of comorbidities.

Diazoxide reduces insulin secretion, and hydrochlorothiazide counteracts the edema and hyperkalemia caused by diazoxide and increases glycemic index.

Orders:

- *Endocrine consult*
- *Surgical consult*
- *Turn the clock forward, and the case will end.*

ESOPHAGEAL DISORDERS

CASE 1: Gastroesophageal Reflux Disease

Setting: *Office*

CC: *"I feel like I am always sucking on pennies."*

VS: *BP, 131/67 mm Hg; R, 16 breaths/min; P, 77 beats/min; T, 98°F*

HPI: *A 41-year-old man with a history of gastroesophageal reflux disease (GERD) presents with occasional substernal chest pain after eating. He constantly feels like he has a metallic taste in his mouth, which is worse at night. These symptoms have been occurring for the past 6 years and are not relieved by the omeprazole he is now taking twice a day. He started with ranitidine but then began omeprazole 3 months later and then 1 year later began twice daily omeprazole. He states that he does not want to take these medications for life. He denies recent weight loss and has no trouble with swallowing. He recently had upper endoscopy, which was negative for strictures but did show terminal esophagitis.*

ROS:

- *Sore throat, especially in the morning*
- *Hoarse voice*
- *Eructation*
- *No shortness of breath*
- *No exertional chest pain*

Physical Exam:

- *Obese-appearing man at the stated age*
- *Throat: mild pharyngeal erythema with no exudates*
- *Chest: lungs clear to auscultation bilaterally; no wheezes*
- *Abdominal: mild epigastric tenderness with deep palpation; stool guaiac negative*

H2 blockers (e.g., ranitidine)

- Block two-thirds of acid
- Histamine stimulation is one of the three stimulants to parietal cells
- Histamine potentiates gastrin and acetylcholine

Which of the following is the most likely diagnosis?

a. Refractory GERD

b. Peptic ulcer disease (PUD)
c. Mallory-Weiss tear
d. Duodenal ulcer disease
e. Pleurisy

Answer a. Refractory GERD

The patient's symptoms are classic for GERD: sore throat, metallic taste or at times a bitter taste, hoarseness, chronic cough, and wheezing. This patient also has been on optimal PPI therapy without improvement and therefore can be labeled as refractory GERD.

PUD gives abdominal pain that may or may not be worsened with eating. Duodenal ulcer and gastric ulcer are two types of PUD. The pain of duodenal ulcer is more often improved with eating. This difference with the pattern of pain in relation to food is not sufficient by itself to distinguish between a duodenal ulcer and a gastric ulcer. A Mallory-Weiss tear gives hematemesis preceded by retching and vomiting. Pleurisy or pleuritis is chest pain with deep breathing.

The patient is advised to continue his PPI medications for 3 more months but is counseled on making therapeutic lifestyle changes.

Everyone on a PPI has a high gastrin level. Low acid = High gastrin

Which of the following is most likely to improve this patient's symptoms?

a. Weight loss
b. Avoiding tight-fitting garments
c. Avoid spicy foods
d. Chewing gum
e. Eating peppermint

Answer a. Weight loss

Of all lifestyle modifications, weight loss and elevating the head of the bed reduce symptoms the most. Dietary medications help, but such modifications increase noncompliance to changes because of restriction of enjoyable foods. Tight-fitting garments and gum chewing have not been shown to change outcomes, and peppermint actually makes GERD worse.

On USMLE Step 3, "lifestyle changes" must be tried unless they explicitly tell you that they have failed, regardless of PPI status. Order under "counseling," "education," or "advising."

You can actually order "No tight-fitting garments" on CCS.

Alarm symptoms in GERD:
- Dysphagia
- Weight loss
- Anemia
- Blood in stool

Long-term side effects of PPI therapy:
- Osteoporosis
- Increased risk of *Clostridium difficile* infection
- Community-acquired pneumonia

Gastric acid is needed to properly absorb calcium (Ca^{++}).
PPIs Irreversibly block the hydrogen/potassium adenosine triphosphatase enzyme system (the H+/K+ ATPase).

Advance the clock 1 month and then 3 months later.

Order Interval History:
Symptoms continue despite taking PPIs and making lifestyle changes. Examination findings are unchanged, and the patient expresses concern again about taking omeprazole for so long.

24-hour pH
- *Most accurate test of GERD*
- *When diagnosis is not clear*

What is the best next step in management of this patient?

a. Upper endoscopy
b. Esophageal manometry
c. Continue PPI therapy for another 6 months
d. Change to another PPI
e. Start baclofen

Answer b. Esophageal manometry

This patient clearly has refractory GERD despite optimal medical therapy and, in addition, no longer wishes to take medications. The patient needs a surgical or endoscopic procedure to tighten his lower esophageal sphincter. The best next step in management is now to refer for esophageal manometry as part of the preoperative workup before antireflux surgery. Upper endoscopy has

already been performed in this patient; continuing PPI therapy for longer will not work because he is already on twice-daily regimen. There is currently no difference between PPIs, so changing from one to another will not change outcomes. Last, although baclofen and prokinetic agents have been shown to reduce GERD episodes, because of their numerous side effects, neither class of medications is used adjunctively to treat GERD.

Before surgery, all patients need an upper endoscopy and manometry to assess esophageal length and hiatal hernia and to ensure no other diagnoses such as achalasia or scleroderma exist. This patient will then be ready for antireflux surgery.

Barrett's esophagus: Columnar metaplasia (Figure 7-1)

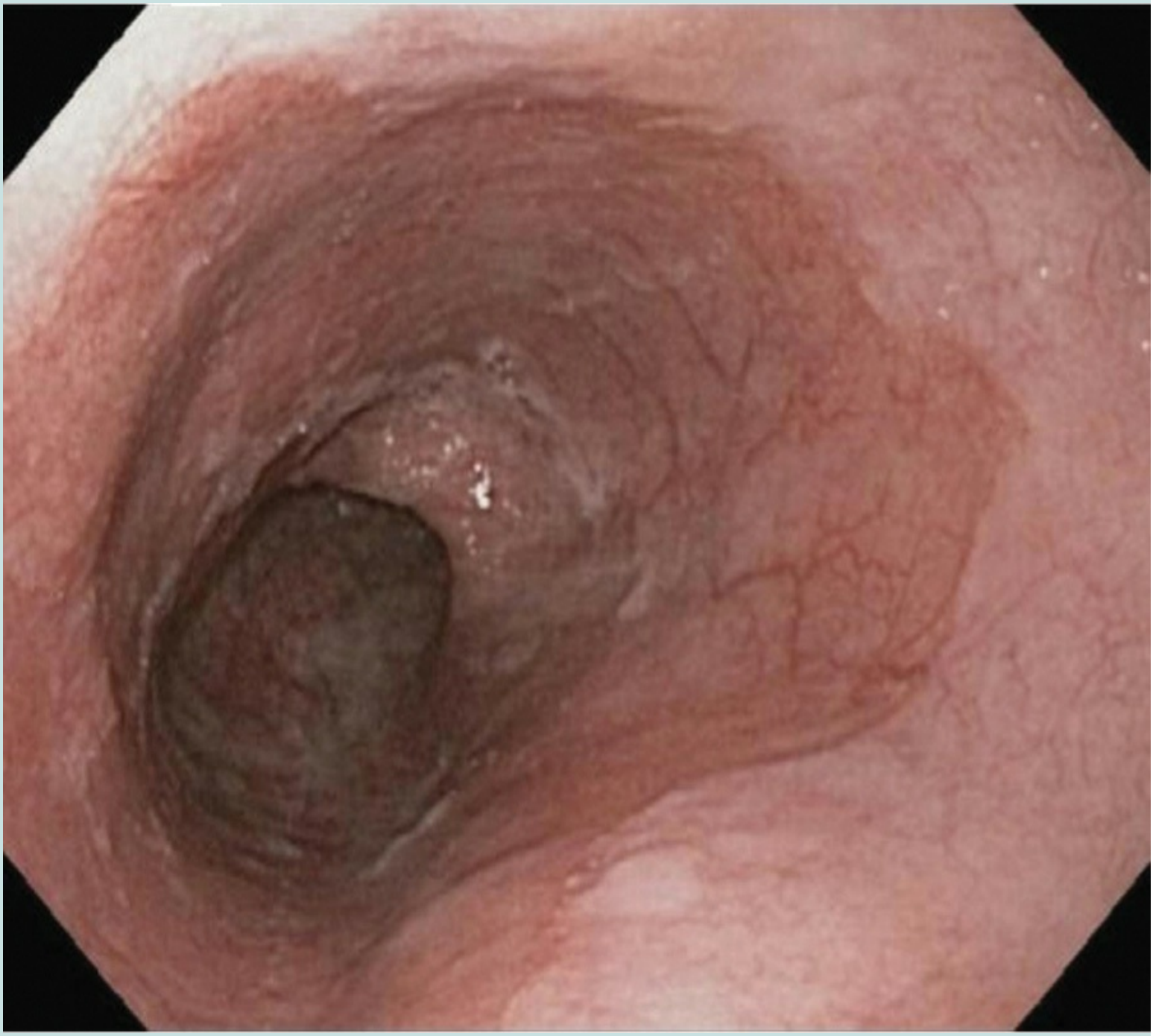


Figure 7-1. Endoscopic appearance of Barrett's esophagus. (Reproduced, with permission, from Jajoo K, Saltzman JR. Barrett esophagus. In: Greenberger NJ, Blumberg RS, Burakoff R, eds. *Current Diagnosis & Treatment: Gastroenterology, Hepatology, & Endoscopy*. 2nd ed. New York: McGraw-Hill; 2012.)

Barrett's esophagus leads to adenocarcinoma, not squamous cell cancer.
Antireflux surgery is the correct answer when the case describes:
1. Failed optimal medical treatment
2. Noncompliance or refusal to take lifelong medications
3. Severe esophagitis
4. Stricture formation
5. Barrett's columnar-lined epithelium (without severe dysplasia or carcinoma)

Which of the following is the mechanism of GERD?

a. Incomplete relaxation of lower esophageal sphincter (LES)
b. *Helicobacter pylori* effect
c. Excess acid production
d. Increased myogenic reactivity
e. Columnar metaplasia of esophagus

Answer a. Incomplete relaxation of lower esophageal sphincter (LES)

GERD is not from *Helicobacter* spp.; it is from an inappropriate level or relaxation of the LES. Excess acid production is the mechanism of gastrinoma or Zollinger-Ellison syndrome. Columnar metaplasia is Barrett's esophagus.

CCS TIP: *On USMLE Step 3, order surgery when PPIs do not control GERD. Consult surgery first and then order the procedure.*

Consultants on CCS never make specific recommendations.

Nissen fundoplication
- Reduces symptoms in 85% to 90% of patients.
- Tightens the sphincter by wrapping the stomach around the lower esophagus

Nissen fundoplication (Figure 7-2)
- 360-degree "wrap" or collar around the esophagus Dor fundoplication
- 180-degree wrap around the esophagus

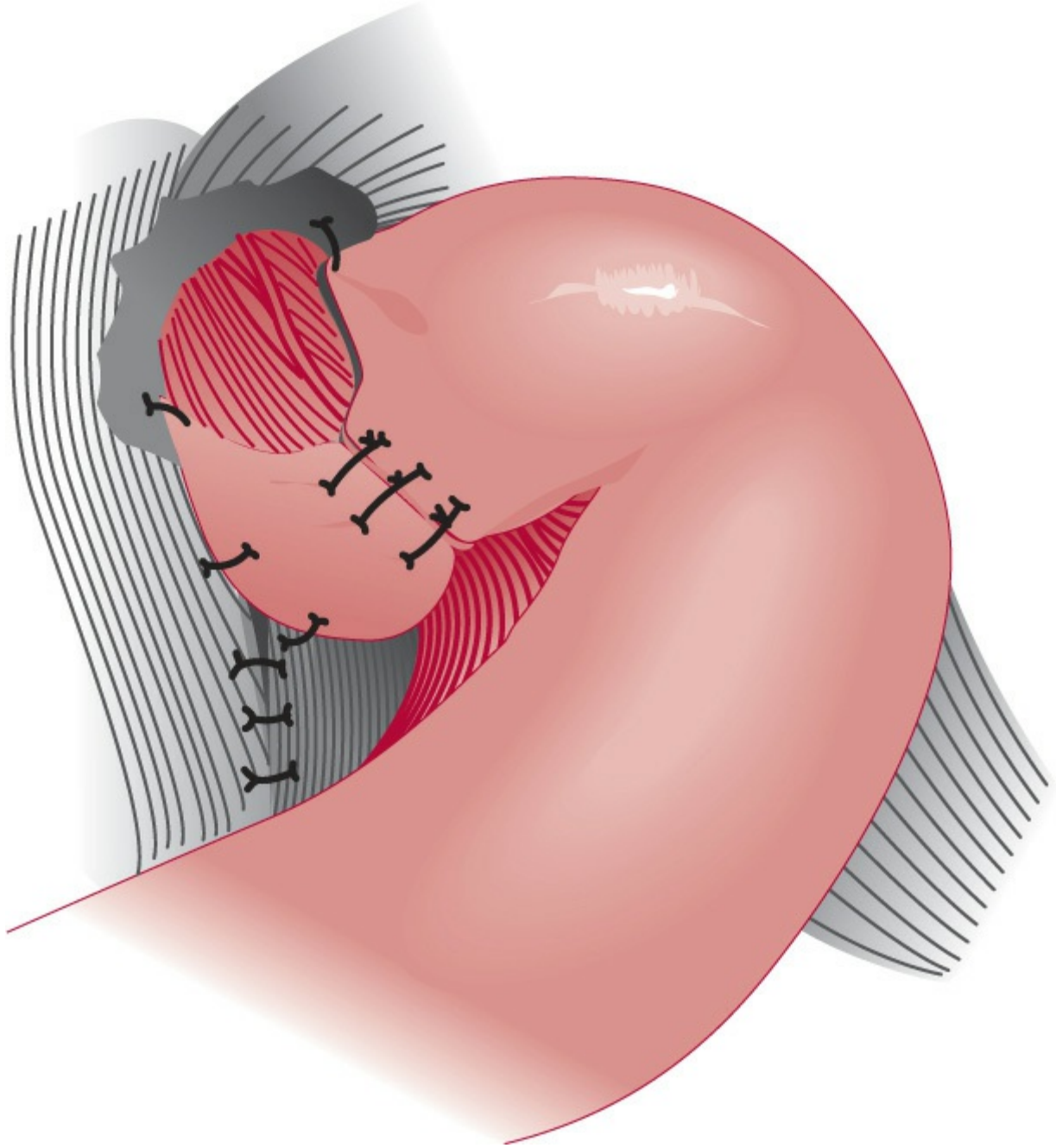


Figure 7-2. Nissen fundoplication (360 degrees) (Reproduced, with permission, from Doherty GM, eds. *Current Diagnosis & Treatment: Surgery*. 13th ed. New York: McGraw-Hill; 2010.)

Which of the following is a complication of Nissen fundoplication?

a. Gas bloat syndrome
b. Diarrhea
c. Constipation
d. Malabsorption
e. Vomiting

Answer a. Gas bloat syndrome

Gas bloat syndrome is the inability to eliminate swallowed air or gas from carbonated beverages or foods by belching. Treatment is with simethicone. A patient cannot get diarrhea or constipation from an esophageal treatment. Also, a patient cannot vomit when his or her sphincter has been tightened.

CASE 2: Boerhaave's Syndrome

Setting: *ED*

CC: *"I feel like there is a knife in my chest."*

VS: *BP, 92/60 mm Hg; R, 19 breaths/min; P, 101 beats/min; T, 100.9°F*

HPI: *A 39-year-old man is brought to the emergency department by his girlfriend with severe substernal chest pain. The pain began 6 hours ago after he left his birthday party. He consumed a great deal of alcohol at the party, more than he usually does. Shortly after, he started vomiting when he got home, and then he began having dry heaves after which he experienced a sharp, stabbing chest pain. The pain is constant, 10 of 10, sharp, with radiation to his left shoulder and without alleviating factors. The patient admits to nausea and pain with swallowing.*

PMH: *No significant past medical history*

ROS: *No shortness of breath*

Physical Exam:

- *General: patient is of stated age; uncomfortable and toxic appearing*
- *Chest: No tracheal deviation. Lungs clear except at lower left lung base, where there are mild rales. No accessory muscle use, but tachypnea is seen.*
- *Positive Hamman's sign and cool skin*
- *Cardiac: tachycardia*
- *Abdomen: epigastric tenderness with guarding*

What is the most likely diagnosis?

a. Peptic ulcer disease
b. Traumatic viscous injury
c. Gastroesophageal reflux disease (GERD)
d. Boerhaave's syndrome

Answer d. Boerhaave's syndrome

The most common cause of esophageal perforation is iatrogenic or secondary to endoscopy. The term *Boerhaave's syndrome* is reserved for perforations that are spontaneous and caused by vomiting. Other causes include pill esophagitis, caustic ingestions, and infectious ulcers in patients with AIDs.

This patient presents with severe chest pain that occurred after repetitive bouts of vomiting for an extended period of time. That, combined with the findings of subcutaneous air (known as Hamman's sign) and decreased breath sounds in the left lower lung base caused by pleural effusion, leads to this diagnosis. These patients can also have concomitant pneumothorax, but in this patient,

breath sounds are bilateral, and the trachea is midline. Traumatic viscous injury is rare in the setting of a case without trauma, and GERD is a mucosal disease. Perforated peptic ulcers would present with abdominal pain with no subcutaneous air in the chest.

Initial Orders:

- *Complete blood count (CBC)*
- *Comprehensive metabolic profile*
- *Lactic acid level*
- *Chest radiography, prothrombin time, partial thromboplastin time, and international normalized ratio*
- *Placement of a nasogastric tube*
- *Nothing by mouth (NPO)*
- *Blood type and crossmatch*

What is the best next step in management of this patient?

a. Consult surgery
b. Intravenous (IV) fluids and antibiotics
c. Upper endoscopy
d. Barium esophagram
e. Discharge the patient home

Answer b. Intravenous (IV) fluids and antibiotics

Whenever a patient appears unstable or toxic, the next step in management is always IV fluids to raise the blood pressure. These patients should be transferred to the intensive care unit. Antibiotics that cover gut flora (such as imipenim–cilastin, piperacillin–tazobactam, or ampicillin–sulbactam) should be used. If a cephalosporin (such as cefepime) or a quinolone (such as ciprofloxacin) is chosen, metronidazole must be added. Cefepime, as with most cephalosporin antibiotics, does not cover anaerobes. Consulting surgery is important but does not take precedence over resuscitation because this patient is febrile and tachycardic. Two systemic inflammatory response syndrome criteria are observed, and with a perforation, sepsis is imminent. If respiratory distress is encountered, intubation should be ordered. Upper endoscopy is controversial with suspected perforation and may worsen the condition to air insufflation. Barium esophagram is the distractor choice and the most common wrong answer. Remember that barium is caustic and not water soluble and will lead to chemical pneumonitis as it extravasates through the perforation. If a contrasted procedure is absolutely essential, we would use Gastrografin, which is water soluble. Barium, if it went through the perforation and into the pleural space, would be a disaster.

Discharging the patient is the best way to ensure death because an untreated esophageal perforation carries a nearly 100% mortality rate. The most common source for infection in esophageal perforation is mediastinitis, which classically sets in hours after viscous injury.

Boerhaave's syndrome = Full thickness
Mallory-Weiss tear = Limited to submucosa only

The five layers of the esophagus from outside in are:
1. Adventitia
2. Muscularis propria
3. Submucosa
4. Lamina propria
5. Mucosa

What is the best initial test for esophageal perforation?

a. Upright chest radiography
b. Chest computed tomography (CT) scan
c. Chest magnetic resonance imaging (MRI)
d. Upper endoscopy

Answer a. Upright chest radiography

The best initial test for esophageal perforation is an upright chest radiography, which will show free meditational air and a left-sided pleural effusion in approximately 65% of cases. Although chest CT and sometimes MRI or endoscopy can be used, Step 3 is very big on your knowing the order in which to use tests. They will not want you skipping an easy test such as a chest radiograph to jump straight to a chest CT. The most common location for esophageal perforation is at the left posterolateral wall of the lower third of the esophagus 2 to 3 cm before the stomach.

Esophageal perforation can also be confirmed by water-soluble contrast esophagram (Gastrografin), which reveals the location and degree of tear. CT scan can also be used and will show esophageal wall edema and thickening, extraesophageal air, periesophageal fluid, mediastinal widening, and fluid in the pleural sac.

Boerhaave's syndrome is Caused by a sudden increase in intraesophageal pressure combined with negative intrathoracic pressure caused by straining or vomiting.

Advance the clock 10 to 20 minutes at time in an unstable patient like this. Repeat the vital signs at 15- to 30-minute intervals:

CCS TIP: *The current orders are always in front of you when you are on CCS. The currently ordered medications and laboratory studies are also on a list in front of you. The exact order*

time as well as the "Report available" time will be listed. All you have to do is move the clock forward to the time it says "Report available," and the test report will pop up.

CCS TIP: *Intravenous fluids can only be ordered as "bolus" or "continuous." Exact dosing is not possible.*

Normal saline is in place.

Results:

- *CBC: white blood cell (WBC) count: 19,500/mm^3 (elevated)*
- *Lactic acid: 1.9 md/dL (elevated)*
- *The remainder of the CBC, electrolytes, and coagulation profile are normal.*

What is the best next step in management of this patient?

a. Surgical repair
b. Observation for several days
c. Wait for the results of blood cultures
d. Repeat endoscopy to assess for spontaneous closure in 2 to 3 days

Answer a. Surgical repair

The next step in the management of this patient is surgical repair. Surgery is the mainstay of therapy in patients with perforation. Primary surgical repair with concomitant debridement, irrigation, and resection or diversion if diseased necrotic esophagus is needed. A feeding jejunostomy is also be placed to avoid using the esophagus for 1 to 2 weeks. The most common reason for death in esophageal perforation is a delay in a diagnosis. The mortality rate approaches 50% if the diagnosis is delayed beyond 24 hours. The most common postoperative infections include abscess, mediastinitis, and tracheoesophageal fistulas.

Advance the clock 2 to 3 hours. Surgery is performed, and the patient is doing well.

Transfer the patient after surgery; admit the patient to the intensive care unit. The case will end.

CASE 3: Mallory-Weiss Tear

Setting: *ED*

CC: *"I vomited up blood."*

VS: *BP, 100/67 mm; R, 19 breaths/min; P, 89 beats/min; T, 98.7°F*

HPI: *A 24-year-old woman presents to the emergency department with two episodes of bloody vomitus in the last hour. She vomited 15 times, but only the last two times had blood in it. She admits to taking ipecac before the vomiting because she has been trying to lose weight. She says the vomitus looked bright red and denies the appearance of coffee grounds. She shows a cup of the vomitus, which is clearly bright red blood.*

ROS:

- *No chest pain*
- *No shortness of breath*
- *No abdominal pain*

Physical Exam:

- *Thin and emaciated appearing*
- *Dried blood around mouth*
- *Poor dentition and numerous filled dental caries*
- *Mild epigastric tenderness*

What is the most likely diagnosis?

a. Perforated duodenal ulcer
b. Mallory-Weiss tear
c. Boerhaave's syndrome
d. Variceal bleed
e. Diverticular bleed

Answer b. Mallory-Weiss tear

Mallory-Weiss tears are characterized by longitudinal, up and down, tears in the mucosal layers of the esophagus secondary to forceful vomiting and retching. In this patient, it is obvious that she has anorexia nervosa, and the use of ipecac as a well-known emetic gives the reason for vomiting. Remember that it is not always going to be an alcoholic who has a Mallory-Weiss tear. Boerhaave's syndrome does not have bloody emesis, and variceal bleeds do have bloody emesis but occur only in the setting of cirrhosis, which this patient does not have in her history. Also, variceal bleeding is not particularly associated with vomiting. A perforated duodenal ulcer would have bloody emesis but would also have severe abdominal pain, and diverticular bleed does not fit because we are quite literally on the wrong end.

Big vomit = Big pressure
Big pressure = Tears

A sudden rise in intraabdominal pressure with forceful retching breaks the mucosa.

Mallory-Weiss: mucosal tear
Boerhaave's syndrome: breaks through full thickness

What is the best next step in the management of this patient?

a. Chest computed tomography (CT)
b. Intravenous (IV) normal saline
c. Intubation
d. Gastrografin
e. Transfuse packed red blood cells and platelets

Answer b. Intravenous (IV) normal saline

All patients with gastrointestinal bleeding need normal saline, a complete blood count (CBC), type and cross, and prothrombin time/international normalized ratio (INR) and to get transfused if the cell counts are low. A low cell count means platelets less than 50,000 with bleeding, or a hematocrit less than 25% to 30%, depending on the age of the patient. It is premature to order transfusion before knowing the results of the CBC.

This patient's vital signs are within normal limits, and she has no evidence of respiratory distress, so intubation is not right to do first. If the patient was actively vomiting blood and airway compromise was possible, immediate intubation and mechanical ventilation would be initiated.

Initial Orders:
- *CBC*
- *Comprehensive metabolic profile*
- *Lactic acid*
- *Prothrombin time, partial thromboplastin time, and INR*
- *Nothing by mouth (NPO)*
- *Blood type and crossmatch*

Patients who are bleeding should be admitted to the intensive care unit.
Consult gastroenterology but remember to choose upper endoscopy as well. Consultants do not offer anything in the CCS.

What is the most accurate test to diagnose this condition?

a. Upper endoscopy
b. Barium swallow
c. CT scan
d. Gastrografin

Answer a. Upper endoscopy

Upper endoscopy is the definitive treatment to diagnose a Mallory-Weiss tear because this is a mucosal injury and therefore will not be seen with enough sensitivity by barium swallow. CT scan is also not indicated for similar reasons, and CT lacks the advantage of concomitant therapeutic intervention that endoscopy can provide. On endoscopy, the tear will appear as a red longitudinal break in the mucosa and can occasionally be covered by a clot or be bleeding actively.

The treatment of these tears centers around hemostatic methods, which include injection of epinephrine and a sclerosing agent into the artery, bipolar electrocoagulation, or placing a hemostatic clip and mechanically closing the defect.

Mallory-Weiss tears
- Single and longitudinal
- Distal end of esophagus

Bleeding results from lacerations to submucosal arteries.

Advance the clock to get the upper endoscopy report:

Endoscopy report:
- *Nontransmural tear found (Figure 7-3)*
- *Clip placement*

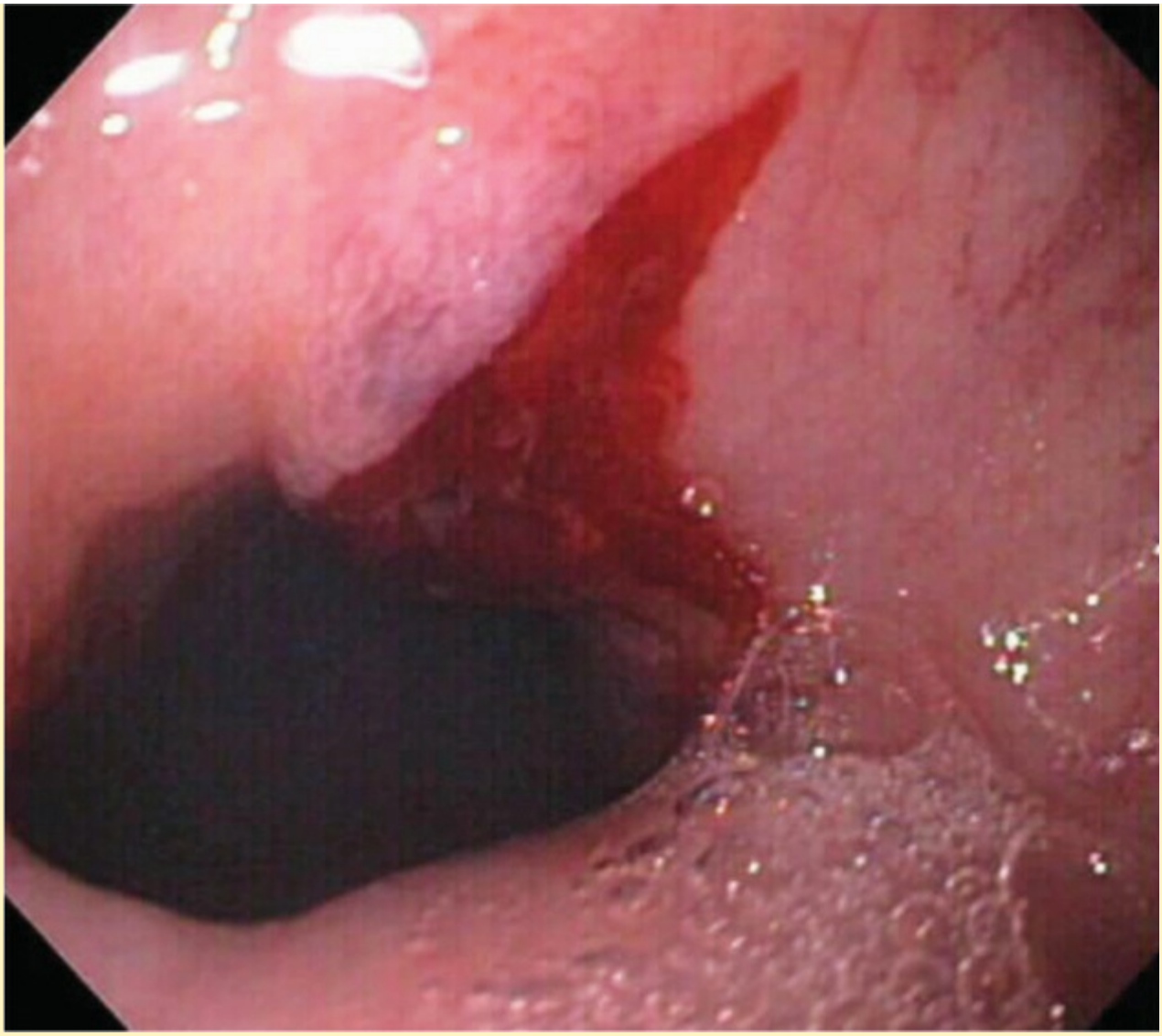


Figure 7-3. Mallory-Weiss tear at the gastroesophageal junction. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

Advance the clock 8 to 12 hours. Repeat vital signs and CBC.

Results:

- *Blood pressure: 110/80 mm Hg*
- *Without evidence of rebleeding*
- *Hematocrit 34% on next two CBCs over the next 48 hours*

Which of the following medications should be started on all patients with Mallory-Weiss tears?

a. Omeprazole
b. Clarithromycin and amoxicillin
c. Metoclopramide
d. Erythromycin

Answer a. Omeprazole

Omeprazole should be started in an effort to reduce stomach acid and promote healing. There is no

role for clarithromycin and amoxicillin because no infectious process is occurring, and there is no need for prokinetic agents such as metoclopramide or erythromycin. Mallory-Weiss tears have nothing to do with *Helicobacter pylori*.

The majority of Mallory-Weiss tears will resolve spontaneously; however, endoscopy must still be performed. Coagulopathy gives the highest risk of rebleeding in patients with Mallory-Weiss tears.

If the patient has not had evidence of bleeding 48 hours after endoscopy, then step down the patient to general floors. Turn the clock forward, and the case will end.

Which is most effective therapy in patients with refractory hemorrhage in Mallory-Weiss syndrome?

a. Angiography
b. Laparoscopic resection
c. Blakemore tube
d. Vessel overstitching

Answer d. Vessel overstitching

More than 95% of patients will respond to endoscopic modalities of hemostatic; therefore, vessel overstitching is rarely done. Vessel overstitching via surgical intervention is the most accurate therapeutic step in patients who have refractory hemorrhage.

CASE 4: Achalasia

Setting: *Office*

CC: *"I am having difficulty swallowing."*

VS: *BP, 131/67 mm Hg; R, 16 breaths/min; P, 77 beats/min; T, 98°F*

HPI: *A 45-year-old man is evaluated for a 1-year history of dysphagia to solids and liquids that is associated with occasional regurgitation that is worse at night. The patient does not smoke or drink alcohol and states that he otherwise feels well. He says occasionally he feels a lump in his neck after swallowing. The lump alleviates after recurrent flexion coupled with extension of the neck. The patient denies any recent travel history.*

ROS:

- *10-lb weight loss*
- *Occasional chest pain*
- *No shortness of breath*
- *No nausea or diarrhea*

PMH: *Recurrent pneumonia in the right lower lung (RLL)*

Physical Exam: *Physical exam is unremarkable.*

What is the most likely diagnosis?

a. Infectious esophagitis
b. Pill-induced esophagitis
c. Achalasia
d. Zenker's diverticulum
e. Diffuse esophageal spasm (DES)

Answer c. Achalasia

Dysphagia to solids and liquids, evidence of aspiration (recurrent pneumonia), and occasional chest pain are classical for the diagnosis. Furthermore, the sensation of food stuck in the throat (known as "globus sensation") is indicative of an esophageal motility issue. The most common mistake made is the assumption that there is no weight loss in achalasia; however, there is mild weight loss of 5 to 10 lb. Infectious esophagitis and pill-induced esophagitis would present in a patient with HIV and pain with swallowing or a patient who recently began medications such as bisphosphonates. Zenker's diverticulum classically presents with regurgitation and halitosis with recurrent RLL pneumonia. DES presents as severe substernal chest pain and dysphagia. This patient's pain is not severe, and DES does not cause aspiration pneumonia.

Because this patient presents with a single complaint and is stable, follow the diagnostic approach for the disease in question. If the patient was unstable, you would proceed with resuscitation and the ABCs (airway, breathing, and circulation).

Swallowing consists of the coordinated motion of the upper and lower esophageal sphincters to relax, and a peristaltic wave is created that advances the food bolus into the stomach.

Which of the following is the mechanism of achalasia?

a. Stricture
b. Smooth muscle spasm
c. Loss of myenteric plexus
d. Vagal insufficiency

Answer c. Loss of myenteric plexus

Achalasia results from the breakdown of the myenteric plexuses in the esophageal wall as well as degeneration of the nitric oxide inhibitory neurons that effect the relaxation of esophageal smooth muscle. When these neurons are destroyed, there is unopposed signaling from stimulatory neurons that yields smooth muscle contraction.

Which of the following is the best next step in the management of this patient?

a. Upper endoscopy
b. CT scan of the chest
c. Barium radiography
d. Esophageal manometry
e. 24-hour pH monitoring

Answer c. Barium radiography

Barium radiography (barium swallow) is the best next step in the management of a patient presenting with signs and symptoms of achalasia. Barium radiography is a test of anatomy and is the appropriate screening test for motility issues. The critical reason for obtaining a barium swallow is the identification of a mass lesion, which would raise the differential of malignancy causing obstruction and dysphagia. Upper endoscopy is a test of mucosal abnormalities, and a CT scan does not always demonstrate a mass lesion. Furthermore, CT scans may show a dilated esophagus with a nonspecific finding in dysmotility. Twenty-four-hour pH monitoring is indicated in patients with atypical presentations of gastroesophageal reflux disease.

Order a barium radiography study and turn the clock forward. The result will pop up on the

screen.

If travel to South America is mentioned consider Chagas' disease, which is caused by *Trypanosoma cruzi* and is the most common underlying etiology for achalasia.

Barium testing reveals esophageal achalasia. On imaging note dilation of the esophageal body, retained barium, and distal esophageal narrowing (bird's beak).

Barium radiography reveals esophageal dilation with a smooth tapering distally and the to-and-fro movement of barium. Common terms seen in radiologic descriptions of achalasia are "bird's beak," "rat tail," and "mega-esophagus."

What is the most accurate test to diagnose achalasia?

a. Upper endoscopy with biopsy
b. CT scan of the chest
c. Barium radiography
d. Esophageal manometry
e. 24-hour pH monitoring

Answer d. Esophageal manometry

The most accurate test for the diagnosis of achalasia is esophageal manometry. Esophageal manometry is a test of motility physiology and will demonstrate the following findings: the lower esophageal sphincter (LES) fails to relax upon wet swallow (<75% relaxation); pressure of the LES less than 26 mm Hg is normal, greater than 100 mm Hg is considered as achalasia, and aperistaltic waves in esophageal body. Although upper endoscopy with biopsy will show a lack of myenteric plexus, this test is considered only if the manometry is nondiagnostic or the patient is unable to tolerate the procedure.

Order an esophageal manometry study and turn the clock forward. The result will display on the screen.

Esophageal manometry is the most accurate diagnostic test for achalasia, DES, nutcracker esophagus, and all other dysmotility issues.

Esophageal manometry reveals a LES pressure of 126 mm Hg (elevated) with aperistaltic waves most acutely at the distal end of the esophagus.

CCS TIP: *When reading results of a high-resolution manometry motility study: Pressure measurements are recorded with color coding (red = high; blue = low). LES = lower esophageal sphincter; PIP = pressure inversion point; UES = upper esophageal sphincter.*

What is the best next step in the management of this patient?

a. Proton pump inhibitors
b. Budesonide
c. Surgical myotomy
d. Pneumatic dilatation
e. Nitrates

Answer c. Surgical myotomy

The most effective therapy for a patient with achalasia is surgical myotomy. The most common wrong answer is pneumatic dilatation. Originally thought to be the best initial therapeutic step, those guidelines have changed because of a high perforation rate of up to 5% and severe postprocedural heartburn. Medical therapy with nitrates and calcium channel blockers is for patients who are unwilling or poor surgical candidates. These agents are not superior to surgical intervention. Budesonide has no role in the treatment of achalasia. The role of botulinum toxin injections is purely as an adjunct to medical therapy and is not superior to surgical myotomy. If the patient has concurrent gastroesophageal reflux disease (GERD), a surgical myotomy combined with an antireflux procedure such as Dor fundoplication is performed.

Botulinum toxin injection is associated with high rates of tachyphylaxis. Its mechanism of action is to poison the excitatory (acetylcholine-releasing) neurons of the lower esophageal sphincter.

Order a surgical consult and a myotomy for achalasia. Preoperative laboratory studies, including CBC, CMP, and coagulation parameters, should also be obtained at this time. Turn the clock forward, and the case will end.

CASE 5: Esophageal Cancer

Setting: *Office*

CC: *"I am having difficulty swallowing."*

VS: *BP, 121/67 mm Hg; R, 15 breaths/min; P, 87 beats/min; T, 98.9°F*

HPI: *A 59-year-old man presents with the complaints 4 months of progressively worsening difficulty swallowing solid foods and most recently has had trouble with swallowing liquids. The patient states that his clothing does not fit as well as it used to, and his wife who accompanies him states that his voice is hoarse sounding. The patient admits to regurgitating liquid the night before after drinking water. The patient admits to a 50-pack-year smoking history and drinks 1 pint of whiskey per day with dinner.*

ROS:

- *20-lb unintentional weight loss*
- *No chest pain*
- *No reflux symptoms*
- *No shortness of breath*
- *No fevers*
- *No nausea, vomiting, or diarrhea*

Physical Exam: *The patient appears older than the stated age and is cachectic.*

What is the most likely diagnosis?

a. Infectious esophagitis
b. Esophageal malignancy
c. Achalasia
d. Zenker's diverticulum
e. Diffuse esophageal spasm (DES)

Answer b. Esophageal malignancy

The most likely diagnosis is esophageal malignancy, either squamous cell carcinoma or adenocarcinoma. The presentation of progressively worsening dysphagia to solids and then liquids with concomitant weight loss should raise the concern for esophageal malignancy. Smoking and alcohol use also raise the risk for the development of malignancy in the esophagus. Infectious esophagitis is most commonly caused by candida in an HIV-positive patient, and achalasia would require the findings of dysphagia with recurrent aspiration. Zenker's diverticulum would be correct if halitosis and regurgitation of rotten food particulate matter were mentioned. DES is classically found in a patient with intermittent noncardiac chest pain that is severe.

If the patient has a history of longstanding gastroesophageal reflux disease, the most common etiology is Barrett's esophagus → adenocarcinoma.

If the patient has a history of smoking and alcohol abuse → squamous cell carcinoma is most common subtype of esophageal carcinoma.

Which of the following tests is most likely to yield an accurate diagnosis?

a. Upper endoscopy
b. Computed tomography (CT) scan of the chest, abdomen, and pelvis.
c. Barium radiography
d. Esophageal manometry
e. 24-hour pH monitoring

Answer a. Upper endoscopy

Upper endoscopy is the best next step in the management of this patient. Given this patient's risk factors and insidious weight loss in 4 months, the most appropriate means to attain a diagnosis is through tissue sampling. Upper endoscopy allows for accurate visualization and obtaining tissue. Early studies found that diagnostic accuracies were directly correlated with the number of biopsies taken (up to seven). Barium radiography is the best initial test but note that the question asked for the "test most likely to yield a diagnosis."

Therefore, in a purely academic approach, a barium swallow would be appropriate; however, in practice and on the CCS, going straight to endoscopy is considered appropriate.

CT scan of the chest, abdomen, and pelvis is the correct answer for staging a patient with confirmed malignancy. Esophageal manometry and 24-hour pH monitoring are the appropriate tests for patients with physiologic dysphagia or atypical GERD. This patient's symptoms are caused by an obstructive phenomenon.

Order a gastrointestinal consultation and upper endoscopy with biopsy for questionable esophageal malignancy. Turn the clock forward, and the results will appear.

Lugol's iodide
• Reacts with glycogen components of normal squamous mucosa
• Neoplastic tissue is depleted of glycogen

• Squamous carcinoma remains unstained

Advance the clock to where the report will be available for the upper endoscopy.

Results:

- *Large fungating ulcerated mass is seen extending from what appears to be the mucosa.*
- *Multiple biopsies are obtained.*
- *Lugol's staining and immunohistochemistry confirm squamous cell carcinoma.*

Which of the following is the best test to diagnose T or N staging in a patient with esophageal cancer?

a. Endoscopic ultrasonography
b. Transthoracic echocardiography
c. Computed tomography (CT) scan of the chest
d. Magnetic resonance imaging (MRI) of the chest
e. Surgical exploration

Answer a. Endoscopic ultrasonography

Endoscopic ultrasonography is most accurate test for staging of invasive esophageal cancer, with an overall accuracy for tumor (T) and node (N) staging of 80% to 90%.

After the establishment of a diagnosis through tissue diagnosis, staging is the best next step in all malignancies. TNM is an abbreviation for tumor (T), node (N), and metastasis (M).

You do not need to know the subclassification of the TNM staging for the USMLE for any malignancy. You simply need to know what they stand for and how to diagnose each component.

Transthoracic echocardiography does not have the resolution to obtain information regarding the layers of the esophagus. CT scan of the best is equal in diagnosis of tumor staging but does not have the ability to perform endoscopic ultrasound-guided fine-needle aspiration of lymph nodes.

Positron emission tomography scanning
18F-fluorodeoxyglucose
Detects content of mass lesions without biopsy

CCS TIP: *The three methods of advancing the clock—"On," "In," and "Next available*

result"—are equal.

Advance the clock to get the results.

TNM staging reveals T3N3M1 staging consistent with metastatic disease. The patient endorses a wish to purse treatment.

Order: *Surgical and oncologic consultation. Turn the clock forward, and the case will end. CCS cases strongly emphasize the initial management of cases.*

CASE 6: Zenker's Diverticulum

Setting: *Office*

CC: *"My breath smells really bad."*

VS: *BP, 111/57 mm Hg; R, 12 breaths/min; P, 77 beats/min; T, 98.6°F*

HPI: *A 43-year-old man presents with a 3-month history of halitosis and finding regurgitated food items on his pillow. The patient states that he has at times had difficulty swallowing but that occurs "once in a while." His wife who accompanies him tells you that his breath has become unbearable, and she can no longer sleep next to him.*

PMH: *Fusobacterium necrophorum abscess and pneumonia*

ROS:
- *No chest pain*
- *No shortness of breath*

Physical Exam: *Positive halitosis on oral-pharyngeal examination*

What is the best next step in the management of this patient?

a. Barium radiography
b. Computed tomography (CT) scan of the chest
c. Upper endoscopy
d. Nasogastric tube aspiration

Answer a. Barium radiography

The most accurate test for diagnosing a patient with intermittent dysphagia is with a barium swallow. In this patient's case, the most likely diagnosis is Zenker's diverticulum. Dysphagia and *fetor ex ore* (halitosis) with regurgitation is the classic triad for Zenker's diverticulum. Furthermore, this patient's pneumonia and abscess development with oral flora organisms is consistent with aspiration pneumonia. Barium will fill the diverticulum and be easily outlined in the subsequent radiographic images. CT scan of the chest can be used to diagnose diverticula, but it is only used if barium swallow fails to delineate an underlying pathology. The most common complaint in patients with Zenker's diverticulum is dysphagia. The second most common is regurgitation of undigested food hours after eating.

What is the underlying pathophysiology for the development of Zenker's diverticulum?

a. Rhabdomyolysis
b. Brainstem defect

c. Cranial nerve loss
d. High bolus pressure

Answer d. High bolus pressure

The development of Zenker's diverticulum is caused by high bolus pressures during swallowing combined with congenitally high resistance at the upper esophageal sphincters. These boluses cause an outpouching in the inherently weakened area known as Killian's triangle found in the posterior pharynx. Zenker's diverticulum is an outpouching found at Killian's triangle, which is found between the transverse fibers of the cricopharyngeus and the oblique fibers of the lower inferior constrictor. They are always above the upper esophageal sphincter.

Order a barium swallow for the patient, and turn the clock forward. Have the patient return to the office after 1 week. The results will appear on the screen (Figure 7-4).

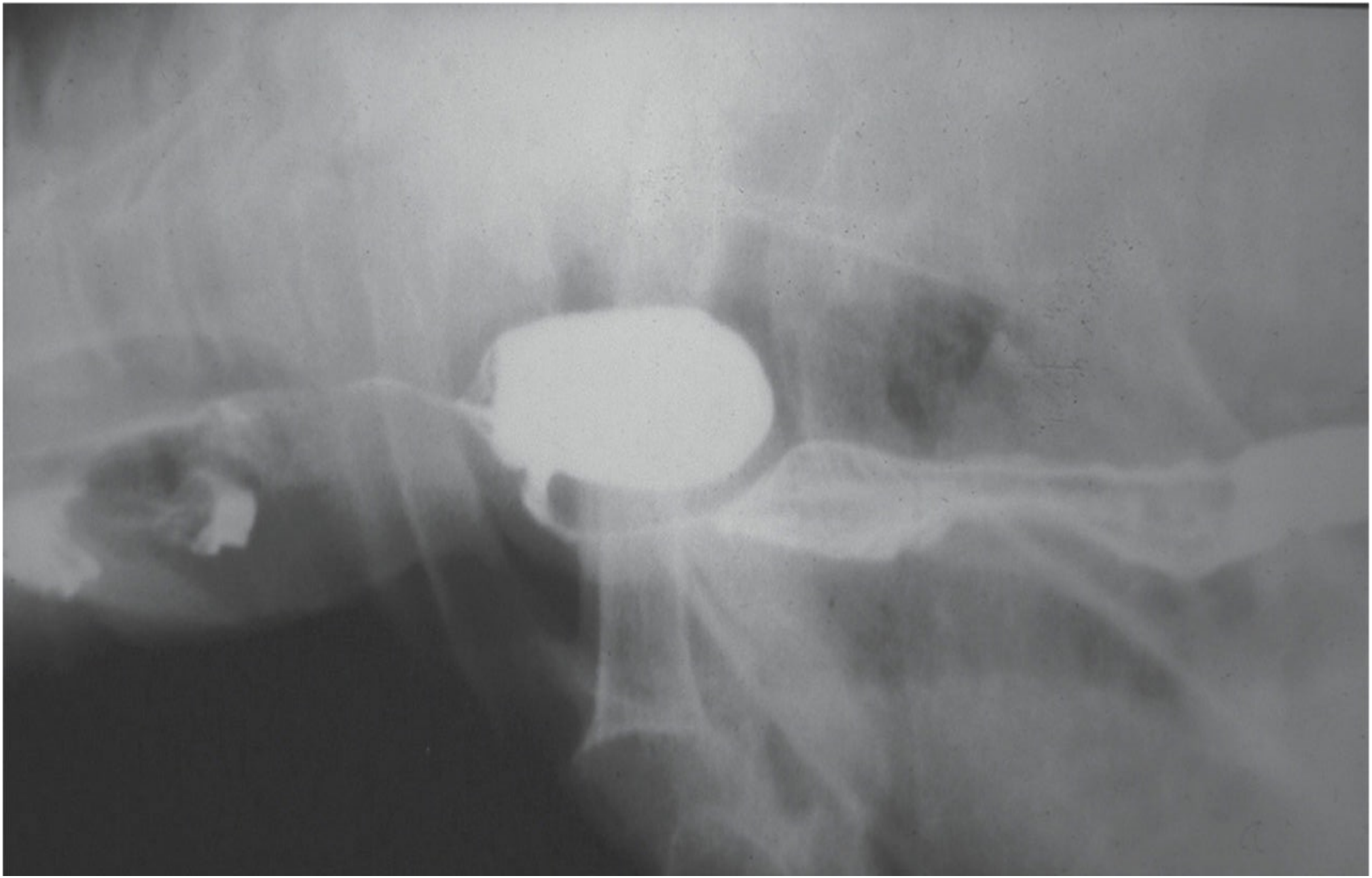


Figure 7-4. Pharyngoesophageal diverticulum (Zenker's diverticulum). (Reproduced, with permission, from Doherty GM, ed. *Current Diagnosis & Treatment: Surgery*. 13th ed. New York: McGraw-Hill; 2010.)

Endoscopy in the setting of Zenker's diverticulum increases risk of perforation.

Barium swallows reveals contrast pooling in the hypopharynx above the upper esophageal sphincter consistent with a diverticulum.

Types of diverticula in esophagus:
- Above the upper esophageal sphincter: Zenker's diverticulum
- Middle of the esophagus: traction diverticulum
- Above the lower esophageal sphincter: epiphrenic diverticulum

Which of the following is the best next step in the management of this patient?

a. Proton pump inhibitor (PPI)
b. Endoscopic resection
c. Surgical resection
d. Sclerosing agents
e. Banding procedure

Answer c. Surgical resection

The most effective therapy for a patient with Zenker's diverticulum has been surgical intervention in the form of one-stage cricopharyngeal myotomy and diverticulectomy. The most common complication after the procedure is mediastinitis and vocal cord paralysis.

Order a surgical consultation even though the surgeon will give no helpful suggestions. Turn the clock forward, and the case will end.

Endoscopic diverticulotomy is only considered for patients who are not surgical candidates and is only performed in tertiary referral centers.

CASE 7: Steakhouse Syndrome

Setting: *ED*

CC: *"I have a bulge in my chest."*

VS: *BP, 111/77 mm Hg; R, 14 breaths/min; P, 87 beats/min; T, 98.6°F*

HPI: *A 25-year-old man presents after having dinner in a steakhouse near the hospital. The patient states that while he was eating, he got the sensation that the food was stuck in his chest, but after drinking a few sips of beer, he felt better. The patient state this has happened to him before, and it usually occurs on the first bite of really tough foods such as meat or breads. The patient denies ever having to induce vomiting and denies any history of gastroesophageal reflux disease (GERD) or anemia. His recent yearly physical examination results were normal, and he has no history of allergies.*

ROS:

- *No chest pain*
- *No nausea or vomiting*

Physical Exam: *Physical examination is unremarkable.*

What is the most likely diagnosis?

a. Schatzki's ring
b. Eosinophilic esophagitis
c. Plummer-Vinson syndrome
d. Achalasia

Answer a. Schatzki's ring

The presentation of occasional food bolus impaction that self-resolves and is most pronounced with large chewy foods is classical for steakhouse syndrome. The underlying cause of this syndrome is Schatzki's ring (Figure 7-5). Schatzki's ring presents with intermittent dysphagia. Eosinophilic esophagitis is commonly seen in patients with difficulty swallowing and multiple allergies that is constant. Eosinophilic esophagitis is a diagnosis made exclusively through biopsy. Plummer-Vinson syndrome is the combination of esophageal webs, which can cause dysphagia but would also have concomitant iron deficiency anemia, which this patient does not have. Plummer-Vinson syndrome is associated with squamous cell cancer. Achalasia classically presents with dysphagia, but this is persistent and not intermittent.

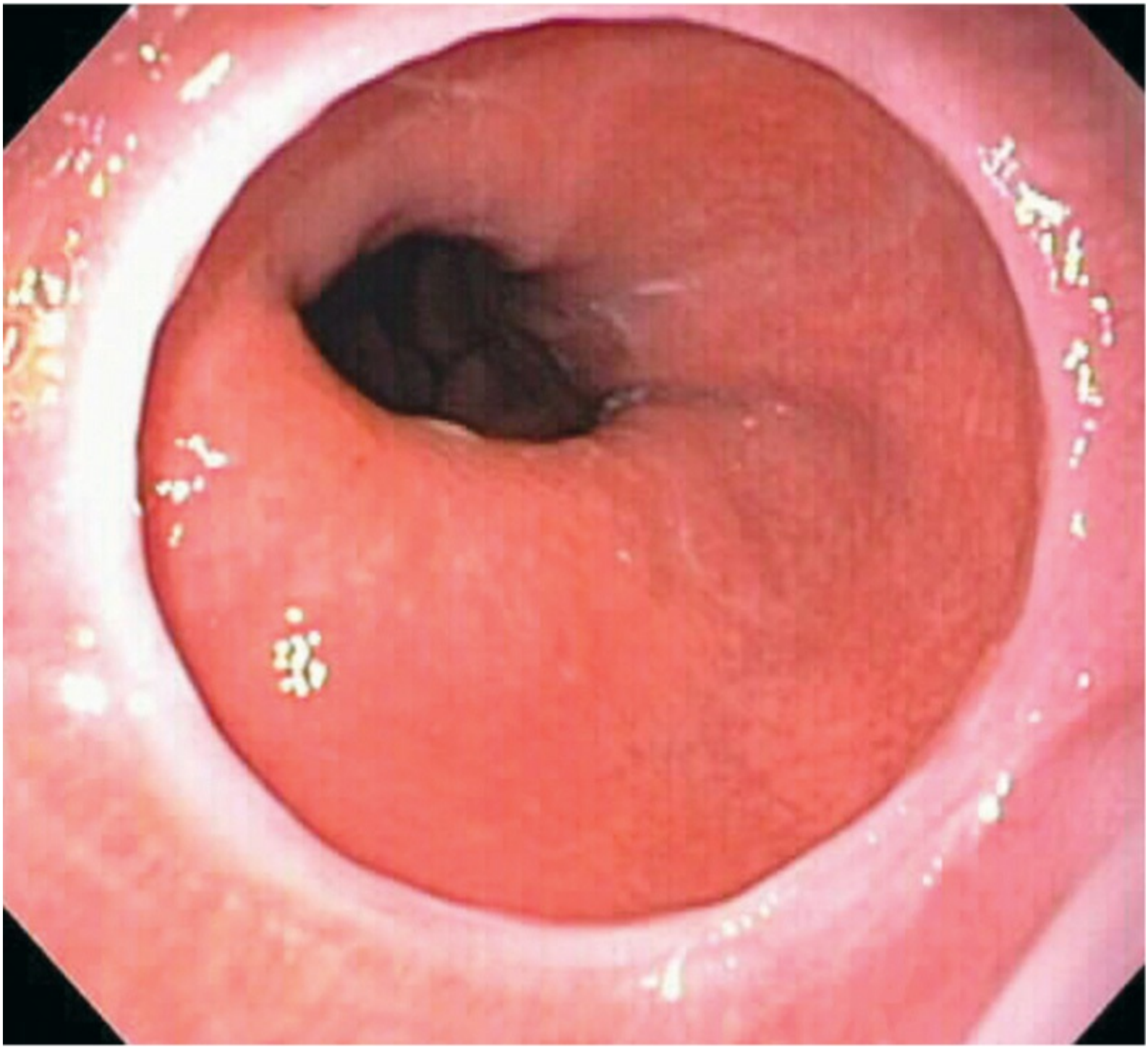


Figure 7-5. Schatzki's ring at the gastroesophageal junction. (Reproduced, with permission, from Wong Kee Song L, Topazian M. Gastrointestinal endoscopy. In: Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

Etiology of iron deficiency in Plummer-Vinson syndrome: not known Not from blood loss

There are two kinds of rings in the esophagus, A and B rings. A rings are muscular and near the esophagogastric junction, commonly in children. B rings are mucosal structures commonly at the squamocolumnar junction that are smooth and thin.

What is the best next step in the management of this patient?

a. Barium radiography
b. Computed tomography (CT) scan of the chest
c. Upper endoscopy

Answer a. Barium radiography

Barium esophagram has a higher sensitivity than upper endoscopy in detecting esophageal rings and is the best test to diagnose anatomic abnormalities of the esophagus. CT scan of the chest lacks the resolution to detect rings as the esophagus is not distended. Results of a barium swallow show a concentric narrowing at the squamocolumnar junction. The patient's condition is unchanged.

Barium is only ordered when there is no risk for perforation; otherwise, always order Gastrografin. Whereas barium is caustic to mediastinal structures, Gastrografin is water soluble.

What is the best initial therapy for this patient?

a. Balloon dilatation
b. Electrosurgical incision
c. Surgical resection
d. Steroid injection

Answer a. Balloon dilatation

The best initial therapy for a patient with esophageal rings a single dilation with pneumatic balloons. The dilatator balloon typically increases in size up to 20 mm and literally ablates the mucosal ring through "crush phenomenon." Electrosurgical incision via endoscopy and steroid injections are not considered the best initial therapy but are used for refractory rings that have not resolved after dilation. Surgical resection is for patients who have failed all therapies.

> *The patient undergoes balloon dilatation under endoscopic guidance with no immediate complications.*

What should be added after pneumatic dilation?

a. Metoclopramide
b. Calcium channel blocker
c. Omeprazole
d. Sucralfate
e. *Helicobacter pylori* therapy

Answer c. Omeprazole

For patients with concomitant reflux symptoms and esophageal rings, PPI therapy must be started after pneumatic dilatation. *H. pylori* has no effect in rings and webs. Calcium channel blockers

would only make it worse by decreasing LES pressure. After dilatation, turn the clock forward, and the case will end.

The patient returns after 3 months with recurrent food impaction that self-resolved with time. The patient is inquiring about further management. He is frustrated.

What is the best response to this patient who inquires about further therapies for his Schatzki's ring?

a. Endoscopy for eosinophilic esophagitis
b. Surgical resection
c. Intralesional steroids
d. Mesalamine

Answer a. Endoscopy for eosinophilic esophagitis (Figure 7-6).

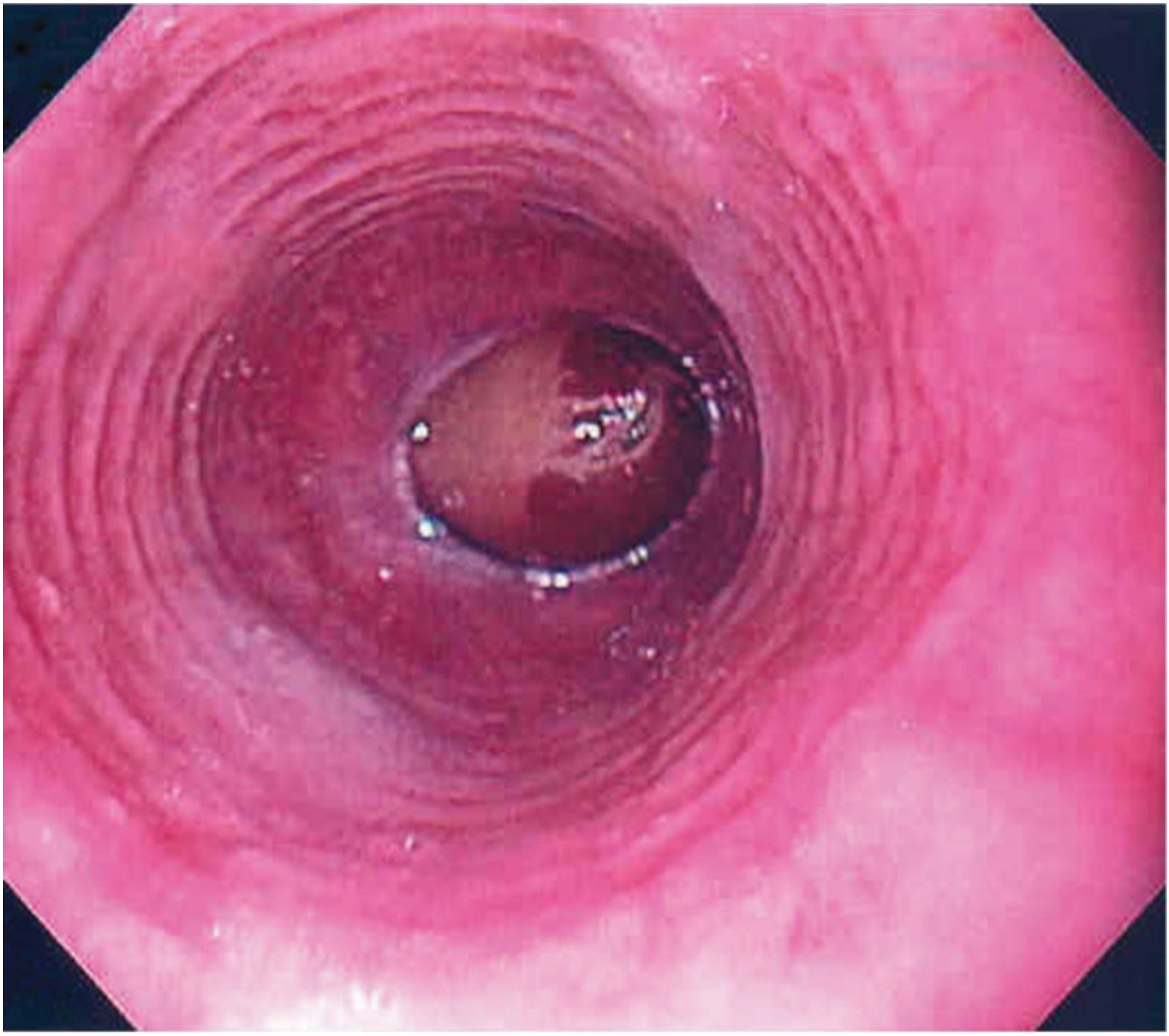


Figure 7-6. Eosinophilic esophagitis with multiple circular rings of the esophagus, creating a corrugated appearance and an impacted grape at the narrowed esophagogastric junction. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

For a patient with refractory Schatzki's rings that do not heal after balloon dilatation, the best next step in management is to rule out eosinophilic esophagitis because this is a cause of recurrent ring formation. This is followed by intralesional steroid injections in conjunction with dilatation or endoscopic electrosurgical intervention. If these procedures do not result in resolution of the lesion, then surgical intervention is the best next step.

If the case did not end after dilatation, order a surgical consultation on the CCS. Fortunately, steroid injection and electrosurgical intervention are not found on the CCS software. Therefore, the only course you can follow for refractory rings is surgical resection. Turn the clock forward, and the clock will end.

STOMACH

CASE 1: Upper Gastrointestinal Bleed

Setting: *ED*

CC: *"I vomited blood."*

VS:

Supine:

BP: 114/77 mm Hg

Standing:

BP: 84/67 mm Hg
R: 18 breaths/min
P: 121 beats/min
T: 98.8°F

HPI: *A 62-year-old vice president of a major computer company presents with hematemesis that began this morning. He has been having abdominal pain for the last week and then felt nauseated, after which he had vomited four times. The vomit was bright red in color with some small clots. He still has abdominal pain and points to his epigastrium, saying the pain is 8 of 10 and non-radiating. He feels dizzy and lightheaded. He had dark-colored stool yesterday and again this morning.*

PMH: *Arthritis of left knee and right shoulder*

Meds: *Naproxen twice daily, aspirin*

SH: *30-pack per year smoker. Consumes 2 to 3 alcoholic beverages weekly*

ROS:

- *No headache*
- *No visual disturbance*
- *No shortness of breath or respiratory difficulty*

When the physical examination says, "Oriented × 3," it means person, place, and time. It is easy to lose track of the date in a hospital. However, if a person can speak and does not know his or her name ("person"), it is either a psychiatric disorder or malingering.

Physical Exam:

- *Awake alert and oriented* × 3
- *Abdomen: mildly distended; tender to palpation over the epigastrium*
- *Rectal examination reveals melenic stools that are strongly heme positive*

Tenderness is on exam.

Pain is on history.

Initial Orders:

- *Complete blood count (CBC)*
- *Comprehensive metabolic profile (CMP)*
- *Prothrombin time (PT)*
- *Partial thromboplastin time (PTT)*
- *Type and crossmatch*
- *2 units of packed red blood cells (PRBCs)*
- *Electrocardiography (ECG)*
- *Consultation with gastroenterology*

CCS TIP: ***The most common cause of death in gastrointestinal (GI) bleeding is myocardial ischemia; therefore, always get an ECG.***

Severe anemia = Ischemia

Low hemoglobin makes oxygen transport to tissue impossible. The heart cannot distinguish between hypoxia, stenosis, carbon monoxide poisoning, and anemia. All are "felt" by the heart as decreased oxygen delivery to tissues.

What is the best next step in the management of this patient?

a. Intravenous (IV) normal saline bolus
b. Wait for hematocrit (Hct)
c. Upper endoscopy
d. Abdominal ultrasonography
e. IV omeprazole

Answer a. Intravenous (IV) normal saline bolus

The most critical part of the initial evaluation of any patient who presents with upper GI bleeding is to assess blood volume replacement and the airway. This patient has no evidence of breathing difficulty but does demonstrate significant circulatory compromise in the form of hemorrhagic shock. The evidence for this is tachycardia, hypotension, and orthostatic hypotension. This patient should immediately have two large-bore IV lines placed and receive normal saline boluses followed by PRBCs. Waiting for the Hct could prove fatal. The first hematocrit is nearly useless if it is normal because it will take hours to see what the real hematocrit is. Volume resuscitation must be done immediately as based on vital signs. This patient has likely lost 35% of his blood volume. You must lose 15% to 20% to become orthostatic. The patient has a pulse higher than 100 beats/min and systolic blood pressure less than 100 mm Hg, which means a 30% volume loss. Starting IV omeprazole is appropriate but is not the best next step in management because hemodynamic stability trumps all other choices. The patient is not stable enough for upper endoscopy, and

ultrasonography has no role in upper GI bleeding.

What is the demarcation point between upper and lower GI bleeding?

a. Esophagus
b. Stomach
c. First and second parts of duodenum
d. Ligament of Treitz

Answer d. Ligament of Treitz

Upper GI bleeding is defined as any bleeding that occurs proximal to ligament of Treitz, which delineates the crossover point between the duodenum and jejunum.

Systolic blood pressure <100 mm Hg and heart rate >100 beats/min = ≥30% blood volume loss.
"Orthostatic" means a systolic blood pressure drop of 20 mm Hg and diastolic drop of 10 mm Hg or heart rate increase of 10 beats/min.

It's all in the stool!
- Red blood demonstrates lower GI bleeding or very high-volume upper GI bleeding
- Coffee-ground emesis: 5 to 10 mL of blood loss proximal to the ligament of Treitz
- Black stool: upper GI bleeding from 100 mL of blood loss
- Heme-positive stool: brown from 5 to 10 mL of blood loss

CCS TIP: *Any patients who presents in shock with hypotension not responsive to fluids must be admitted to the ICU.*

Move the clock forward 15 to 30 minutes. The patient receives a 2-L bolus of normal saline.

Results:
- *CBC: Hct: 28*
- *Gastroenterology consults tells you nothing of use.*
- *PT: 1.2*
- *PTT = 28 seconds (normal)*
- *Blood urea nitrogen (BUN)/creatinine = 45/1.2*
- *ECG: Sinus rhythm with nonspecific ST changes*

Order:
- *Obtain vital signs.*

Move the clock forward 2 minutes to get the results.

Results:

- *Heart rate, 84 beats/min; lying flat, 94 beats/min standing*
- *Blood pressure, 118/76 mm Hg; lying flat, 108/72 mm Hg standing*

CCS TIP: *All consults on CCS say, "I saw your patient. There are no specific recommendations." Never expect a CCS consultation to help you answer the case.*

High BUN with GI bleeding = Renal hypoperfusion + Blood in gut = High BUN

Which is a mechanism of high BUN-to-creatinine ratio in prerenal azotemia from decreased renal perfusion?

a. Increased filtration of protein at the glomerulus
b. Decrease in antidiuretic hormone (ADH) effect at the proximal tubule
c. Afferent arteriolar dilation
d. ADH increases urea reabsorption at the collecting duct

Answer d. ADH increases urea reabsorption at the collecting duct

ADH places aquaporins into the collecting duct at the kidney. This increases water reabsorption from the collecting duct and into the renal medullary interstitium. This would dilute the concentrating ability of the kidney. ADH also puts "urea transporters" directly into the collecting duct and causes direct urea reabsorption in the collecting duct.

Hct <30 + Old = PRBCs
Hct <25 + Young = PRBCs
International normalized ratio (INR) >1.5 = fresh-frozen plasma (FFP) and vitamin K
Platelets <50,000 with active bleeding = transfuse

What is best next step in the management of this patient?

a. Endoscopy
b. Angiography
c. Bleeding scan
d. IV omeprazole
e. IV ranitidine

Answer d. IV omeprazole

IV proton pump inhibitor (PPI) therapy is the best next step in management and should be initiated in all patients with suspected upper GI bleeding before endoscopy as part of the initial set of orders. PPI therapy has been shown to reduce rebleeding, downgrade the severity of the lesions, and promote healing of the stomach lining caused by increased pH. PPI therapy also promotes clot stabilization and therefore improves outcomes. Endoscopy should be done concurrently, but PPIs are tried first. Angiography is only for failed endoscopic hemostatic control with endoscopy, and the bleeding is massive. Bleeding scans are only for lower GI bleeds when you think there is blood loss likely happening but you do not know for sure. Nuclear bleeding scans are quite nonspecific. Ranitidine does not adequately raise stomach PH above 4 and is not nearly as useful in upper GI bleeding as a PPI.

H2 blockers (eg, ranitidine)
- Do not raise stomach PH adequately

Tachyphylaxis
- IV H2 therapy does not reduce morality rates but only promotes healing of the ulcers.

Three stimulants of acid/H+ from gastric parietal cells:
- Histamine
- Acetylcholine/vagal stimulation
- Gastrin

What is the best next step in the management of this patient?

a. Endoscopy
b. Angiography
c. Surgery
d. Nasogastric tube

Answer a. Endoscopy

After adequate volume resuscitation, correcting for anemia, and coagulopathy, the best next step is upper endoscopy known as esophagogastroduodenoscopy (EGD). EGD allows for diagnosis and intervention of the bleeding site. Endoscopy is the best initial diagnostic and therapeutic procedure. A nasogastric tube is wrong because it does not change management. If you are going to do an upper endoscopy, placing a nasogastric tube does not matter. There is nothing you can do therapeutically through a nasogastric tube. Lavage or decompression is not meaningful.

Order an endoscopy and then turn the clock forward. You will get the report from the procedure.

PPI + Endoscopy: All patients
Nuclear (technetium) bleeding scan: suspected GI bleed; source not found with scope
Angiography: localizes source of bleeding to guide surgery

Sources of upper GI bleeds
• Peptic ulcer: secondary to *Helicobacter pylori* or nonsteroidal antiinflammatory drug abuse
• Variceal bleeding: cirrhosis
• Mallory Weiss tear: preceded by forceful vomitus
• Arteriovenous malformation: seen commonly in aortic stenosis

Move the clock forward enough for the patient to undergo an EGD.

A large ulcer (Figure 8-1) is noted in the antrum with a nonbleeding visible vessel. Epinephrine and a sclerosing agent are injected into the vessel for hemostasis. Biopsies are taken to assess for H. pylori.

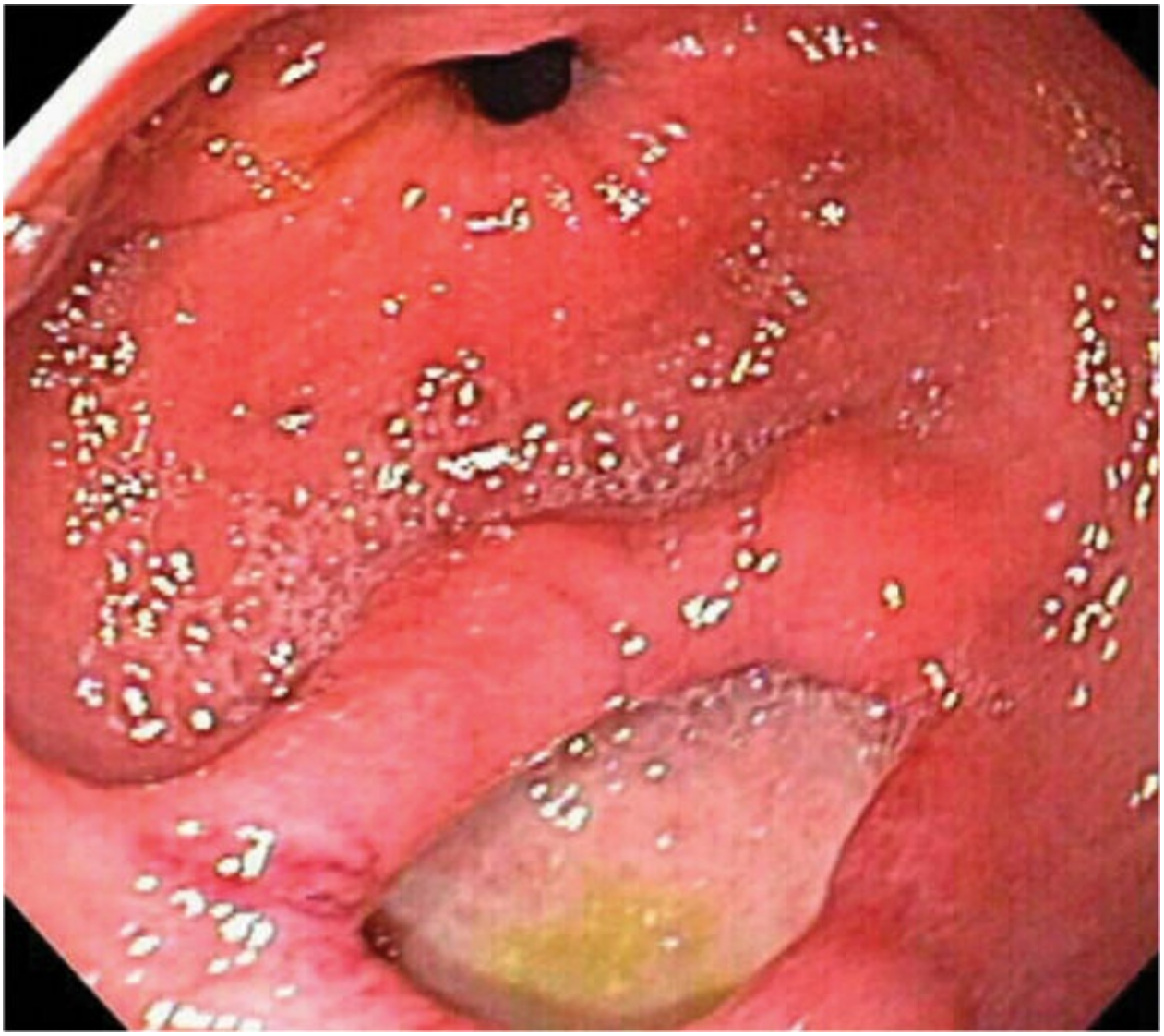


Figure 8-1. Gastric antral ulcer. (Reproduced, with permission, from Wong Kee Song L, Topazian M. Gastrointestinal endoscopy. In: Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

H. pylori
- Microaerophilic helix shaped
- Gram-negative bacterium
- Produces oxidase, catalase, and urease

Smoking and alcohol only *impair* ulcer healing. They do not *cause* ulcers.

Forrest classification of endoscopic findings. As you progress down the list, the rate of rebleeding decreases.
- Class Ia: Spurting hemorrhage
- Class Ib: Oozing hemorrhage
- Class IIa: Nonbleeding visible vessel

- Class IIb: Adherent clot
- Class IIc: Flat pigmented spot
- Class III: Clean ulcer base

After endoscopy, order a CBC the next morning and turn the clock forward.

CCS TIP: *The Hct should be higher or stabilized from admission. If it is lower, then the case will continue.*

Move the clock forward 12 to 24 hours. The repeat CBC shows that the Hct is still 24 after the patient received 2 more units of PRBCs.

GI bleeding stops spontaneously in 80% of patients.

What is the best next step in the management of this patient?

a. Endoscopy
b. Angiography
c. Surgery

Answer b. Angiography

After a failed endoscopy, the best next step to control bleeding is angiography with coil embolization of the vessel. Success rates for patients with acute peptic ulcer bleeding can reach 98%, with recurrent bleeding rates up to 20%. Patients should have a serum creatinine less than 1.5 mg/dL and an INR less than 1.5 and a platelet count greater than 50,000.

Nasogastric tube
- No therapeutic role
- Will not stop the bleeding

After angiography, order:
- *BUN/creatinine*
- *CBC*

Move the clock forward. If the case does not end, prepare for a curve ball.

Twenty-four hours later when you are on rounds, the Hct is still 22 despite 6 units of PRBCs. The patient is still tachycardic.

What is the best next step in the management of this patient?

a. Endoscopy
b. Angiography
c. Surgery
d. Add an H2 blocker to the PPI
e. Add sucralfate to the PPI

Answer c. Surgery

Surgery is the best next step in the management of complicated peptic ulcer disease (PUD) with persistent or massive recurrent GI bleeding. Additionally, if a patient presents with hemodynamic instability despite vigorous resuscitation, or shock with recurrent hemorrhage, surgery is indicated. Surgical treatments for PUD include oversewing of the artery with truncal vagotomy, or antrectomy with gastrojejunostomy (Billroth II procedure).

After surgery is completed, keep the patient in the intensive care unit, order a CBC, and turn the clock to rounds the next day. The case will end.

CASE 2: Perforated Gastric Ulcer

Setting: *ED*

CC: *"My stomach hurts."*

VS: *BP, 94/67 mm; P, 131 beats/min; R, 26 breaths/min; T, 95.9°F*

HPI: *A 45-year-old man with a long history of peptic ulcer disease (PUD) presents with the sudden onset of gnawing sharp abdominal pain that began 4 hours ago. The pain is severe (10 of 10), constant, with radiation to both his shoulders, and is associated with nausea. When the pain began, it was so severe that it caused him to collapse. He also vomited blood once and has recently noticed that his stools have become dark and sticky looking. The patient says he cannot get comfortable, and the pain is unbearable. He has been having off and on abdominal pain worsened by food for the past few weeks. The pain was similar to when he had an ulcer 3 years ago.*

PMH: *PUD, endoscopy 3 years ago, osteoarthritis*

Medications: *Pantoprazole daily*

ROS:

- *No dizziness*
- *Patient admits to lightheadedness*
- *No chest pain*
- *No shortness of breath*

Physical Exam:

- *The patient appears anxious and in pain.*
- *Abdomen is firm and rigid, and there is guarding with marked distension. There is significant pain in the right lower quadrant (RLQ).*
- *Pulse is weak and thready*
- *Extremities are cool to touch*

Initial Orders:

- *Complete blood count (CBC)*
- *CMP*
- *Prothrombin time (PT)*
- *Partial thromboplastin time (PTT)*
- *Type and crossmatch*
- *2 units packed red blood cells (PRBCs)*
- *Electrocardiography (ECG)*
- *Nasogastric tube placement*

What is the most likely diagnosis?

a. Perforated gastric ulcer
b. Gastritis
c. Non-ulcer dyspepsia
d. Acute cholecystitis
e. Acute cholangitis

Answer a. Perforated gastric ulcer

The most likely diagnosis is perforated gastric ulcers. Classic presentation is a patient with a long history of PUD who presents with a sudden onset of severe diffuse abdominal pain accompanied with tachycardia, a weak pulse, and hypothermia. Both RLQ and pain that radiation to both shoulders are also seen in gastric perforation. On examination, peritoneal signs such as rigidity and guarding are hallmark findings. This patient should be aggressively resuscitated with intravenous (IV) fluids and prepared for diagnostic imaging. Gastritis does not give hypotension, guarding, or rebound. Non-ulcer dyspepsia is a diagnosis of exclusion and does not fit this clinical presentation. Acute cholecystitis is right upper quadrant (RUQ) pain accompanied by fever and elevated white blood cell counts, and acute cholangitis has an obstructive picture seen on liver function tests.

Perforations are more common in the duodenum than the stomach. Peptic ulcers can be gastric or duodenal.

Syncope from ulcer perforation:
• Acidic fluid released to peritoneal cavity
• Release of vasoactive mediators
• Drop in blood pressure

Do not move on to diagnostic studies until hemodynamic stability has been obtained. Place 2 large-bore IV lines, IV saline or Ringer's lactate, and oxygen.

What is the best initial test?

a. Upright chest radiography
b. Upper gastrointestinal (GI) series
c. Abdominal ultrasonography
d. Portable abdominal radiography
e. Abdominal paracentesis

Answer a. Upright chest radiography

Upright chest radiography will show free air collecting in the RUQ. The top of the diaphragm is always seen on an upright chest radiograph (Figure 8-2). The most common wrong answer is abdominal radiography, but portable radiography is done while the patient is lying supine, so the air will not collect in the RUQ.

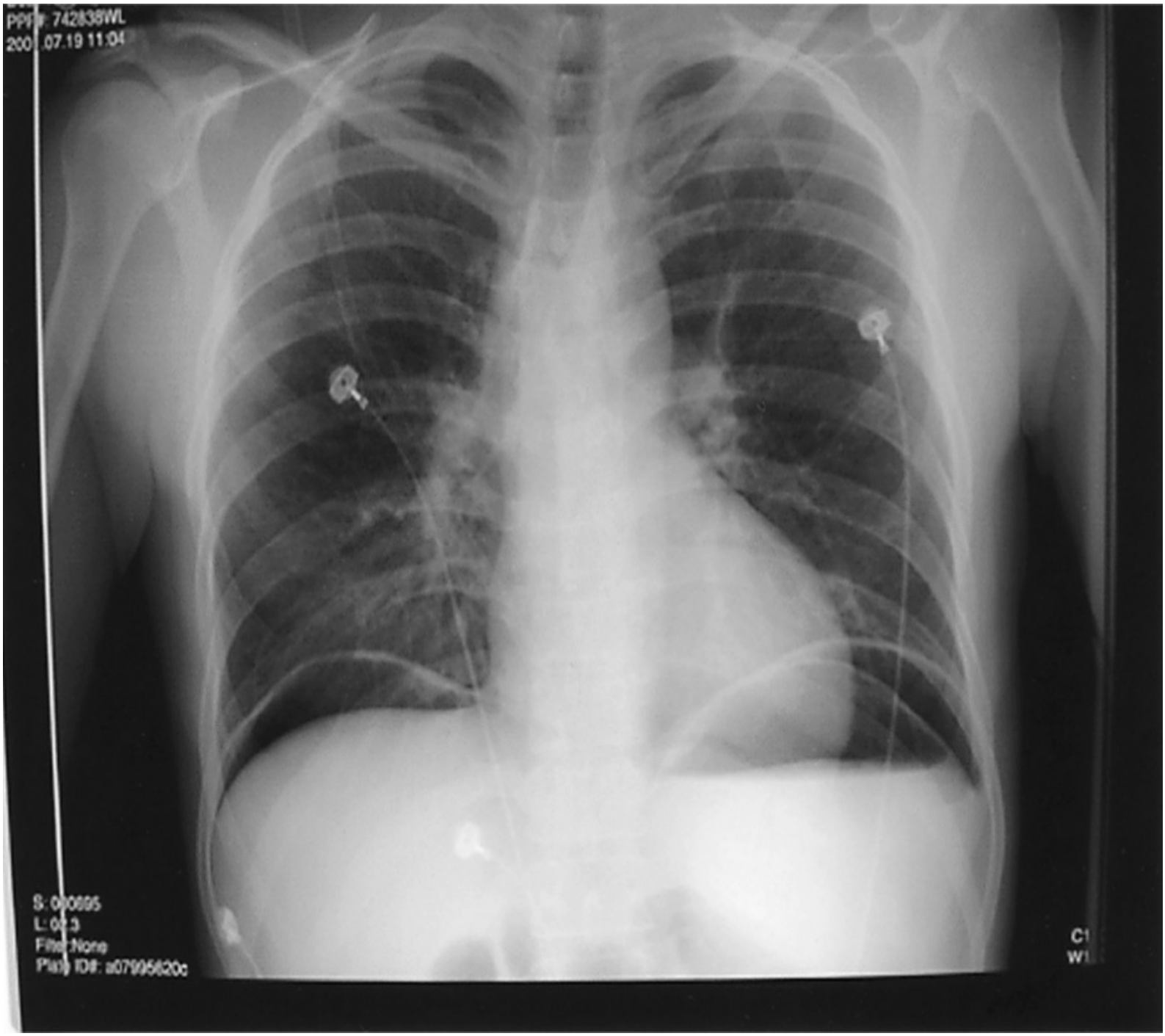


Figure 8-2. Upright anteroposterior chest radiograph demonstrating pneumoperitoneum from a perforated peptic ulcer. (Reproduced, with permission, from Stone C, Humphries RL, eds. *Current Diagnosis & Treatment Emergency Medicine*. 7th ed. New York: McGraw-Hill; 2011.)

Abdominal radiography will not always show the top of the diaphragm. Upper GI series is done with barium, which is caustic if it extravasates into peritoneum, and takes too long; as time increases, so does the mortality rate. Abdominal ultrasonography currently does not have the resolution to detect viscous perforation, and abdominal paracentesis has no value in diagnosing a

perforation.

What is the most accurate test?

a. Upper GI series
b. Abdominal ultrasound
c. Computed tomography (CT) scan of the abdomen
d. Abdominal paracentesis

Answer c. Computed tomography (CT) scan of the abdomen

A CT scan of the abdomen is the most accurate diagnostic test and should be performed using water-soluble oral contrast to look for extravasation. Paracentesis is used to look for spontaneous bacterial peritonitis. Upper GI series is never correct. Anyone who used to get an upper GI series is better seen with upper endoscopy. You cannot do anything therapeutic with an upper GI series, and you cannot biopsy for either *Helicobacter pylori* or gastric cancer.

Antibiotics against gram-negative rods, anaerobes, and mouth flora
- Ampicillin–sulbactam
- Ticarcillin–clavulanic acid
- Piperacillin–tazobactam
- Combination of third-generation cephalosporin and metronidazole

E. coli
- Most common organism in peritoneal cultures after perforation
- Gram negative
- Facultative anaerobic, rod-shaped bacterium
- Produces vitamin K

The patient is given IV fluids and piperacillin–tazobactam, and a CT scan shows extravasation of contrast from the antrum.

What is the best next step in the management of this patient?

a. Surgery
b. Antibiotics
c. IV fluids
d. endoscopy

Answer a. Surgery

After hemodynamic resuscitation and starting empiric antibiotics, emergent surgical closure of defect with a piece of omentum known as a Graham patch is the standard of care. Patchy therapy is indicated in patients who have ongoing sepsis, a delayed presentation, comorbid disease, or significant peritoneal contamination.

Proton pump inhibitor (PPI) therapy promotes healing.
PPIs work by irreversibly blocking the hydrogen/potassium adenosine triphosphatase enzyme system (the H+/K+ ATPase) of the gastric parietal cells.

Advance the clock to the point where surgery is completed. You do not have to ask for additional consent on CCS. There is "general consent" considered to be obtained at the beginning of each case as it would be on hospital entry.

After surgery is completed, keep the patient in the intensive care unit, continue IV omeprazole, and turn the clock to rounds the next day. The case will end.

CCS TIP: *How do you know whether to ask for a consult for a specific procedure? On CCS, you do not know which procedure needs a consult. Just order the procedure, and the program will tell you when you need to order the consult.*

No amount of gastrin or histamine stimulation can overcome the blocking of the H+/K+ pump.

CASE 3: Mucosa-Associated Lymphoid Tissue Lymphoma

Setting: *Office*

CC: *"I'm following up on results from my endoscopy."*

VS: *BP, 124/67 mm Hg; R, 12 breaths/min; P, 71 beats/min; T, 98.9°F*

HPI: *A 42-year-old woman presents to your office after undergoing an upper endoscopy. The patient underwent the procedure because of abdominal pain and heme-positive stools of 2 months' duration. Her pain was worse with eating. At times she noticed dark stools. Endoscopy revealed one clean-based ulcer in the antrum; biopsies were taken. Her pain today is somewhat decreased but not completely gone. The pathologic report of the antral biopsies demonstrates numerous Helicobacter pylori and mucosal changes originating in the B cells in the marginal zone of the MALT (mucosa-associated lymphoid tissue).*

ROS:

- *No chest pain*
- *No fever*
- *No shortness of breath*

Physical Exam: *Mild epigastric tenderness*

H. pylori

- Helix-shaped gram-negative rod
- Microaerophilic
- Produces oxidase, catalase, and urease
- The most common stain to use for *H. pylori* is hematoxylin and eosin stain.

How does urease inside *H. pylori* help it survive?

a. Increases amount of urea in the stomach

b. Takes urea out of the blood and into the gastric lining

c. Urease decreases acid production

d. Creates ammonia (NH_3^+) to neutralize acid

e. Blocks histamine

Answer d. Creates ammonia (NH_3^+) to neutralize acid

Urease splits urea into carbon dioxide and ammonia (NH_3^+). Ammonia neutralizes hydrogen ion (H^+) and forms ammonium (NH_4^{++}).

Ammonia eats Acid (H+) to make AmmoniUM!
Your ACID tastes Um!!!

The flagella at the end of the *H. pylori* help drive it through the mucosa of the gastric lining.

What is the best next step in the therapy of this patient?

a. Surgical resection
b. Add clarithromycin and amoxicillin
c. Add clarithromycin and ampicillin
d. Rifaximin
e. Add metronidazole and tetracycline
f. No changes needed

Answer b. Add clarithromycin and amoxicillin

The first-line therapy for a patient who is infected with *H. pylori* and has developed a concomitant MALT lymphoma is to eradicate the bacterial burden. The most commonly prescribed regimen consists of a proton pump inhibitor (PPI) such as omeprazole, clarithromycin, and amoxicillin. Treat for 7 to 14 days. Surgical resection is too invasive as first-line therapy, and rifaximin has not been shown to be effective yet in trials against *H. pylori*. The combination of omeprazole, clarithromycin, and ampicillin is incorrect and is considered a distracter because many test takers confused amoxicillin with ampicillin. PPIs alone will not eradicate *H. pylori*.

Order omeprazole, clarithromycin, and amoxicillin. Move the clock forward and have the patient return to the office after 2 to 4 weeks.

CCS TIP: *You will never lose points by ordering "interval history" in a patient you have not seen for a while.*

Clarithromycin:
• Inhibits the 50S subunit of bacterial ribosome
• Prevents translation of peptides

The patient returns 2 days later with an erythematous maculopapular rash on her trunk.

Physical Exam:

- *No skin breaks; oral mucosa is not involved*
- *Blood pressure: 124/82 mm Hg*

All PPIs are equal in efficacy and unequal in price.

What is the next step in the management of this patient?

a. Discontinue all medications and start steroids.
b. Discontinue the previous regimen and start omeprazole, clarithromycin, and metronidazole.
c. Discontinue all therapy and obtain *H. pylori* serology.
d. Continue current therapy.

Answer b. Discontinue the previous regimen and start omeprazole, clarithromycin, and metronidazole.

This patient has an allergy to penicillin medications, which includes amoxicillin; therefore, the best next step in management would be to discontinue the current regimen and start omeprazole, clarithromycin, and metronidazole. For all patients who have penicillin allergies, metronidazole is substituted for amoxicillin. Starting steroids is not the correct answer because this is a simple drug reaction, and the best therapy for the allergy is stopping the offending agent. Obtaining *H. pylori* serology is always the wrong answer because it is an IgG antibody and offers no information about current infection status. Continuing the current therapy is not in the best interest of this patient because a rash with penicillin theoretically can raise the risk of anaphylaxis if the offending agent is continued.

Stop amoxicillin and start metronidazole. Move the clock forward 4 weeks.

Interval History: *Symptoms have improved, and the patient wants to know if her lymphoma has healed.*

What is the most appropriate next step in the management of this patient?

a. Stool antigen assay testing for *H. pylori*
b. Urea breath testing
c. *H. pylori* serology
d. Repeat biopsy
e. Urine immune-assay for *H. pylori*
f. Checking for *H. pylori* eradication is not necessary

Answer b. Urea breath testing

Urea breath testing performed 4 weeks or more after treatment is the best test to check for

eradication. Stool antigen testing may be less expensive but is also less accurate and requires the patient to be off PPIs. Serology is always the wrong answer because serology remains positive indefinitely. Serology cannot tell old versus new disease. A repeat biopsy is only indicated to test for eradication if the patient has had treatment failure and antibiotics resistance is suspected. Urine immune assay was explored and is a failure; urine immune assay is never correct. Failure to check for eradication could be detrimental in a patient who has confirmed malignancy.

Check for *H. pylori* eradication with:
- Persistent symptoms after *H. pylori* treatment
- *H. pylori*–associated ulcer
- Gastric MALT lymphoma
- Resection for early gastric cancer

Order a urea breath test and move the clock forward. There is no need to send the patient home because the test result comes back in 1 hour.

Urea breath test
- Oral carbon-labeled urea
- Urease splits it
- Labelled carbon is exhaled and detected.

Result: *Urea breath test result is positive.*

CCS TIP: *On the multiple choice section of the test, they may tell you that the stool antigen is positive. Treat both positive tests the same way.*

What is best next step in management?

a. Recheck breath test for *H. pylori* after another 4 weeks
b. Treat with bismuth, PPI, tetracycline, and metronidazole.
c. Order gastric biopsy to confirm the positive urea breath test.
d. Repeat the same set of medications for another round.

Answer b. Treat with bismuth, PPI, tetracycline, and metronidazole.

Treating with bismuth, PPI, tetracycline, and metronidazole is the best next step in a patient who has failed treatment with "triple therapy." The urea breath test has a sensitivity and specificity of 95%, so ordering a biopsy or waiting longer to check again is not necessary for confirmation.

The best initial therapy for MALT lymphoma is to treat for *H. pylori* infections. It is one of the few cancers in which treating the organism causes regression of the malignancy.

Order bismuth, PPI, tetracycline, and metronidazole and have the patient return after 4 weeks. On the return visit, order another urea breath test because it is still necessary to confirm bacterium eradication. Move the clock forward 4 weeks.

Interval History: *The patient feels fine and has no more pain.*

Orders:

- *Urea breath test: no CO_2 tagged by isotope*
- *Negative H. pylori evaluation*

What is the best next step in management of this patient?

a. Recheck for *H. pylori* infection after another 4 weeks

b. No further follow-up is needed

c. Order an endoscopic biopsy to confirm regression of MALT lymphoma every 3 months indefinitely

d. Order an endoscopic biopsy to confirm MALT lymphoma every 3 to 6 months for the first 2 years

Answer d. Order an endoscopic biopsy to confirm MALT lymphoma every 3 to 6 months for the first 2 years.

After successful eradication of *H. pylori*, the best next step in management is to perform endoscopy with biopsies every 1 to 3 months until histologic clearance of the MALT lymphoma is attained. This is then followed by surveillance endoscopy every 6 months for at least the first 2 years.

Move the clock forward 3 months.

Orders:

- *Endoscopy*
- *Biopsies*

Turn the clock forward, and the results will appear on screen.

Result: *Biopsy: Abnormal B cells in the marginal zone of the MALT consistent with MALTOMA*

Cancer originating from B cells in the marginal zone of the mucosa-associated lymphoid tissue is known as MALT lymphoma. The most common cause is *H. pylori* infection.

One third of gastric MALT lymphomas will persist despite treatment for *H. pylori*.

What test will detect the reason for this patient's persistent *H. pylori* lymphoma?

a. t(11;18) chromosomal translocation
b. Adenocarcinoma
c. Squamous cell cancer
d. Barrett's esophagus

Answer a. t(11;18) chromosomal translocation

A genetic translocation, t(11;18) can lead to resistance to helicobacter.

Order: *After demonstration of treatment failure with antibiotics and a positive t(11;18) result, the best next step is radiation therapy followed by chemotherapy with rituximab, and evaluation for surgical resection with curative intent (partial or total gastrectomy).*

Screen patients about to start rituximab (anti CD-20 monoclonal antibody) for hepatitis B. If chronic hepatitis B is present and you start rituximab therapy, you can precipitate a hepatitis flare and potential liver failure.

Orders:

- *Oncology consultation*
- *Surgical consultation*

Move the clock forward, and the case will end.

CASE 4: Stomach Cancer

Setting: *Office*

CC: *"I am losing weight."*

VS: *BP, 104/67 mm Hg; R, 18 breaths/min; P, 91 beats/min; T, 100.0°F*

HPI: *A 65-year-old woman presents to the office with a 6-month history of weight loss and early satiety. The patient states that she has lost about 20 lb unintentionally. She no longer has the same appetite and is unable to eat as much as she previously could. She also has a rash on her neck folds.*

ROS:

- *No nausea*
- *No vomiting*
- *Positive dark stools*

Physical Exam:

- *Mild epigastric tenderness*
- *Dark velvety rash over the posterior neck folds (Figure 8-3)*
- *Left supraclavicular adenopathy*
- *Periumbilical adenopathy*

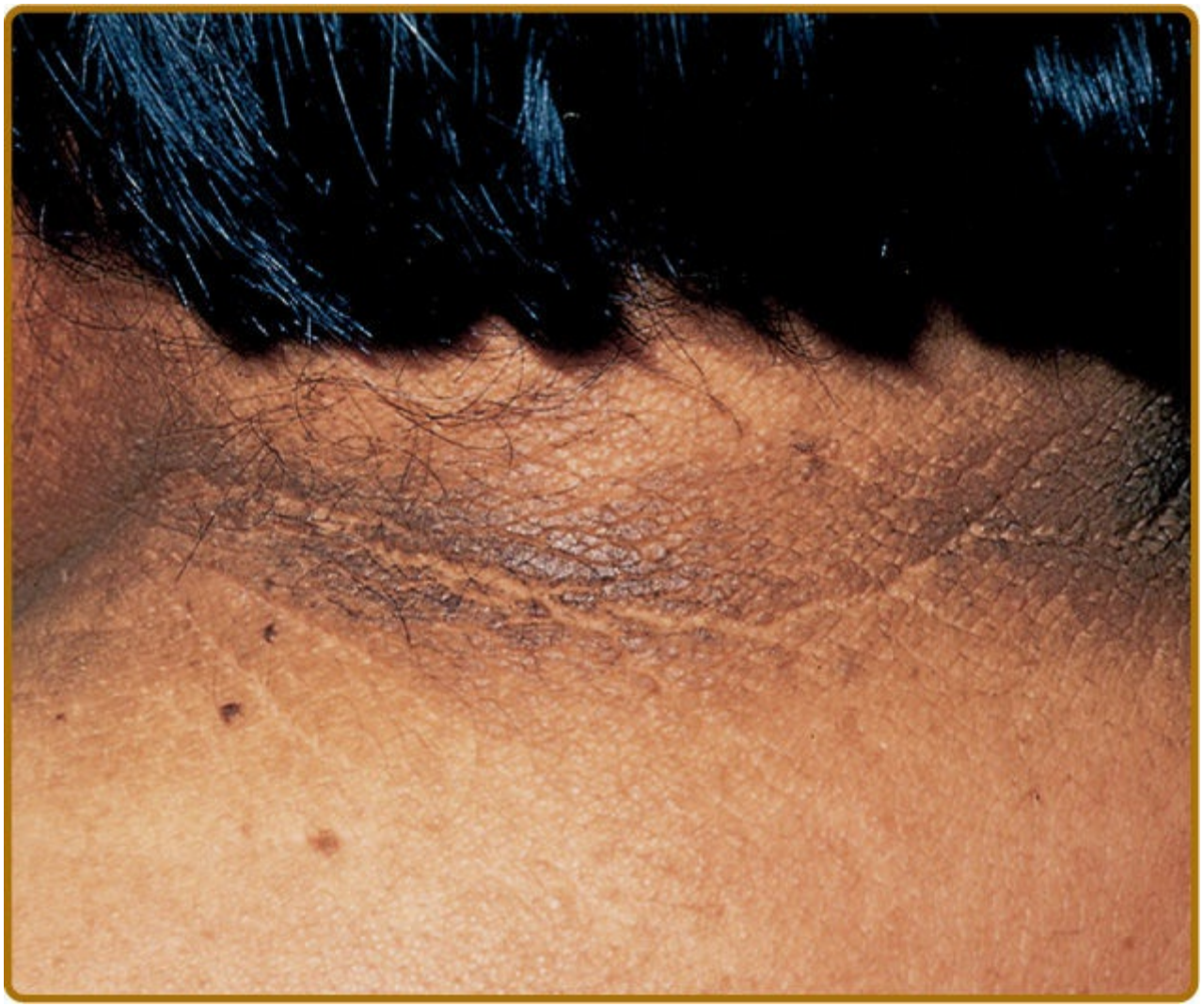


Figure 8-3. Acanthosis nigricans involving the neck. (Reproduced, with permission, from Goldsmith LA, Katz SI, Gilchrest BA, et al, eds. *Fitzpatrick's Dermatology in General Medicine*. 8th ed. New York: McGraw-Hill; 2012.)

What is the most likely diagnosis?

a. Diabetes mellitus type 2
b. Insulin resistance
c. Gastric adenocarcinoma
d. Hypothyroidism

Answer c. Gastric adenocarcinoma

The combination of early satiety, acanthosis nigricans, and a positive Virchow's node or Sister Mary Joseph's node is indicative of gastric adenocarcinoma. Gastric cancer is the second most common cause of cancer-related death in the world. These are findings that are sensitive for gastric adenocarcinoma but are not specific. Other dermatologic findings include the sudden appearance of diffuse seborrheic keratoses known as sign of Leser-Trelat. Although DM2 and insulin resistance may have the finding of acanthosis nigricans, the findings of early satiety and enlarged lymph nodes are not inline. Hypothyroidism presents with fatigue and weight gain but lymph node enlargement is not a part of the presentation of decreased thyroid function.

Left supraclavicular adenopathy = Virchow's node
Periumbilical adenopathy = Sister Mary Joseph's node
Dark velvety rash over the skin folds = Acanthosis nigricans

What is the best next step in the management of this patient?

a. Barium swallow
b. Computed tomography (CT) scan of the abdomen
c. Upper endoscopy
d. Colonoscopy
e. Abdominal magnetic resonance imaging (MRI)

Answer c. Upper endoscopy

The best next step in the management and the most accurate test in the diagnosis of gastric cancer is an upper endoscopy with biopsy of ulcers and masses. Confirmation of disease through tissue diagnosis is followed by staging of the disease with a CT scan. Barium swallow does not allow for tissue diagnosis and has a high false-positive rate because gastric folds can be misinterpreted. Colonoscopy is literally chasing the disease from the wrong end, and abdominal MRI is the wrong answer for nearly all diseases. MRI is based on water content of tissues. The water content of gastrointestinal tissues is nearly the same for all of them, so there is not much distinction to be made by MRI.

Helicobacter pylori virulence is from factor cytotoxin-associated gene A (CagA)

Orders:
- *Gastrointestinal consolation*
- *Upper endoscopy with biopsy*
- *Complete blood count*
- *Comprehensive metabolic profile (CMP)*
- *Prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR)*

CCS TIP: *Do not forget to order a biopsy; otherwise, the patient will get an endoscopy without tissue sampling.*

Move the clock forward 1 week. Have the patient return to the office.

Move the clock to when it says, "Report available."

Upper endoscopy results:
- *Large ulcerated mass extruding from the antrum*

- *Slow oozing vessel*
- *Mucosa is highly friable*

Laboratory findings:

- *Elevated blood urea nitrogen*
- *Hemoglobin: 10.1 mg/dL*
- *MCV: 73*
- *Prothrombin time (PT), partial thromboplastin time (aPTT), international normalized ratio (INR): normal*

CCS TIP: *CCS always tells you exactly what the time is that results become available. You do not have to do anything to get those results; you just have to move to or past the time it says, "Report available," and it will pop up automatically.*

Results:

- *Pathology: highly undifferentiated adenocarcinoma with signet ring cells (Figure 8-4)*
- *H&E stain: positive for numerous H. pylori organisms*
- *Signet ring cells = stomach cancer*

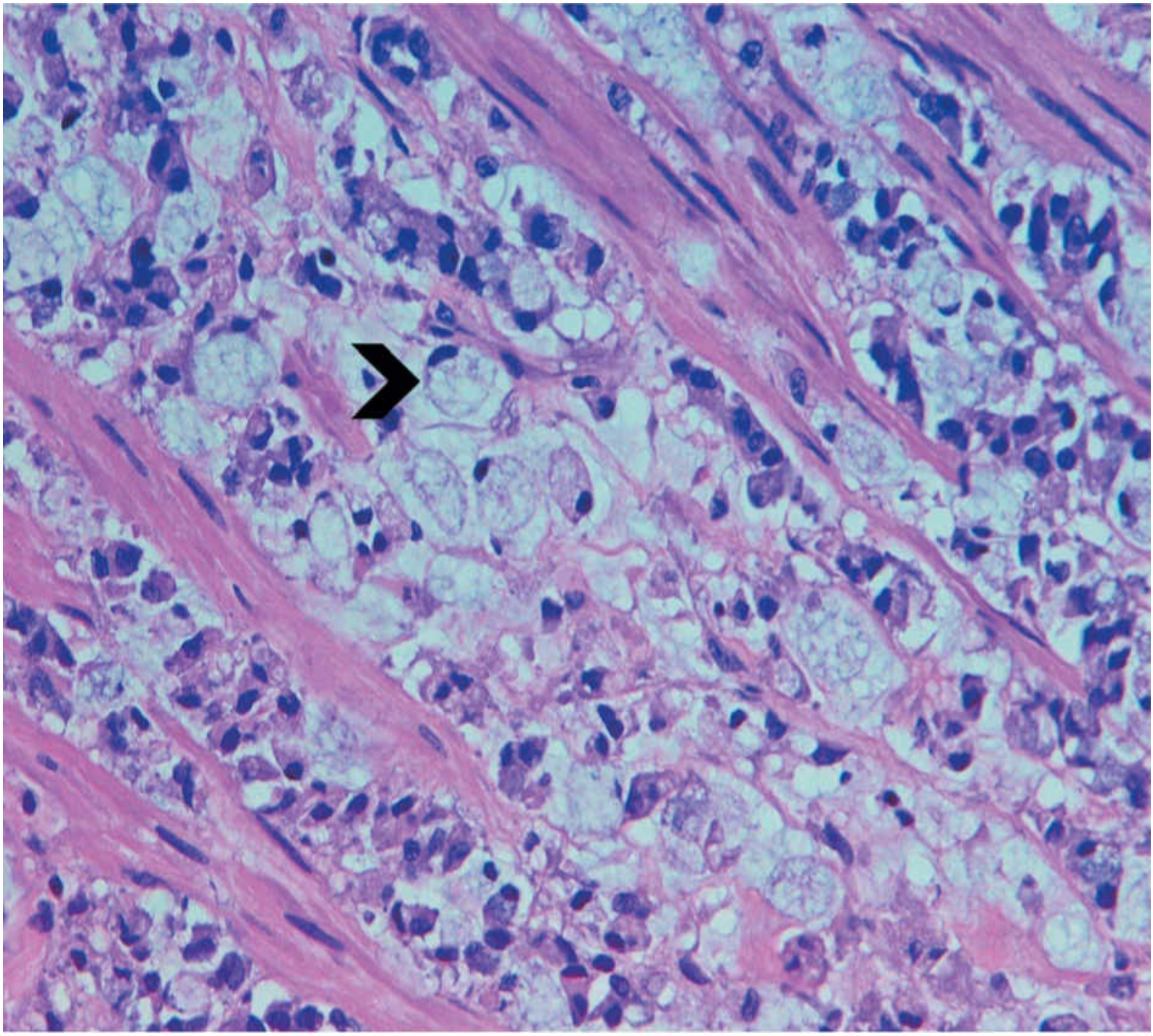


Figure 8-4. A high-power view of the neoplasm. Note the characteristic signet-ring cell appearance of the neoplastic cells *(arrowhead)*. Hematoxylin and eosin, 400×. (Reproduced, with permission, from Kemp WL, Burns DK, Brown TG, eds. *Pathology: The Big Picture*. New York: McGraw-Hill; 2008.)

The number of ringed cells is directly correlated with a poor prognosis.

What is the best next step in management?

a. Abdomen computed tomography (CT) and endoscopic ultrasonography (EUS)
b. Exploratory laparotomy
c. Surgical resection of stomach
d. Chemotherapy followed by surgical resection

Answer a. Abdomen computed tomography (CT) and endoscopic ultrasonography (EUS)

After the diagnosis of gastric cancer is made, the best next step is always staging. CT scan of the abdomen and pelvis and EUS are indicated. Order a CT scan of the abdomen and pelvis along with endoscopic ultrasonography of the stomach. The main point of the scans is to see if the cancer is localized enough to surgically remove it. If there is spread to local tissues, chemotherapy and radiation may make it small enough to remove. If there is more widespread metastasis, complete surgical resection, and therefore a chance at a cure, is impossible.

EUS is the single most accurate test of masses of the pancreas and just outside the esophagus.

Advance the clock to get the results of the scans.

Results:

- *Abdominal CT scan: Evidence of metastasis to regional lymph nodes and lesions are not seen in the liver.*
- *EUS shows tumor invasion into the serosa.*
- *These findings are consistent with stage III disease.*

Layers of the stomach from inner to outer

- Mucosa
- Submucosa
- Muscularis externa: consists of inner oblique layer, middle circular layer, Auerbach plexus, and outer longitudinal layer
- Serosa

Which of the following is the best next step in the management of this patient?

a. Endoscopic mucosal resection (EMR)
b. Endoscopic submucosal dissection (ESD)
c. Surgical resection with adjuvant chemotherapy and radiation
d. Palliative care only
e. Chemotherapy only

Answer c. Surgical resection with adjuvant chemotherapy and radiation

The best therapy for a patient with advanced gastric malignancy disease and lymph node involvement is surgical resection with adjuvant chemotherapy and radiation. EMR is only applicable in disease that is limited to mucosal involvement only or stage 0 or 1; ESD is for stage 1 disease. If the disease goes beyond the second layer or involves lymph nodes, surgery is performed.

If metastases have spread farther than the local area, surgery will not be curative.

Stage 0: Limited to the inner lining of the stomach
Stage I: Penetration to the second or third layer of the stomach
Stage II: Penetration to the second layer and more distant lymph nodes
Stage III: Penetration to the third layer and more distant lymph nodes or penetration to the fourth layer
Stage IV: Cancer has spread to nearby tissues and more distant lymph nodes

Order a surgical consultation to evaluate for gastric malignancy and turn the clock forward. The case will end.

COLON

CASE 1: Colon Cancer

Setting: *Office*

CC: *"I feel weak."*

VS: *Stable*

HPI: *A 65-year-old man presents with weakness and fatigue of 3 months' duration. He states that he is usually very active, but as of late, he has been unable to participate in his normal activities.*

PMH: *Coronary artery disease s/p 2 drug eluding stents (DES) 5 years ago*

Meds: *Metoprolol, aspirin*

ROS:
- *Less frequent bowel movements, straining to push, and pencil-like stools*
- *No abdominal tenderness to palpation*

SH:
- *Refuses screening colonoscopy*
- *Refuses pneumonia and zoster vaccine*

FH: *Father had colon cancer at 55 years of age*

Physical Exam:
- *Patient's shirt appears too large*
- *20-lb weight loss since last visit 1 year prior*
- *Pale conjunctiva*
- *Skin appears pallored*

What is the best next step in the management of this patient?

a. Complete blood count (CBC)
b. Stool occult blood
c. Iron studies
d. Basic metabolic profile
e. Colonoscopy
f. All of the above

Answer f. All of the above

This patient is presenting with signs and symptoms of anemia, and given his age and risk factors most likely has colon adenocarcinoma. The first step is to establish the patient's cause of fatigue by checking his CBC, iron studies, and kidney function. This should be combined with a stool occult blood test and eventually a colonoscopy if possible. If the patient had presented with melena, an upper endoscopy would have been considered, but given the change in bowel habits and stool caliber, it is likely a left-sided malignancy.

Hematochezia is more often caused by rectosigmoid than right-sided colon cancer.

Given the patient's family history, when would have been the appropriate screening interval for this patient?

a. Age 40 years and every 5 years thereafter
b. Age 40 years and every 10 years thereafter
c. Age 45 years and every 5 years thereafter
d. Age 45 years and every 10 years thereafter
e. Age 50 years

Answer a. Age 40 years and every 5 years thereafter

The screening interval is normally age 50 years and every 10 years thereafter, if normal, for all patients without a family history. However, in patients who have a first-degree relative with colon cancer, the screening should begin 10 years before the age of the relative or age 40 years, whichever comes first, and should be repeated every 5 years.

Gene changes in colon cancer
- General colon cancer: K-ras mutations
- Familial adenomatous polyposis: *APC* gene
- Hereditary nonpolyposis colon cancer syndrome or Lynch syndrome: *MSH2, MLH1*, and *PMS2* genes

Colorectal cancer screening with colonoscopy has the highest sensitivity and specificity and reduces mortality rates the most.

Strep bovis endocarditis = Colon cancer = Do colonoscopy as the next step

Orders:
- *Complete blood count (CBC)*
- *Stool occult blood*
- *Iron studies*

- *Basic metabolic profile (BMP)*
- *Colonoscopy*
- *Gastrointestinal consult*

Result: *Laboratory study results reveal a hemoglobin of 7.6 g/dL, with low serum iron, ferritin, and a high total iron-binding capacity (TIBC). The stool occult blood test result was positive. The BMP was within normal limits. Colonoscopy revealed a large ulcerated mass in the left lower quadrant (Figure 9-1).*

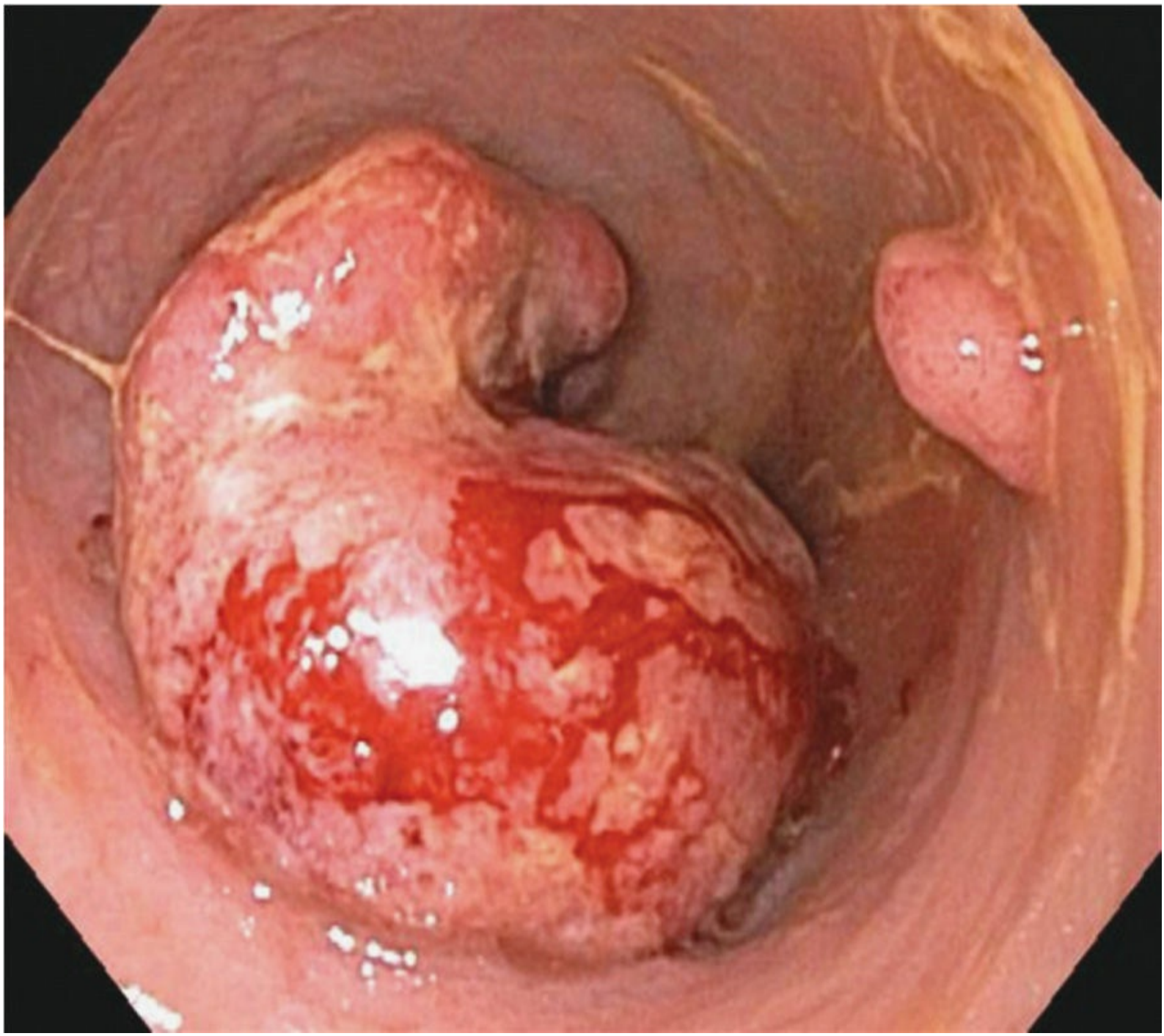


Figure 9-1. Colon cancer. (Reproduced, with permission, Greenberger NJ, Blumberg RS, Burakoff R, eds. *Current Diagnosis & Treatment: Gastroenterology, Hepatology, & Endoscopy*. 2nd ed. New York: McGraw-Hill; 2012.)

In iron deficiency anemia, iron studies will reveal low serum iron, low serum ferritin, and

TIBC.

CCS TIP: *Computed tomographic colonography (CTC, formerly "virtual colonoscopy") is always the wrong answer on USMLE Step 3 or CCS.*

What is the best next step in the management of this patient?

a. Computed tomography (CT) scan of the chest, abdomen, and pelvis
b. Surgical resection
c. Chemotherapy with a 5-fluorouracil (F-FU)–based regiment
d. All of the above

Answer a. Computed tomography (CT) scan of the chest, abdomen, and pelvis

Before the establishment of a treatment regimen, staging of the colorectal cancer is needed because the stage changes the management plan. Surgical resection combined with chemotherapy is considered to be a part of treatment after a patient has the staging established.

5-FU is a thymidylate synthase inhibitor that in turn causes synthesis of the pyrimidine thymidine to be blocked.

Order:
• *CT scans of the chest, abdomen, and pelvis with contrast*

Turn the clock forward for results.

CT of the chest abdomen and pelvis reveals a large mass in the left lower quadrant.

Orders:
• *Surgical consult for colon cancer*
• *Laparoscopy*
• *Oncology consult*

Turn the clock forward, and the case will end.

CASE 2: Toxic Megacolon

Setting: *ED*

CC: *"My abdomen hurts."*

VS: *BP, 98/55 mm Hg; P, 120 beats/min; R, 20 breaths/min; T, 101.2°F*

HPI: *A 37-year-old woman presents with profuse watery diarrhea of 3 days' duration with a frequency of 10 episodes of nonbloody diarrhea without mucus. The patient states that it began suddenly and was unrelated to anything she had eaten. Today her abdomen hurts, and she feels lightheaded.*

Meds: *Clindamycin for cellulitis 2 weeks ago*

ROS:
- *Fevers*
- *Nausea*
- *Vomiting*

Physical Exam:
- *Increased bowel sounds*
- *Distended abdomen with tympani*
- *Tender abdomen to palpation in the left lower quadrant*
- *Guarding with rebound*

What is the most likely diagnosis?

a. Gastroenteritis
b. Ulcerative colitis
c. Toxic megacolon
d. Ischemic colitis
e. Diverticulitis

Answer c. Toxic megacolon

Patients presenting with severe abdominal distension, dehydration, pain, and fever with diarrhea are likely to have toxic megacolon. There are numerous causes, but this patient's is *Clostridium difficile* infection caused by recent antibiotic exposure. Gastroenteritis does present with nausea, vomiting, and diarrhea but is not associated with severe distension and pain. Ulcerative colitis does not present this acutely and would have bloody diarrhea. Ischemic colitis and diverticulitis do not affect a patient this young and would not have a history of antibiotic exposure.

C. difficile is the leading cause of hospital-acquired diarrhea.

In patients with HIV infection or AIDS, cytomegalovirus colitis is the leading cause of toxic megacolon.

The BI/NAP1 strain of *C. difficile* is the most strongly associated with toxic megacolon.

Saccharomyces boulardii as a probiotic in the treatment of C. difficile is contraindicated in patients taking immunosuppressive medication, who have had recent surgical intervention, or who have had recent prolonged hospitalization.

What is the best next step in the management of this patient?

a. Abdominal radiography
b. *C. difficile* toxin assay
c. Intravenous (IV) normal saline
d. Complete blood count (CBC)
e. Basic metabolic profile (BMP)
f. All of the above

Answer f. All of the above

In a patient presenting with signs and symptoms of toxic megacolon, the initial management consists of obtaining an abdominal radiography, CBC, *C. difficile* toxin assay, and resuscitation of the patient with normal saline. A BMP is needed to ensure the patient does not have life-threatening electrolyte imbalances such as hypokalemia and to measure renal function. An abdominal radiography is the best initial test and is used to measure the dilation of the transverse colon, which is most commonly dilated. Dilation of 6 cm or more of is diagnostic of toxic megacolon.

Orders:
- *Abdominal radiography*
- *C. difficile toxin assay*
- *IV normal saline*
- *CBC*
- *BMP*

The CBC reveals a white blood cell (WBC) count of 21,500 cells/mm^3, a blood urea nitrogen/creatinine ratio of 36/1.9, and a positive C. difficile toxin assay. Abdominal radiography demonstrates severe large bowel dilation with the transverse bowel measuring

6 cm (Figure 9-2).

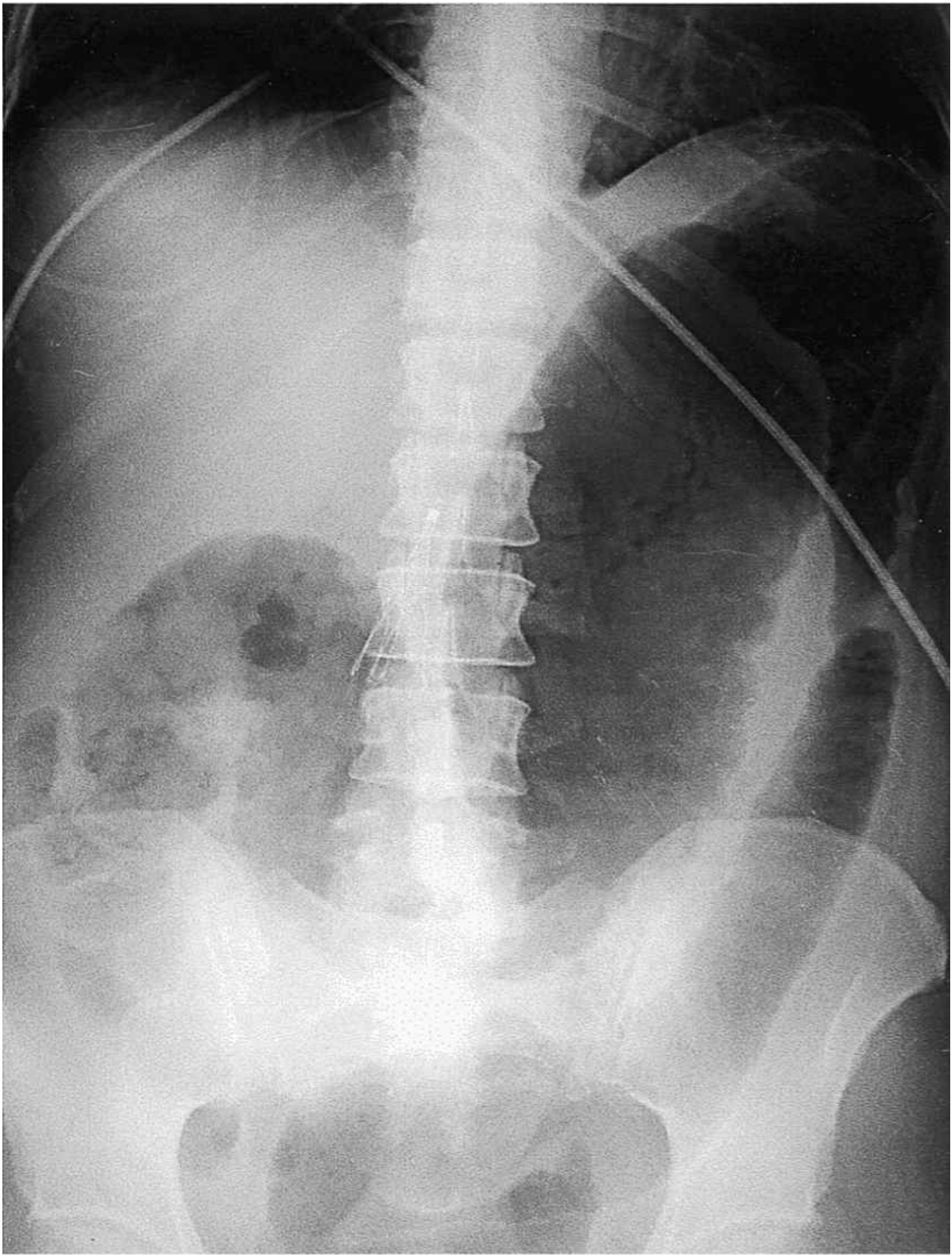


Figure 9-2. Toxic megacolon with perforation. Supine radiograph demonstrates marked mucosal nodularity and thickening of the transverse colon. (Reproduced, with permission, from Bongard FS, et al. *Current Diagnosis & Treatment: Critical Care*. 3rd ed. New York: McGraw-Hill; 2008.)

What is the most appropriate therapy for this patient?

a. Surgical consult
b. IV vancomycin
c. Oral vancomycin
d. Oral metronidazole
e. Rectal steroid suppository
f. Oral vancomycin and oral metronidazole

Answer f. Oral vancomycin and oral metronidazole

In patients with toxic megacolon caused by severe *C. difficile* colitis, the first step is to stop the offending antibiotic, then treat with vancomycin and metronidazole orally. Surgical consult is reserved for patients after 48 to 72 hours of observation under antibiotic therapy. IV vancomycin is always the incorrect answer in the treatment of *C. difficile* because it does not cross into the bowel from intravascular circulation. Surgery in the form of colectomy is for patients who do not improve within 48 to 72 hours or in those who show evidence of localized perforation.

Vancomycin recognizes and binds to the two D-ala residues on the end of the peptide chains on the bacterial cell wall.
Metronidazole inhibits nucleic acid synthesis by disrupting the DNA of bacterial cells.

Orders:
- *Nothing by mouth (NPO)*
- *Oral vancomycin*
- *Oral metronidazole*
- *Intensive care unit transfer*

Turn the clock forward 48 hours. If the patient improves, the case will end, and no further therapeutic steps are necessary. However, if the case does not end, then do an interval check on the patient's condition.

After 48 hours, the patient's WBC count has increased 23,500 cells/mm^3, and her pain has not improved. She continues to have up to 7 to 10 bowel movements per day.

Orders:
- *Surgical consult*
- *Laparoscopy*

Turn the clock forward, and the case will end.

Patients with azotemia, lactic acidosis, or WBC counts above 20,000/mm^3 are more likely to require emergency colectomy.

CASE 3: Volvulus

Setting: *ER*

CC: *"I have severe constipation."*

VS: *Stable*

HPI: *A 74-year-old woman awaiting guardianship complains of acute onset of abdominal pain described as cramping and increasing in intensity. The patient has vomited twice and feels nauseated. The patient has not had a bowel movement in several days and is unable to pass stool.*

PMH:
- *History of chronic constipation*
- *Hypertension*

Meds: *Lisinopril*

Physical Exam:
- *Abdomen is generally diffusely distended and tympanitic*
- *Mild tenderness in the right lower quadrant*
- *Digital rectal examination reveals firm, hard stool*

What is the best next step in the management of this patient?

a. Upright abdominal radiography
b. Contrast enema
c. Intravenous (IV) hydration
d. Antiemetics
e. Computed tomography (CT) scan of the abdomen

Answer a. Upright abdominal radiography

An intestinal obstruction should be suspected when a patient presents with symptoms that include abdominal pain, nausea, and vomiting along with a physical examination that reveals a distended and tympanic abdomen. The most accurate test is a CT scan to aid in finding the location of obstruction from between the large bowel and small bowel. If the CT scan is equivocal, the patient should undergo a contrast enema.

The most common site of volvulus is the cecum followed by the sigmoid colon.
Type 1: Cecal volvulus develops from twisting of the cecum around the mesentery
Type II: Volvulus develops from counterclockwise torsion of the cecum

Type III: Upward folding of the cecum

Orders:

- *Upright abdominal radiography; if findings are indicative of volvulus, then order a CT scan.*
- *CT scan of the abdomen*

Abdominal radiography reveals a coffee bean sign as seen in Figure 9-3. CT scan reveals an obstruction at the level of cecum with evidence of a whirl sign.

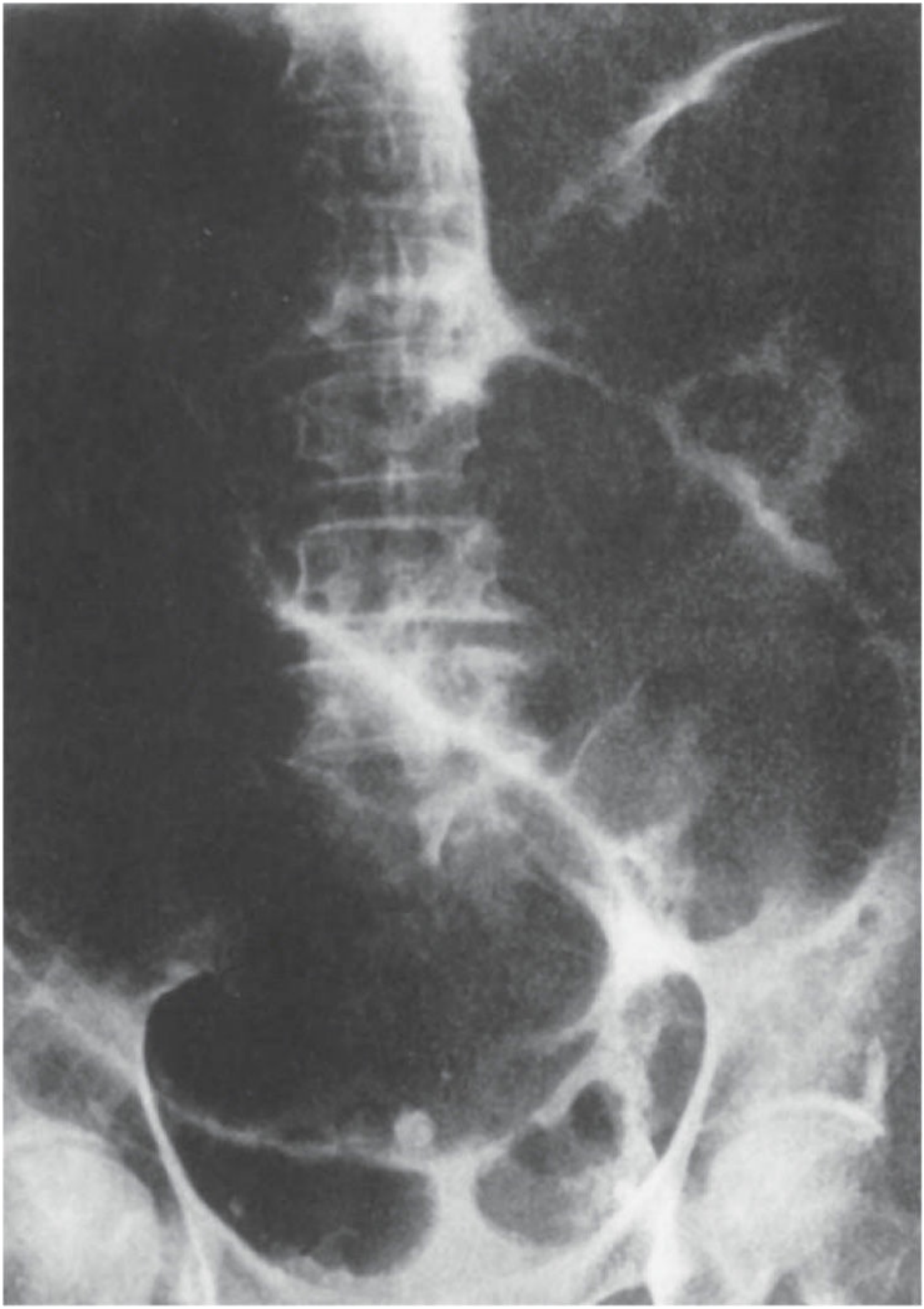


Figure 9-3. Sigmoid volvulus. Note distention of large bowel and central stripe, giving a "coffee bean" appearance. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York: McGraw-Hill; 2011.)

Findings of volvulus
- Upright abdominal radiograph reveals a "coffee bean" sign
- CT scan demonstrates the "whirl sign"
- Barium enema demonstrates a tapered or "bird's beak" sign

What is the most likely diagnosis?

a. Volvulus
b. Small bowel obstruction
c. Ischemic colitis
d. Appendicitis
e. Typhlitis

Answer a. Volvulus

A colonic volvulus occurs when a part of the colon twists on its mesentery, resulting in an acute obstruction (Figure 9-4). The classic patient presentation is colicky-like abdominal pain with nausea, vomiting, and pain. Small bowel obstruction presents similarly, but radiologic evidence points to the level of obstruction being in the large bowel. Ischemic colitis has abdominal pain but more commonly in the left lower quadrant with bloody diarrhea. Appendicitis does have right lower quadrant pain but would be a clear diagnosis on the CT scan. Typhlitis is a viral inflammation of the cecum that presents with pain but self-resolves over time.

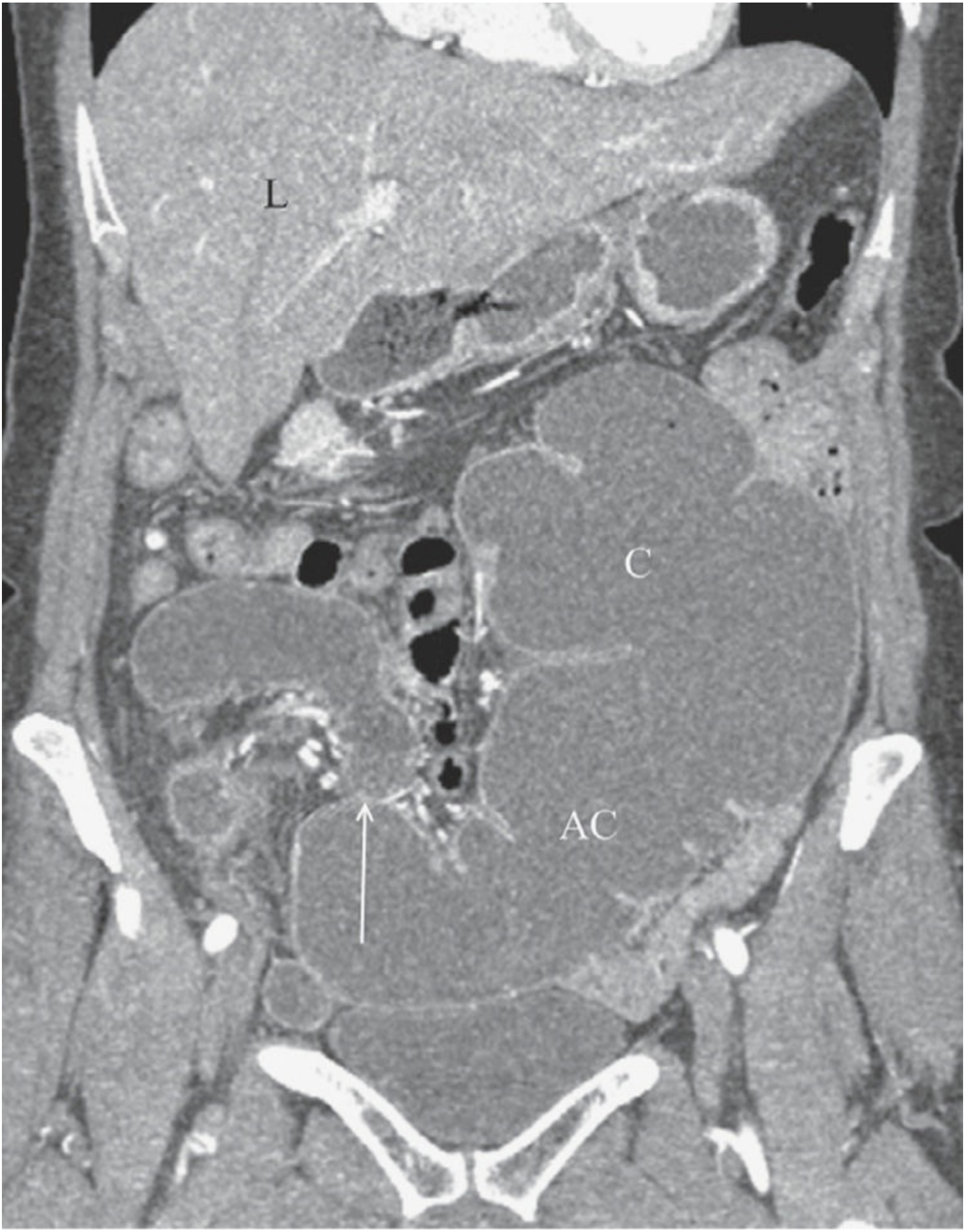


Figure 9-4. Coronal computed tomography image showing a right colon volvulus with the twist in the ascending colon *(arrow)* causing marked distention of a portion of the ascending colon. (Reproduced, with permission, from Chen MM, Pope TL, Ott DJ, eds. *Basic Radiology*. 2nd ed. New York: McGraw-Hill; 2011.)

What is the most appropriate therapy for this patient?

a. Surgical right hemicolectomy
b. Endoscopy decompression
c. Hartmann procedure
d. Percutaneous cecostomy
e. Cecopexy

Answer a. Surgical right hemicolectomy

For cecal volvulus, the best therapy after resuscitating the patient is with crystalloid and correct hypovolemia. The next step is to prepare the patient for surgery for right hemicolectomy. Endoscopic decompression carries too high a risk of perforation in the cecum and is the best initial therapy in the sigmoid, as is the Hartman procedure. Cecostomy and cecopexy are the therapies indicated in patients who are poor surgical candidates.

CASE 4: Acute Mesenteric Ischemia

Setting: *ED*

CC: *"It hurts so bad."*

VS: *BP, 150/95 mm Hg; R, 22 breaths/min; P, 121 beats/min; T, 98.9°F*

HPI: *A 72-year-old man presents with an onset of severe abdominal pain described as sharp, constant, and unremitting. The pain is 10 of 10, and the patient is unable to stay still and says he cannot find a comfortable position.*

PMH:
- *Coronary artery disease*
- *Diabetes mellitus*

SH: *Smoking 40 pack-years*

ROS:
- *Nausea*
- *Vomiting*

Physical Exam:
- *Toxic, ill-appearing man*
- *Foul breath*
- *Irregularly irregular pulse*
- *No guarding*
- *No rebound*
- *Pain is out of proportion to physical examination findings*

What is the most likely diagnosis?

a. Acute mesenteric ischemia
b. Ischemic colitis
c. Chronic mesenteric ischemia
d. Abdominal aortic aneurysm (AAA)
e. Peptic ulcer disease

Answer a. Acute mesenteric ischemia

Acute mesenteric ischemia is an embolic phenomenon with an abrupt onset of severe abdominal pain. An embolus most commonly secondary to atrial fibrillation occludes a vessel in the mesenteric arterial circulation. The most common vessel affected is the superior mesenteric artery (SMA). This disease is analogous to a myocardial infarction and results in gangrenous dead bowel. Ischemic colitis is a watershed area infarction, yielding sloughing of the mucosa in a low-flow state

commonly seen in patients with atherosclerotic disease. Chronic intestinal ischemia is analogous to bowel angina, in which the patient experiences severe abdominal pain with each meal because of decreased perfusion from atherosclerotic disease. These patients have anorexia and weight loss because of a fear of eating. AAA presents with abdominal pain in a smoker older than age 65 years with a palpable cystic mass in the mid-epigastrium. A peptic ulcer presents with pain that is related to eating.

The celiac axis, the SMA, and the inferior mesenteric artery (IMA) supply the foregut, midgut, and hindgut, respectively.

Most emboli lodge in the SMA just distal to the origin of the middle colic artery.

Initial Orders:
- *Intravenous (IV) access*
- *Normal saline*
- *Nothing by mouth (NPO)*
- *Antiemetics*
- *Morphine*

What is the best next step in the management of this patient?

a. Radiography of the abdomen
b. Computed tomography angiography (CTA)
c. Magnetic resonance angiography (MRA)

Answer b. Computed tomography angiography (CTA)

CTA is the best initial test for patients who have acute mesenteric ischemia. CTA is quick and inexpensive and is the correct test if the patient is stable. It is important to choose choices without oral contrast because the patient must be NPO. Radiography of the abdomen is not specific and simply shows distended loops of bowel and ileus, findings associated with but not pathognomonic for mesenteria ischemia. MRA takes too long, and each minute that passes is bowel that is dying. Percutaneous angiography is reserved for patients who are unstable or are poor surgical candidates.

Lactic acid increases because of anaerobic respiration that results from a lack of blood supply to the gut.

Orders:
- *CTA*

- *Lactic acid*
- *Basic metabolic profile (BMP)*
- *Complete blood count (CBC)*
- *Prothrombin time (PT)*
- *Partial thromboplastin time (PTT)*
- *International normalized ratio (INR)*

CTA demonstrates a nearly occluded SMA with thrombus (Figure 9-5). Lactic acid is elevated at 5.7 mg/dL, white blood cell (WBC) count is 14,500 cells/mm^3, and BMP reveals a bicarbonate of 19 mEq/L. PT, PTT, and INR are normal.

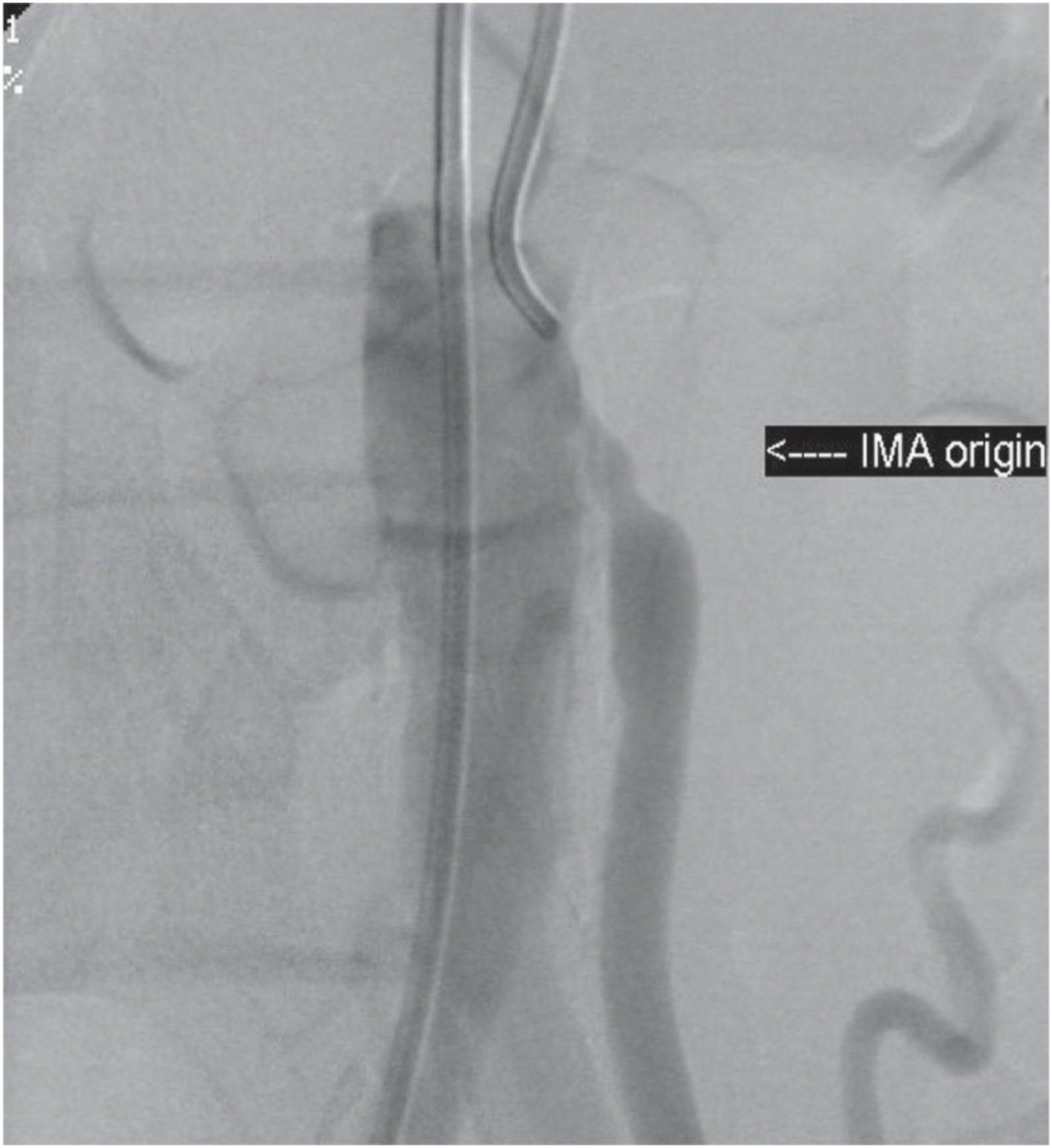


Figure 9-5. Computed tomography slice with the superior mesenteric artery almost completely occluded with thrombus. IMA, inferior mesenteric artery. (Reproduced, with permission, from Hall JB, Schmidt GA, Wood LH, eds. *Principles of Critical Care*. 3rd ed. New York: McGraw-Hill; 2005.)

The SMA comes off the ventral aorta and supplies the midgut by giving off the inferior pancreaticoduodenal artery, middle colic, right colic, and jejunal, and ileal branches.

Stable = CTA

Unstable or peritoneal signs = Percutaneous angiography

What is the most appropriate therapy for this patient?

a. Exploratory laparotomy
b. Angiography with stenting
c. Tissue plasminogen activator
d. Supportive care

Answer a. Exploratory laparotomy

The goal of treatment in acute mesenteric ischemia is to restore intestinal blood flow as rapidly as possible. Exploratory laparotomy allows direct visualization and determination if the bowel is gangrenous. If the bowel is dead, resection is performed. If the bowel is viable, the SMA is exposed, isolated below the mesocolon distal to the middle colic artery, and embolectomy is performed. This is combined with papaverine infusion. Thrombolytics or angiography with stenting is considered if surgical intervention is contraindicated.

Papaverine is an opium derivative that functions as a phosphodiesterase inhibitor, which acts to relax vascular smooth muscle.

Orders:
• *Surgical consult*
• *Angiography*

After perfusion is restored, the intestines are visually observed to allow for assessment of bowel viability.

CASE 5: Ischemic Colitis

Setting: *ED*

CC: *"My abdomen again."*

VS: *BP, 80/50 mm Hg; R, 18 breaths/min; P, 110 beats/min; afebrile*

HPI: *A 75-year-old woman presents with two episodes of cramping abdominal pain followed by bloody diarrhea. The patient was working out in her garden all day and did not maintain hydration.*

PMH:
- *Coronary artery disease*
- *Diabetes mellitus type 2*
- *Hypertension*

SH:
- *40-pack-year smoking history*
- *Daily martini habit—stirred*

Physical Exam:
- *Left lower quadrant tenderness*
- *Rectal examination reveals scant red blood in stool*

What is the most likely diagnosis?

a. Acute mesenteric ischemia
b. Ischemic colitis
c. Chronic mesenteric ischemia
d. Abdominal aortic aneurysm (AAA)
e. Peptic ulcer disease

Answer b. Ischemic colitis

Ischemic colitis is a condition in which there is an ischemic injury of the large intestine resulting from inadequate blood supply. The most common symptoms are crampy abdominal pain caused by ischemia followed by blood diarrhea. The bloody diarrhea is a mix of mucus and blood because the mucosal layer is the farthest from the bowel's blood supply. Acute mesenteric ischemia is an embolic infarct of the bowel in the setting of atrial fibrillation. Chronic intestinal ischemia is analogous to bowel angina, in which the patient experiences severe abdominal pain with each meal caused by decreased perfusion from atherosclerotic disease. These patients have anorexia and weight loss because of a fear of eating. AAA presents with abdominal pain in a smoker older than 65 years of age with a palpable cystic mass in the mid-epigastrium. A peptic ulcer presents with pain that is related to eating.

There are three phases of ischemic colitis:
- *Hyperactive phase: severe pain and bloody, loose stools*
- *Paralytic phase: continuous pain; the abdomen becomes more tender*
- *Shock phase: massive fluid loss; metabolic acidosis develops into shock*

The colon is perfused by the superior mesenteric artery (SMA), the inferior mesenteric artery (IMA), and branches of the internal iliac arteries.

What is the best next step in the management of this patient?

a. Radiography of the abdomen
b. Antibiotic therapy
c. Nasogastric tube placement
d. Stool cultures
e. Computed tomography (CT) scan of the abdomen

Answer e. Computed tomography (CT) scan of the abdomen

CT scan of the abdomen is best initial and most accurate diagnostic test for ischemic colitis. The finding of thickening of the bowel wall in a segmental pattern combined with the clinical findings is diagnostic of ischemic colitis. Radiography of the abdomen is nonspecific, and the other choices are only indicated upon confirmation of the diagnosis.

Order:
- *CT scan of the abdomen and pelvis*

Result: *CT scan of the abdomen reveals thickening of the bowel wall at the rectosigmoid junction extending proximally (Figure 9-6).*

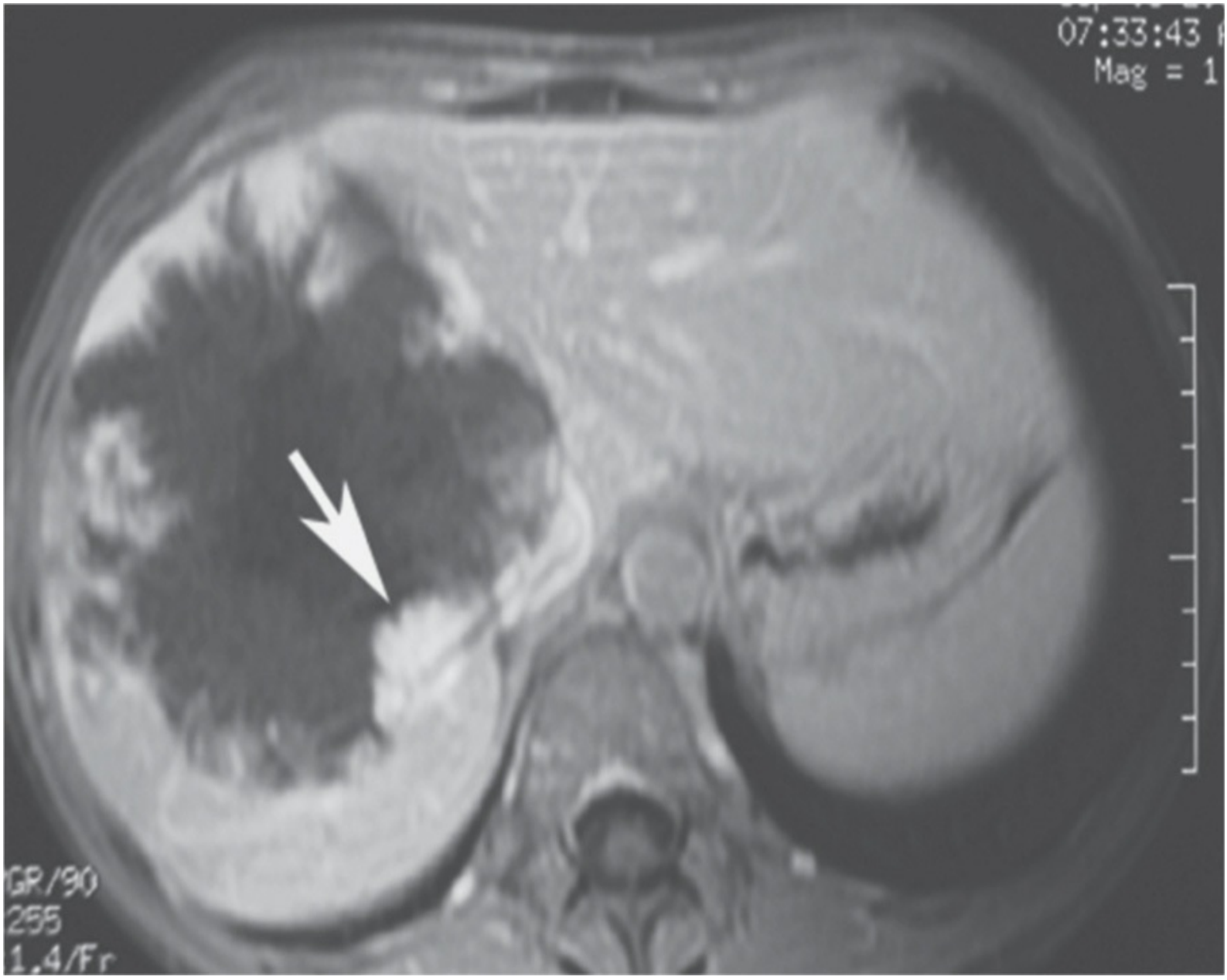


Figure 9-6. Axial multidetector computed tomography image shows thickening of the wall of the left colon *(arrow)* with a lack of wall enhancement. (Reproduced, with permission, from Greenberger NJ, Blumberg RS, Burakoff R, eds. *Current Diagnosis & Treatment: Gastroenterology, Hepatology, & Endoscopy*. 2nd ed. New York: McGraw-Hill; 2012.)

What is the best next step in the management of this patient?

a. Intravenous (IV) fluids and bowel rest
b. Antibiotic therapy
c. Nasogastric (NG) tube placement
d. Exploratory laparotomy

Answer a. Intravenous (IV) fluids and bowel rest

IV fluid hydration to restore adequate bowel perfusion and bowel rest are the mainstays of therapy. Antibiotic therapy is for patients who present with ischemic colitis and have a fever. NG tube placement is done if the patient has ileus, and exploratory laparotomy is the correct answer if the patient has signs of peritonitis or evidence of bowel perforation on imaging.

Endoscopic evaluation in ischemic colitis is the procedure of choice if the diagnosis is equivocal.

Orders:

- *IV access*
- *Normal saline*
- *Nothing by mouth (NPO)*

Turn the clock forward 12 hours.

Interval history reveals the patient feels a bit better.

Turn the clock forward, and the case will end.

The most common locations for ischemic colitis are in the splenic flexure, hepatic flexure, and sigmoid colon.

Case 6: Chronic Mesenteric Ischemia

Setting: *Office*

CC: *"My stomach always hurts."*

VS: *Stable*

HPI: *A 75-year-old man presents with severe, sharp, stabbing abdominal pain every time he eats. The postprandial pain began 6 months ago and has gotten worse over the past 4 weeks. He is afraid to eat and has lost 25 lb in this time.*

PMH:
- *Coronary artery disease*
- *Diabetes mellitus*
- *Hypertension*

SH: *45-pack-year smoking history*

ROS:
- *Nausea*
- *Occasional vomiting from the pain*
- *Postprandial nausea*

Physical Exam:
- *Dry skin*
- *No abdominal tenderness*
- *Skin on lower extremities is shiny without hair*

What is the most likely diagnosis?

a. Acute mesenteric ischemia
b. Ischemic colitis
c. Chronic mesenteric ischemia
d. Peptic ulcer disease

Answer c. Chronic intestinal ischemia

Chronic intestinal ischemia usually results from long-standing atherosclerotic disease of two or more mesenteric vessels. Upon eating, the demand for oxygen is unmet because of atherosclerotic obstruction of blood flow. This causes excruciating pain and thus yields a patient who is scared to eat. As the underlying atherosclerotic disease worsens, the symptoms worsen. Acute mesenteric ischemia would present acutely and would be in a patient with atrial fibrillation, and ischemic colitis is a patient with bloody diarrhea after a low-flow state such as transient hypotension.

What is the best next step in the management of this patient?

a. Angiography
b. Computed tomography angiography (CTA)
b. Magnetic resonance angiography (MRA)
c. Surgical correction

Answer c. Computed tomography angiography (CTA)

In patients with chronic mesenteric ischemic angiography, CTA is both diagnostic and therapeutic. Surgical correction requires angiography to first delineate the location of the lesions and then several bypass procedures and therefore carries a higher rate of complications. CT and MRA take too long and offer no therapeutic advantage.

The celiac trunk, the superior mesenteric artery, and the inferior mesenteric artery provide collaterals if lesions develop in one of these three vessels; therefore, two of three vessels must be affected for chronic mesenteric ischemia to develop.

A disease known as median arcuate ligament syndrome presents similarly to chronic mesenteric ischemia; however, the pathophysiology is caused by external compression of the celiac trunk by the median arcuate ligament or the celiac ganglion rather than atherosclerotic disease.

BILIARY TRACT

CASE 1: Biliary Colic

Setting: *Office*

CC: *"My stomach hurts after eating pizza."*

VS: *Stable*

HPI: *A 40-year-old obese woman with four kids presents with recurrent postprandial right upper quadrant (RUQ) pain. The pain is dull and constant, lasts for about 30 minutes, and radiates to her right scapula. Taking antacids has not helped, and the pain is not improved by defecation or passing flatus.*

ROS: *Nausea occasionally*

Physical Exam: *Murphy's sign negative*

What is the most likely diagnosis?

a. Biliary colic
b. Cholecystitis
c. Choledocholithiasis
d. Cholangitis
e. Pancreatitis

Answer a. Biliary colic

Right upper quadrant pain that radiates to the right scapula in a "fat, fertile, forty female" is always caused by gallstones. Symptoms of gallstones are almost always postprandial because a rise in cholecystokinin (CCK) causes the gallbladder to contract and cause partial obstruction of the cystic duct, causing bile egress to be disrupted. This causes sharp pain that last about 30 minutes, coincidently, the same amount of time CCK is present. Cholecystitis would present with RUQ pain and fevers, and choledocholithiasis are stones in the common bile duct (CBD); CBD presents with jaundice. Cholangitis presents with fevers, RUQ, and jaundice, and pancreatitis is the classic epigastric pain radiating into the back.

The largest component of gallstones is cholesterol. Calcium bilirubin and pigment are additives.

Fat + Fertile + Forty + Female = Estrogen
Estrogen = Smooth muscle relaxant = Causes biliary stasis = Gallstones

What is the best diagnostic test?

a. Computed tomography (CT) scan of the abdomen
b. Abdominal ultrasonography
c. Endoscopic retrograde cholangiopancreatography (ERCP)
d. Magnetic resonance imaging (MRI) of the abdomen

Answer b. Abdominal ultrasonography

Abdominal ultrasonography is the best initial test and most accurate test. Findings of gallstones include acoustic shadowing, which means there are no sound waves seen below the stone or posterior to it. Ultrasonography has greater sensitivity and specificity than CT scan. ERCP is used to both diagnose and remove stones in the complete blood count (CBC) but is not used in imaging of the gallbladder. MRI of the abdomen is always the wrong answer for abdominal processes.

Collins sign is when the pain of cholelithiasis is referred to the tip of the scapula.

Risk factors for gallstones:
- *Female sex*
- *European or Native American ancestry*
- *Increasing age*
- *Obesity*
- *Pregnancy*
- *Gallbladder stasis*

Order: *Abdominal ultrasonography*

Result: *RUQ ultrasound showing a gallbladder containing a gallstone. This study demonstrates a gallstone with distinctive posterior shadowing (Figure 10-1).*

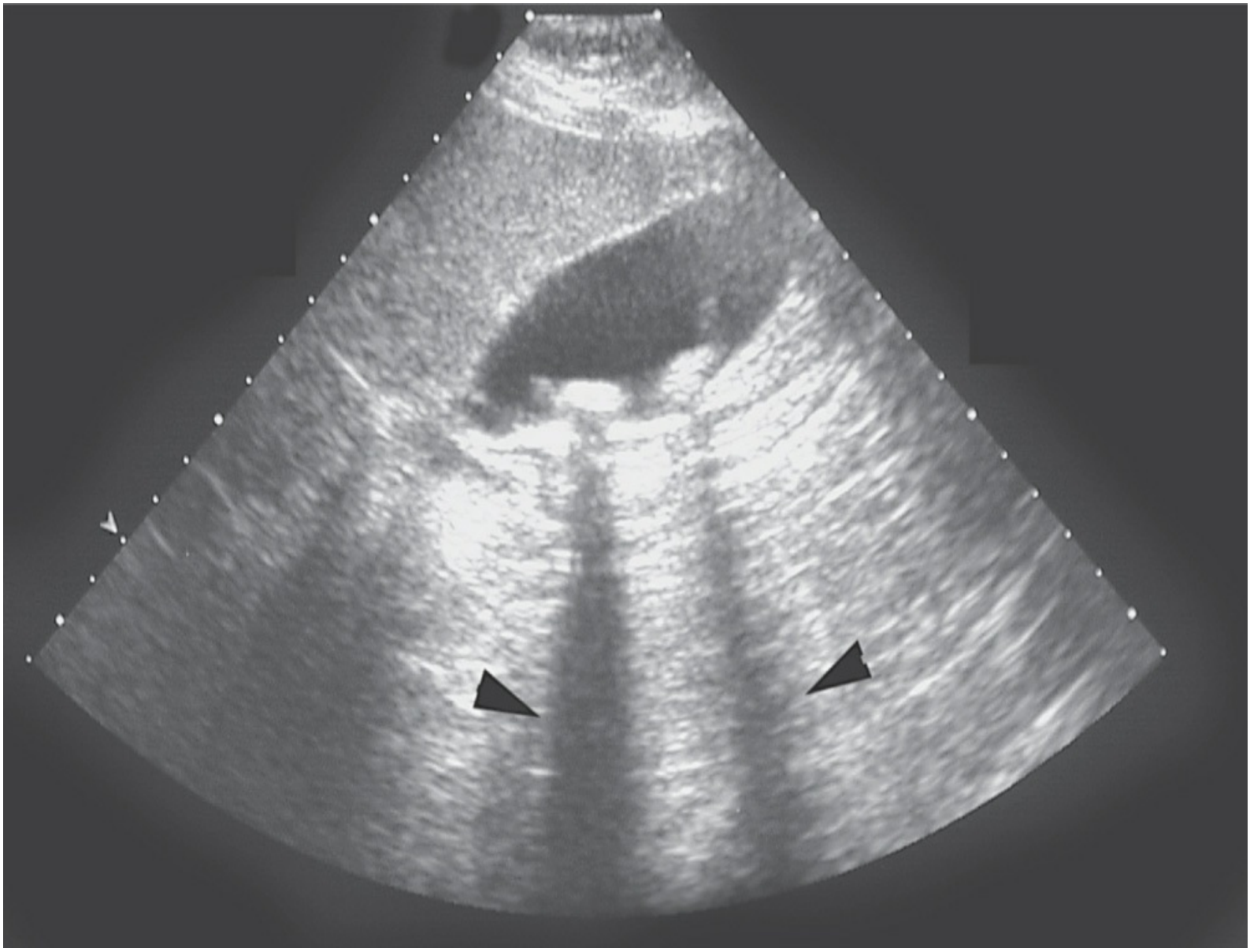


Figure 10-1. Ultrasonography showing two echogenic gallstones in the gallbladder. Note the absence of echoes posterior to the gallstone called "shadowing" *(arrowheads)*. (Reproduced, with permission, from Brunicardi FC, et al. *Schwartz's Principles of Surgery*. 10th ed. New York: McGraw-Hill; 2015.)

What is the best next step in the management of this patient?

a. Laparoscopic cholecystectomy
b. Open cholecystectomy
c. Antibiotic treatment
d. Ursodeoxycholic acid

Answer a. Laparoscopic cholecystectomy

The most appropriate therapy for a patient with symptomatic gallstones is laparoscopic cholecystectomy. Asymptomatic gallstones can be managed expectantly. Open cholecystectomy is the correct answer for patients with ruptured cholecystitis. Antibiotic therapy is the best initial therapy for acute cholecystectomy and would not help this patient because of the lack of infection. Medical treatment with ursodeoxycholic acid is never the correct answer and is only used in patients who are poor surgical candidates or have very small stones (<1 cm).

Symptomatic = Postprandial RUQ pain = Surgery

CASE 2: Acute Cholecystitis

Setting: *ED*

CC: *"My side hurts."*

VS: *BP, 141/98 mm Hg; R, 19 breaths/min; P, 101 beats/min; T, 100.9°F*

HPI: *A 40-year-old obese woman who has four kids presents with right upper quadrant (RUQ) pain that began 4 hours ago. The pain began in the epigastric region and has now localized to the RUQ. The pain is described as sharp and constant, and it radiates to the right shoulder. She has had similar episodes in the last 4 months, but they all self-improved after 45 minutes.*

ROS:

- *Nausea*
- *Nonbloody vomitus x 3*

Physical Exam:

- *Tenderness to palpation in the RUQ*
- *Murphy's sign present*
- *Skin appears jaundiced*

What is the most likely diagnosis?

a. Peptic ulcer disease
b. Cholecystitis
c. Choledocholithiasis
d. Pancreatitis

Answer b. Cholecystitis

The findings of RUQ pain, fever, and Murphy's sign are indicative of cholecystitis. Cholecystitis is caused by blockage of the cystic duct that leads to distension of the gallbladder and subsequent surrounding inflammation caused by bacterial overgrowth. The pain starts in the epigastric region and then localizes to the RUQ. Peptic ulcer disease does have epigastric pain, but the pain increases with eating, not after eating. Pancreatitis is constant epigastric pain that radiates to the back but would not have a positive Murphy's sign.

Murphy's sign: Inspiratory pause elicited during palpation of the RUQ
Ortner's sign: Tenderness when hand taps the edge of right costal arch
Boas' sign: Increased sensitivity below the right scapula

The cystic duct merges with the common hepatic duct to form the common bile duct (Figure 10-2).

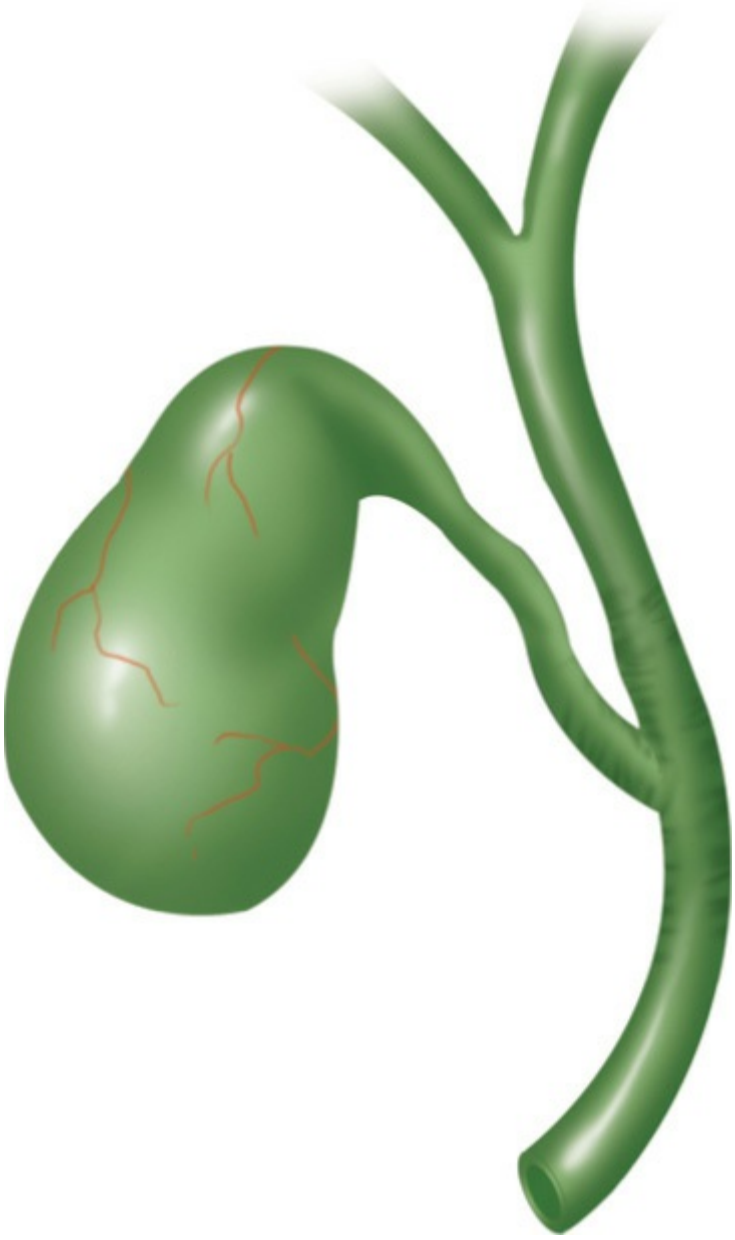


Figure 10-2. Junction between the cystic duct and common hepatic duct. (Reproduced, with permission, from Brunicardi F, Andersen DK, Billiar TR, et al, eds. *Schwartz's Principles of Surgery*. 9th ed. New York: McGraw-Hill; 2010.)

What is the best next step in the management of this patient?

a. Complete blood count (CBC)
b. Comprehensive metabolic profile (CMP)
c. Normal saline
d. Intravenous (IV) access
e. Nothing by mouth (NPO)
f. All of the above

Answer f. All of the above

Upon realization that the patient has an infectious process in the abdomen, laboratory evidence of an inflammatory process and IV fluids are the best next steps.

Orders:
- *CBC*
- *CMP*
- *Normal saline*
- *IV access*
- *NPO*
- *Morphine*

The CBC reveals a white blood cell count of 18,500 cells/mL with 12% bands. CMP is within normal limits. Interval history reveals the patient's pain is mildly improved. She still has a fever.

What is the best initial test to confirm your diagnosis?

a. CT scan of the abdomen
b. Abdominal ultrasonography
c. Endoscopic retrograde cholangiopancreatography (ERCP)
d. Magnetic resonance imaging (MRI) of the abdomen
e. Hepatobiliary scintigraphy (HIDA)

Answer b. Abdominal ultrasonography

Ultrasonography is 95% sensitive and 80% specific for cholecystitis. The sonographic features of acute cholecystitis include gallbladder wall thickening (>5 mm), pericholecystic fluid, gallbladder distention (>5 cm), and a sonographic Murphy's sign.

HIDA scan is the most accurate test for acute cholecystitis but is only used when the diagnosis is equivocal on ultrasonography. A finding that is pathognomonic for acute cholecystitis on HIDA is "nonvisualization of the gallbladder" (Figure 10-3).

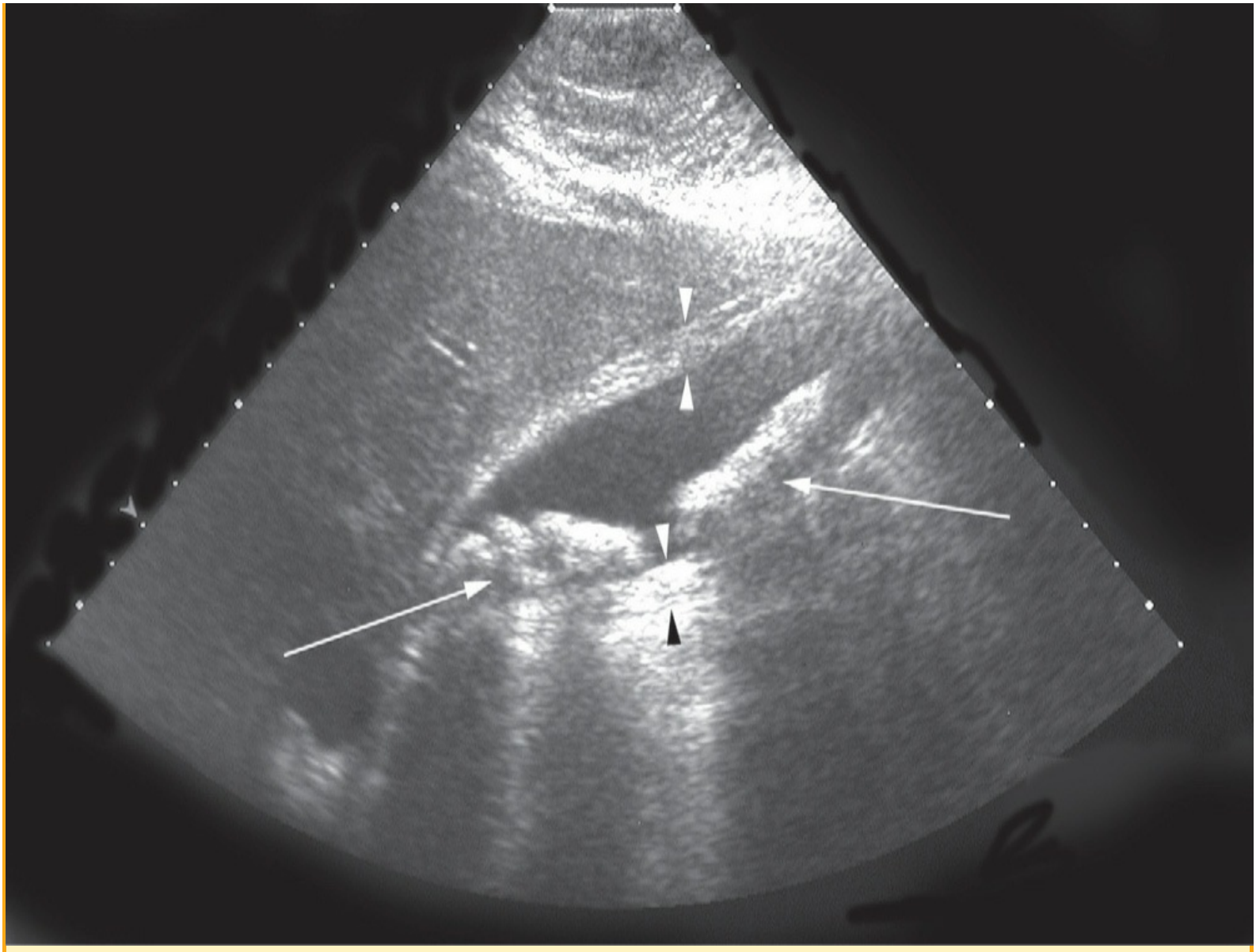


Figure 10-3. Ultrasonography from a patient with acute cholecystitis. The *arrowheads* indicate the thickened gallbladder wall. There are several stones in the gallbladder *(arrows)* throwing acoustic shadows. (Reproduced, with permission, from Brunicardi F, Andersen DK, Billiar TR, et al, eds. *Schwartz's Principles of Surgery*. 9th ed. New York: McGraw-Hill; 2010.)

Orders:

- *Abdominal ultrasonography*
- *Ciprofloxacin*
- *Metronidazole*

Ultrasonography reveals a gallbladder wall thickness of 7mm, pericholecystic fluid, gallbladder distention of 6 cm, and numerous gallstones (Figure 10-4).

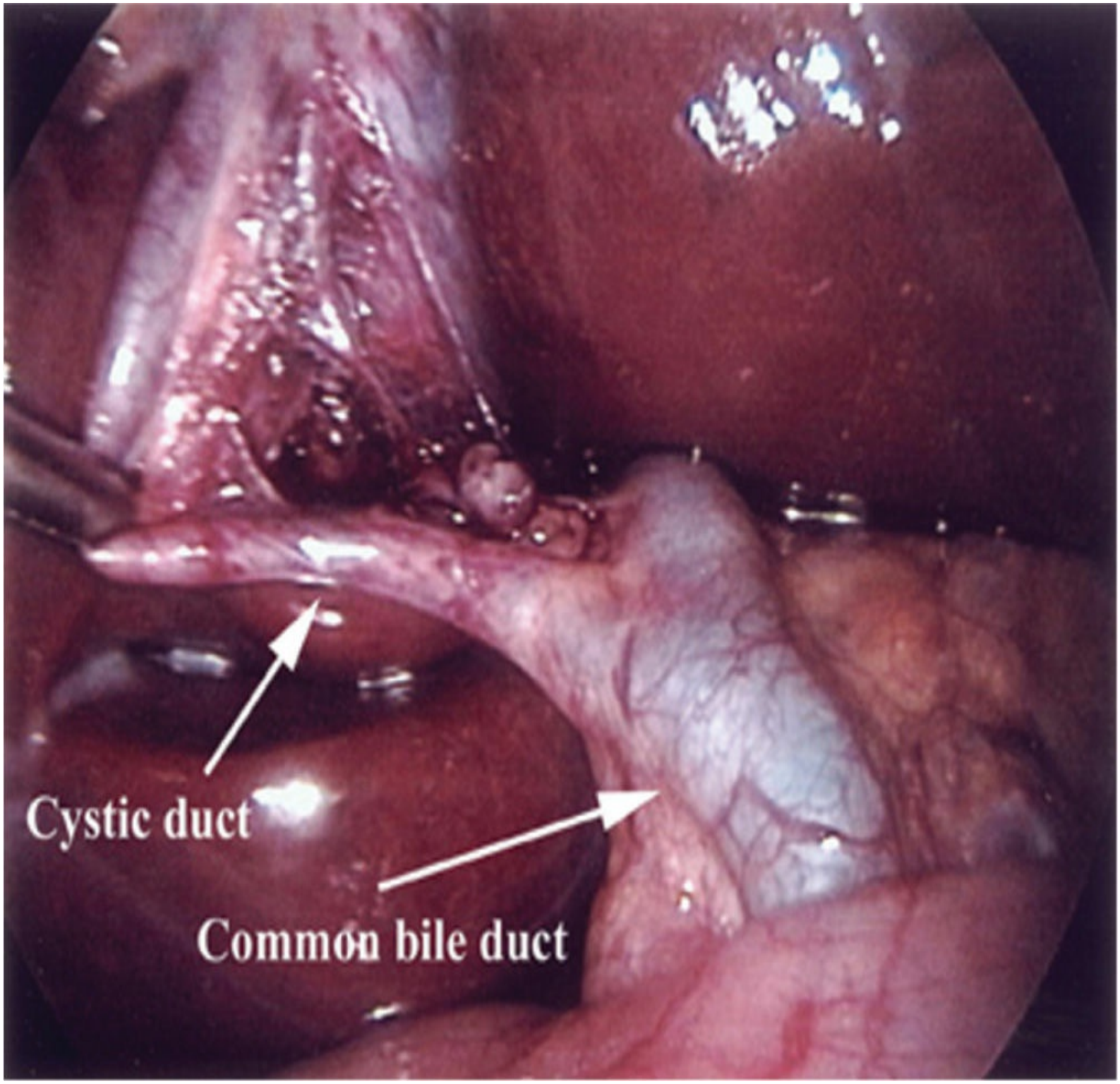


Figure 10-4. An intraoperative picture showing a grasper pulling the infundibulum of the gallbladder laterally, exposing the triangle of Calot that has been dissected. The cystic artery can be seen crossing the dissected area upward and to the left. (Reproduced, with permission, from Oddsdóttir M, Pham TH, Hunter JG. Gallbladder and the extrahepatic biliary system. In: Brunicardi F, Andersen DK, Billiar TR, et al, eds. *Schwartz's Principles of Surgery*. 9th ed. New York: McGraw-Hill; 2010.)

Order: ***Piperacillin–tazobactam***

All patients who have confirmed cholecystitis should receive antibiotics that cover gram-negative aerobes as well as anaerobes.

Piperacillin–tazobactam is a combination antibiotic containing a penicillin derivative and a β-lactamase inhibitor.

The most common infections in cholecystitis include *Escherichia coli, Klebsiella* spp., and enterococcus.

What is the most appropriate therapy for this patient?

a. Laparoscopic cholecystectomy

b. Open cholecystectomy

Answer a. Laparoscopic cholecystectomy

Laparoscopic cholecystectomy (Figure 10-5) is the definitive treatment for acute cholecystitis. Open cholecystectomy is for patients who are morbidly obese, have signs of gallbladder perforation (e.g., abscess, peritonitis, or fistula), giant gallstones, or end-stage liver disease.

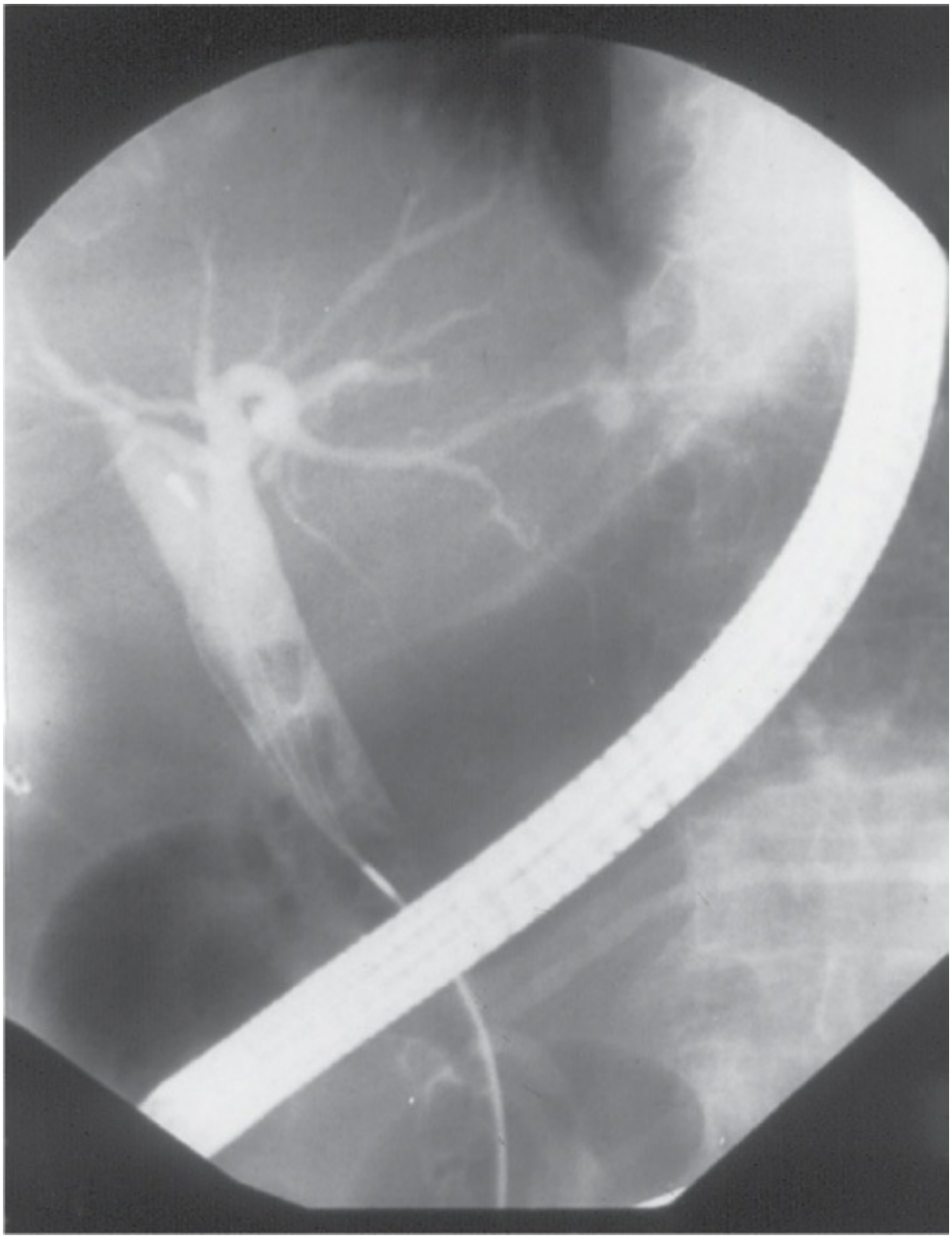


Figure 10-5. Endoscopic retrograde cholangiopancreatography for bile duct stones with cholangitis. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

Orders:

- *Surgical consult*
- *Laparoscopy*
- *Change location to ward*
- *Continue IV antibiotics*

Advance the clock 12 hours, and the case will end.

If after cholecystectomy the patient develops fevers and increased white blood cell (WBC) count 5 to 7 days after surgery = abscess.

If after cholecystectomy the patient develops jaundice = retained stone in the common

bile duct.

The hepatobiliary triangle or Calot's triangle is an anatomic space bordered by the common hepatic duct medially, the cystic duct laterally, and the cystic artery superiorly.

CASE 3: Cholangitis

Setting: *ED*

CC: *"My mother is yellow."*

VS: *BP, 80/40 mm Hg; R, 24 breaths/min; P, 121 beats/min; T 102.5°F*

HPI: *A 55-year-old woman is bought to the emergency department by her daughter for confusion and yellowing skin. She has not seen her mother in 5 days and states that she has been complaining of mild abdominal pain after eating over the past several months. The patient is oriented to person and place but not to time.*

Physical Exam:

- *Lethargic, ill, toxic-appearing woman*
- *Scleral icterus*
- *Jaundice*
- *Tenderness in the right upper quadrant*

Bile reaches the duodenum through the common bile duct and the ampulla of Vater. The sphincter of Oddi is a circular muscle that controls the release of both bile and pancreatic secretions into the gastrointestinal tract.

What is the most likely diagnosis?

a. Cholecystitis
b. Choledocholithiasis
c. Ascending cholangitis
d. Pancreatitis

Answer c. Ascending cholangitis

Ascending cholangitis is an infection of the biliary tract secondary to an occluded gallstone and is also known as biliary sepsis. The findings of cholangitis include right upper quadrant (RUQ) pain, fevers, jaundice, hypotension, and altered mental status. Bile duct obstruction caused by a gallstone is the most common cause followed by strictures, tumors, and preexisting stent occlusion.

Charcot's triad
- Jaundice
- Fever and rigors

• RUQ abdominal pain

Reynold's pentad
• Jaundice
• Fever
• Right upper quadrant abdominal pain
• Hypotension
• Altered mental status

What is the best next step in the management of this patient?

a. Intravenous (IV) access
b. Normal saline bolus
c. Blood cultures
d. Complete blood count (CBC)
e. Comprehensive metabolic profile (CMP)
f. Lactic acid
g. Antibiotic therapy
h. All of the above

Answer h. All of the above

This patient presents with signs and symptoms of sepsis and requires immediate circulatory resuscitation with a normal saline bolus and antibiotics directed at gram-negative and anaerobic bacteria. Laboratory studies should include a CBC, CMP, and lactic acid. Blood cultures are a part of the workup for any patient presenting with fever, but results are only positive in about one third of patients with cholangitis. Administration of broad-spectrum IV antibiotics should be started such as ampicillin and gentamicin or triple therapy with ceftazidime, ampicillin, and metronidazole.

Orders:
• *IV access*
• *Normal saline bolus*
• *Blood cultures*
• *Foley catheter*
• *CBC*
• *CMP*
• *Lactic acid*
• *IV ampicillin*
• *IV gentamicin*

The most common organism isolated in ascending cholangitis is *Escherichia Coli*.

E. coli is a gram-negative, facultative anaerobic, rod-shaped bacterium.

The CBC reveals a white blood count (WBC) of 19,500 cells/mm^3 with 9% bands, blood urea nitrogen/creatinine is elevated to 45/2.1, and lactic acid is 4.3 mg/dl. The patient's blood pressure has improved to 100/75 mm Hg and heart rate has decreased to 99 beats/min.

What is the best next step in the management of this patient?

a. Endoscopic retrograde cholangiopancreatography (ERCP)
b. Percutaneous transhepatic cholangiography (PTC)
c. Open surgical decompression

Answer a. Endoscopic retrograde cholangiopancreatography (ERCP)

ERCP with sphincterotomy (Figure 10-6) is both diagnostic and therapeutic for ascending cholangitis. It allows for radiographic visualization of the bile ducts and stone extraction with stent insertion. PTC is considered when ERCP is unavailable, unsuccessful, or contraindicated. PTC involves transhepatic insertion of a needle into a bile duct followed by injection of contrast material to opacify the bile ducts. Open surgical decompression is for patients in whom the stones are very large or ERCP and PTC have failed.

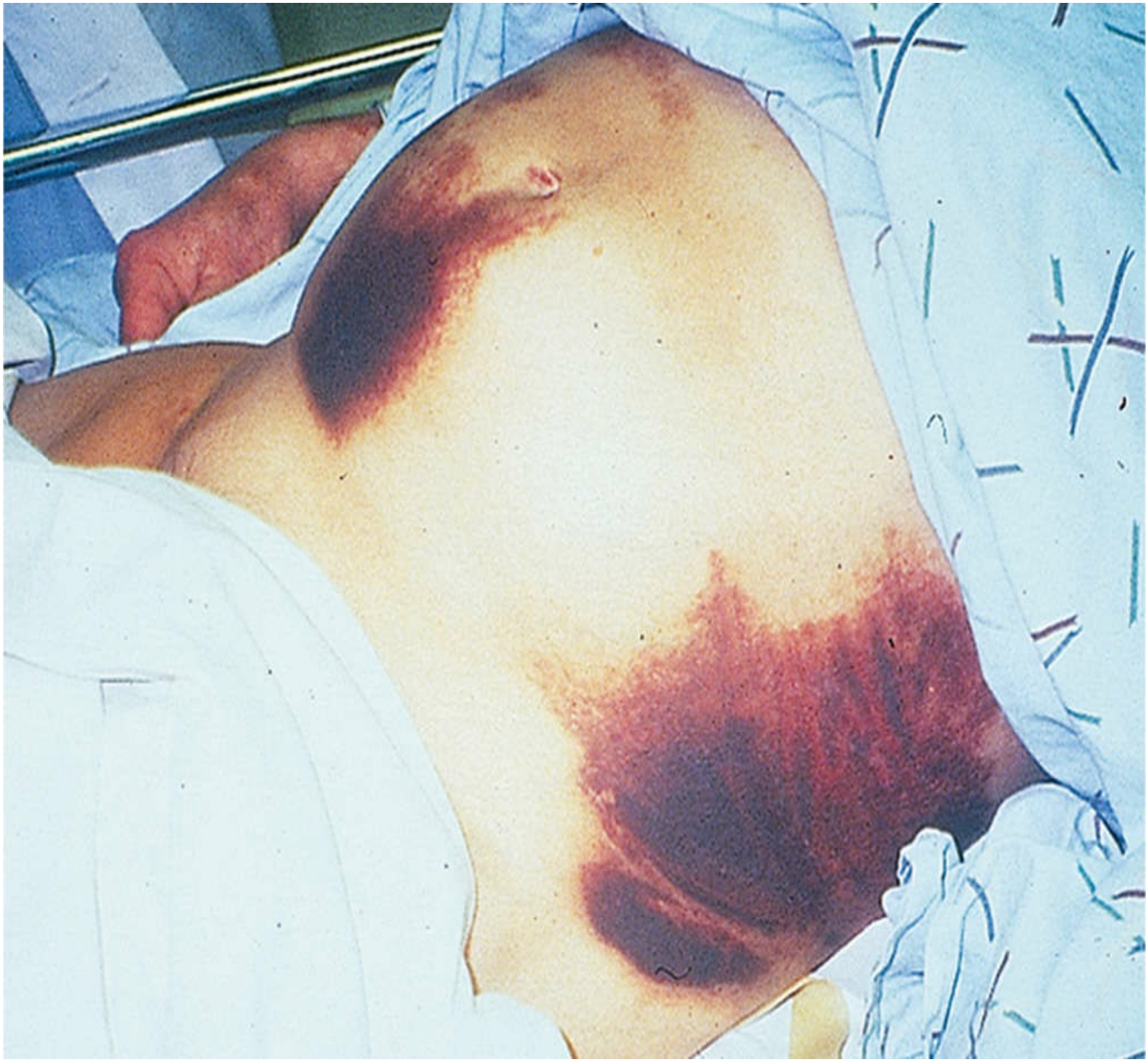


Figure 10-6. Grey Turner's and Cullen's signs. This patient displays both flank and periumbilical ecchymoses characteristic of Grey Turner's and Cullen's signs. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010.)

CASE 4: Pancreatitis

Setting: *ED*

CC: *"My belly hurts"*

VS: *BP, 155/90 mm Hg; R, 18 breaths/min; P, 111 beats/min; T, 99.9°F*

HPI: *A 40-year-old obese woman with four kids presents with severe epigastric pain that radiates to her back. The patient has not had pain until several months ago when she has transient postprandial right upper quadrant (RUQ) pain. The pain is described as dull, boring, and steady. It has become increasingly more severe over the past 6 hours. The patient does not consume alcohol.*

ROS:

- *Anorexia*
- *Nausea*
- *Vomiting*

Physical Exam:

- *Patient in moderate distress*
- *Blood pressure equal in both arms*
- *Abdominal tenderness over the epigastrium with distension and tympani*
- *Diminished bowel sounds*

What is the most likely diagnosis?

a. Gallstone pancreatitis
b. Biliary colic
c. Peptic ulcer disease (PUD)
d. Aortic dissection
e. Ascending cholangitis

Answer a. Gallstone pancreatitis

Pancreatitis is an inflammatory state of the pancreas, which presents with severe epigastric pain that radiates to the back in a patient with nausea, vomiting, anorexia, and ileus. This patient has the risk factors mentioned above, had symptomatic biliary colic several months before presentation, and denies alcohol abuse. Biliary colic would not present with epigastric pain but would have post prandial pain. Aortic dissection would have unstable vitals, while ascending cholangitis would have fevers.

Physical findings consistent with hemorrhagic pancreatitis are Cullen's sign and Grey-

Turn's sign as seen in Figure 10-7

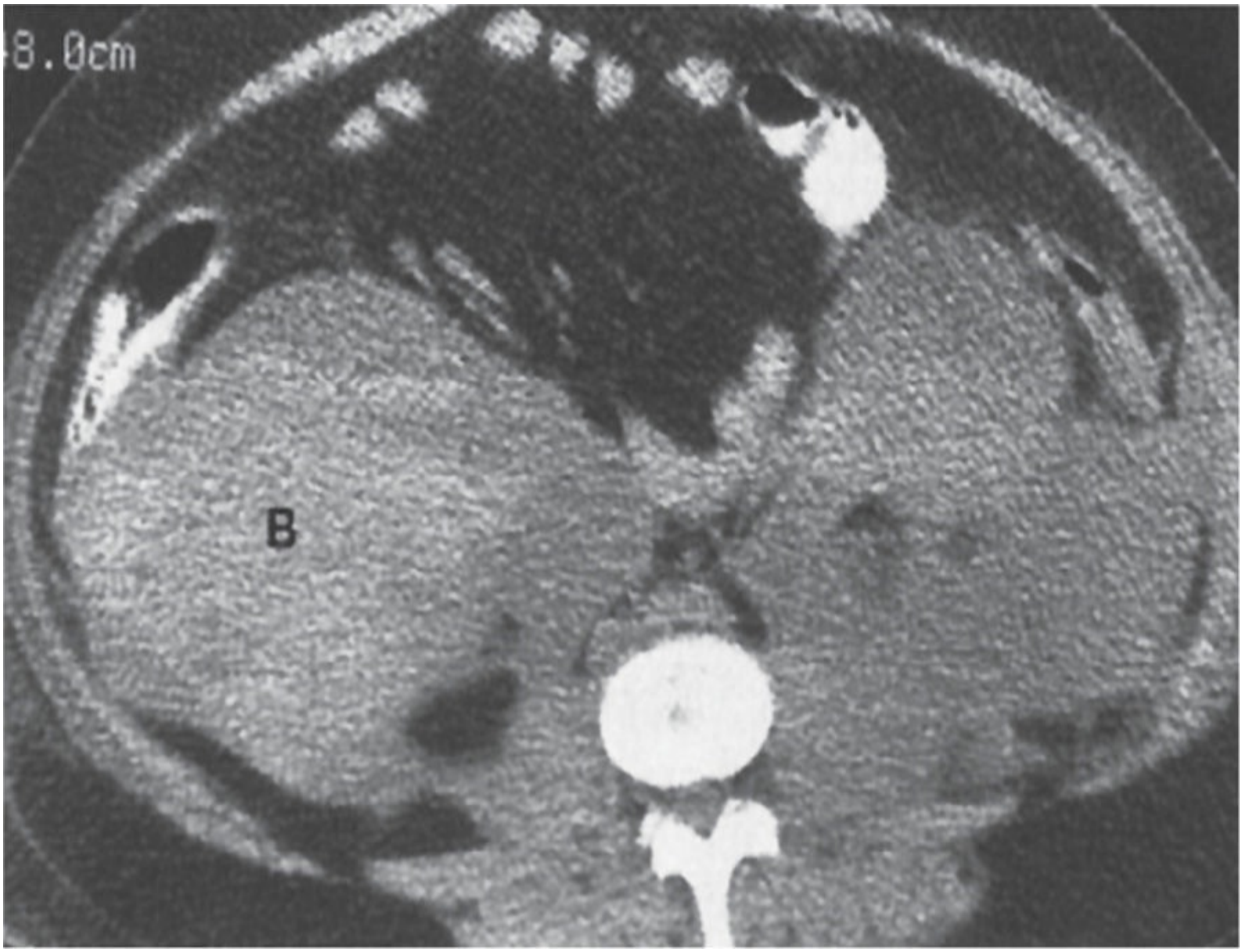


Figure 10-7. Computed tomography scan in a patient with hemorrhagic pancreatitis showing diffusely distributed pancreatic inflammatory exudate containing high-density blood (B) in the right side of the abdomen. (Reproduced, with permission, from Chen MM, Pope TL, Ott DJ, eds. *Basic Radiology*. 2nd ed. New York: McGraw-Hill; 2011.)

The most common causes of acute pancreatitis are gallstones passing into the bile duct and obstructing the sphincter of Oddi.

The most common cause of "idiopathic" pancreatitis is secondary to biliary microlithiasis.

What is the best initial test?

a. Amylase and lipase
b. Complete blood count (CBC)

c. Liver function tests
d. Secretin stimulation test

Answer a. Amylase and lipase

Amylase and lipase is the best initial test for the diagnosis of pancreatitis. Amylase is the most sensitive test, and lipase is the most specific test. CBC is too nonspecific and may show a rise in the white blood cell (WBC) count caused by reactive leukocytosis. A secretin stimulation test is the correct answer to the question "What is the most accurate test for the diagnosis of chronic pancreatitis?"

Amylase and lipase do not correlate with disease severity and should not be trended.

What is the most accurate test?

a. Computed tomography (CT) scan of the abdomen
b. Magnetic resonance imaging (MRI) of the abdomen
c. Ultrasonography of the abdomen

Answer a. Computed tomography (CT) scan of the abdomen

CT scan of the abdomen is the most accurate diagnostic test in the diagnosis of acute pancreatitis, but it is seldom needed in the first 72 hours. It is the best diagnostic test if the patient presents with severe pancreatitis or to assess for complications such as bleeding, necrosis, or abscess. MRI of the abdomen is always the wrong answer in acute abdominal processes, and ultrasonography of the abdomen is the best test to delineate the etiology of the pancreatitis if it is due to gallstones, but ultrasonography does not actually provide information on the pancreas itself.

CT scans provide prognostic information based on the Balthazar score
- *Grade A: Normal pancreas*
- *Grade B: Focal or diffuse gland enlargement*
- *Grade C: Intrinsic gland abnormality*
- *Grade D: Single phlegmon*
- *Grade E: Two or more collections or gas in the pancreas*

What is the best next step in the management of this patient?

a. Nothing by mouth (NPO)
b. Morphine
c. Intravenous (IV) access
d. IV normal saline
e. Ondansetron

f. All of the above

Answer f. All of the above

The mainstays of therapy for the treatment of acute pancreatitis are IV fluids, pain management, antiemetics, and NPO. Patients with acute pancreatitis lose a large amount intravascular volume to third spacing into the retroperitoneum and intraabdominal area. Thus, aggressive hydration with crystalloids or colloids to achieve hemodynamic stability and normal urine output are paramount.

Orders:

- *NPO*
- *IV access*
- *Normal saline*
- *Morphine*
- *Ondansetron*
- *CBC*
- *Comprehensive metabolic profile (CMP)*

Turn the clock forward 48 hours and reassess the patient with a repeat CBC, CMP, and arterial blood gas analysis.

Ranson's Criteria

At admission:

- *Age in years >70 years*
- *WBC count >18,000 cells/mm^3*
- *Blood glucose >12.2 mmol/L (>220 mg/dL)*
- *Serum aspartate aminotransferase >250 IU/L*
- *Serum lactate dehydrogenase >400 IU/L*

Within 48 hours:

- *Serum calcium <2.0 mmol/L (<8.0 mg/dL)*
- *Hematocrit fall >10%*
- *Oxygen (hypoxemia PaO_2 <60 mm Hg)*
- *BUN increased by ≥1.8 mmol/L (≥5 mg/dL) after IV fluid hydration*
- *Base deficit (negative base excess) >5 mEq/L*
- *Sequestration of fluids > 4 L*

Follow-up examination at 48 hours reveals the patient to have continued pain. The serum calcium level is 7.0 mg/dL, and the hematocrit has dropped by 12%.

What is the best next step in the management of this patient?

a. CT scan of the abdomen
b. Magnetic resonance cholangiopancreatography (MRCP) of the abdomen
c. Repeat amylase and lipase
d. Ultrasonography of the abdomen

Answer a. CT scan of the abdomen

Acute pancreatitis can usually be diagnosed based on clinical symptoms and laboratory testing such as amylase and lipase. Therefore, CT scanning of the pancreas should only be performed in the absence of clinical improvement or if the diagnosis is equivocal. MRI of any type in acute abdominal situations is always the wrong answer. Amylase and lipase should never be trended because their values do not correlate to disease activity, and ultrasonography of the abdomen does not have the resolution to image the pancreas because of overlying gas shadows from the transverse colon.

Causes of Pancreatitis

I GET SMASHED:
Idiopathetic
Gallstones
Ethanol
Trauma
Steroids
Mumps
Autoimmune
Scorpion stings
Hyperlipidemia/hypercalcemia
Endoscopic retrograde cholangiopancreatography (ERCP)
Drugs (including azathioprine and diuretics)

Drugs that cause pancreatitis: azathioprine, mercaptopurine, furosemide, estrogen, methyldopa, H2blockers, valproic acid, antibiotics, acetaminophen, salicylates, methanol, organophosphates, and steroids.

Order: *CT scan of the abdomen with contrast*

Turn the clock forward 20 minutes to get results.

CT scanning shows poor, uneven enhancement of pancreatic tissue with massive diffuse swelling consistent with acute hemorrhagic pancreatitis.

What is the best next step in the management of this patient?

The most urgent next step in the management of a patient with hemorrhagic pancreatitis is surgical control of the bleeding. The patient should also be transferred to the intensive care unit and may require resuscitated efforts to maintain circulatory competence.

If CT reads:
Pancreatic duct disruption = Stent placement by ERCP is the best answer.

If CT reads:
Pseudocyst + Symptomatic = Surgical drainage, endoscopic drainage, or percutaneous drainage is the best answer.

If CT reads:
Necrotizing pancreatitis = CT-guided needle aspiration + Antibiotic + Surgical debridement

Order: *Order surgical consult.*

Turn the clock forward, and the case will end.

UROLOGY

CASE 1: Benign Prostatic Hyperplasia

Setting: *Office*

CC: *"I have trouble urinating."*

VS: *Stable*

HPI: *A 68-year-old man presents with trouble urinating and recently difficulty achieving an erection. He must go to the bathroom numerous times during the day, feels a need to run to the bathroom immediately, and awakens at least twice a night to urinate as well. These symptoms have been progressively worsening over the past couple of years but have gotten to the point where he must plan his day around his urinary schedule, albeit unpredictable.*

ROS:

- *Weak urinary stream*
- *Feeling of incomplete evacuation after micturition*
- *Dribbling after micturition*
- *No dysuria*
- *No discharge*

PMH: *Diabetes mellitus type 2*

Physical Exam:

- *Digital rectal examination reveals a smooth prostate without nodularity.*
- *Anal sphincter tone is normal.*

The prostate gland is made up of four zones. They are the peripheral, central, anterior fibromuscular stroma, and transition zones.

What is the most likely diagnosis?

a. Benign prostatic hyperplasia (BPH)
b. Prostatitis
c. Overactive bladder
d. Cystitis
e. Urethral stricture

Answer a. Benign prostatic hyperplasia (BPH)

BPH involves enlargement of the transitional zone of the prostate, leading to compression of the urethral canal which causes difficulty with the normal flow of urine. Prostatitis is an acute inflammatory condition characterized by pain and requires antibiotics. This patient's symptoms are far too progressive to be an acute process. Overactive bladder syndrome is more common in women and is characterized by voiding eight or more times in a 24-hour period. Cystitis is an infection of the bladder leading to pyuria and suprapubic pain. A urethral stricture is caused by trauma or a sexually transmitted disease and would have to be mentioned in the history to be possible.

BPH involves hyperplasia, meaning an increase in the number of prostate cells, rather than hypertrophy, which involves a growth in the number of individual cells.

What is the best next step in the management of this patient?

a. Urinalysis (UA)
b. Urine culture (UC)
c. Blood urea nitrogen/creatinine (BUN/Cr)
d. Renal ultrasonography
e. All of the above

Answer e. All of the above

The proper workup for a patient with the clinical presentation of BPH is to check the UA, UC, and BUN/Cr. A UA and UC must be checked to assess for the presence of blood, leukocytes, bacteria, protein, or glucose. BUN and creatinine are important because BPH can lead to postobstructive renal insufficiency. Any anatomic abnormalities change the management of the patient.

Orders:
- *UA*
- *UC*
- *BUN/Cr*
- *Renal ultrasound*

Turn the clock forward 15 minutes to obtain results.

The patient's UA reveals a normal pH and specific gravity and is negative for blood, white blood cells, bacteria, protein, and glucose. The UC has no growth to date, and the BUN/Cr is at 34/1.7.

The U.S. Preventive Services Task Force does not recommend routine screening with prostate specific agent (PSA) for prostate cancer.

Which of the following are indicated for this patient?

a. α1 Blockers
b. 5α-Reductase inhibitors
c. Lifestyle modifications
d. All of the above

Answer d. All of the above

The accepted medical therapies in patients with BPH include α1 blockers such as tamsulosin, and 5α-reductase inhibitors such as finasteride. Lifestyle modifications include decreasing the consumption of alcohol and caffeine-containing products. Avoidance of antihistamines, diuretics, decongestants, opiates, and tricyclic antidepressants should also be advised.

α-Blockers relax smooth muscle in the prostate and the bladder neck, thus decreasing the blockage of urine flow.
5α-Reductase inhibitors stop the production of dihydrotestosterone (DHT), the hormone responsible for enlarging the prostate.

What is the best next step in the management of this patient?

a. Ultrasonography with postresidual urine volume measurement
b. Abdominal radiography
c. Intravenous (IV) urography

Answer a. Ultrasonography with postresidual urine volume measurement

Ultrasonography is the best next step in the management of any patient with BPH and elevation of the serum creatinine. Ultrasonography allows the volume measurement of the prostate and delineates whether the urethra is compromised. The measurement of a postresidual volume is an indicator of BPH. Normal postresidual volumes are less than 12 mL and are elevated in patients with BPH. Indications for IV urography include hematuria, a history of renal stones, urinary tract infection, or previous urinary tract surgery. Abdominal radiography will not show soft tissue enlargement.

Orders:
- *Transrectal ultrasonography*
- *Postresidual volume*

The patient's ultrasonography demonstrates an enlarged prostate with near total compression of the urethra. The post residual volume is 100 mL or greater.

What is the best next step in the management of this patient?

a. Transurethral incision of the prostate (TUIP)
b. Transurethral resection of the prostate (TURP)

Answer b. Transurethral resection of the prostate (TURP)

In patients with BPH that is not responding to medical therapy or in patients with renal compromise caused by postobstructive nephropathy, the best next step in the management of the patient is TURP. TUIP is used in patients who are not good candidates for a TURP because of comorbidities.

TURP causes ejaculations that are dry, and the man becomes sterile.

Orders:

- *Urology consult*
- *TURP*
- *Transfer the patient to the surgical intensive care unit (SICU).*

Turn the clock forward, and the case will end.

TURP is an unusual procedure these days. 5α-Reductase inhibitors (eg, finasteride) stop the growth of the prostate, and α-adrenergic blockers open the internal sphincter. This is enough usually to eliminate the need for 90% of TURPs.

CASE 2: Kidney Stones

Setting: *ED*

CC: *"My back hurts."*

VS: *BP, 120/80 mm Hg; R, 22 breaths/min; P, 120 beats/min; T, 98.6°F*

HPI: *A 45-year-old man presents to the emergency department with severe left-sided flank pain that radiates into the left side of his groin. The pain began about 6 hours ago and has been progressively getting worse. The pain waxes and wanes, 10 of 10 in intensity, and sharp and stabbing in quality, with no alleviating or aggravating factors.*

PMH: *Gastric bypass 5 years ago*

ROS:

- *Dark urine*
- *Nausea*
- *Vomited twice*

Physical Exam: *Costovertebral angle tenderness*

Upper ureteral stones: Radiate to flank
Mid-ureteral calculi: Radiate anteriorly and caudally
Distal ureteral stones: Radiate into groin

What is the most likely diagnosis?

a. Nephrolithiasis
b. Renal artery embolus
c. Pyelonephritis
d. Lumbosacral strain
e. Testicular torsion

Answer a. Nephrolithiasis

The acute onset of severe flank pain radiating to the groin with hematuria indicates renal stones. The pain waxes and wanes as the stone continues to pass from the kidney into the ureteral system. Hematuria is common. This can be either gross or microscopic. Testicular torsion is acute but presents with severe pain that starts in the scrotum. Pyelonephritis has costovertebral tenderness (CVA) and flank pain as well as fever and dysuria. Renal artery embolus presents with flank pain, and the patient has a history of recent cardiac catheterization or atrial fibrillation. Lumbosacral strain is simply back pain that you can elicit with palpation. Hypertension is not specific enough to

be useful. Anything that causes pain can lead to hypertension.

Four kinds of stones
- Calcium stones (most common type)
- Struvite (magnesium ammonium phosphate) stones
- Uric acid stones
- Cysteine stone

What is the most accurate diagnostic test for this patient?

a. Ultrasonography of the kidneys
b. Kidney, ureters, and bladder (KUB) radiography
c. Computed tomography (CT) scan without contrast
d. CT scan with contrast
e. Intravenous pyelography
f. Magnetic resonance imaging (MRI) of the abdomen
g. Urine analysis

Answer d. CT scan without contrast

The best test to evaluate for a kidney stone is a CT scan of the pelvis without contrast. Ultrasonography is less accurate than a CT scan and is only used in pregnant patients presenting with nephrolithiasis. Calcium-containing stones are radiopaque, but pure uric acid, indinavir-induced, and cysteine calculi are radiolucent on plain radiography. Contrast is contraindicated because the patient may already have renal compromise and a decreased glomerular filtration rate. Intravenous pyelography is always the wrong test and is no longer done; it is analogous to the Schilling test of urology. MRI of the abdomen is also always the wrong answer in acute management of any abdominal process. A urine analysis is needed to corroborate the findings and confirm hematuria.

The most common causes of kidney stones are hypercalciuria, hyperuricosuria, hyperoxaluria, hypocitraturia, and low urinary volume.

Orders:
- *Urinalysis (UA)*
- *CT scan of the abdomen without contrast*

Medication-induced kidney stones:
- Indinavir
- Acyclovir
- Triamterene
- Sulfadiazine
- Topiramate

CT scan of the abdomen reveals a 6-mm distal ureteral stone, and the UA reveals red blood cells too numerous to count (Figure 11-1).

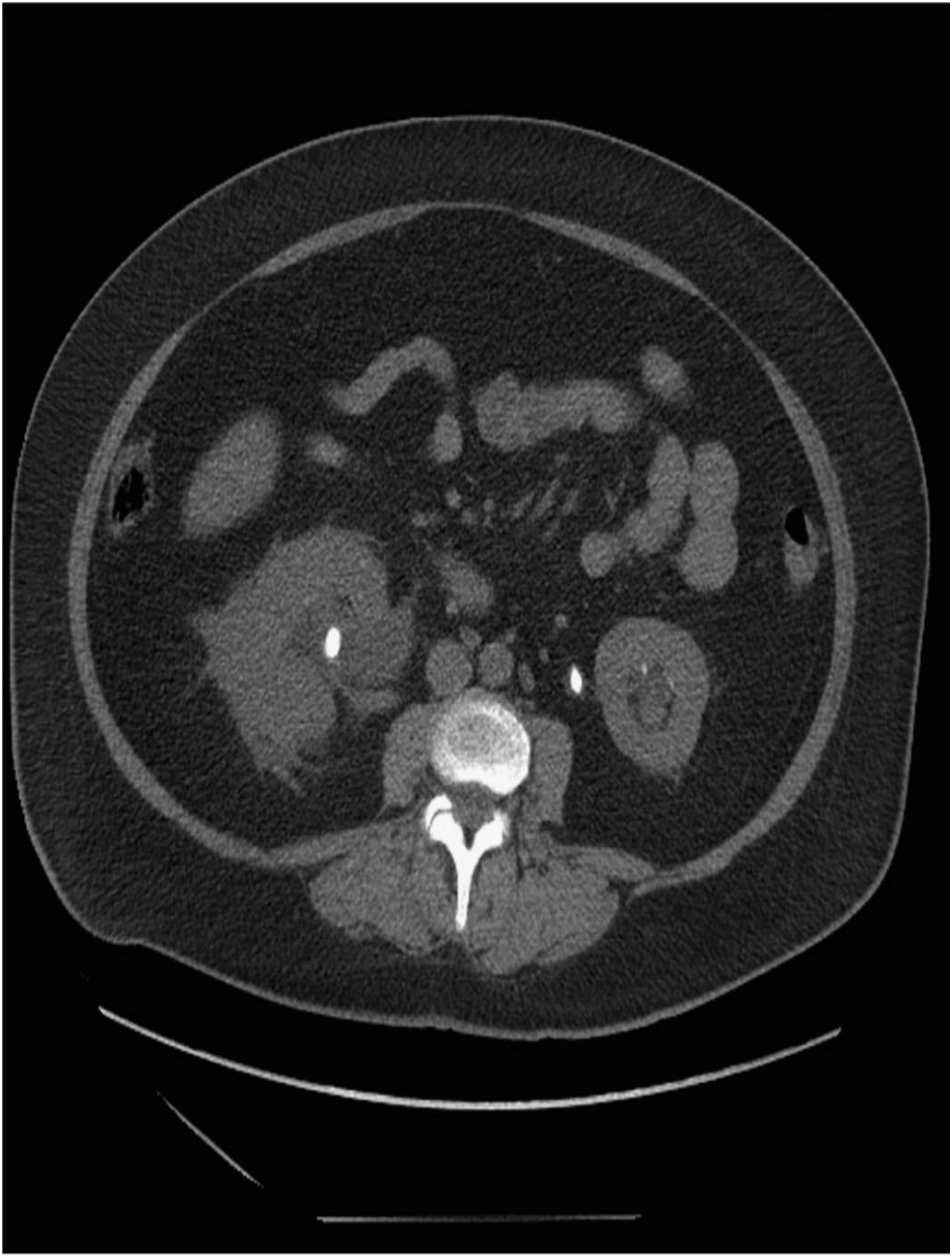


Figure 11-1. Noncontrast computed tomography scan of the abdomen and pelvis showing several stones seen (*arrowheads*). (Reproduced, with permission, from Usatine RP, et al. *The Color Atlas of Internal Medicine*. New York: McGraw-Hill; 2015.)

What is the best next step in the management of this patient?

a. Intravenous (IV) normal saline
b. Morphine
c. Urine strainer
d. α-Blocker
e. Antiemetics
f. All of the above

Answer f. All of the above

To adequately aid a stone in passage, IV normal saline to increase urinary production and flow combined with pain relief and antiemetics will aid in symptom management. α-Blockers such as tamsulosin, or calcium channel blockers such as nifedipine, aid in the distal dilation of the urethra. These are used if the stone is of borderline size. Stones smaller than 5 mm will pass spontaneously. Stones larger than 7 or 8 mm will never pass spontaneously no matter how long you wait. α-Blockers and calcium channel blockers are to help stones pass that are of equivocal size or 5 to 7 mm.

A urine strainer is needed to find the stone after passage and analyze its makeup.

Gastric bypass surgery is a risk factor because of increased enteric oxalate absorption.

Stones <5 mm will pass spontaneously.
Stones >8 mm will not pass spontaneously.

Orders:
- *IV normal saline*
- *Morphine*
- *Urine strainer*
- *Tamsulosin*
- *Nifedipine*
- *Ondansetron*

Turn the clock forward to the next morning, and the case will end.

Extracorporeal shockwave lithotripsy (ESWL) is indicated for stones that are larger than 7 to 8 mm but smaller than 2 cm and lodged in the upper or middle calyx.
Percutaneous nephrostolithotomy procedures are for renal stones larger than 2 cm and for failures from medical therapies and ESWL.

CASE 3: Bladder Cancer

Setting: *Office*

CC: *"My urine is red."*

VS: *BP, 100/60 mm Hg; R, 12 breaths/min; P, 90 beats/min; T, 97.8°F*

HPI: *A 75-year-old African American man presents with painless hematuria of a few weeks' duration. He denies fever, dysuria, urgency, and burning.*

SH: *65-pack-year smoking history*

ROS:

- *No dysuria, urgency, or increased frequency*
- *No abdominal pain*
- *No back pain*
- *No flank pain*

Physical Exam:

- *No costovertebral tenderness*
- *No palpable flank mass*
- *No suprapubic pain*

What is the most likely diagnosis?

a. Bladder cancer
b. Renal cell cancer
c. Prostate cancer
d. Cystitis
e. Urethritis

Answer a. Bladder cancer

Bladder cancer is the most likely diagnosis in a patient with painless hematuria and a history of tobacco use. Renal cell cancer is also a likely diagnosis but would present with abdominal pain, a palpable flank mass, and fevers with heavy sweating. Prostate cancer does not present with hematuria, cystitis has suprapubic pain, and urethritis must have dysuria.

Tobacco smoking is the biggest risk factor for bladder cancer.

Bladder cancers originate in the urothelium, which is a three- to seven-cell mucosal layer

within the muscular bladder.

What is the most accurate test for bladder cancer?

a. Computed tomography (CT) scan of the abdomen
b. Urinalysis (UA)
c. Voided urinary cytology
d. Cystoscopy
e. Fluorescence in situ hybridization (FISH)

Answer d. Cystoscopy

Cystoscopy is the most accurate test for bladder cancer because it allows for both visualization and biopsy of lesions. UA will show hematuria but will not reveal the actual lesion. Voided urinary cytology has low yield and low sensitivity and must be combined with FISH to be more accurate.

Orders:
- *Cystoscopy*
- *Urology consult with biopsy*

Cystoscopy reveals a 2-cm lesion in the posterior lateral portion of the bladder. Biopsy of the lesion reveals transitional cell cancer.

Phenacetin, aniline dyes, cyclophosphamide, and excessive alcohol use are associated with transitional cell carcinoma.

What is the best treatment for transitional cell carcinoma?

a. Transurethral resection of bladder tumor
b. Mitomycin
c. Intravesicular injection of Bacillus Calmette–Guérin (BCG)
d. All of the above

Answer d. All of the above

First-line treatment is transurethral resection of bladder tumor followed by injection by mitomycin as chemotherapy and immunotherapy by BCG.

Smoking cessation is a must for a patient with bladder malignancy.

Orders:

- *Transurethral resection of bladder tumor*
- *Intravesicular BCG*
- *Mitomycin*

Turn the clock forward, and the case will end.

Mitomycin cross-links DNA and is used to prevent the recurrence of malignancy.

CASE 4: Prostate Cancer

Setting: *Office*

CC: *"I have a question"*

VS: *Stable*

HPI: *A 67-year-old African American man presents to the office worried about prostate cancer. He has a father who passed away of prostate cancer. His brother recently had a prostate specific antigen (PSA) checked after discussing it with his physician, and this patient would like to get one.*

PMH: *Hypertension*

Med: *Lisinopril*

ROS:

- *Increased urination at night*
- *No difficulty initiating stream*
- *No overt hematuria*
- *No dysuria*

Physical Exam:

- *Digital rectal examination (DRE) reveals a smooth but firm prostate without nodularity.*
- *Anal sphincter tone is normal.*

What must you tell your patient regarding current guidelines for PSA screening?

a. We perform annual screening.
b. Screening is not recommended.
c. Screening is recommended after the age 50 years.
d. Screening is recommended in patients with first-degree relatives with prostate cancer.

Answer b. Screening is not recommended

The U.S. Preventive Services Task Force currently recommends against PSA-based screening for prostate cancer because of the high number of false positives. However, if a patient is worried about the disease, then he is advised to talk with his doctors about the risk and benefits of the test and its implications. PSA is a unique test in all of medicine in this method of patient involvement. Although PSA is now a class D recommendation, which means "No benefit and probable harm," if the patient still wishes to do the test, then it should be performed.

BRCA-2 mutations increase the risk for prostate cancer.

After an informed discussion with the patient, he decides to have a PSA test done. You have explained the risk and benefits to the patient.

Orders:

- *PSA*
- *Send the patient home and bring him back in 3 days; results will be available then.*

PSA testing reveals the patient's PSA level to be 12.5 ng/mL. The patient has had no interval change in his health or complaints.

Lobes of prostate to zones of Prostate

- Anterior lobe = Transitional zone
- Posterior lobe = Peripheral zone
- Lateral lobes = All zones
- Median lobe = Central zone

PSA greater than 4.0 should be considered suspicious for malignancy. Biopsy must always eventually be done.

What is the best next step in the management of this patient?

a. Transrectal ultrasonography (TRUS) with biopsy
b. Magnetic resonance imaging (MRI) of the pelvis
c. Computed tomography (CT) scan of the pelvis with contrast
d. Multiple blind biopsies

Answer a. Transrectal ultrasonography (TRUS) with biopsy

TRUS is the most accurate imaging test because it allows for both identification and obtaining a tissue specimen for analysis. MRI and CT scan may allow for the identification of a prostate lesion, but it does not allow for tissue analysis. If you cannot feel the location of a prostate lesion by DRE, then transrectal ultrasonography is needed to guide the location of where to place the biopsy needle.

A single dose of ciprofloxacin is indicated before prostate biopsy to reduce postbiopsy bacteriuria.

Orders:

- *Urology consult*
- *TRUS*
- *CT scan of the chest, abdomen, and pelvis*
- *Ciprofloxacin*
- *Send the patient home to return after 1 week*

CCS TIP: *Turn the clock forward to obtain the results of the biopsy.*

The most common complication after TRUS with biopsy is bleeding.

If no lesion is found on ultrasonography, then multiple blind biopsies are performed.
A TRUS of the prostate demonstrates an area of hypoechoic foci in the anterior lobe. A core biopsy was obtained and demonstrates moderately differentiated adenocarcinoma with a Gleason score of 7. The patient has no symptoms of dysuria. A CT scan demonstrates no evidence of disease. Staging is T2 (Figure 11-2).

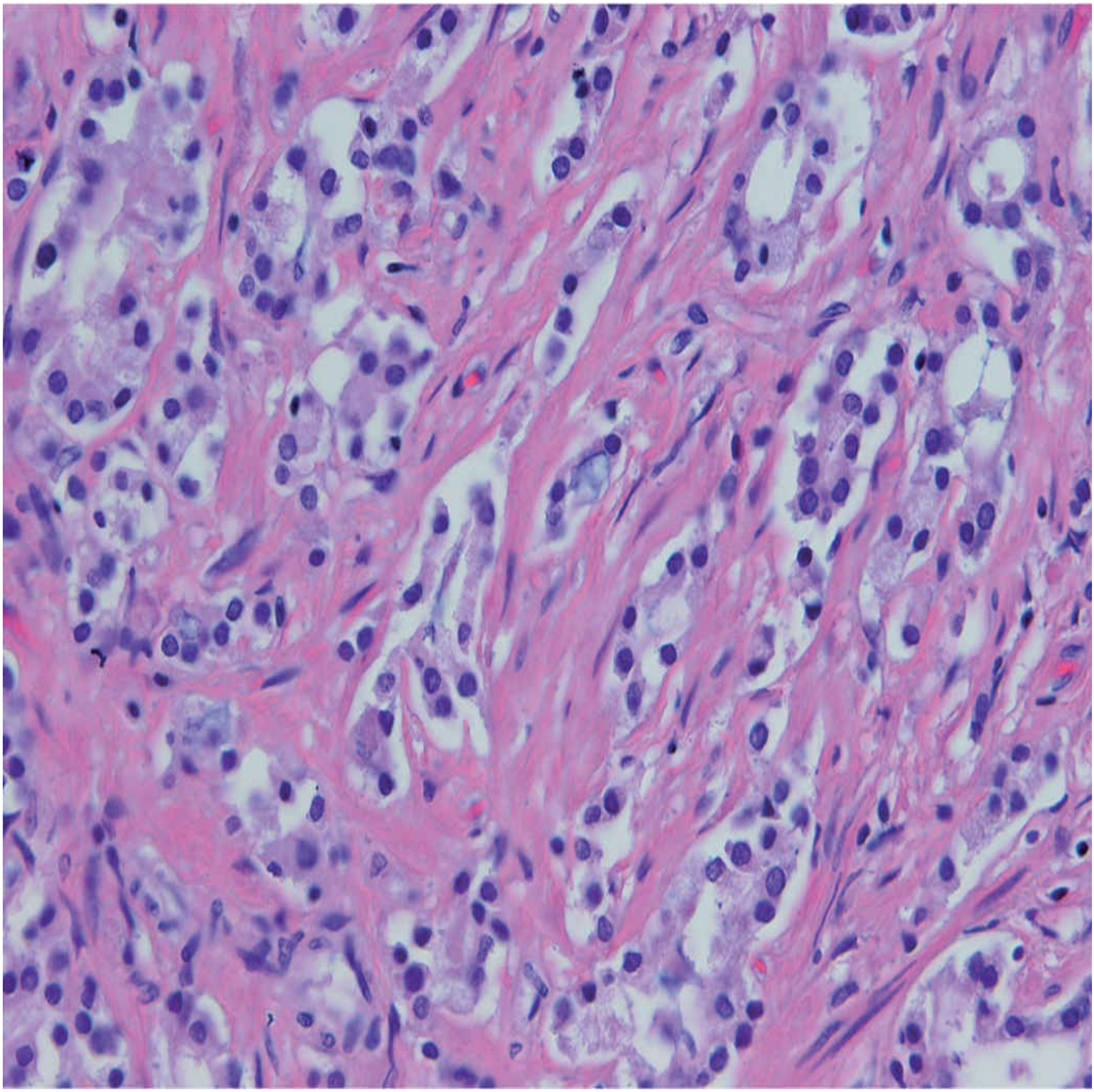


Figure 11-2. Prostatic adenocarcinoma. Adenocarcinoma is one of the major forms of carcinoma. In well- and moderately differentiated forms, the glandular histology is readily apparent (as in this section). Hematoxylin and eosin, 400×. (Reproduced, with permission, from Kemp WL, Burns DK, Brown TG, eds. *Pathology: The Big Picture*. New York: McGraw-Hill; 2008.)

Gleason score:
2 to 6 indicates a low-grade or well-differentiated tumor
7 indicates a moderate-grade or moderately differentiated tumor
8 to 10 indicates a high-grade or poorly differentiated tumor

Prostate cancer preferentially metastasizes to the bone.

What is the best next step in the management of this patient?

a. Radical prostatectomy
b. Radiation
c. Both of the above

Answer c. Both of the above

The correct therapy for a patient with prostate cancer is combination of radical prostatectomy, radiation, or both. This is especially true with a high Gleason score. High Gleason score means a high likelihood of metastases.

Surgery is followed by serial PSA measurements, yearly DREs, and repeated biopsies. Watchful waiting is not a therapeutic option in a person with a focal lesion and a high Gleason score.

DREs do not raise the PSA level by a clinically significant amount.

Orders:
- *Radical prostatectomy*
- *Radiation therapy*
- *Radiation oncology*

CCS TIP: *Turn the clock forward. The case should end. If it does not, that means they will bring the patient back for further management.*

The patient returns 1 year later with excruciating back pain. On physical examination, there is no tenderness to palpation, but there is reduced range of motion of the lumbar spine. No focal neurologic deficits are noted. There is 5 of 5 strength in the lower extremities.

What is the best initial therapy for patients with metastatic prostate cancer?

a. Flutamide
b. Leuprolide
c. Zoledronic acid
d. Finasteride
e. All of the above

Answer a. Flutamide

Androgen blockade is the most appropriate next step and appropriate therapy for a patient with

metastatic prostate cancer. This is a combination of testosterone receptor blockers such as flutamide and leuprolide or goserelin, which are the gonadotropin-releasing hormone (GnRH) agonists. Bisphosphonates such as zoledronic acid slow the progression of pathologic fractures through osteoclastic inhibition.

You must *not* give a GnRH agonist such as leuprolide first. There will an initial bump up on androgen levels from an initial bump up in follicle-stimulating hormone and luteinizing hormone (LH) levels. It is important to block the tissue effect with flutamide first. This is especially true of those with spinal metastases in whom even a slight increase in testosterone levels can paralyze the patient.

GNRH agonists → Lead to transient rise in LH. This flare is blocked by testosterone receptor blockers such as flutamide. Leuprolide increases LH and then subsequently decreases it.

Bilateral orchiectomy is not done for androgen deprivation therapy.

Orders:

- *Flutamide*
- *Leuprolide*
- *Zoledronic acid*

Turn the clock forward, and the case will end.

GnRH agonists work by leading to downregulation of receptors on the pituitary.

CASE 5: Testicular Cancer

Setting: *Office*

CC: *"My girlfriend found a bump in my scrotum!"*

VS: *Stable*

HPI: *A highly anxious and frightened 21-year-old man presents to the urgent care clinic with a lump on the left side of his scrotum. The lump was found incidentally by his girlfriend, and he was so scared that he came to the office immediately.*

ROS:

- *No scrotal pain*
- *No cough*
- *No weight loss*
- *No sweating*

PMH: *Cryptorchidism*

Physical Exam: *Painless swelling or nodule of one testicle*

What is the most likely diagnosis?

a. Testicular cancer
b. Epididymitis
c. Orchitis
d. Testicular torsion
e. Spermatocele

Answer a. Testicular cancer

Any man who presents with a painless scrotal lump should be assumed to have testicular cancer until proven otherwise. A patient with epididymitis presents with acute pain, as do those with testicular torsion, which this patient does not have. Orchitis presents with pain but also has a fever. Last, spermatoceles are smooth, painless swellings that transilluminate upon examination.

Testicular cancer is the most common solid malignancy affecting men between the ages of 15 and 35 years.

What is the best next step in the management of this patient?

a. α-Fetoprotein (AFP) level
b. Lactate dehydrogenase (LDH) level

c. β-Human chorionic gonadotropin (β-hCG) level
d. Computed tomography (CT) scan of the abdomen and pelvis
e. All of the above

Answer e. All of the above

Checking a patient for serum markers will aid in corroborating the diagnosis. Serum levels of AFP and β-hCG are elevated in nonseminomatous germ cell tumors. Patients with pure seminoma may have elevated levels of β-hCG but do not have elevated AFP levels. LDH will also be elevated and offers prognostic indicator of tumors but is not sensitive or specific for germ cell tumors. A CT scan of the abdomen and pelvis will be used for staging.

AFP is only secreted by nonseminomas.

The most common testicular cancers are germ cell tumors, seminoma, and nonseminoma.

Orders:
- *AFP*
- **β**-*hCG*
- *LDH*

The patient's AFP and β-hCG are elevated above 10,000 ng/mL. The LDH is markedly elevated as well. The CT scan shows no metastatic lesions. The patient staging is stage 1.

What is the appropriate treatment for this patient?

a. Inguinal orchiectomy
b. Radiation
c. Chemotherapy

Answer a. Inguinal orchiectomy

The correct therapy for a patient with testicular cancer is an inguinal orchiectomy of the affected testicle. Local disease is then followed up by radiation. Patients with metastatic disease are treated with chemotherapy with a cisplatin-based regiment.

Cisplatin is one of the agents used in metastatic disease. It works by crosslinking DNA and triggering apoptosis.

Fine-needle biopsy of the testicle is always the wrong answer.

Order: *Surgical consult*

Turn the clock forward, and the case will end.

Unique Features of Testicular Cancer

- *You can wait and observe with CT scans for recurrence of disease.*
- *Never cut the scrotum or put a needle directly into it.*

CARDIOVASCULAR SYSTEM

CASE 1: Abdominal Aortic Aneurysm

Setting: *Office*

CC: *Well visit*

VS: *Stable*

HPI: *A 66-year-old man presents to the office for a well visit. He has no complaints and feels well. His wife has been complaining that his belly has been increasing in girth over the past year.*

PMH:
- *Hypercholesterolemia*
- *Bilateral osteoarthritis in the knee*

Meds:
- *Aspirin*
- *Atorvastatin*

SH: *50-pack-year smoker*

ROS:
- *Occasional pain in the knee*
- *No back pain*

Physical Exam:
- *Pulsatile abdominal mass*
- *Bruit heard over the periumbilical region*

What is the most likely diagnosis?

a. Aortic dissection
b. Abdominal aortic aneurysm (AAA)
c. Small bowel obstruction (SBO)
d. Renal artery stenosis

Answer b. Abdominal aortic aneurysm (AAA)

An AAA is the most likely diagnosis and presents in a patient older than 65 years of age with a history of smoking and atherosclerotic disease. The findings of an unruptured AAA include periumbilical bruits and a pulsatile mass that is palpable over the abdomen. Aortic dissection causes abdominal disease in patients with a history of hypertension. SBO presents with increasing

abdominal girth caused by distension but would be acute (not over the course of a year), and renal artery stenosis does give a bruit but would have elevated blood pressures.

In acute rupture of an AAA, signs and symptoms include abdominal pain, back pain, tachycardia, and unequal blood pressures between the upper and lower extremities.

The U.S. Preventive Services Task Force recommends one-time screening for AAA by ultrasonography in men ages 65 to 75 years who have ever smoked.

What is the biggest risk factor for AAA?

a. Atherosclerosis
b. Hypertension
c. Syphilis
d. Smoking

Answer a. Atherosclerosis

The biggest risk factors for abdominal aortic aneurysm are atherosclerosis and being older than 65 years of age. Hypertension is actually a risk factor for the development of aortic dissection. Syphilis causes aortitis in the thoracic segment of the aorta and attacks the vasa vasorum. Smoking is a risk factor but does not convey the same risk as atherosclerosis.

AAAs are caused by a failure in structural proteins of the aorta, elastin, and collagen combined with overexpression of metalloproteinases, causing remodeling of tissue matrices.

Treponema pallidum causes aortitis through attack on the vasa vasorum or the vessels of the vessels.

What is the best next step in the management of this patient?

a. Ultrasonography
b. Abdominal radiography
c. Computed tomography (CT) scan of the abdomen
d. Magnetic resonance imaging (MRI) of the abdomen
e. Angiography

Answer a. Ultrasonography

Ultrasonography is the least invasive and most cost-effective method to obtain management changing information regarding an AAA. Size in a stable unruptured AAA will delineate whether or not the patient will require surgery. Abdominal radiography has very low sensitivity and will only show an AAA if there are calcifications. CT or MRI of the abdomen will offer more information including rostral-caudal extent and if there is extension into the suprarenal aorta. Angiography offers the same information but is overly invasive.

Less frequent causes of AAA include Marfan's syndrome, Ehler-Danlos syndrome, and collagen vascular diseases.

Orders:

- *Abdominal ultrasonography*
- *Send the patient home and have him return in 24 hours.*

Turn the clock forward to obtain result and have the patient return to the office.

Ultrasonography of the aorta reveals dilation in abdominal segment measuring 6.1 cm in diameter without evidence of free fluid in the abdomen (Figure 12-1).

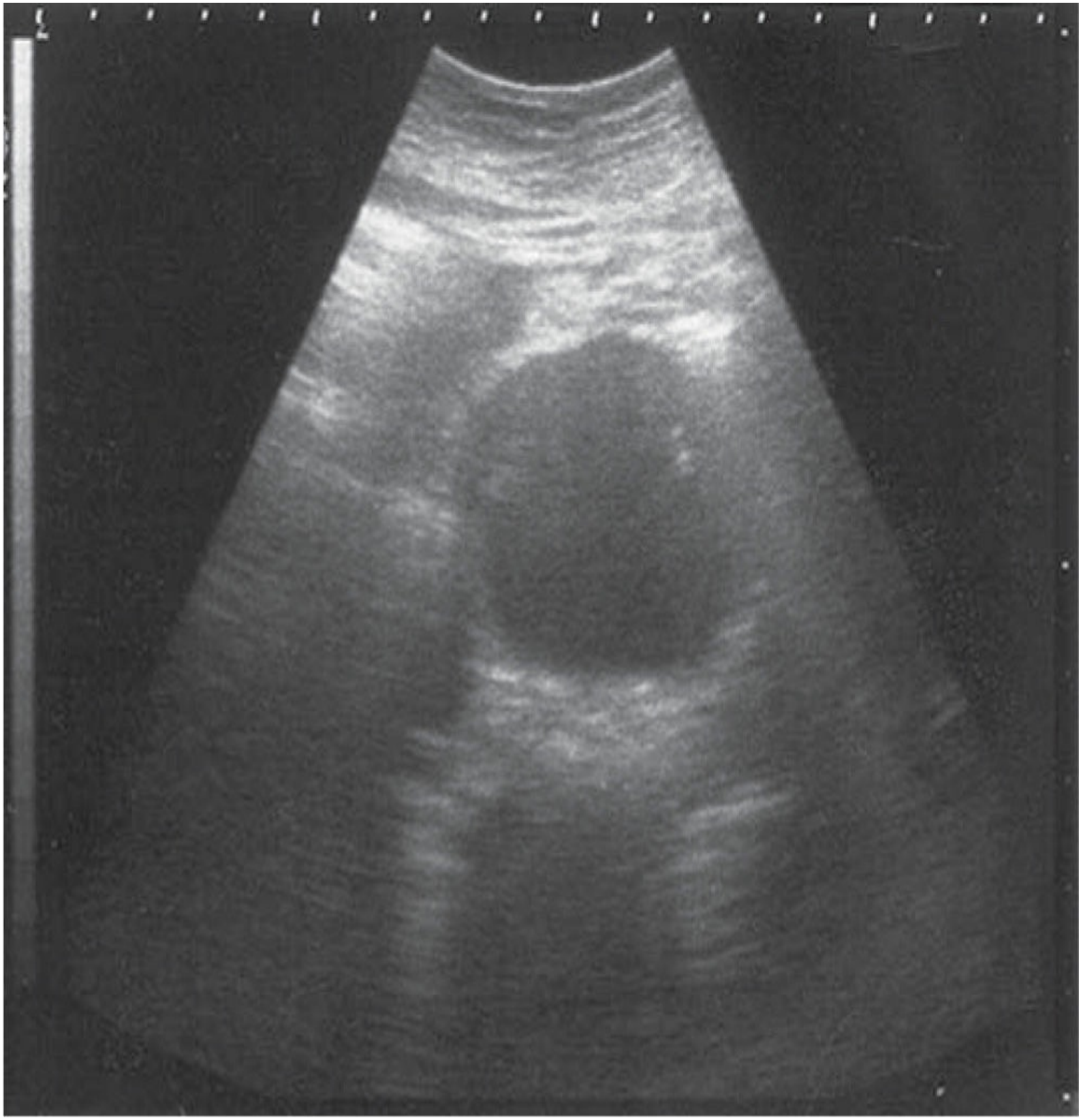


Figure 12-1. Ultrasound image of an abdominal aortic aneurysm in the transverse plane. (Reproduced, with permission, from Tintinalli JE, Stapczynski J, Ma O, et al, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York: McGraw-Hill; 2011.)

What is the best next step in the management of this patient?

a. Observation and repeat ultrasonography in 6 months
b. Observation and repeat ultrasonography in 12 months
c. Surgery after ultrasonography in 12 months
d. Surgery now

Answer d. Surgery now

The patient should have surgery now. AAAs that are larger than 4.5 cm should be referred for surgical intervention because the risk of rupture increases with every centimeter they increase. Observation and ultrasonography is for AAA that are between 3.0 cm and 4.4 cm.

AAAs <3 cm: no follow-up.
AAAs 3 to 4 cm: ultrasonography every 12 months
AAAs 4 to 4.5 cm: ultrasonography every 6 months
AAAs >4.5 cm: surgery

Orders:

- *Surgical consult*
- *Admit to the surgical intensive care unit (SICU)*

Turn the clock forward, and the case will end.

CASE 2: Aortic Dissection

Setting: *ED*

CC: *"My back hurts."*

VS: *BP, 200/100 mm Hg; P, 101 beats/min; afebrile*

HPI: *A 54-year-old man presents to the emergency department with severe chest pain that radiates to his back. The pain is 9 of 10, increasing in intensity, and constant and is described as a tearing sensation. It began earlier this morning and has progressively gotten worse. He denies shortness of breath but does state he feels dizzy and lightheaded.*

PMH: *Hypertension*

ROS:

- *Flank pain*
- *No nausea*
- *No vomiting*
- *Noncompliant with medications*

Physical Exam:

- *An interarm blood pressure differential greater than 20 mm Hg*
- *Bounding carotid and radial pulses*
- *Holosystolic murmur radiates to the axilla*

What is the most likely diagnosis?

a. Aortic dissection
b. Abdominal aortic aneurysm (AAA)
c. Pancreatitis
d. Renal artery stenosis

Answer a. Aortic dissection

Aortic dissection occurs when a tear in the intima causes blood to flow between the layers of the wall of the aorta, creating a false lumen. An acute aortic dissection presents with severe chest pain that radiates to the back in the setting of uncontrolled hypertension. Physical examination findings seen in acute dissection are a holosystolic murmur, which is mitral regurgitation; bounding pulses; and interarm arm blood pressure difference of greater than 20 mm. AAAs can present with back pain, but they do not have uncontrolled hypertension, and there would have to be mention of a palpable cystic mass with or without a bruit. Pancreatitis would present with severe epigastric pain and radiation the back; however, this patient presents with severe chest pain. Uncontrolled hypertension does fit the presentation of renal arteries gnosis, but flank pain does not. The flank pain is caused by the dissection crossing the point at which the renal arteries branch from the aorta.

The aorta is composed of the intima, media, and adventitia.
- The intima, the innermost layer, is lined by endothelium.
- The media is responsible for imparting strength and is made of intertwining sheets of elastic tissue.
- The outermost layer of the aorta is adventitia and largely consists of collagen.
- The vasa vasorum, which supplies blood to the outer half of the aortic wall, lies within the adventitia.

Aortic dissections carry a very high mortality rate: one third of patients die within the first 24 hours, and 50% die within 48 hours.

What is the biggest risk factor for the development of aortic dissection?

a. Smoking
b. Hypertension
c. Alcohol use
d. Hyperlipidemia
e. Syphilis

Answer b. Hypertension

Hypertension is the most important factor for the development of acute aortic dissection. In up to 70% of cases, the patients will have uncontrolled blood pressure. Smoking and alcohol use contribute to the development of elevated blood pressure but are not directly linked to the development of aortic dissection. Hyperlipidemia is the correct answer to the question, "Which of the following is most important factor for the development of AAAs?" Syphilis does raise the risk of dissections by involving the vasa vasorum but not as uncontrolled arterial hypertension.

There are only three holosystolic murmurs:
- Mitral regurgitation
- Tricuspid regurgitation
- Ventricular septal defect

The most common site of dissection is the first few centimeters of the ascending aorta, with 90% occurring within 10 cm of the aortic valve.

Initial Orders:

- *Complete blood count (CBC)*
- *Electrocardiography (ECG)*
- *Troponin*
- *Blood urea nitrogen/creatinine (BUN/Cr)*
- *CK-MB*
- *Lactate dehydrogenase (LDH)*

ECG reveals sinus tachycardia without ST segment changes. Troponin and CK-MB are not elevated, and the CBC demonstrates a white blood cell count 18,000 cell/mm^3. BUN/Cr is elevated at 24/1.75. LDH is elevated at 500 IU/L.

Dissections involving the coronary ostia also involve the right coronary artery and result in ST segment elevation in leads II, III, and aVF.

LDH catalyzes the conversion of pyruvate to lactate as it converts NADH to NAD+.

LDH is elevated because of hemolysis in the false lumen.

What is the best next step in the management of this patient?

a. Magnetic resonance angiography (MRA)
b. Computed tomography angiography (CTA)
c. TransTHORACIC echocardiography (TEE)
d. Percutaneous angiography

Answer c. TransTHORACIC echocardiography (TEE)

All of the above imaging modalities are equal in sensitivities for detecting an acute aortic dissection, but TEE can be used at the bedside, which makes it ideal for hemodynamically unstable patients. MRA takes too long, and the patient will die in the time you get a full study. CTA is prohibited in this case given the elevation in BUN/Cr.

The DeBakey classification of dissections:

- Type I involves the ascending aorta, aortic arch, and descending aorta.
- Type II is confined to the ascending aorta.
- Type III is confined to the descending aorta distal to the left subclavian artery.

Order:

- *TEE*

TEE reveals findings consistent with an aortic dissection and mitral regurgitation (Figure 12-2).

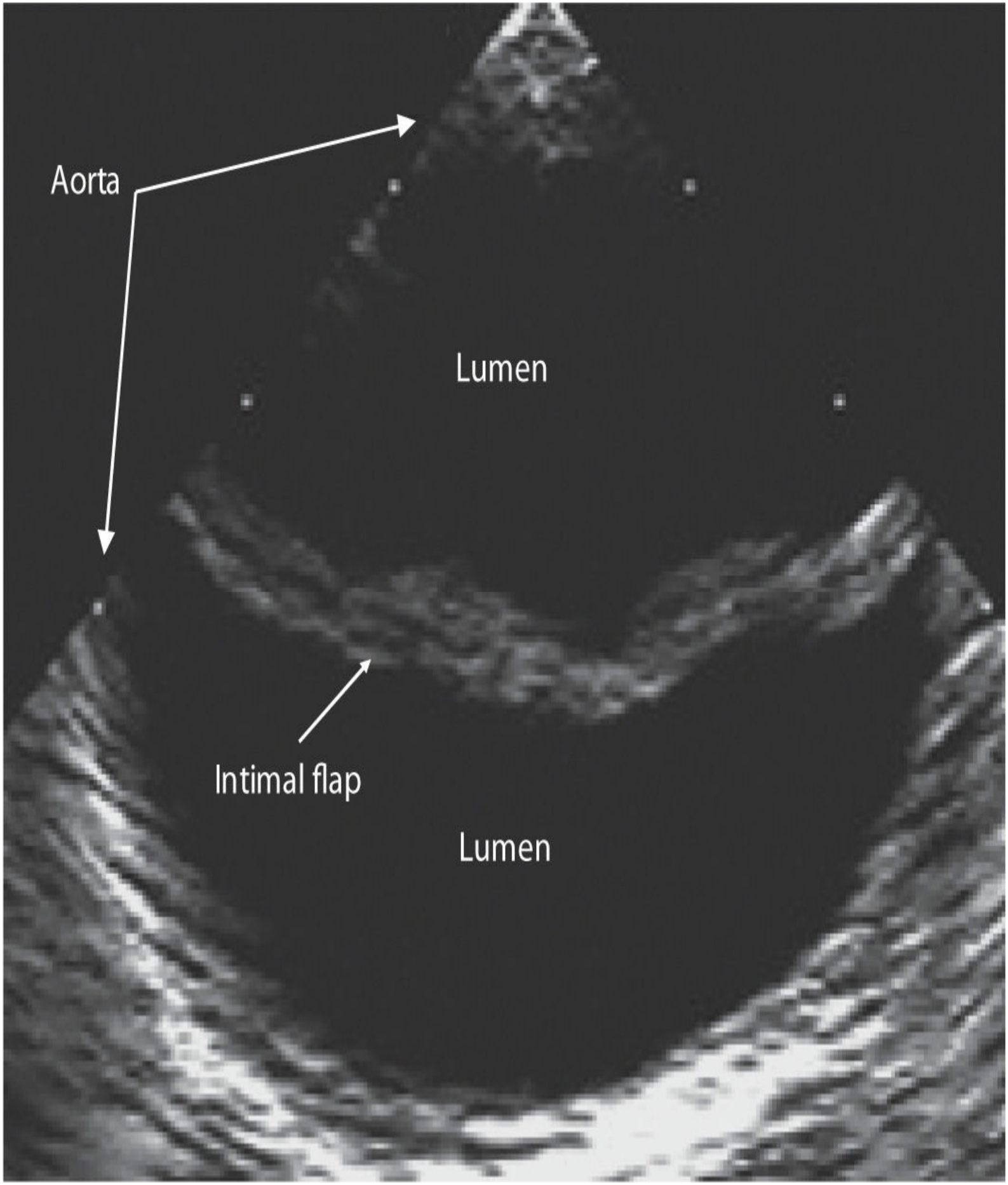


Figure 12-2. Aortic dissection. Transesophageal image demonstrating an intimal flap separating two aortic lumina. The true versus the false lumen cannot be determined by this single image. (Reproduced, with permission, from Pahlm O, Wagner GS, eds. *Multimodal Cardiovascular Imaging: Principles and Clinical Applications*. New York: McGraw-Hill; 2011.)

What is the best next step in the management of this patient?

a. Metoprolol
b. Labetalol
c. Hydralazine
d. Amlodipine
e. Nitroprusside

Answer b. Labetalol

The best next step in the management of this patient is to reduce systemic blood pressure and in turn shearing forces on the walls of the aorta. This can be best accomplished by intravenous (IV) labetalol, which acts to decrease blood pressure and cardiac contractility by antagonizing β1, β2, and α1 receptors. Metoprolol does not affect peripheral vascular resistance and thus is not an appropriate choice for rapid blood pressure decrease. Hydralazine and nitroprusside do reduce total peripheral resistance, but a reflex tachycardia would ensue, causing further tearing of the intima. Last, amlodipine would take 4 to 6 hours to work, in which time the patient will have likely already expired.

After β blockade with labetalol has been initiated, adding nitroprusside is appropriate to lower the blood pressure further but never as a sole agent.

Labetalol blocks β1, β, and α1 receptors.

Nitroprusside → nitric oxide → NO activates guanylate cyclase and cGMP. cGMP activates protein kinase G to inactivate myosin light chains → vascular relaxation

Orders:
- *IV line*
- *Labetalol*
- *Cardiology consult*
- *Lung examination*

The patient is given labetalol. The lung examination does not reveal wheezing, and the patient denies shortness of breath.

Patients receiving a nonselective β blockers must be checked for bronchospasm.

What is the most effective therapy for this patient?

a. Thoracic endovascular aortic repair (TEVAR)
b. Surgical repair
c. Angiographic stenting
d. Observation

Answer b. Surgical repair

Surgical repair is the most important next step and the most effective therapy in this patient. The goal of surgery is to address the affected layers of the aorta, suture them together, and reinforce the aorta with a graft. TEVAR is only attempted in patients who are not surgical candidates, and stenting and observation are the most accurate ways to achieve mortality will lead to death.

Order:
• *Surgical consult*

Turn the clock forward, and the case will end.

CASE 3: Peripheral Vascular Disease

Setting: *Office*

CC: *"My legs hurt."*

VS: *Stable*

HPI: *A 64-year-old man states that he has a dull ache in his legs when he walks from his apartment to the grocery store. The pain is mostly in his thigh and buttocks. He describes it as a dull ache, without swelling, and it does not radiate. The pain gets better with rest. He denies any pain while sitting or standing but only when walking.*

PMH:
- *Coronary artery disease s/p 2 stents in LAD*
- *Hyperlipidemia*
- *Diabetes mellitus type 2*

Meds:
- *Aspirin*
- *Clopidogrel*
- *Lisinopril*
- *Glargine*

SH: *80-pack-year active smoking history*

ROS: *Difficulty achieving erection*

Physical Exam:
- *Skin on the lower extremities is shiny, hairless, and dry with occasional scaly patches*
- *Diminished popliteal and dorsalis pedis pulse*

What is the most likely diagnosis?

a. Varicose veins
b. Restless leg syndrome
c. Peripheral vascular disease (PVD)
d. Deep venous thrombosis (DVT)

Answer c. Peripheral vascular disease (PVD)

PVD is the most common diagnosis in a patient with a history of atherosclerotic disease who presents with claudication. Risk factors for PVD include smoking, hyperlipidemia, and diabetes mellitus. Physical diagnosis reveals shiny hairless legs caused by the lack of perfusion, and in advanced cases, livedo reticularis can be seen. Restless leg syndrome is a disorder in which there is an urge or need to move one's legs to stop unpleasant sensations, but it is unrelated to exertion

and occurs most commonly at night while the person is trying to fall asleep. Varicose veins are swollen, twisted, and engorged veins caused by an increase in venous pressure from valvular incompetence. A clot occluding venous flow secondary to Virchow's triad, which is venous stasis, hypercoagulability, and endothelial damage, characterizes DVTs.

What is the best next step in the management of patient?

a. Allen's test
b. Schilling's test
c. Ankle brachial index (ABI)
d. Computed tomography angiography (CTA)

Answer c. Ankle brachial index (ABI)

The ABI is the ratio of the ankle systolic blood pressure divided by the brachial systolic pressure measured with a Doppler probe. An Allen's test is used to measure the patency of the ulnar artery before manipulation of the radial artery. Schilling's test is to diagnose pernicious anemia and is no longer done. CTA in a patient with diabetes without measuring the blood urea nitrogen/creatinine (BUN/Cr) raises the risk for contrast-induced nephropathy.

Claudication is caused by an increased oxygen (AVo_2) demand by muscles in the leg.

Angina of the legs = claudication

Creatinine greater than 1.5 mg/dL means no CT scans.

Order:
• *ABI*
ABI reveals a value of 0.6.

ABI:
• Between 0.9 and 1.2 = normal
• <0.9 = peripheral arterial disease (PAD)
• >1.3 = heavy calcification of vessels

What is the best next step in the management of patient?

a. Increase dose of aspirin
b. Cilostazol
c. Pentoxifylline
d. Warfarin
e. Vitamin E supplementation

Answer b. Cilostazol

Because this patient is already on the first-line therapy, which is aspirin boosted by clopidogrel, the next best drug to add on is cilostazol. Cilostazol is indicated to provide symptomatic relief and slow the progression of the disease. Increasing the dose of aspirin from 81 to 325 mg has been associated with greater bleeding episodes. Pentoxifylline and warfarin have not been shown to improve outcomes in patients with claudication and PAD. Vitamin E supplementation to boost antioxidant effects is equal to placebo and has no role in PAD.

Cilostazol is a phosphodiesterase 3 inhibitor that suppresses platelet aggregation and is a direct arterial vasodilator.

Cilostazol should be taken with high-fat meals because it increases absorption and is contraindicated in patients with congestive heart failure because of causing increasing mortality.

The best nonpharmacologic therapy for PAD is supervised exercise therapy.

Order:
• *Cilostazol*

Send the patient home and bring him back in 6 weeks.

The patient returns to the office. He has some minor relief of his symptoms but still feels a dull ache in his lower extremities. He says he is unable to make it to the bathroom on time because of the pain and has had accidents.

Buttock and hip: Aortoiliac disease
Thigh: Common femoral artery or aortoiliac

Upper two-thirds of the calf: Superficial femoral artery
Lower one-third of the calf: Popliteal artery
Foot claudication: Tibial or peroneal artery

What is the best next step in the management of patient?

a. Compression therapy
b. Revascularization through bypass
c. Continue medical therapy
d. Amputation

Answer b. Revascularization through bypass

After failure of medical therapy for the treatment of PAD, the best next step in the management of the patient is surgical intervention, most commonly in the form of revascularization through bypass surgery. Compression therapy and continued medical therapy have not been shown to change outcomes in such advanced disease. Amputation is reserved for patients who have severe arterial occlusive disease and gangrenous changes.

CASE 4: Pulmonary Embolism

Setting: *ED*

CC: *"My chest hurts."*

VS: *BP, 95/69 mm Hg; R, 30 breaths/min; P, 109 beats/min; T, 98.9°F; pulse oximetry, 91%*

HPI: *A 33-year-old woman presents with a sudden onset of shortness of breath and chest pain that began 4 hours earlier. She recently returned from Australia on a flight where she was bedridden for 2 weeks before departure for a sprained ankle. The chest pain is described as sharp, right sided, and worsened with deep breathing.*

SH: *15-pack-year smoking history*

FH: *Factor V Leiden mutation*

Meds:
- *Oral contraceptive pill (OCP) daily*
- *Multivitamin*

ROS: *Nausea*

Physical Exam:
- *Lightheaded*
- *Mild cyanosis to lips*
- *Respiratory distress notable with intercostal retractions*
- *Lungs clear to auscultations bilaterally*
- *S_1 and S_2 normal*
- *Painful left calf with swelling and cordlike protrusion*

What is the most likely diagnosis?

a. Pulmonary embolism (PE)
b. Pneumonia
c. Pulmonary tamponade
d. Pericarditis
e. Costochondritis

Answer a. Pulmonary embolism (PE)

PE is the most likely diagnosis when a patient presents with a sudden onset of shortness of breath, chest pain, and pain with inspiration. Common risk factors include the use of OCPs, smoking, and immobility such as being bedridden or being on a long flight. This patient also has the potential for a factor V Leiden mutation, which conveys an inherent hypercoagulability. Patients with pneumonia can have chest pain with deep breathing but also have a fever and a cough. Pulmonary tamponade

presents with low arterial blood pressure; distended neck veins; and distant, muffled heart sounds. Pericarditis presents with chest pain, but it would be positional in nature and improves with leaning forward, and costochondritis is chest pain that is reproducible through palpation.

The three primary factors that predisposes to clot formation is known as Virchow's triad:
- Endothelial injury
- Stasis or turbulence of blood flow
- Blood hypercoagulability

The most common presenting sign of PE is tachypnea.

To assess the chances of a patient having a PE, the Wells score is used:
- Clinically suspected DVT: 3.0 points
- Alternative diagnosis is less likely than PE: 3.0 points
- Tachycardia (heart rate >100 beats/min): 1.5 points
- Immobilization (≥3 days)/surgery in previous 4 weeks: 1.5 points
- History of DVT or PE: 1.5 points
- Hemoptysis: 1.0 points
- Malignancy (with treatment within 6 months) or palliative: 1.0 points
  - Score >6.0: High probability 59% of PE
  - Score 2.0 to 6.0: Moderate probability 29% of PE
  - Score <2.0: Low probability 15% of PE

What is the best next step in the management of this patient?

a. Chest radiography
b. Ventilation/perfusion (V/Q) scan
c. Computed tomography pulmonary angiography (CTPA)
d. Electrocardiography (ECG)
e. D-Dimer

Answer c. Computed tomography pulmonary angiography (CTPA)

The best next step in the management of this patient is to obtain radiologic evidence of a PE. A combination of the clinical evidence and Well's score of greater than 6 indicates a 50% or above change of having a PE. Chest radiography is the most common wrong answer because the classic finding of a Hampton's hump is extremely rare. In a low or moderate suspicion of PE, a normal d-dimer level will exclude the diagnosis of a PE but should only be used in patients with a Well's

score of 4. V/Q scan is the most accurate diagnostic test for a PE, but in the case of a patient who is unstable, nuclear medicine scintography would take too long, so CTPA is used. The findings of a large S wave in lead I, a large Q wave in lead III, and an inverted T wave in lead III (S1Q3T3) are highly nonspecific because they are seen in patients without PE and should never be used as diagnostic testing for PE.

Chest radiography must be performed to rule out preexisting lung disease before V/Q scans because of a high rate of nondiagnostic studies.

Orders:

- *Prothrombin time (PT)*
- *Partial thromboplastin time (PTT)*
- *International normalized ratio (INR)*
- *CTPA*

The most common hypercoagulable state is a factor V Leiden mutation.

Factor V functions as a cofactor to allow factor Xa to activate thrombin. Thrombin in turn cleaves fibrinogen to form fibrin, which creates a clot. Activated protein C cleaves and degrades factor V to limit the clotting. However, in factor V Leiden mutation, factor V no longer "listens" to protein C and continues to form clots.

The PT, PTT, and INR are all within normal limits. Spiral CTPA demonstrates a large filling defect consistent with massive saddle embolus in the main pulmonary artery. The patient still feels short of breath and has increasing pain on deep inspiration. Vital signs are unchanged.
Oral contraceptives raise the risk of deep venous thrombosis or PE three times.

What is the most appropriate therapy in this patient?

a. Tissue plasminogen activator (tPA)
b. Heparin
c. Warfarin
d. Rivaroxaban
e. Inferior vena cava (IVC) filter

Answer a. Tissue plasminogen activator (tPA)

Thrombolytic therapy should be used in patients with evidence of hemodynamic compromise unless there is a contraindication such as bleeding risk. Low-molecular-weight heparin as a bridge to warfarin is the correct answer in patients without hemodynamic compromise and is for use in stable

patients only. IVC filters are indicated in patients who have had a recurrent DVT or PE but who have a contraindication to oral anticoagulants such as a recent gastrointestinal bleed.

The most common adverse effect of tPA is bleeding.

tPA cleaves the zymogen plasminogen at its arginine–valine peptide bond into the serine protease plasmin.

tPA is used in the treatment of myocardial infarction with ST-elevation, acute ischemic stroke, and acute massive PE.

Orders:

- *tPA*
- *Transfer the patient to the intensive care unit.*

Turn the clock forward, and the case will end.

When is thrombolysis indicated?

- *Right ventricular dysfunction*
- *Cardiopulmonary resuscitation*
- *Moderate PE*
- *Severe hypoxemia*
- *Free-floating right atrial or ventricular thrombus*
- *Patent foramen ovale*

ORTHOPEDICS

CASE 1: Carpal Tunnel Syndrome

Setting: *Office*

CC: *"My hands hurt."*

VS: *Stable*

HPI: *A 43-year-old woman presents with painful burning and tingling in both her hands. She works as an administrative assistant. She has recently noticed an inability to grasp her coffee mug and has been dropping items when trying to pick them up. The symptoms are worse at night, and shaking her hands and wrists alleviates the symptoms somewhat. The tingling is most pronounced in the lateral fourth and fifth fingers.*

PMH: *No significant past history*

ROS: *Hands always feel hot*

Physical Exam:
- *Tingling in the hands is induced after 90 seconds of flexing the wrists*
- *Wasting of the thenar eminence*

What is the most likely diagnosis?

a. Diabetic neuropathy
b. Multiple sclerosis
c. Carpal tunnel syndrome
d. Syphilis
e. Syringomyelia

Answer c. Carpal tunnel syndrome

Carpal tunnel syndrome is a collection of symptoms caused by the compression of the median nerve within the carpal tunnel. Symptoms include paresthesias, motor weakness, and wasting of the muscles innervated by the median nerve. Multiple sclerosis is a demyelinating disorder of the central nervous system with multiple neurologic deficits, commonly visual disturbance. Diabetic neuropathy would present with pain and tingling in a "stocking and glove" distribution, but this patient does not have diabetes. Syphilis can cause tabes dorsalis, but this would affect vibratory sense, 2-point discrimination, and proprioception. Syringomyelia is a lack of pain and temperature in a capelike distribution.

In carpal tunnel syndrome, sensory fibers often are affected first followed by motor fibers.

The median nerve is damaged within the rigid confines of the carpal tunnel, initially undergoing demyelination followed by axonal degeneration.

Wasting and weakness of the median-innervated hand muscles include:
- L: First and second lumbricals
- O: Opponens pollicis
- A: Abductor pollicis brevis
- F: Flexor pollicis brevis

Tinel sign: Gentle tapping over the median nerve in the carpal tunnel region elicits this sign (Figure 13-1).

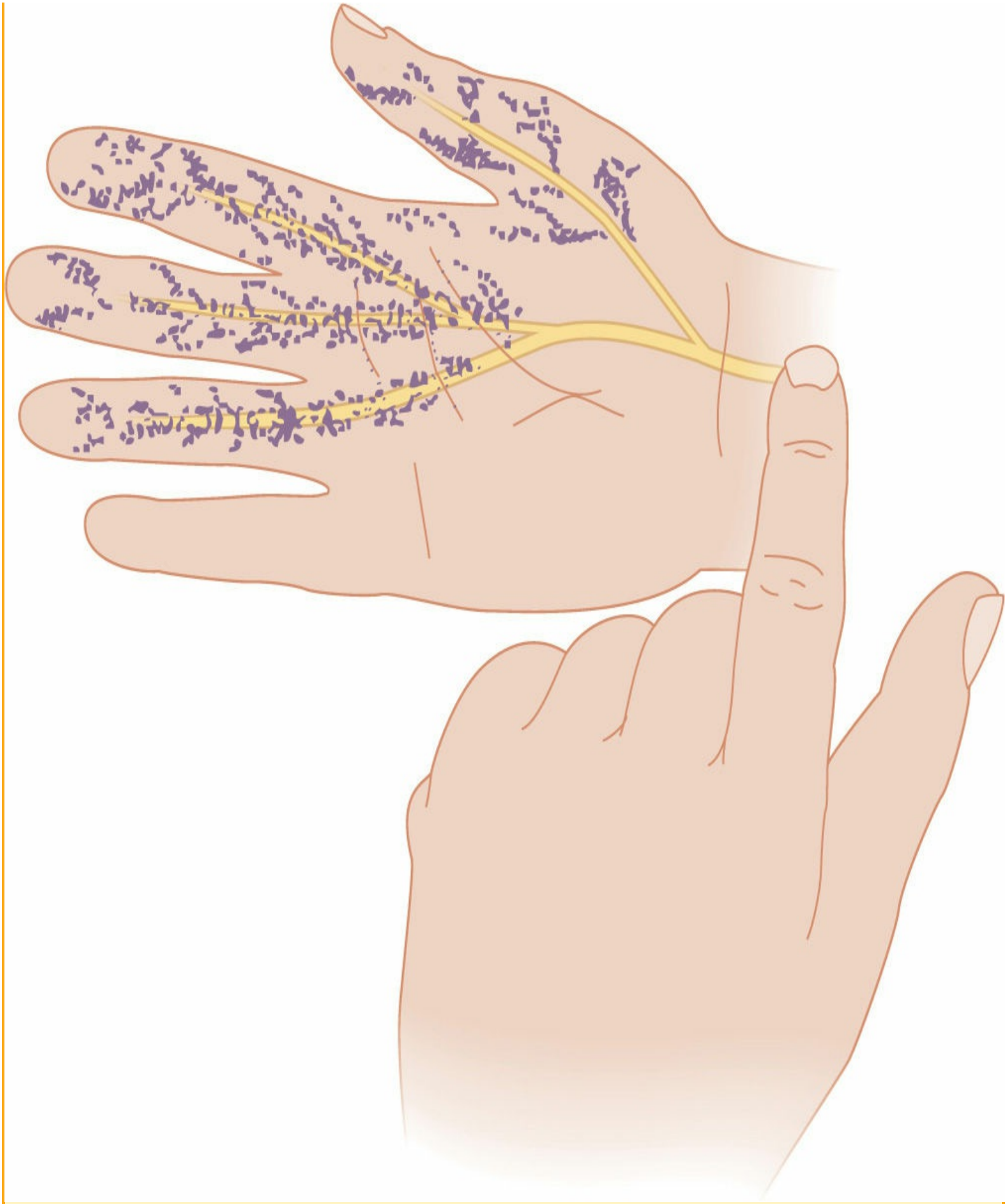


Figure 13-1. Tinel sign. The Tinel test is performed by tapping the volar surface of the wrist over the median nerve. (Reproduced, with permission, from Simon RR, Sherman SC. *Emergency Orthopedics*. 6th ed. New York: McGraw-Hill; 2011.)

Phalen sign: Tingling in the median nerve distribution is induced by full flexion (Figure 13-

2).

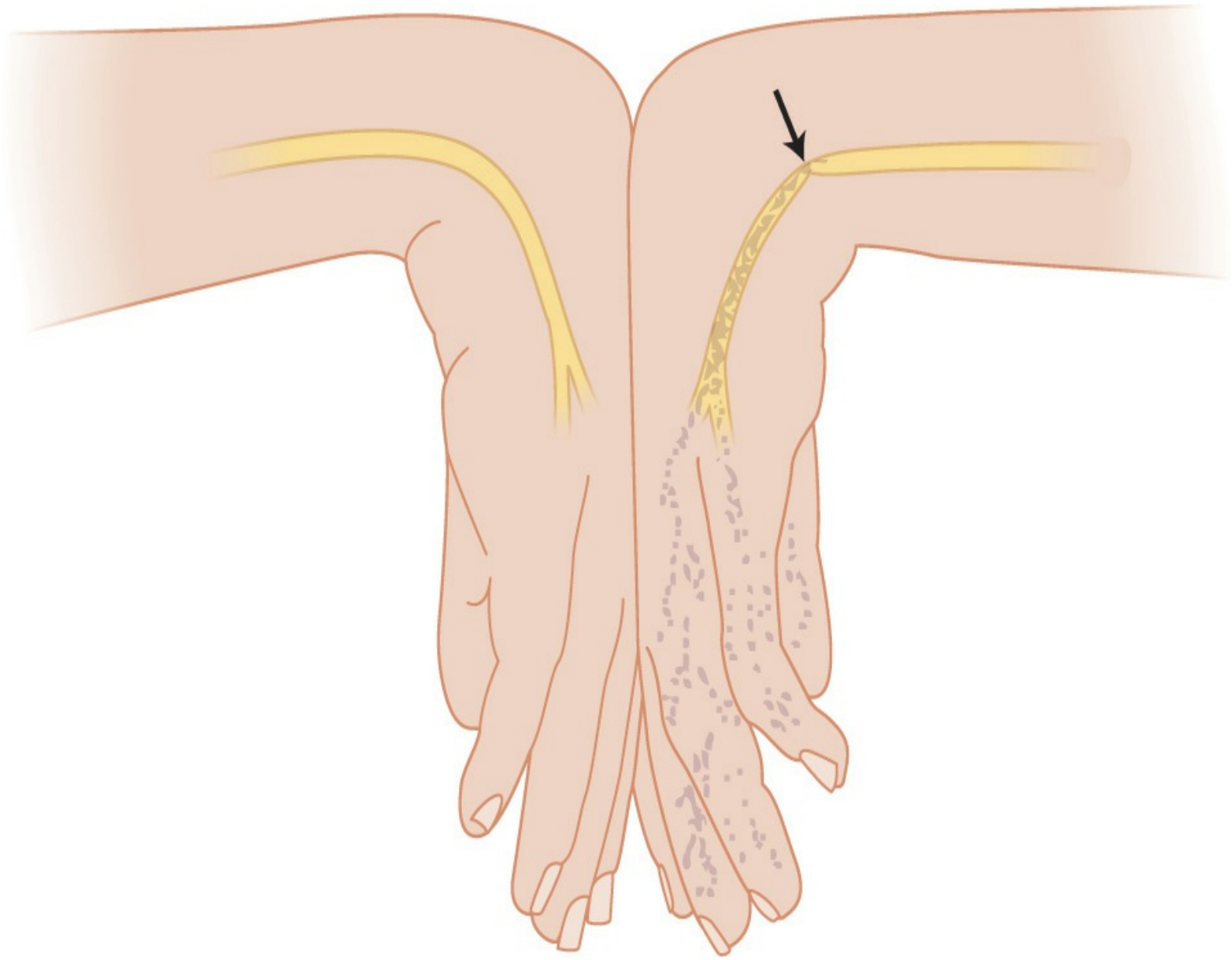


Figure 13-2. Phalen maneuver. The Phalen maneuver is performed by compressing the opposing dorsal surfaces of the hand with the wrists flexed together as shown. (Reproduced, with permission, from Simon RR, Sherman SC. *Emergency Orthopedics*. 6th ed. New York: McGraw-Hill; 2011.)

What is the best next step in the management of this patient?

a. Surgery
b. Wrist splinting
c. Nonsteroidal antiinflammatory drugs (NSAIDs)
d. Oral steroids
e. Steroid injection
f. Physical therapy or yoga
g. Ultrasound therapy

Answer b. Wrist splinting

After the diagnosis of carpal tunnel syndrome is made, the best next step is conservative therapy with placement of the affected hands into a wrist splint in the "neutral position." Wrist splints, oral steroids, ultrasound therapy, and yoga are only effective in the short term, but wrist splinting is the most effective (Figure 13-3). Steroid injection is considered second-line therapy and a bridge to surgery. Surgery is considered the most definitive therapy and should only be used if splinting and conservative measures have failed.

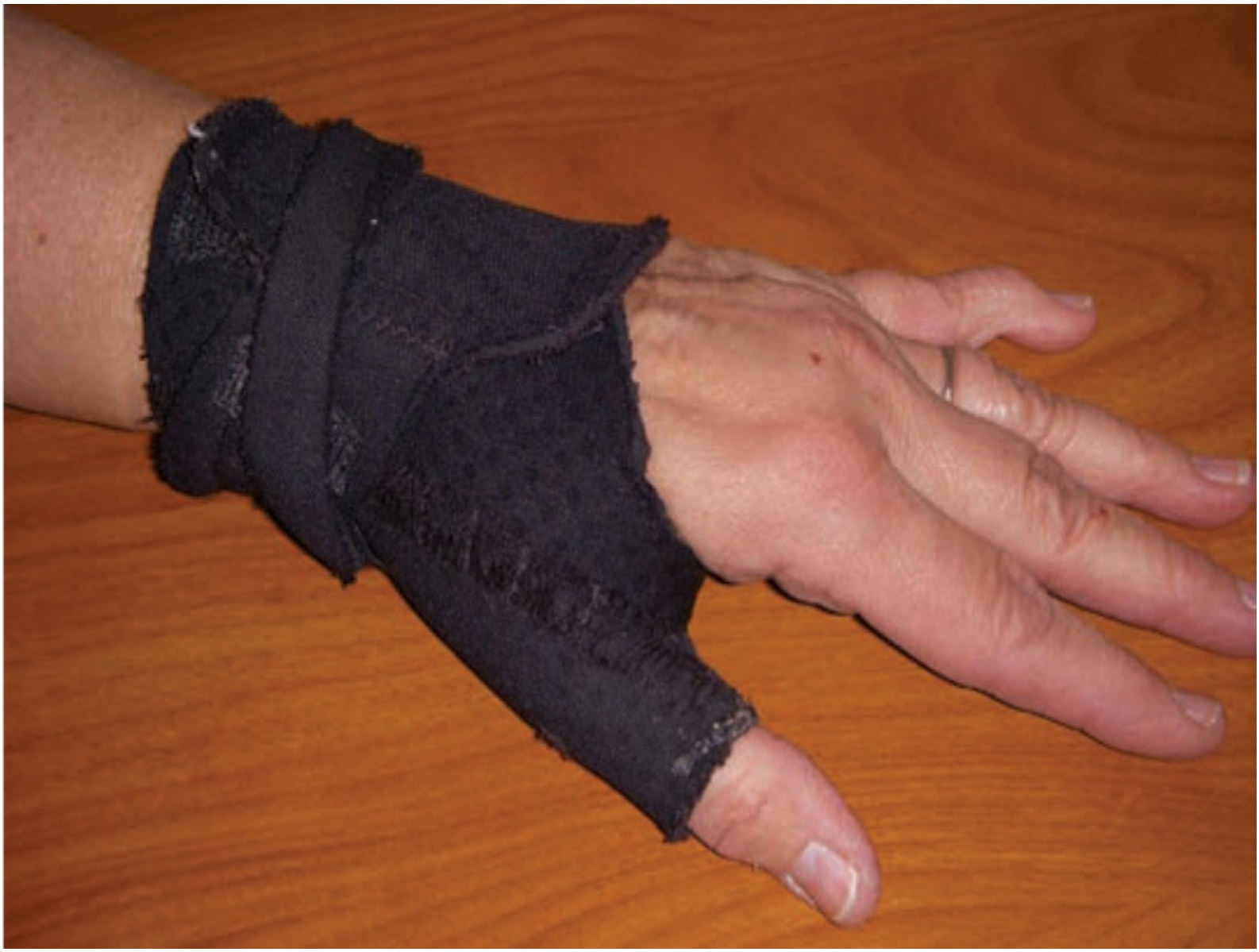


Figure 13-3. Typical wrist splint with the wrist in neutral position for treatment of carpal tunnel syndrome. (Used, with permission, from Barbara Steckler and Judy Tintinalli.)

Order:

• *Wrist splint*

Send the patient home for 4 to 6 weeks and bring her back. On the return visit, do a repeat history and physical examination.

Bones of the carpal tunnel are:

- Scaphoid
- Lunate
- Triquetrum
- Pisiform
- Trapezium
- Trapezoid
- Capitate
- Hamate

The patient returns and states she has had little relief in her hands. Tapping of the median nerve still elicits paresthesias.

What is the best next step in the management of this patient?

a. Surgery
b. Steroid injection
c. NSAIDs
d. Physical therapy

Answer b. Steroid injection

Second-line therapy for a patient with carpal tunnel syndrome is steroid injection directly into the carpal tunnel, which is only used after conservative measures have failed. If the patient returns with symptoms and conservative measures such as splinting and steroid injections have failed, the patient should be referred for surgery.

The carpal bones form the dorsal surface of the tunnel, and the volar surface is formed by the flexor retinaculum.

Surgery in carpal tunnel syndrome involves cutting the transverse ligament.

Orders:
- *Intraarticular steroid injection*
- *Send the patient home and bring her back in 4 weeks. Turn the clock forward.*

If the patient returns and still has symptoms, order a surgical consult and carpal tunnel release. Turn the clock forward, and the case will end.

CASE 2: Fat Embolism

Setting: *ICU*

CC: *"Status post bicycle struck by motor vehicle accident."*

VS: *BP, 100/45 mm Hg; R, 30 breaths/min; P, 110 beats/min; T, 101.3°F; pulse oximetry, 91%*

HPI: *A 35-year-old woman was brought to the emergency department after being struck by a taxi while crossing an intersection on her bicycle. The patient was unconscious and subsequently intubated in the field. In addition to numerous lacerations, the patient also fractured both femurs. Twenty-four hours later, while on rounds, it is noted that the patient's oxygen saturation has decreased and heart rate has increased, and the patient is breathing over the vent. The nurse noted a tonic-clonic seizure this morning.*

PMH: *Migraines*

Physical Exam:

- *Subconjunctival and oral hemorrhages*
- *Retinal hemorrhages are visible upon funduscopic examination*
- *Reddish brown nonpalpable petechial rash over the upper body and trunk*

What is the most likely diagnosis?

a. Pulmonary embolism (PE)
b. Fat embolism
c. Amniotic fluid embolism
d. Thrombotic thrombocytopenic purpura (TTP)
e. Henoch-Schönlein purpura (HSP)

Answer b. Fat embolism

Fat embolism is a type of embolism that is secondary to physical trauma, such as long bone traumas. It can also occur from parenteral lipid infusion or burns. The triad of findings in a patient with fat embolism is neurologic dysfunction, petechial rash, and respiratory distress. This patient presents with all findings: the neurologic dysfunction manifested as a seizure, while the respiratory distress is seen as the patient overbreathing the vent and dropping pulse oximetry. A PE presents with respiratory distress but would not have a petechial rash, and an amniotic fluid embolism requires the patient to be pregnant. TTP is a combination of neurologic dysfunction and purpura but would not include a patient in respiratory distress. Last, HSP is small vessel vasculitis with deposition of IgA, classically seen after a recent bacteria or viral illness such as streptococci or hepatitis B.

Fat embolism are caused by large fat droplets being released into the venous system and obstructing capillary beds.

The most effective prophylactic measure to prevent fat emboli is to reduce long bone fractures as soon as possible after the injury.

What is the best next step in the management of this patient?

a. Heparin
b. Low-molecular-weight heparin (LMWH)
c. Surgical fixation of the long bones
d. Inferior vena cava filter placement
e. Observation

Answer c. Surgical fixation of the long bones

The best next step in the management of this patient is stabilization of long bone fractures. Fixation within 24 hours has been shown to reduce the incidence of respiratory distress from embolic phenomenon. LMWH and anticoagulation are the most common wrong answers and are indicated if there is a blood clot that has embolized, but not for fat. Placement of inferior vena cava filters is not indicated, and observation will result in detrimental outcomes. The mainstay of therapy after surgical fixation is supportive care.

Fat embolism typically manifests 24 to 72 hours after the initial insult.

Supportive care alone is the mainstay of therapy for fat embolism.

Orders:

- *Surgical consult*
- *Orthopedics consult*
- *Preoperative laboratory studies: prothrombin time, partial thromboplastin time, international normalized ratio, complete blood count, and comprehensive metabolic profile*

Turn the clock forward, and the case will end.

CASE 3: Compartment Syndrome

Setting: *ED*

VS: *BP, 150/90 mm Hg; R, 18 breaths/min; P, 101 beats/min; afebrile*

HPI: *A 25-year-old man who works in a pizza shop presents 3 days after burning his right upper extremity. He was putting his right arm into the oven to grab his favorite slice and subsequently developed a circumferential burn that encompassed his entire upper forearm. Today he presents with significant pain distal to the burn and a pins and needles sensation in his right hand.*

Physical Exam:

- *0 of 5 strength on extension of the right hand*
- *Decreased radial pulses noted by palpation and barely audible by Doppler*
- *Skin distal to the burn is tense and swollen.*
- *There is congestion of the digits with increased capillary refill time.*
- *A black eschar is seen running circularly around the upper right arm.*

What is the most likely diagnosis?

a. Cellulitis
b. Upper extremity deep venous thrombosis (DVT)
c. Rhabdomyolysis
d. Acute compartment syndrome
e. Arterial embolism

Answer d. Acute compartment syndrome

The 6 Ps of compartment syndrome are pain out of proportion to what is expected based on the physical examination findings, paresthesia, pallor, paralysis, pulselessness, and poikilothermia. The underlying etiology of compartment syndrome is rising pressures in the muscle compartment. This is because the fascia layer does not stretch, and thus any swelling, bleeding, or accumulation of fluid can cause significant impairment. Cellulitis would present with pain and fever, but there is never neurologic compromise or lack of pulses. An upper extremity DVT would present with painful swelling, and arterial embolism presents as painful swelling in the setting of a patient with atrial fibrillation. Rhabdomyolysis presents with muscle pain and elevated creatinine kinase levels.

The first P sign of compartment syndrome to occur is paresthesia.

Four compartments of the hand:
• Superficial volar (flexor)
• Deep volar
• Dorsal (extensor) compartment
• Compartment containing the mobile wad of Henry

The five compartments of the lower leg:
• Anterior
• Lateral
• Superficial posterior
• Deep posterior
• Tibialis posterior

What is the best next step in the management of this patient?

a. Computed tomography scan of the right upper extremity
b. Surgical fasciotomy
c. Radiography of the right upper extremity
d. Antibiotics
e. Observation

Answer b. Surgical fasciotomy

Compartment syndrome is a clinical diagnosis and only requires testing with pressure gauging in patients who have an equivocal presentation. If the diagnosis is clear, then the best next step is surgery, known as a fasciotomy, to allow the pressure in the muscle compartments to return to normal. Imaging has no role in the diagnosis of compartment syndrome because testing can take too long and risk permanent damage. Antibiotics are used in addition to fasciotomy, and observation is the best way to cause necrosis of the limb.

If the diagnosis is equivocal, the best next step is to measure intracompartmental pressure. A value greater than 30 mm Hg is an indication for fasciotomy.

Failure to relieve the pressure can cause decreased capillary perfusion and lead to necrosis.

Volkmann's contracture is a permanent flexion contracture of the hand at the wrist, resulting in

a clawlike deformity of the hand and fingers (Figure 13-4).

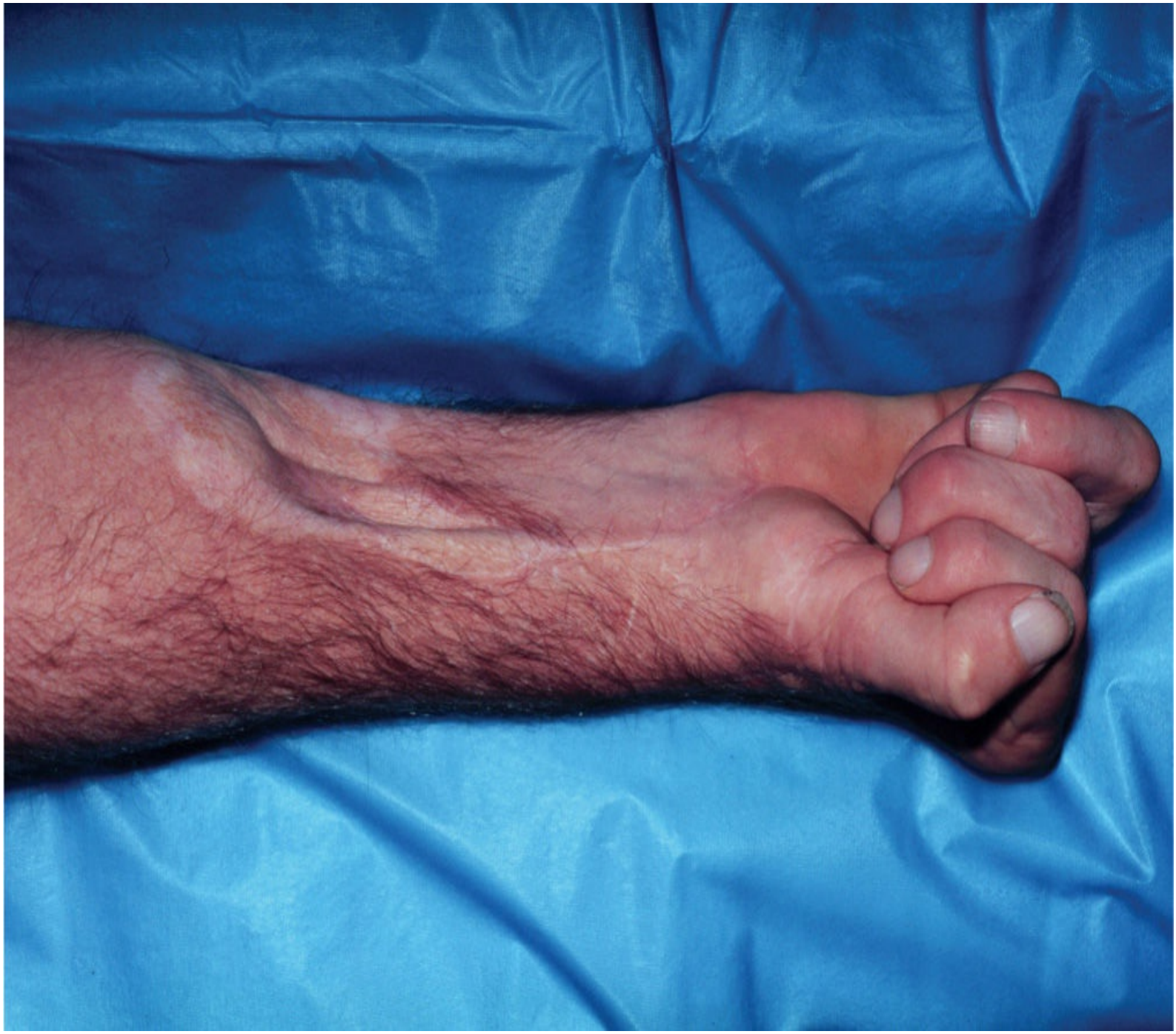


Figure 13-4. Compartment syndrome. A Volkmann's contracture is a serious late complication of unrelieved compartment syndrome. (Reproduced, with permission, from Raukar NP, Raukar GJ, Savitt DL. Extremity trauma. In: Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010.)

Orders:

- *Surgical consult*
- *Fasciotomy*
- *Preoperative laboratory studies: prothrombin time, partial thromboplastin time, international normalized ratio, complete blood count, and comprehensive metabolic profile*
- *Antibiotics*

Turn the clock forward, and the case will end.

CASE 4: Anterior Cruciate Ligament Injury

Setting: *Office*

CC: *"My knee hurts."*

VS: *Stable*

HPI: *A 27-year-old male football player presents to your office 1 week after being tackled. The tackle came across laterally against his right knee, causing him to twist his knee. He remembers hearing a loud popping sound and was unable to return to play secondary to pain, swelling, and instability of the knee. One day later, he noticed significant swelling, difficulty walking, and bruising around the knee.*

Physical Exam:

- *More than 3 mm of side-to-side difference is noticed when the knee is placed in a position of 20 to 30 degrees of flexion and an anteriorly directed force is applied to the proximal calf.*
- *An anterior force is applied, and tibial excursion is noted on the affected knee.*

What is the most likely diagnosis?

a. Anterior cruciate ligament (ACL) injury
b. Posterior cruciate ligament (PCL) tear
c. Medial collateral ligament (MCL) knee injury
d. Osgood-Schlatter disease
e. Osteoarthritis (OA)

Answer a. Anterior cruciate ligament (ACL) injury

An ACL tear is a debilitating musculoskeletal injury commonly seen in athletes after lateral force is applied to the lateral side of the knee, causing a twisting motion. Common physical findings are a positive Lachman test result or anterior drawer sign. In a Lachman test, the knee is flexed at 30 degrees, and a pulling force is applied to the tibia to assess the amount of anterior motion of the tibia compared with the femur. In the drawer sign test, the tibia is drawn forward anteriorly and compared with the dislocation in the femur. The PCL would give a posterior drag test, and a MCL injury is caused by valgus stress to the knee. Osgood-Schlatter disease is an irritation of the patellar ligament at the tibial tuberosity that presents with chronic pain in teenagers. OA is a chronic joint degeneration that takes many years to develop and would not be as acute as in this patient.

The ACL is attached to a fossa on the posteromedial edge of the lateral femoral condyle of the femur, and the tibial insertion is located in a fossa that is anterior to the anterior tibial spine.

The two tests for ACL tears are Lachman test and anterior drawer test.

What is the best next step in the management of this patient?

a. Surgical repair
b. Magnetic resonance imaging (MRI) of the knee
c. Physical therapy
e. Nonsteroidal antiinflammatory drugs (NSAIDs)

Answer a. Surgical repair

Intraarticular reconstruction of the ACL is the most appropriate therapy for this patient and should be performed within 2 to 4 weeks after injury. An MRI is the most accurate diagnostic test, but if the diagnosis is clear from a good history and physical examination, then it is unnecessary. MRI is only confirmatory and thus not the best next step in management (Figure 13-5). Physical therapy is adjunctive therapy to all knee injuries but does not take the place of joint repair. NSAIDs can be used for pain relief only.

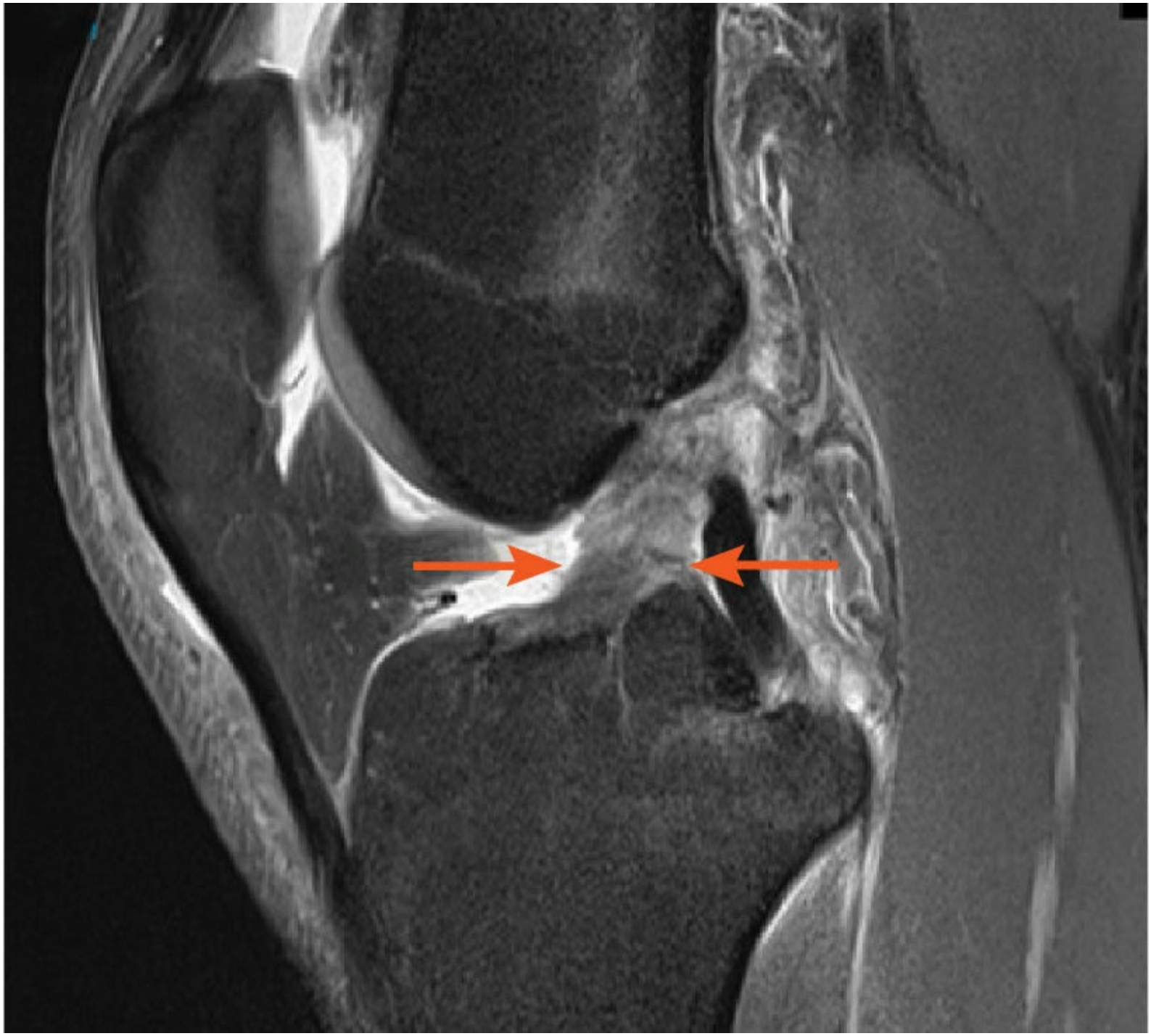


Figure 13-5. Anterior cruciate ligament tear *(arrow)*.

MRI is only used if the diagnosis is not clear from the history and physical examination. The unhappy triad is an injury to the ACL, MCL, and the medial meniscus.

Orders:

- *Orthopedics consult for ACL repair*
- *Preoperative laboratory studies: prothrombin time, partial thromboplastin time, international normalized ratio, complete blood count, and comprehensive metabolic profile*
- *Physical therapy*

Turn the clock forward, and the case will end.

CASE 5: Achilles Rupture

Setting: *ED*

CC: *"My ankle hurts."*

VS: *Stable*

HPI: *A 26-year-old woman who was recently diagnosed with a urinary tract infection (UTI) presents with the sudden onset of severe lower calf and ankle pain in her left leg. The patient states that she was running in a marathon, and at mile 22, she heard a loud popping sound and felt like she had been shot in the back of the left leg.*

Meds:

- *Ciprofloxacin*
- *Oral contraceptive pills (OCPs)*

ROS:

- *Limping*
- *Unable to walk*

Physical Exam:

- *Gastrosoleus complex muscle is tender, warm, and bruised*
- *Excessive dorsiflexion of the affected leg*
- *No passive plantar flexion of the foot with calf squeeze*
- *Patient unable to stand on toes of affected foot*

What is the most likely diagnosis?

a. Ruptured Baker's cyst
b. Achilles tendon rupture
c. Ankle fracture
d. Reactive arthritis
e. Deep venous thrombosis (DVT)

Answer b. Achilles tendon rupture

A patient with an Achilles tendon rupture presents with a sudden snap in the lower calf associated with acute, severe pain and an inability to walk. The patient is unable to walk and has two significant physical examination findings. The first is hyperdorsiflexion, in which the foot has excessive dorsiflexion, and a positive Thompson test result, when squeezing the calf does yield plantar flexion. A ruptured Baker's cyst presents with pain behind the knee, and reactive arthritis is the classic "can't pee, can't see, can't climb a tree" after urethritis or UTI. A DVT presents with unilateral swelling and a palpable cord in the back of the leg, with pain upon dorsiflexion.

The main blood supply is derived from both long and short component of the vincula.

The Achilles tendon is formed from the tendons of the gastrocnemius and soleus muscles.

What is the best next step in the management of this patient?

a. Surgical repair
b. Conservative management
c. Magnetic resonance imaging (MRI) of the leg
d. Ultrasonography
e. Radiography

Answer a. Surgical repair

Treatment can include surgical and nonsurgical approaches, and the surgical option is the best next step in management for a young patient who is a good surgical candidate. Nonsurgical management is reserved for elderly adults and those who are poor surgical candidates. Imaging such as ultrasonography, MRI, or radiography is only used if the patient's physical findings are equivocal. Conservative management includes casting, pain management, and physical therapy and is reserved for elderly adults.

The most accurate diagnostic test for Achilles tendon rupture is MRI.
Quinolone antibiotics are associated with tendon rupture because they are toxic to teknocytes.

Orders:

- *Orthopedics consult for ACL repair*
- *Preoperative laboratory studies: prothrombin time, partial thromboplastin time, international normalized ratio, complete blood count, and comprehensive metabolic profile*
- *Physical therapy*

Turn the clock forward, and the case will end.

CASE 6: Ruptured Baker's Cyst

Setting: *Office*

CC: *"The back of my knee hurts."*

VS: *Stable*

HPI: *A 64-year-old woman with rheumatoid arthritis (RA) presents with severe popliteal and calf pain that is nonradiating in her right knee. The patient states that this pain is different from the pain she has in both of her knees. The patient states she noticed a swelling in the back of her leg before the pain, but she thought it was due to her RA.*

PMH:
- *RA*
- *Diabetes mellitus type 2*

Meds:
- *Methotrexate*
- *Occasional acetaminophen*

Physical Exam:
- *Warm and tenderness in the popliteal fossa*
- *Large ecchymoses noticed from the popliteal fossa down to the ankle*
- *Significant decreased range of motion compared with the left knee*
- *Positive Homan's sign*

What is the most likely diagnosis?

a. Deep venous thrombosis (DVT)
b. Popliteal artery aneurysm
c. Ruptured Baker's cyst
d. Osteoarthritis
e. Anterior cruciate ligament (ACL) rupture

Answer c. Ruptured Baker's cyst

The most likely diagnosis is a ruptured Baker's cyst. A Baker's cyst arises because of preexisting trauma or damage to the knee joint, allowing the synovial sac of the knee to protrude posteriorly and create a bulge. After some time, the cyst will pinch off rather than continue to communicate with synovial joint and can rupture, causing severe pain and bleeding. A DVT can cause Homan's sign but does not cause bruising, and a popliteal artery aneurysm would cause a pulsatile swelling behind the knee. OA causes pain in the back of the knee in some patients but no bruising, and an ACL rupture would occur after trauma to the knee.

A Baker’s cyst is not a true cyst, and there is communication with the synovial sac (Figure 13-6).

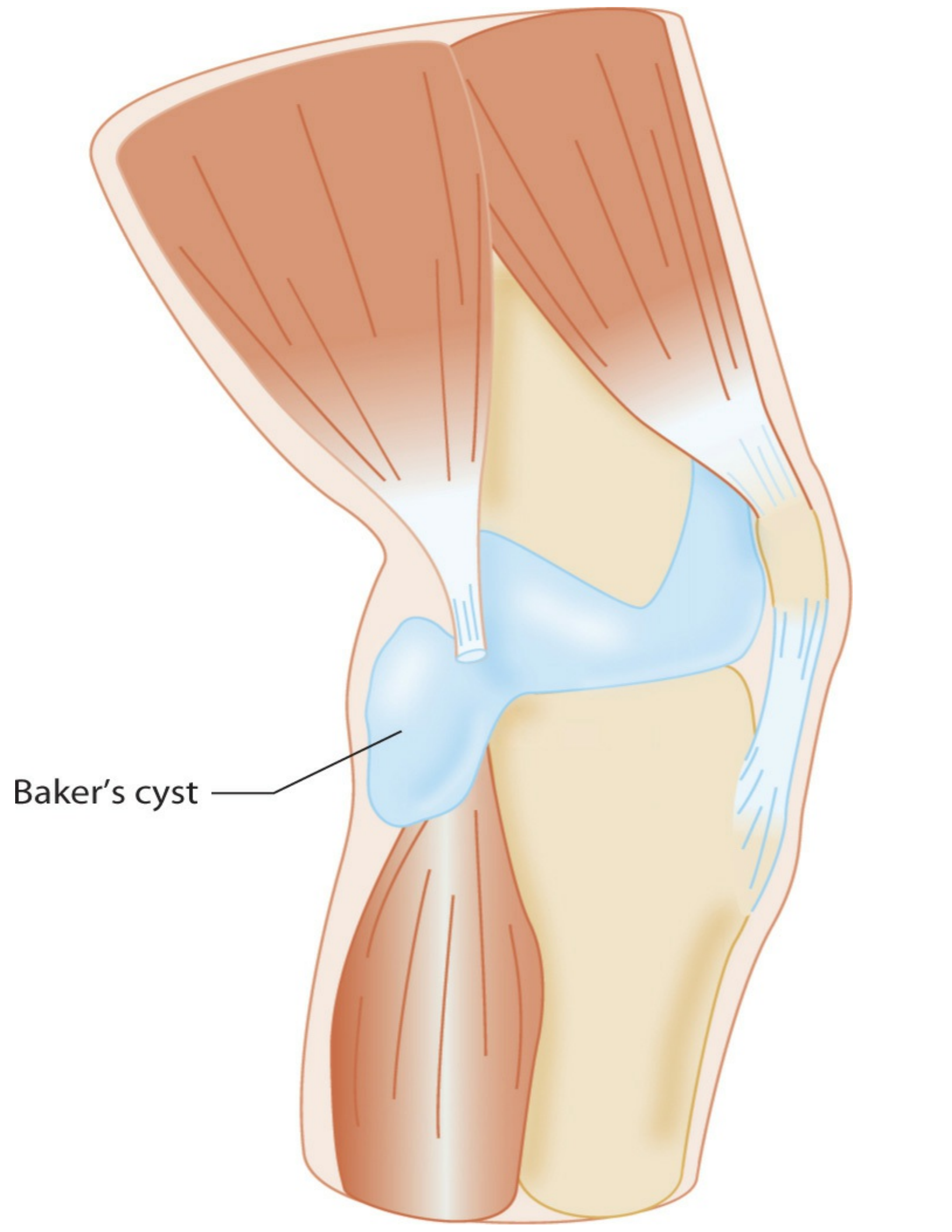

Baker's cyst

Figure 13-6. A Baker's cyst (an extension of the semimembranosus bursa). (Reproduced, with permission, from Simon RR, Sherman SC. *Emergency Orthopedics*. 6th ed. New York: McGraw-Hill; 2011.)

Baker's cysts are associated with rheumatoid arthritis, Lyme disease, and meniscal tears.

What is the best next step in the management of this patient?

a. Steroid injection
b. Leg elevation
c. Nonsteroidal antiinflammatory drugs (NSAIDs)
d. Physical therapy
e. All of the above

Answer e. All of the above

Given the fact that this patient's cyst has ruptured, the treatment is to prevent reaccumulation of fluid and provide pain relief. A steroid injection combined with physical therapy, leg elevation, and NSAIDs are the mainstays to prevent a new cyst from forming.

Whereas the best initial test for an unruptured Baker's cyst is ultrasonography, the most accurate test is MRI (Figure 13-7).

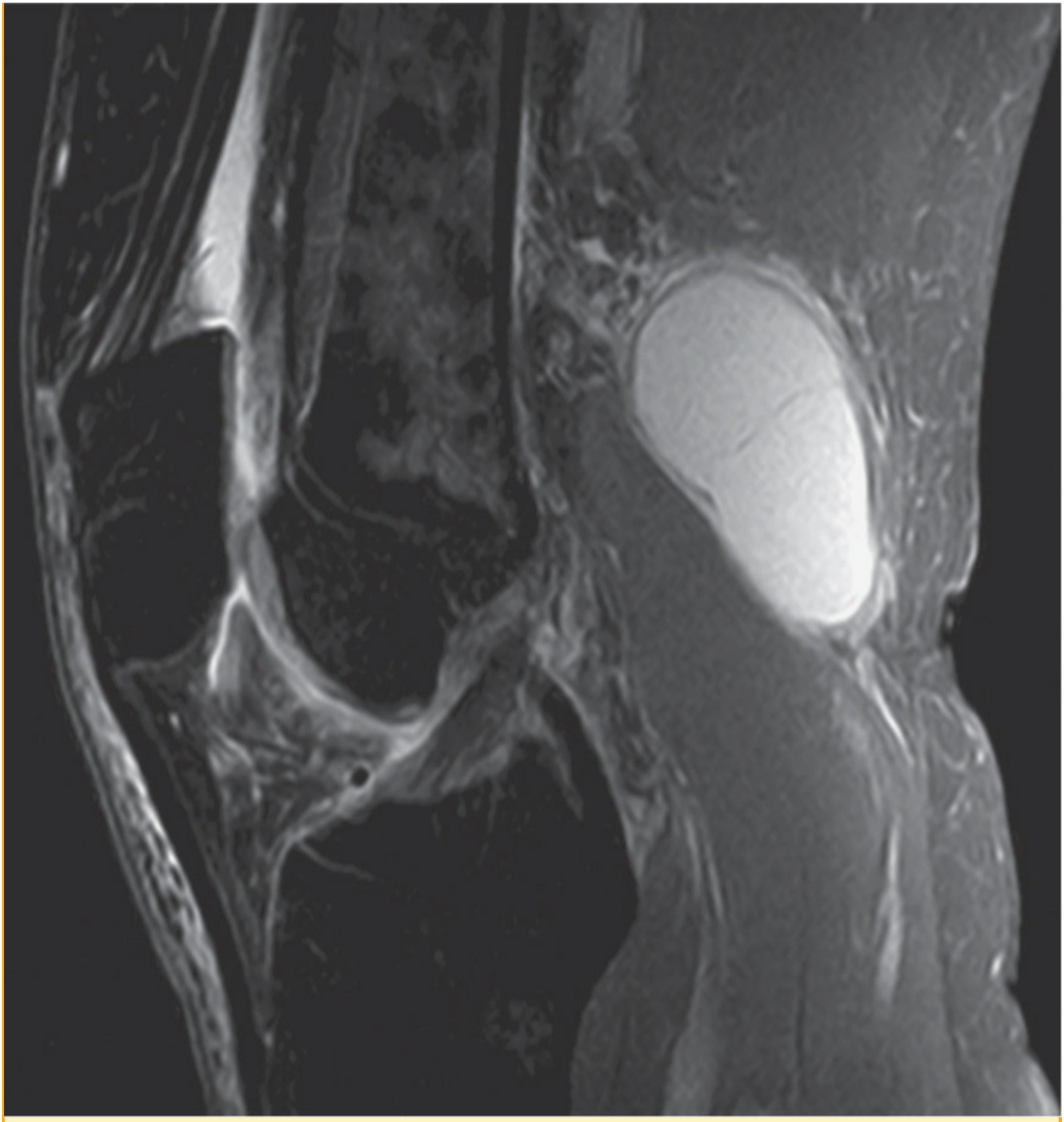


Figure 13-7. A Baker's cyst seen on sagittal magnetic resonance imaging.

If a patient has a painful unruptured Baker's cyst, surgical consult for excision is the most definitive therapy.

Orders:

- *Intraarticular steroid injection*
- *Ibuprofen*
- *Send the patient home and bring her back in 4 weeks.*

Turn the clock forward, and the case will end.

CASE 7: Hip Fracture

Setting: *ED*

CC: *"My mother fell."*

VS: *BP, 140/90 mm Hg; R, 18 breaths/min; P, 121 beats/min; afebrile*

HPI: *A daughter brings in her 75-year-old mother after she was found on the floor of her apartment. The mother lives alone and said she fell while trying to get to the bathroom from bed and tripped over her carpet. She denies any preceding chest pain, palpitations, or loss of consciousness. When her daughter tried to help her to walk, she could not bear weight on the affected leg.*

PMH:
- *Osteoporosis*
- *Gastroesophageal reflux disease*
- *Mild cognitive impairment*

Physical Exam:
- *Small abrasions over bilateral knees*
- *The right leg is shorter than the left and externally rotated compared with the right.*
- *Painful right hip with limited range of motion*

What is the most likely diagnosis?

a. Femoral neck fracture
b. Kidney stone
c. Femoral shaft fracture
d. Slipped capital femoral epiphysis
e. Legg-Calvé-Perthes syndrome

Answer a. Femoral neck fracture

Femoral neck fractures present with significant pain in the affected hip joint after a fall or trauma. On examination, ecchymosis, limited range of motion, and a shortened externally affected leg is seen. The pain is described as constant and can radiate into the inguinum, similar to the pain of kidney stone, but that pain starts in the flank. A femoral shaft fracture would be distally and cause a shortened (but not rotated) leg. Slipped capital femoral epiphysis is a form of femoral neck fracture but which occurs in obese adolescents and not adults. Legg-Calvé-Perthes syndrome is a form of vascular necrosis of the femoral head that is commonly seen in young children.

The greater and lesser trochanters are sites for muscle attachment. The iliopsoas muscle

connects to the lesser trochanter, and the abductors attach to the greater trochanter.

Osteoporosis is the most common risk factor for femoral neck fractures in elderly adults.

What is best next step in the management of this patient?

a. Radiography of the affected hip
b. Radiography of both hips
c. Magnetic resonance imaging (MRI)of the pelvis
d. Ultrasonography of the abdomen

Answer b. Radiography of both hips

Radiography of the affected hip is obviously the best initial test, but it is important to get an image of both hips to rule out a contralateral occult fracture. The most accurate test is a MRI of the pelvis, while ultrasound is the best test for deep venous thromboses, kidney stones, and non–bone-related pathology. In addition, preoperative laboratory studies should be obtained at this time in preparation for possible surgical intervention.

The blood supply of the femoral neck comes from the medial and lateral circumflex arteries, which are branches of the deep femoral artery.

Orders:
- *Complete blood count (CBC)*
- *Morphine*
- *Comprehensive metabolic profile (CMP)*
- *Partial thromboplastin time*
- *Prothrombin time*
- *Radiography of the pelvis with femoral neck views*

Result: *CBC, CMP, and coagulation profiles are within normal limits. Radiography of the pelvis reveals a femoral neck fracture with shortening and impaction of the femoral neck consistent with Garden class 4.*

Garden Classification

Type	Description
1	Stable fracture with impaction in valgus
2	Complete but nondisplaced
3	Partially displaced with varus displacement but with contact between the two fragments
4	Completely displaced with no contact between the fracture fragments

What is best next step in the management of this patient?

a. Hip replacement
b. Observation
c. Screw and pinning
d. Physical therapy

Answer a. Hip replacement

A hip replacement or hemiarthroplasty is the most appropriate therapy for a patient with a femoral neck fracture. Screw and pinning are the correct answers for patients with intertrochanteric fractures. Physical therapy is to be ordered after surgical intervention, and observation will never cause bone to fuse.

Hip replacement is when the head and neck of the femur are completely replaced with a prosthetic joint, and hemiarthroplasty is when the broken part of the femoral bone is replaced with a metal implant.

Orders:
- *Cefazolin*
- *Orthopedics consult*

- *Hip replacement*
- *Admit to wards*
- *Physical therapy*

Turn the clock forward, and the case will end.

CASE 8: Morton's Neuroma

Setting: *Office*

CC: *"My foot hurts."*

VS: *Stable*

HPI: *A 27-year-old account executive for a failing medical board review company presents with pain and tingling in her right foot. She states the pain is most notable between her second and third metatarsals. She says her foot feels better when she removes her 4-inch heels and massages her foot. The pain occurs a few times a week and waxes and wanes in intensity.*

PMH: *History of gonorrhea treated 6 months ago*

Physical Exam: *Palpating the affected web space causes a palpable click that reproduces the symptoms.*

What is the most likely diagnosis?

a. Metatarsal fracture
b. Tibial stress fracture
c. Morton's neuroma
d. Plantar fasciitis

Answer c. Morton's neuroma

Morton's neuroma is a common and painful condition of the common digital nerve of the foot, most commonly seen between the second and third web spaces. A metatarsal fracture presents after trauma and is accompanied by severe constant pain with possible ecchymosis. A tibial stress fracture is an overuse injury with pain over the tibial bones rather than in the foot, and plantar fasciitis is self-resolving pain in the bottom of the foot that feels like a tack and improves with walking.

The neuroma develops on a branch of the common digital nerve in the foot.

What is the best next step in the management of this patient?

a. Radiography of the foot
b. Ultrasonography of the foot
c. Magnetic resonance imaging (MRI) of the foot

Answer b. Ultrasonography of the foot

The best initial test for a Morton's neuroma is an ultrasonography; however, it is uncommonly done because a history and physical examination is adequate to make the diagnosis. Radiography of the foot will not pick up the neuroma because they are not radiopaque, and MRI of the foot is the most accurate diagnostic test.

When a patient is thought to have a Morton's neuroma, the best initial therapy is to rest the feet and stop wearing painful shoes.

Orders:

- *Ultrasonography of the foot*
- *Send the patient home*
- *Counsel the patient to stop wearing high-heeled pointy shoes*

Result: *The patient returns after 4 weeks and says she cannot live without her red-colored-shoes, and her feet hurt more.*

What is the best next step in the management of this patient?

a. Steroid injection
b. Alcohol ablation
c. Gabapentin
d. Surgical resection

Answer a. Steroid injection

If conservative measures such as wide based shoes are not helping or the patient is not compliant, a steroid injection is the best next step. The most definitive therapy is surgical resection of the nerve and removing it from within the web space. Gabapentin has not been shown to help, and alcohol ablation does not have enough evidence or studies to back it as a viable treatment modality.

Orders:

- *Steroid injection*
- *Send the patient home to return in 4 weeks. If the patient's condition does not improve, obtain an orthopedics consult for resection of the neuroma.*

OPHTHALMOLOGY

CASE 1: Open-Angle Glaucoma

Setting: *Office*

CC: *"I have difficulty seeing."*

VS: *Stable*

HPI: *A 76-year-old African American man presents for primary care evaluation. He has no complaints and is in the office for a well visit. Recently he has begun using reading glasses. He no longer drives because of difficulty reading signs.*

PMH: *Benign prostatic hyperplasia*

FH: *Glaucoma*

Physical Exam: *Presence of cupping at the optic disc on funduscopy (Figure 14-1).*

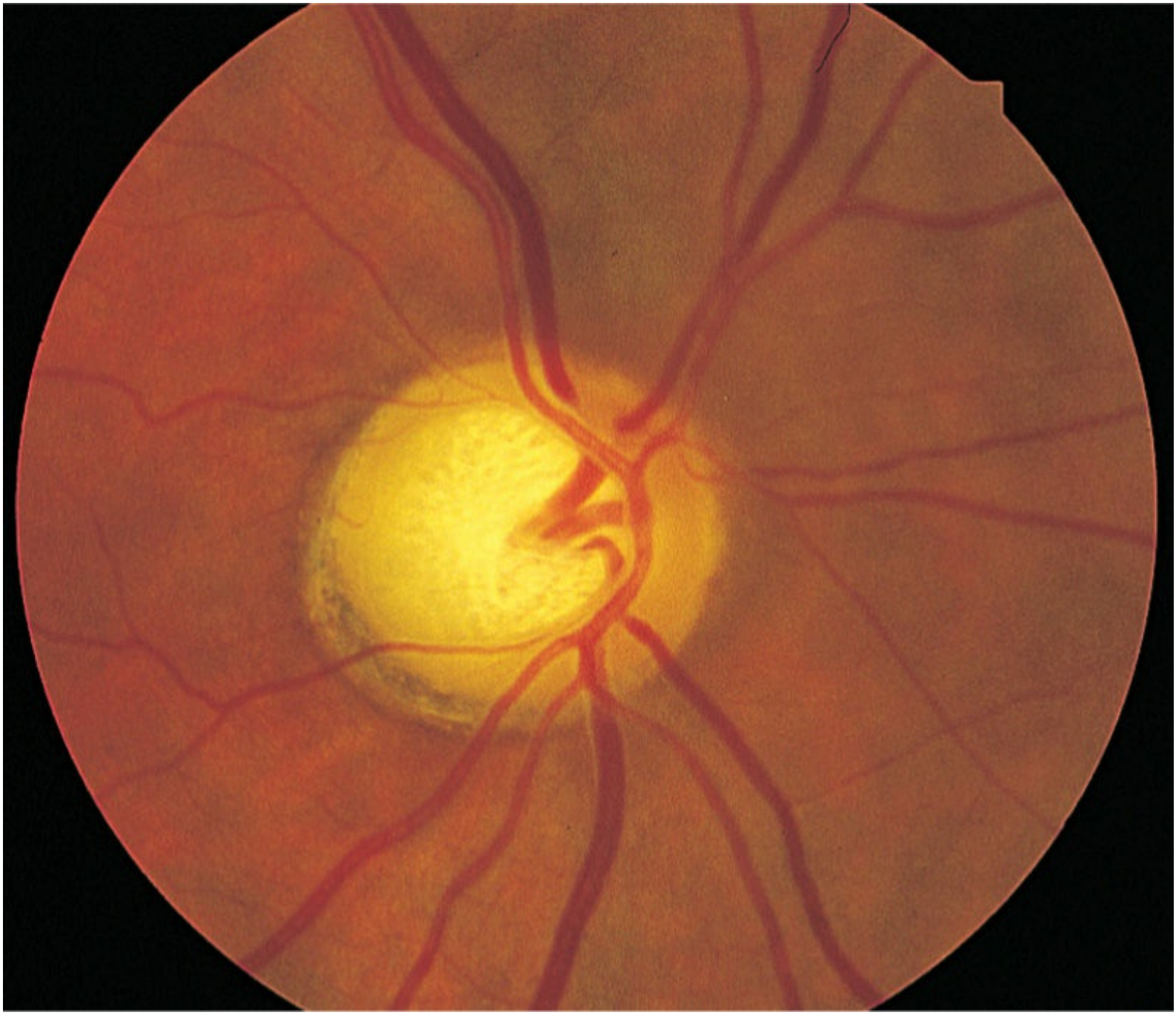


Figure 14-1. Optic disk cupping in glaucoma. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012).

What is the most likely diagnosis?

a. Open-angle glaucoma
b. Idiopathic intracranial hypertension (IIH)
c. Angle-closure glaucoma
d. Diabetic retinopathy
e. Optic nerve drusen

Answer a. Open-angle glaucoma

Open-angle glaucoma is a disorder that results in increased pressure in the eye. Open angle chronic glaucoma is painless and develops over time. On examination there is optic disc cupping describes a hollowed-out appearance of the optic nerve or "disc" on funduscopy. A cup whose diameter is

greater than 50% of the vertical disc diameter is indicative of glaucoma. IIH has optic disc blurring; angle-closure glaucoma is painful and presents with a fixed red eye. Diabetic retinopathy has neovascularization and cotton wool spots, and optic nerve drusen has globules of mucoproteins and mucopolysaccharides that progressively calcify in the optic disc.

Aqueous humor → trabecular meshwork → canal of Schlemm

The U.S. Preventive Services Task Force does not recommend screening for glaucoma.

What is the best next step to confirm the diagnosis in of this patient?

a. Tonometry
b. Visual field defects
c. Tonometry and visual field defects

Answer c. Tonometry and visual field defects

Tonometry alone is not enough to diagnose glaucoma, and neither is visual field defects alone; however, together their sensitivity and specificity are high enough to confirm glaucoma. Furthermore, the absence of nerve damage on funduscopy does not rule out open-angle glaucoma because many patients with elevated pressure do not have evidence of nerve damage. For cases in which patients are equivocal on both, corneal thickness measurement or pachymetry is the tiebreaker.

Intraocular pressure (IOP) and what to do!
- IOP >40 mm Hg: emergency referral
- IOP 30 to 40 mm Hg: urgent referral to ophthalmology office
- IOP 25 to 29 mm Hg: evaluation within 1 week
- IOP 23-24 mm Hg: repeat measurement in 6 months

Orders:
- *Tonometry*
- *Optic field testing*

Turn the clock forward to obtain the results of tests.

Result: *Tonometry reveals IOP of 25 with mild visual field deficits.*

What is the best next step in the management of this patient?

a. Pharmacologic therapy
b. Laser therapy
c. Surgical therapy

Answer a. Pharmacologic therapy

Lowering IOP has been shown to reduce the risk of progression of visual field loss and optic disc changes. There are two major kinds of medications: the first increases aqueous outflow, and the second decreases aqueous production. Laser therapy is second-line treatment and increases aqueous outflow. Surgical therapy is for refractory cases and creates a filtration bleb to allow aqueous humor to leave the eye through an alternative route.

Prostaglandin analogs, such as latanoprost, *increase* outflow of aqueous humor.
β-Blockers, such as timolol, *decrease* aqueous humor production.
Carbonic anhydrase inhibitors, such as acetazolamide, *inhibit carbonic anhydrase* in the ciliary body and decrease aqueous humor production.

Orders:
- *Latanoprost*
- *Timolol*
- *Acetazolamide*

Turn the clock forward, and the case will end.

CASE 2: Angle-Closure Glaucoma

Setting: *ED*

CC: *"My left eye really hurts."*

VS: *BP, 160/90 mm Hg; R, 20 breaths/min; P, 100 beats/min; T, 100.1°F*

HPI: *A 74-year-old man presents to the emergency department with severe left eye pain, nausea, vomiting, and decreased vision in his eye. He sees halos around lights and has a terrible headache on the left side as well. This began about 2 hours ago while he was at the movie theater and has not decreased in intensity whatsoever.*

PMH: *Hyperopia*

Physical Exam:
- *Conjunctival redness*
- *Corneal edema*
- *A shallow anterior chamber on funduscopy*
- *A mid-dilated pupil (4 to 6 mm) that reacts poorly to light*
- *The conjunctival vessels are dilated*

What is the most likely diagnosis?

a. Conjunctivitis
b. Corneal abrasion
c. Infectious keratitis
d. Angle-closure glaucoma
e. Traumatic hyphema

Answer d. Angle-closure glaucoma

The combination of painful red eye with decreased vision, corneal edema, and a shallow anterior chamber are the findings of note seen in angle-closure glaucoma. Classic presentation of corneal abrasion is a patient who presents with the sensation of sand in the eye, and infectious keratitis is seen in patients who have recently received steroids with herpetic infections of the optics. Traumatic hyphema does have a red eye, but it occurs when a patient has frank blood in the anterior chamber (Figure 14-2).

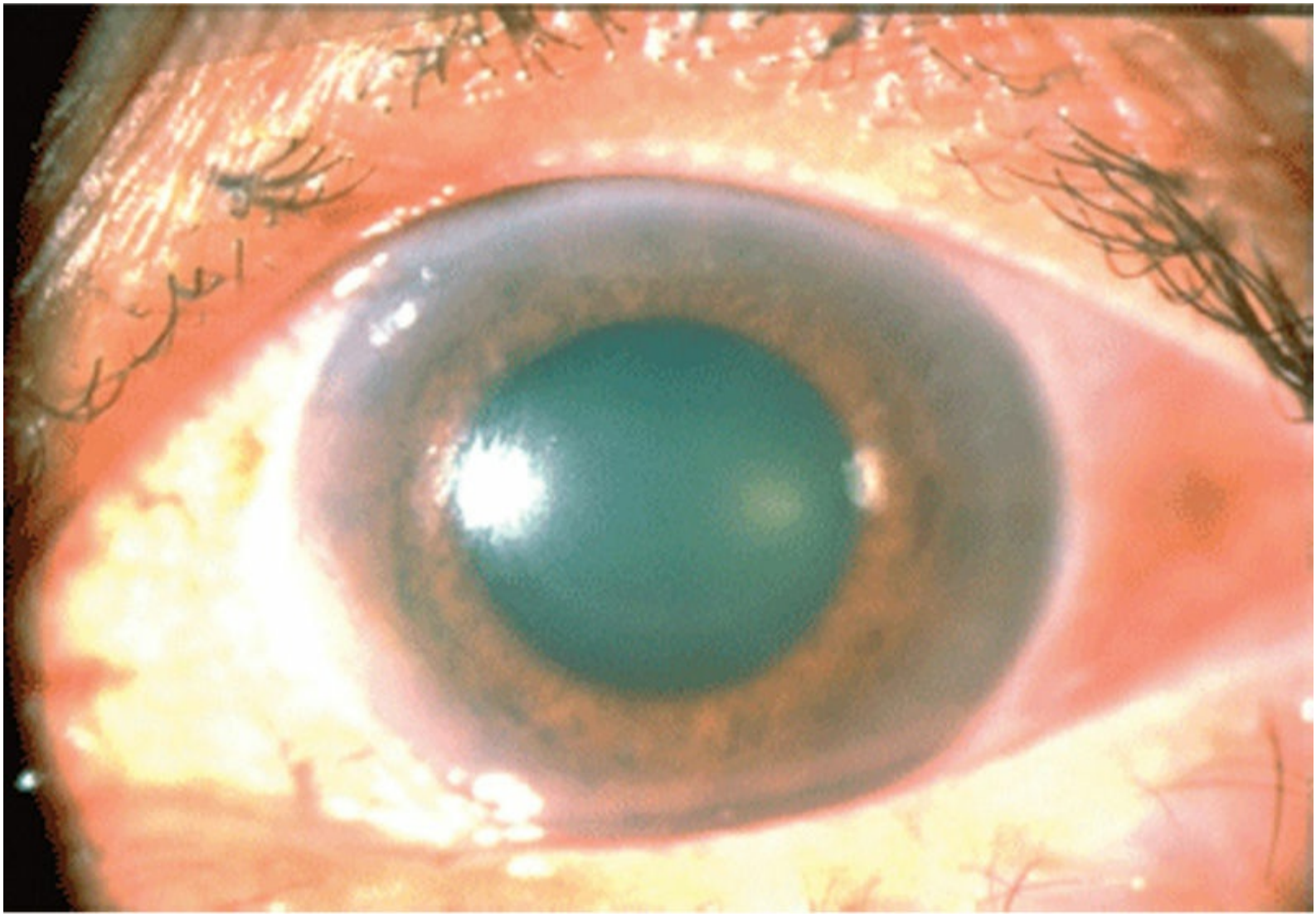


Figure 14-2. Mid-dilated pupil and corneal clouding (seen as loss of typical corneal sheen and dulling of corneal light reflex) in a case of acute angle-closure glaucoma. (Reproduced, with permission, from McKean SC, et al. *Principles and Practice of Hospital Medicine*. New York: McGraw-Hill; 2012.)

Clues to diagnosis of angle-closure glaucoma:
- Red eye with pain
- Halo vision
- No history of glaucoma

Acute angle-closure glaucoma occurs most commonly at night because low light levels cause mydriasis, and folds of the peripheral iris block the angle of Schlemm.

What is the best next step in the management of this patient?

a. Pharmacologic therapy by an ophthalmologist
b. Laser iridotomy by an ophthalmologist
c. Gonioscopy by an ophthalmologist

d. Slit lamp grading by an ophthalmologist
e. Computed tomography (CT) scan of the orbit

Answer c. Gonioscopy by an ophthalmologist

The best next step in the management of this patient is to refer to an opthalmologist for gonioscopy, which is the most accurate test for diagnosing angle-closure glaucoma. This is typically combined with tonometry to garner a pressure. This uses a special lens, which allows to visualize the angle and look for closure. This must be done by ophthalmologists and is one of the few times in the entire USMLE in which a consult must be called for both diagnosis and treatment.

Orders:
• *Ophthalmology consult*
• *Gonioscopy*
• *Turn the clock forward*
Gonioscopy reveals complete closure of the angle of Schlemm.

What is the best next step in the management of this patient?

a. Pharmacologic therapy by ophthalmologist
b. Laser iridotomy by ophthalmologist
c. Surgical iridotomy

Answer a. Pharmacologic therapy by ophthalmologist

The most appropriate therapy for angle-closure glaucoma is topical pressure-lowering eye drops combined with systemic acetazolamide. The combinations most often used for eye drops are timolol, apraclonidine, and pilocarpine. The intraocular pressure should be rechecked after 60 minutes, and if medical treatment is successful, then laser peripheral iridotomy is the next most appropriate therapy. If the angle has not opened after 60 minutes through both treatment modalities, then surgical peripheral iridectomy is the ultimate therapy.

Orders:
• *Timolol, apraclonidine, and pilocarpine eye drops*
• *Turn the clock forward 60 minutes, and repeat gonioscopy.*
The patient reports decreased corneal edema and eye pain. Repeat gonioscopy reveals opening of the angle.

Orders:
• *Laser iridotomy*
• *Turn the clock forward, and the case will end.*

Always check the other eye; 50% of the time, the other eye has an episode of angle closure within 5 years.

CASE 3: Retinal Vein Occlusion

Setting: *ED*

CC: *"I can't see out of my left eye."*

VS: *Stable*

HPI: *A 67-year-old man presents with loss of vision in his left eye. He states that the loss of vision was gradual with several episodes of blurring, and it looks blue-gray out of the affected eye. The patient has no other complaints and has no pain associated with the loss of vision in either eye. He is able to see normally out of this other eye and says this has never happened to him before.*

ROS: No headache

Physical Exam:

- *Variable dot and flame hemorrhages in all four quadrants*
- *Optic nerve swelling*
- *Retinal vein engorgement and tortuosity*
- *No cotton wool spots*

What is the most likely diagnosis?

a. Central retinal artery occlusion
b. Central retinal vein occlusion (CRVO)
c. Retinal detachment
d. Temporal arteritis

Answer b. Central retinal vein occlusion (CRVO)

CRVO occurs presumably secondary to Virchow's triad and leads to blood flow egress compromise. Overall, it is unknown precisely why the retinal vein is obstructed. The most common location is in the central retinal vein, which causes pressure to build in the capillaries and subsequent hemorrhage and leakage of fluid and blood. Macular ischemia causes nonperfusion of the retina and, in turn, visual loss. Retinal detachment would have to be preceded by trauma, and temporal arteritis is a rheumatologic condition associated with a headache. Central retinal artery occlusion presents with a more acute painless vision loss associated with a "curtain falling over the eye" when caused by emboli.

Funduscopy will reveal dilated retinal veins.

What is the most accurate test for the diagnosis of CRVO?

a. Fluorescein angiography
b. Magnetic resonance imaging of the brain
c. Clinical examination
d. Funduscopy

Answer a. Fluorescein angiography

Fluorescein angiography of the retinal vein is most accurate test to diagnose CRVO; however, it is a test that is not always done because clinical presentation is usually enough. It is a confirmatory test when clinical examination findings are equivocal.

What is the best next step in the management of this patient?

a. Ranibizumab
b. Laser photocoagulation
c. Dexamethasone
d. All of the above

Answer d. All of the above

The treatment involves the acute administration of dexamethasone for the macular edema followed by laser photocoagulation and ranibizumab to prevent neovascularization.

CCS TIP: *In CRVO, after the diagnosis is confirmed based on history and physical examination, order treatment next. Confirmatory tests are done only when the presentation is equivocal.*

Orders:
- *Ranibizumab*
- *Laser photocoagulation*
- *Dexamethasone*
- *Ophthalmology consults*

Turn the clock forward, and the case will end.

Ranibizumab inhibits vascular endothelial growth factor (VEGF).
VEGF inhibitors treat macular degeneration and diabetic retinopathy.

CASE 4: Central Retinal Artery Occlusion

Setting: *ED*

CC: *"I can't see out of my right eye."*

VS: *Stable*

HPI: *A 70-year-old man presents with persistent painless loss of vision. He says there is a complete loss of vision.*

PMH:
- *Hypertension*
- *Diabetes*

ROS:
- *No pain*
- *No palpitations*
- *No headache*

Physical Exam:
On funduscopy:
- *Pale retina*
- *Macule is redder than surrounding pale retina*
- *Afferent pupillary defect when light is shined in the unaffected eye*
- *Irregularly irregular pulse*
- *No focal neurologic deficits*

What is the most likely diagnosis?

a. Central retinal artery occlusion (CRAO)
b. Central retinal vein occlusion (CRVO)
c. Retinal detachment
d. Temporal arteritis
e. Cerebrovascular accident (CVA)

Answer a. Central retinal artery occlusion (CRAO)

The presentation of painless visual loss that is complete and a pale retina with a cherry red spot on the macula is consistent with CRAO. CRVO presents with an edematous retina and blurry vision. Because no headache is mentioned and there is no trauma, retinal detachment and temporal arteritis are unlikely. Last, complete visual loss can be apart of a CVA, but without focal neurologic deficits, it is more likely localized to the CRAO rather than a stroke.

Internal carotid artery → ophthalmic artery → central retinal artery
The first branch of the carotid is the ophthalmic artery.

Atherosclerosis of the ipsilateral carotid artery is the most common cause of CRAO.

What is the best next step in the management of this patient?

a. Heparin
b. Clopidogrel
c. Pilocarpine
d. Thrombolytic therapy

Answer d. Thrombolytic therapy

Intraarterial thrombolytic therapy is done to establish reperfusion in CRAO. There really is no clear therapy proven to reverse retinal artery occlusion. We use ocular massage, oxygen, and thrombolytics because they may have some benefit, and the alternative is just to let the patient go blind in that eye.

It is not clear if intravenous thrombolytics or administering it directly into the retinal artery is superior. Ocular massage causes an increased aqueous outflow through the increased pressure and may dislodge the embolism. Although it does not necessary always help, it is attempted. Anterior chamber paracentesis uses a syringe to cause a sudden decrease in ocular pressure. This requires highly trained individuals, who are not always available. Last, vasodilator medications such as nitroglycerin are used as adjunctive therapy while the patient is about to undergo thrombolytic therapy.

Eyes are a part of the central nervous system (CNS). Perfusion must be restored within 100 minutes.

The brain and neural tissue have no glycogen stores
No glycogen = No stored glucose
CNS cells eat only glucose
No glycogen = Extreme sensitivity to tissue hypoxia

Electrocardiography (ECG) must always be performed to rule out atrial fibrillation.

Orders:
• *Ophthalmology consult*
• *Thrombolytic therapy*
CCS TIP: *In CRAO, echocardiography, ECG, telemetry, and carotid Doppler should be performed to find the underlying cause.*

What is the best next step in the management of this patient?

a. Carotid artery duplex ultrasonography
b. ECG
c. Hypercoagulability testing
d. All of the above

Answer d. All of the above

All of the above should be done. However, in this patient, the irregularly irregular pulse indicates that the patient is likely in atrial fibrillation and will need to have a workup to confirm the arrhythmia. However, because the most common cause is carotid artery stenosis, duplex ultrasonography is necessary. If both the ECG and ultrasonography are negative, then the patient will require a hypercoagulability workup.

The most common cause of thrombophilia is a factor V Leiden mutation.

Orders:
• *ECG*
• *Carotid duplex*

Turn the clock forward, and the case will end.

Thrombolytics break down clot before it has been permanently stabilized by factor XIII. It only dissolves fresh clots.

CASE 5: Retinal Detachment

Setting: *ED*

CC: *"I can't see out of my right eye."*

VS: *BP, 180/76 mm Hg; R, 18 breaths/min; P, 101 beats/min; T, 99.0°F*

HPI: *A 35-year-old woman presents after a motor vehicle accident in which she was texting while driving. She was wearing a seat belt and has very few injuries. She is unable to see out of her right eye and complains of flashes of light in the affected eye. The patient points to numerous black dots moving around in her field of vision and says her right eye is heavy. Just after arriving at the emergency department, she thought a curtain was coming down around her right visual field.*

Physical Exam: *On funduscopy, numerous retinal folds and posterior vitreous detachment are seen (Figure 14-3).*

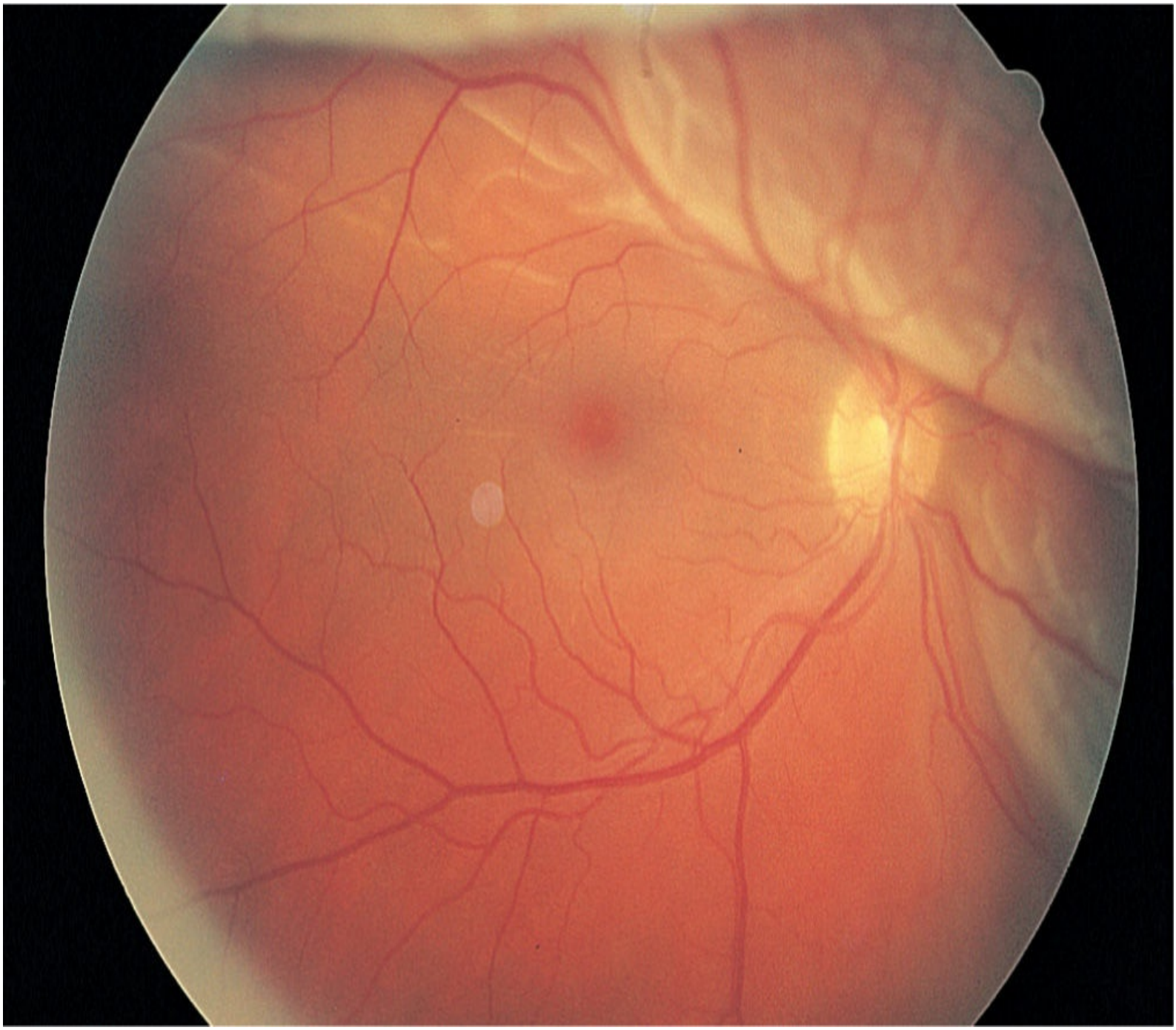


Figure 14-3. Retinal detachment appears as an elevated sheet of retinal tissue with folds. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

What is the best next step in the management of this patient?

a. Consult ophthalmology
b. Start steroids
c. Consult surgery
d. Tilt back her head

Answer d. Tilt back her head

The management of retinal detachment is all about the physical reattachment of the retina with the sclera behind it. You do need to consult ophthalmology, but do *not* wait for the consultant to start to try to reattach the retina.

Posttraumatic vision loss, flashes of light, and floaters are highly suggestive of retinal

detachment. Retinal detachment must have an ophthalmologic consult immediately because this is an emergency. You might say that consults on Step 3 CCS are irrelevant because they do not tell you what to do. The point of the consultation in a retinal detachment is that you demonstrate that you know that there is no meaningful therapy for a detachment other than to physically return the retina to physical contact with the sclera.

Posterior vitreous detachment allows vitreous fluid to seep under the retina and peel it away like a bubble under wallpaper.

What is the most effective therapy for a patient with retinal detachment?

a. Laser photocoagulation
b. Surgery
c. Intravenous glue injection
d. Pilocarpine

Answer a. Laser photocoagulation

Laser photocoagulation, in which areas of the retina are tacked back on to eye, prevents the spread of the detachment. Surgical therapy is used when the patient has a large or complex retinal detachment and laser photocoagulation fails. Laser photocoagulation, cryotherapy, and scleral buckling are all clearly superior to the physical reattachment of the retina with surgery.

You move the clock forward to the time of the laser photocoagulation treatment. Have the patient return to the office at 1, 2, and 4 weeks after the procedure. Do an interval history.

Interval History: *The patient still has significant visual loss. The retina is only partially reattached.*

Which of the following should be tried?

a. Enucleation
b. Injection of gas into the vitreous chamber
c. Acetazolamide
d. β-Blockers

Answer b. Injection of gas into the vitreous chamber

When initial therapy with laser photocoagulation and cryotherapy do not work, there are still several procedures that may work to physically reattach the retina. Injection of an expansile gas into the vitreous chamber of the eye and tilting the head forward can help push the retina back against the sclera. This procedure requires that the patient be face down for 18 hours a day. Scleral buckling to pull the sclera into physical contact with the retina can also be performed. β-Blockers,

acetazolamide, and pilocarpine are treatments for glaucoma that have no effect in retinal detachment.

CASE 6: Macular Degeneration

Setting: *Office*

CC: *"Trouble seeing, that has been worsening over the past 2 years."*

VS: *Stable*

HPI: *A 75-year-old man presents with gradual visual loss over the past several years. He has been using reading glasses, magnifying glasses, and extra lights when reading menus at restaurants. He has to let his wife drive the car because he has difficulty with seeing the road signs. Recently his wife says he thinks the edges of doors are curved and mentions he has become very depressed because of this. When you ask him direct questions, he says he cannot see your face.*

Physical Exam:

- *Visual acuity drastically reduced to 20/80*
- *Visual field testing reveals central scotomas*
- *Metamorphopsia*
- *Trouble discerning colors, specifically dark ones from dark ones and light ones*

On funduscopy (Figure 14-4):

- *Numerous pigmentary changes*
- *Severe neovascularization*
- *Hard exudates and hemorrhages*
- *No drusen*

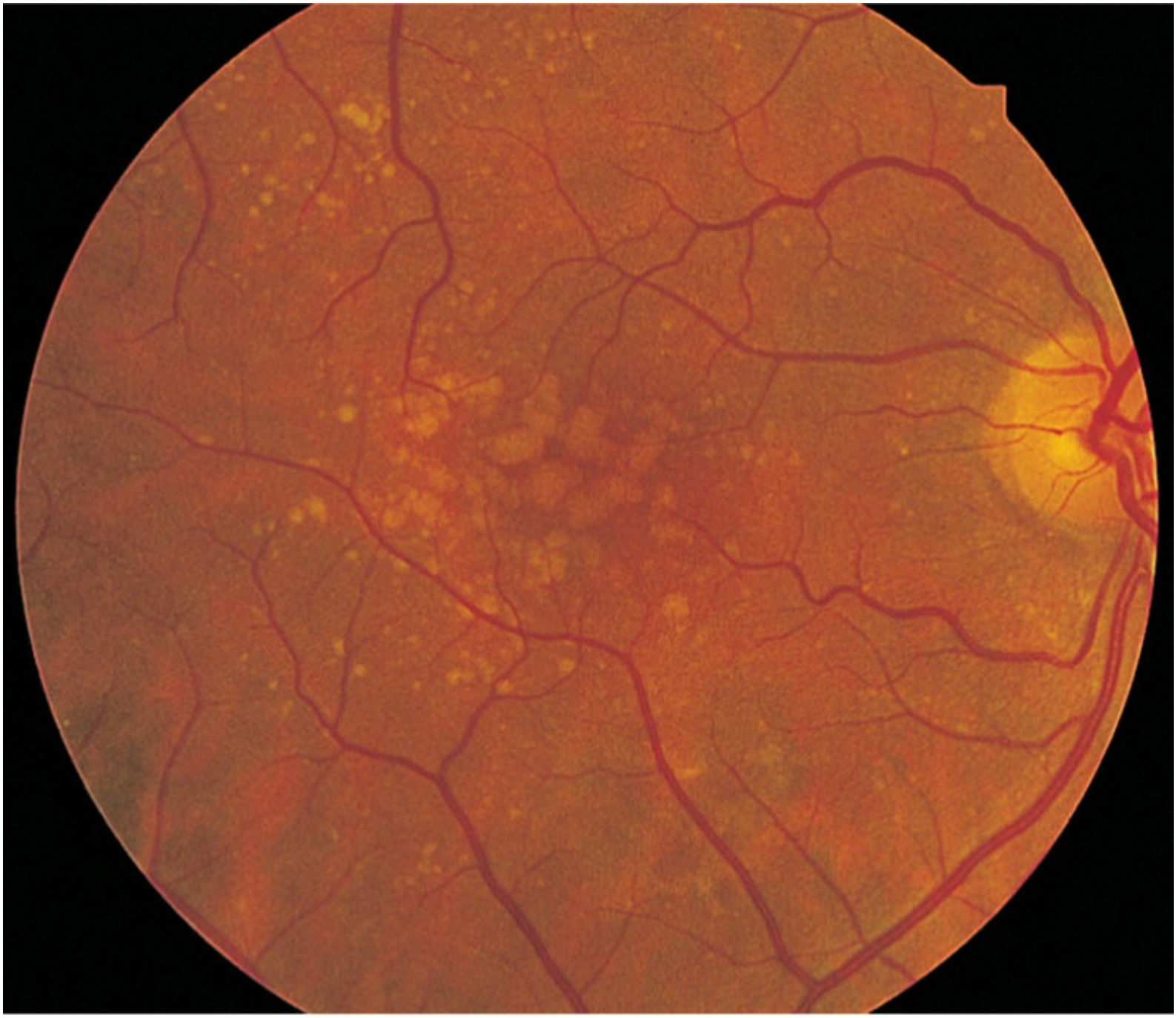


Figure 14-4. Age-related macular degeneration. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

What is the most likely diagnosis?

a. Central retinal artery occlusion (CRAO)
b. Macular degeneration, wet type
c. Macular degeneration, dry type
d. Retinal detachment
e. Diabetic retinopathy

Answer b. Macular degeneration, wet type

Macular degeneration is a gradual loss of vision and can appear in two forms, wet and dry. In the dry form, cellular debris called drusen accumulates between the retina and the choroid; in the wet form, new blood vessels grow up from the choroid behind the retina. In either form, the underlying

insult to the retina causes retinal detachment and progressive visual loss. In this patient, because the funduscopic examination shows neovascularization and no drusen, it points toward the dry type.

Macular degeneration is the most common cause of blindness in the United States.
- Dry = nonexudative
- Wet = exudative

Metamorphopsia is when a grid of straight lines appears wavy, and parts of the grid may appear blank.

What is the most modifiable risk factor for the development of macular degeneration?

a. Alcohol abuse
b. Smoking
c. Marijuana use
d. Age
e. Hypertension

Answer b. Smoking

Smoking is the major modifiable risk factor for macular degeration; the remainder of risk factors are not, and age cannot be modified. All patients who have macular degeneration should be counseled to quit smoking immediately.

Vascular endothelial growth factor (VEGF) mutations are the underlying cause of wet macular degeneration and are related to the *CFH* gene mutation.

What is the most accurate diagnostic test for the diagnosis of macular degeneration?

a. Fluorescein angiography
b. Optical coherence tomography
c. Tonometry
d. Funduscopy

Answer a. Fluorescein angiography

Fluorescein angiography is used in the diagnosis and localization of abnormal vascular processes.

Combined with a proper ophthalmologic examination, this is the best way to diagnose macular degeneration. Optical coherence tomography is actually used to follow the response to treatment.

Orders:
- *Ophthalmology consult*
- *Fluorescein angiography*

What is the most appropriate therapy for this patient?

a. Steroids
b. Bevacizumab
c. Heparin
d. Aspirin

Answer b. Bevacizumab

Bevacizumab is a VEGF inhibitor that treats the underlying cause for patients with wet macular degeneration. By inhibiting VEGF locally through direct instillation into the eye, blood vessels do not grow, subsequently slowing progression of the retinal detachment. Steroids, heparin, and aspirin have no role in slowing the pathogenesis of macular degeneration.

If the patient develops abdominal pain while taking bevacizumab for colon cancer = upright chest radiography to investigate for perforation

Order:
- *Bevacizumab*

After ordering bevacizumab, turn the clock forward, and the case will end.

Omega-3 fatty acids slow the progression of macular degeneration.

CASE 7: Diabetic Retinopathy

Setting: *Office*

CC: *"I'm having trouble seeing."*

VS: *Stable*

HPI: *A 61-year-old man with diabetes presents with complaints of difficulty seeing. He states that he has not been taking his insulin because of a lack of insurance. He says that he has blank spots in his vision that are black, and he has been having progressively worsening vision for the past few years. He has a large 2-cm foul-smelling ulcer under his left calcaneus that has not responded to wound therapy.*

PMH: *Type 2 diabetes mellitus for 10 years*

Med: *Glargine insulin (noncompliant)*

Physical Exam:

Funduscopy reveals (Figure 14-5):

- *Macular edema*
- *Vitreous hemorrhage consistent with flame hemorrhages*
- *Numerous cotton wool spots*
- *Neovascularization*

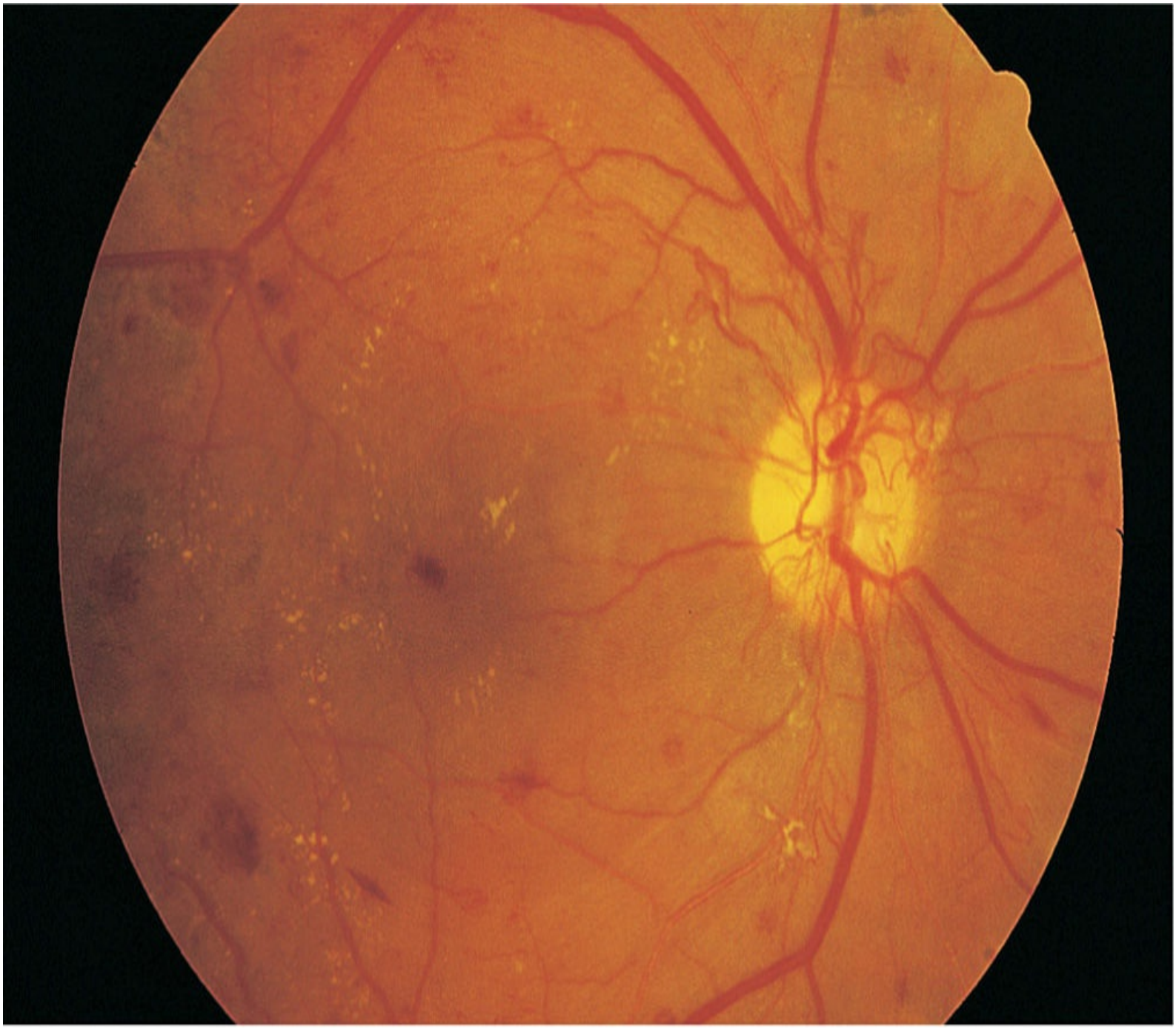


Figure 14-5. Diabetic retinopathy results in scattered hemorrhages, yellow exudates, and neovascularization. (Reproduced, with permission, from Longo DL, Fauci AS, Kasper DL, et al, eds. *Harrison's Principles of Internal Medicine*. 18th ed. New York: McGraw-Hill; 2012.)

What is the most likely diagnosis?

a. Central retinal artery occlusion (CRAO)
b. Macular degeneration, wet type
c. Macular degeneration, dry type
d. Retinal detachment
e. Diabetic retinopathy

Answer e. Diabetic retinopathy

Diabetic retinopathy is the result of microvascular retinal changes. High blood sugar leads to pericyte death and thickening of the basement membrane, leading to breakdown of the vascular

walls known as nonproliferative retinopathy. This makes the retinal blood vessels more permeable and eventually leads to neovascularization known as proliferative diabetic retinopathy. CRAO presents with painless complete visual loss, and macular degeneration has central scotomas and gradual visual loss. Retinal detachment must mention trauma to the eye for the insult to cause a tear.

What is the best next step in the management of this patient?

a. Panretinal photocoagulation
b. Vitrectomy
c. Vascular endothelial growth factor (VEGF) inhibitors

Answer a. Panretinal photocoagulation

Panretinal photocoagulation is the best next step in the management of this patient. The goal is to create 1600 to 2000 burns with a laser in the retina with the goal of reducing the retina's oxygen demand, which decreases the chances of ischemia. If there is less retinal tissue, there is less metabolic activity. In proliferative retinopathy, the laser is used to destroy blood vessels. Vitrectomy is used when a patient has less hemorrhage as a result of neovascularization and VEGF inhibitors are adjunctive therapy.

Aspirin has no role in slowing the progression of diabetic retinopathy.

Microvascular changes can be slowed by glycemic changes.

Orders:
- *Ophthalmology conference*
- *Bevacizumab*

Turn the clock forward, and the case will end.

CASE 8: Orbital Cellulitis

Setting: *ED*

CC: *"My eye is swollen."*

VS: *BP, 100/60 mm Hg; R, 20 breaths/min; P, 101 beats/min; T, 101.1°F*

HPI: *An 18-year-old man presents to the emergency department with a severely swollen left eye. The patient recently had bacterial rhinosinusitis; he was prescribed amoxicillin–clavulanate, but he did not fill the prescription. He states that moving his eye causes pain, and he has noticed that his left eye is bulging. He denies any recent trauma to the eye and does not recall any foreign bodies.*

PMH: *Psoriasis*

Med: *Multivitamin*

Physical Exam (Figure 14-6):

- *Limited extraocular movement*
- *Proptosis*
- *Diplopia*
- *Redness and swelling of the eyelid*
- *White discharge and purulence of the eye*
- *Inability to open the eye*

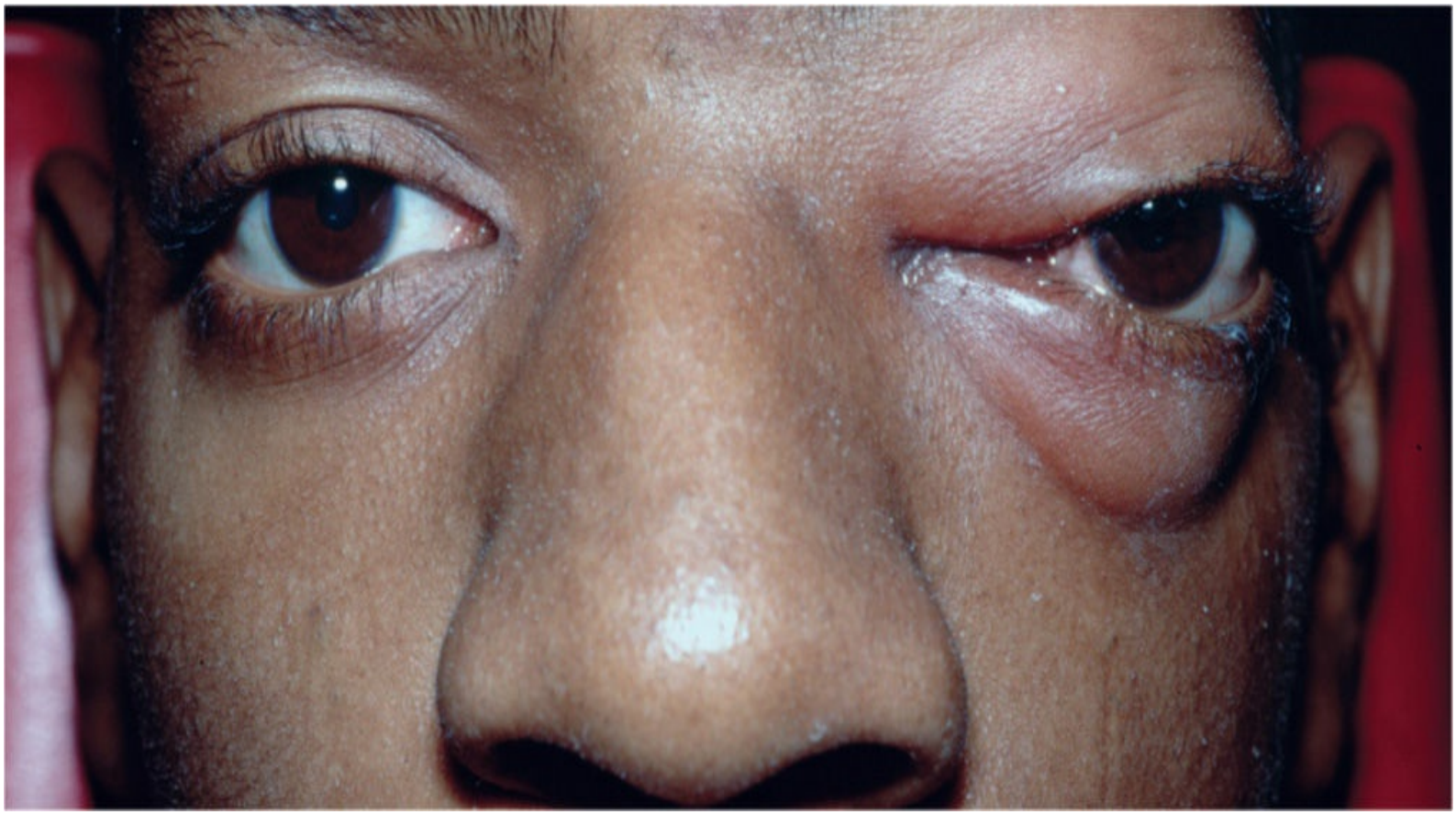


Figure 14-6. Findings consistent with orbital cellulitis. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010.)

What is the most likely diagnosis?

a. Central retinal artery occlusion (CRAO)
b. Macular degeneration, wet type
c. Orbital cellulitis (OC)
d. Retinal detachment
e. Diabetic retinopathy

Answer c. Orbital cellulitis (OC)

The presentation of fever, purulent discharge, erythema with swelling, and pain upon moving the eye are hallmark findings for OC. However, it is difficult to distinguish between OC and preseptal cellulitis because one cannot see inflammation of the extraocular muscles and fatty tissues within the orbit on visual inspection. CRAO, retinal detachment, diabetic retinopathy, and macular degeneration do not have systemic findings such as fever. OC is the only ophthalmologic condition in which a patient develops a fever.

Preseptal cellulitis = infection anterior to the orbital septum
Orbital cellulitis = infectious process posterior to orbital septum

Staphylococcus aureus, Streptococcus pneumoniae, and β-hemolytic streptococci are three bacteria that can be responsible for orbital cellulitis.

What is the best next step in the management of this patient?

a. Magnetic resonance imaging (MRI) of the orbit
b. Computed tomography (CT) scan of the orbit
c. Ultrasonography of the orbit

Answer b. Computed tomography (CT) scan of the orbit

The reason why imaging must be done quickly and as the best next step in the management of this patient is to conclude whether this is preseptal cellulitis versus OC. The most accurate test is an MRI; however, because MRI takes too long and CT scan takes minutes, the best next step in the management of this patient is CT scan of the orbit. CT will confirm whether the infection is past the septum and invading the musculature and fat of the eye. Remember that OC is an emergency; more time wasted means fewer eyeballs saved. Ultrasonography in the hands of skilled technician can reveal abscesses, but it does not have the resolution to see past the septum.

After the infection destroys the eye, its next target is the brain. Urgent identification and initiation of antibiotics reduce morbidity.

Orders:
• *CT scan of the orbit*
• *Ophthalmology consult*

Inflammation of extraocular muscles, fat stranding, and anterior displacement of the globe are seen. No abscess is identified. There are air fluid levels in the ethmoid sinus consistent with sinusitis (Figure 14-7).

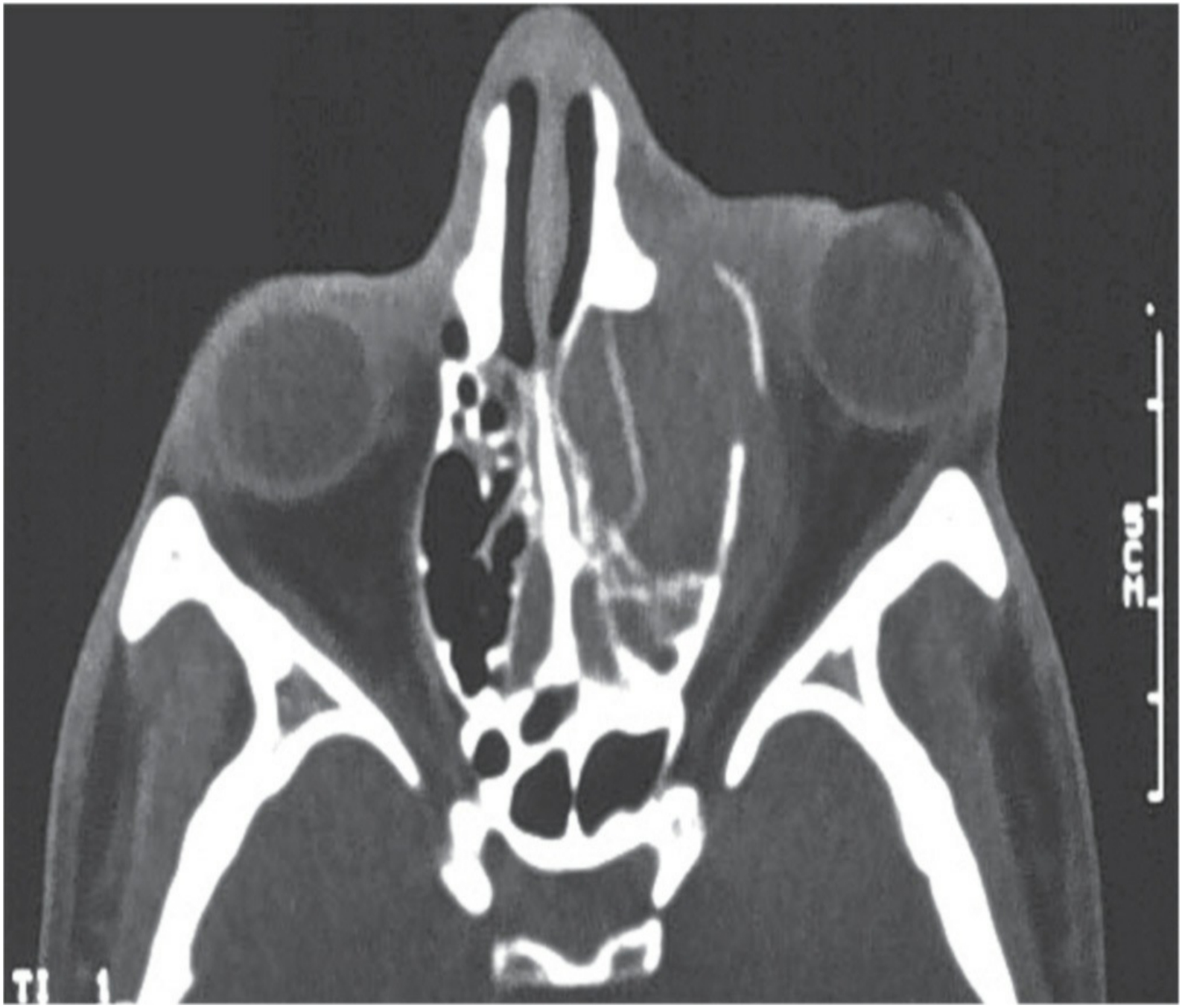


Figure 14-7. Orbital cellulitis seen on computed tomography scan. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010.)

What is the best next step in the management of this patient?

a. Intravenous (IV) vancomycin
b. IV methicillin
c. Surgical consult

Answer a. Intravenous (IV) vancomycin

The best next step in the management of this patient is to order IV antibiotics that cover both methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA). This is because of the increasing number of patients who develop OC caused by MRSA in the community. Therefore, IV methicillin is the incorrect antibiotic because it will not cover MSSA; IV over oral must always be given to achieve therapeutic serum levels quickly. Surgical consults are only the correct answer if the patient has an abscess revealed on the CT scan.

Flushing and erythematous rash after vancomycin is called red man syndrome and is caused by mast cell degranulation. Slow the infusion, and it will self-resolve.

CCS TIP: *If you see an abscess in the CT scan findings, the next step is a surgical consult followed by vancomycin.*

Order:

- *Vancomycin*

Turn the clock forward, and the case will end.

DERMATOLOGIC DISEASES

CASE 1: Cellulitis

Setting: *ED*

CC: *"My leg hurts."*

VS: *BP, 121/86 mm Hg; R, 18 breaths/min; P, 89 beats/min; T, 100.9°F*

HPI: *A 32-year-old man presents to the emergency department 3 days after being in India for 1 week. He had several mosquito bites and now has pain over the anterior part of his right leg. He had some fevers at home as well.*

ROS:

- *Fever*
- *Chills*
- *Leg pain*

Physical Exam:

- *An erythematous, warm, tender, 2-cm, fluctuant wound is seen over the anterior tibia of the right leg (Figure 15-1).*

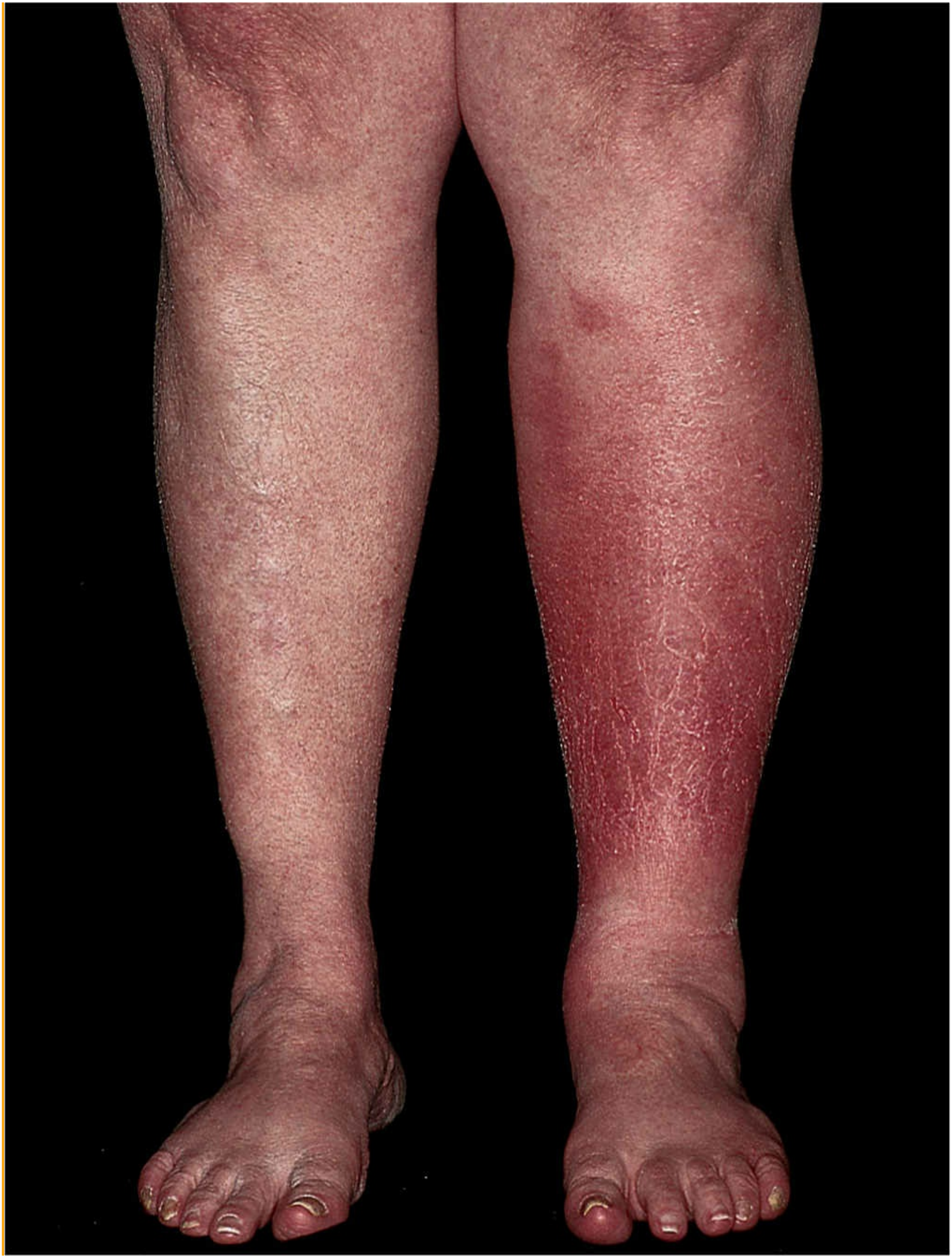


Figure 15-1. Cellulitis. Cellulitis of the left leg characterized by erythema and mild swelling. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010. Photo contributor Frank Birinyi, MD.)

- *There is serosanguineous drainage when the leg is pressed followed by purulent material that can easily be expressed from beneath the wound (Figure 15-2).*

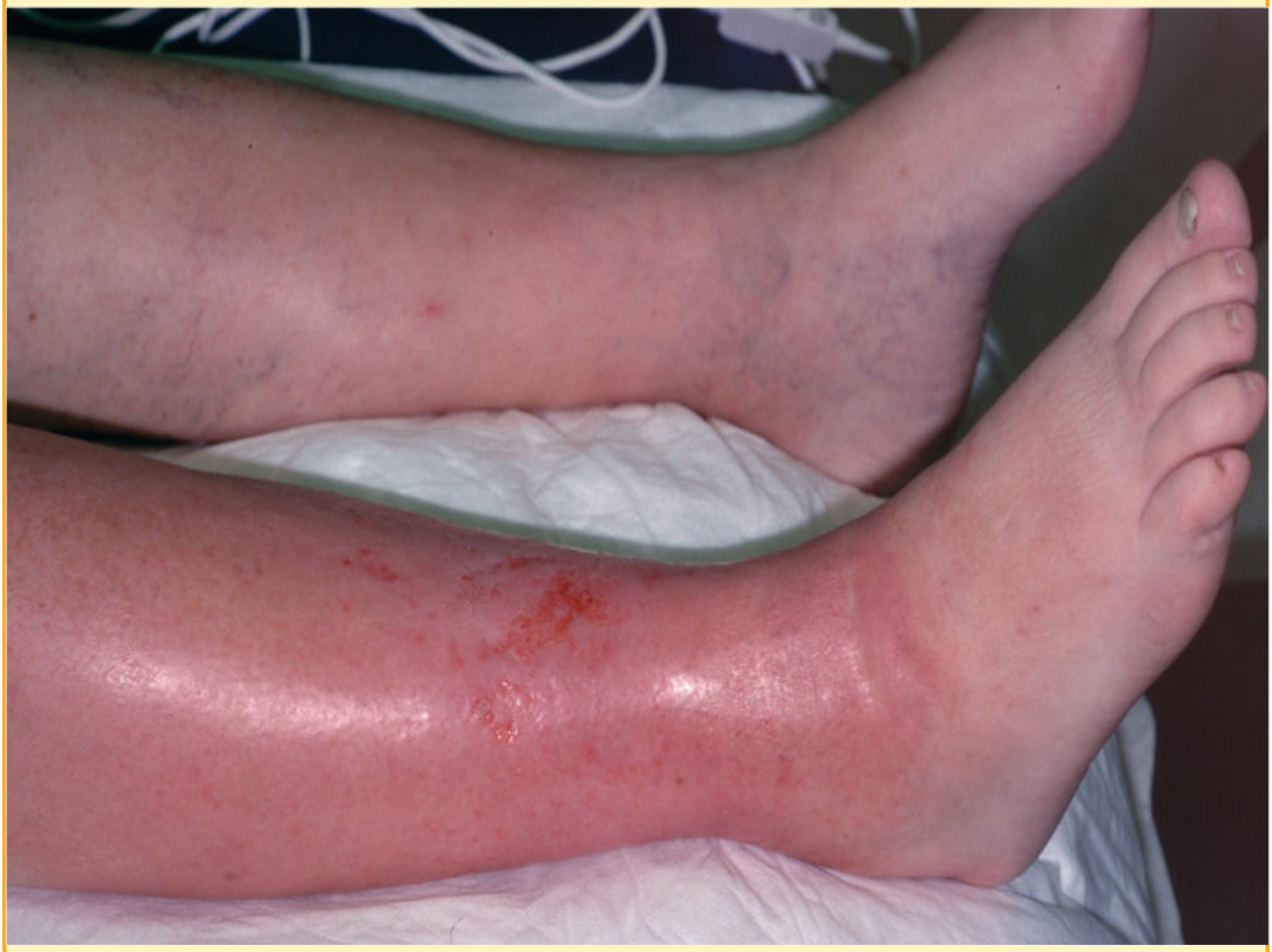


Figure 15-2. Cellulitis. Erythema consistent with cellulitis of the right lower extremity. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010. Photo contributor: Lawrence B. Stack, MD.)

What is the most likely diagnosis?

a. Erysipelas
b. Complicated cellulitis
c. Necrotizing fasciitis

d. Pyoderma gangrenosum
e. Lymphangitis

Answer b. Complicated cellulitis

Cellulitis is nonnecrotizing inflammation of the skin and subcutaneous tissues of the skin. It occurs because of a breach in the skin, which commonly can occur from self-inoculation with bacteria. Common breaches of the skin are puncture wounds, cuts, and insect bites. Erysipelas is an infection of the subcutaneous fat, and necrotizing fasciitis presents with a skin infection with severe pain out of proportion to examination findings. Pyoderma gangrenosum is seen commonly in patients with inflammatory bowel disease. Lymphangitis is an infection of the lymphatics caused by streptococcal species.

Staphylococcus aureus creates a yellowish gold pigment.

S. aureus has coagulase in its cell surface.
Coagulase "melts" into tissues to damage them.

The five skin infections caused by streptococcal species are LINES:

Lymphangitis
Impetigo
Necrotizing fasciitis
Erysipelas
Scarlet fever

What is the best next step in the management of this patient?

a. Incision and drainage
b. Antibiotics
c. Surgical consult
d. All of the above

Answer d. All of the above

With a patient who presents with complicated cellulitis, also known as an abscess, the management involves incision and drainage by surgery to treat the underlying process. This is followed by starting targeted antibiotics that will treat the most common organisms and supportive care such as antipyretics.

Orders:
- *Trimethoprim–sulfamethoxazole*
- *Surgical consult*
- *Incision and drainage*

The most common organism to cause cellulitis is *S. aureus* (methicillin-resistant *S. aureus* [MRSA] and methicillin-susceptible *S. aureus* [MSSA])

Oral antibiotics that cover MRSA and MSSA are:
- Clindamycin
- Doxycycline
- Trimethoprim–sulfamethoxazole

The patient undergoes an incision and drainage and is given antibiotics. A total of 7 cc of purulence is expressed from the lesion on his leg, and it is bandaged.

Ceftaroline is the only cephalosporin that covers MRSA.

Order:
- *Change the patient's location to home*

The patient returns to the emergency department 2 days later and says his wound is improving but is still red and painful. The culture from the incision and drainage grows 10,000 colonies of MRSA.

Orders:
- *Vancomycin*
- *Admit to the hospital*

Turn the clock forward, and the case will end.

Any patient who does not improve after 48 to 72 hours after initiation of oral treatment needs to be admitted for intravenous (IV) antibiotics.

Vancomycin, linezolid, daptomycin, and ceftaroline are IV medications that cover MRSA.

Staphylococci are gram-positive cocci in clusters.

CASE 2: Necrotizing Fasciitis

Setting: *ED*

CC: *"I have the worst leg pain in the world!"*

VS: *BP, 90/65 mm Hg; R, 22 breaths/min; P, 121 beats/min; T, 101.5°F*

HPI: *A 25-year-old man presents with a painful erythematous swelling of his right arm. He is a known injections drug user (IDU). At times he uses saliva to lubricate his needles. He says this pain and swelling began 6 hours ago.*

PMH: *Appendicitis at age 9 years*

SH: *Active IDU*

ROS:

- *Severe pain*
- *Fevers*
- *Chills*
- *Rigors*

Physical Exam:

- *Severely erythematous purple right upper extremity*
- *Crepitus upon palpation*
- *Skin is open; gloved fingers can pass easily between the two layers*
- *A bullae is present that easily breaks and releases fluid that resembles dish water (Figure 15-3).*

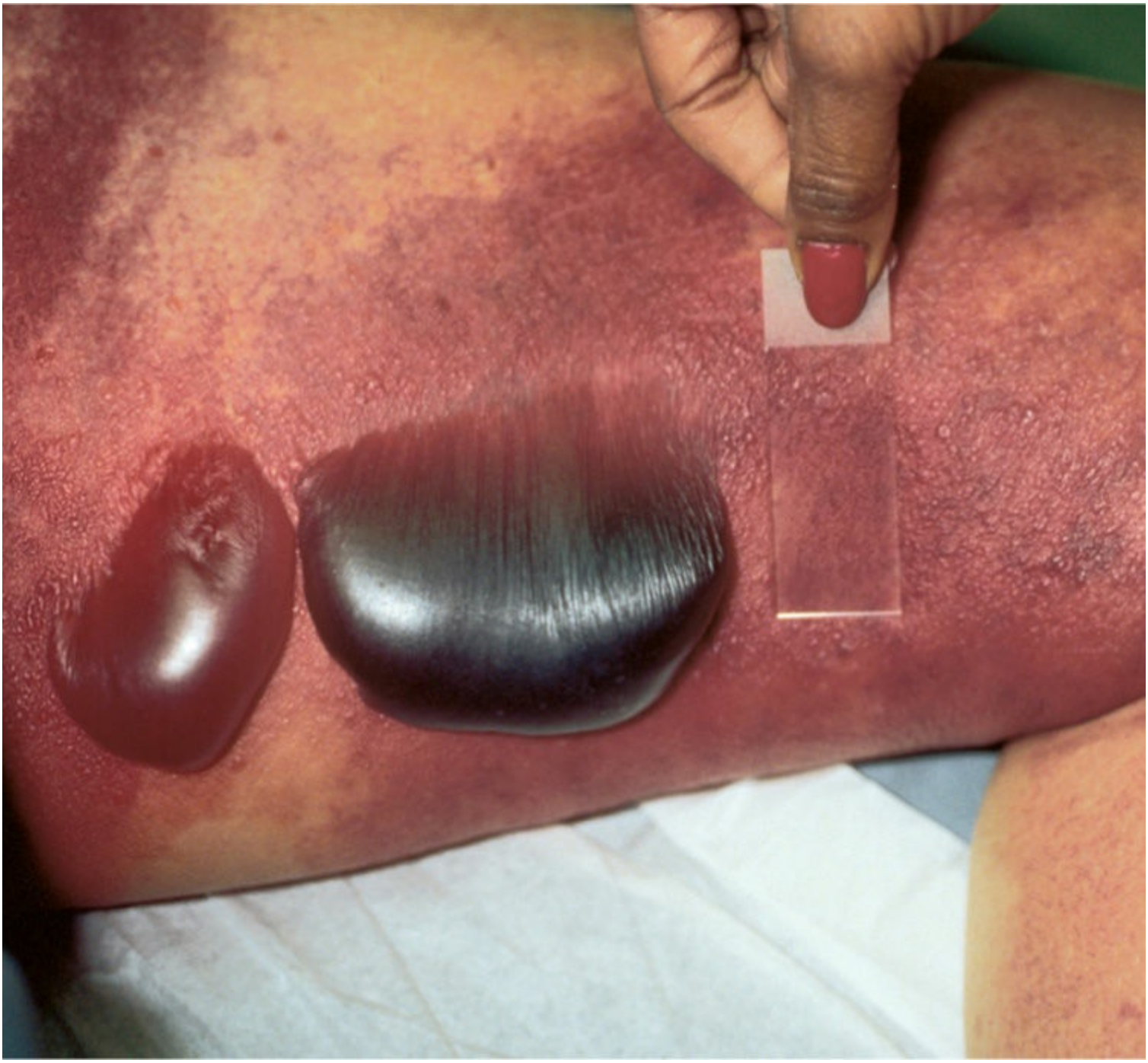


Figure 15-3. Necrotizing fasciitis. Large cutaneous bullae are seen on the leg of this patient with necrotizing fasciitis. Note the dark purple fluid in the bullae. (Reproduced, with permission, from Knoop KJ, Stack LB, Storrow AB, Thurman R, eds. *The Atlas of Emergency Medicine*. 3rd ed. New York: McGraw-Hill; 2010. Photo contributor: Lawrence B. Stack, MD.)

Bullae occur in pemphigus vulgaris, bullous pemphigus, and necrotizing fasciitis.

Needle use introduces skin flora into the venous system.

What is the most likely diagnosis?

a. Erysipelas

b. Necrotizing fasciitis (NF)
c. Pyoderma gangrenosum
d. Lymphangitis
e. Scarlett fever

Answer b. Necrotizing fasciitis (NF)

NF is a rapidly progressive infection of the fascia, with secondary necrosis of the subcutaneous tissues along with gangrene. The infection is most commonly caused by group A hemolytic streptococci and occurs classically in immunocompromised patients, those with HIV, IDU, and alcoholics. The remainder of choices do not progress quickly over hours but progress over days and do present with severe pain, crepitus, or bullae.

3 Types of infections in NF:
• Type I, or polymicrobial
• Type II, or group A streptococcal
• Type III gas gangrene, or clostridial myonecrosis

Group A β-hemolytic streptococcus (*Streptococcus pyogenes*)
Gram-positive cocci in pairs and chains
Catalase negative

What is the most urgent next step in the management of this patient?

a. Surgical consult
b. Observation
c. Start antibiotics and intravenous (IV) normal saline

Answer a. Surgical consult

Surgical consult for debridement is the most urgent next step in the management of necrotizing fasciitis. Observation will only lead to death, and starting antibiotics and IV normal saline are to be done while on the way to surgery. Broad-based antibiotics to cover aerobic gram-positive and gram-negative organisms and anaerobes should be started in all patients with NF. Starting them first and waiting for a response will not delay the impeding severe sepsis that will occur in this patient.

Tissues of patients with severe cases of NF lack neutrophils because of streptococcal chemokine protease. This is how a streptococcus group is able to cause so much damage so quickly.

Clindamycin inhibits bacterial toxin synthesis and should be added for synergy to all antibiotic regimens for necrotizing fasciitis.

Orders:

- *Admit to the surgical intensive care unit (SICU)*
- *Surgery consult*
- *Ceftaroline*
- *Clindamycin*

Turn the clock forward, and the case will end.

IDUs need to have coverage for methicillin-resistant S. aureus added. Vancomycin, linezolid, daptomycin, or ceftaroline is acceptable.

Catalase breaks down hydrogen peroxide into water and oxygen.

CASE 3: Skin Cancer

Setting: *Office*

CC: *"My mole looks different."*

VS: *Stable*

HPI: *A 73-year-old man presents saying that a mole on his shoulder appears different to his wife. The mole appears larger to her, and she claims it has even changed color. He is new to the office, and no previous records or pictures exist.*

PMH: *Hyptension*

SH: *Retired tugboat captain*

Physical Exam: *A 7-mm asymmetric, irregularly bordered, multicolored nevi is seen on the lateral aspect of the right shoulder. The nevus is elevated but irregular.*

What is the most likely diagnosis?

a. Malignant melanoma
b. Squamous cell cancer
c. Basal cell carcinoma
d. Actinic keratosis

Answer a. Malignant melanoma

A patient who presents with a mole that has fulfilled any of the American Cancer Society ABCDE warning signs should immediately be evaluated for melanoma by performing a full-thickness skin biopsy. Melanoma should be suspected in any skin lesion that is asymmetric, has an irregular border, is dark in color, is larger than 6 mm in diameter, or is elevated (Figure 15-4). Basal cell carcinoma appears as tiny flesh-colored ulceration, and squamous cell presents as a red crusted or scaly patch on the skin. Actinic keratosis is the premalignant condition that causes squamous cell cancer. Skin cancers are the most common malignancy in the world. Irregularity in color or darkening of the lesion suggests the need for a biopsy.

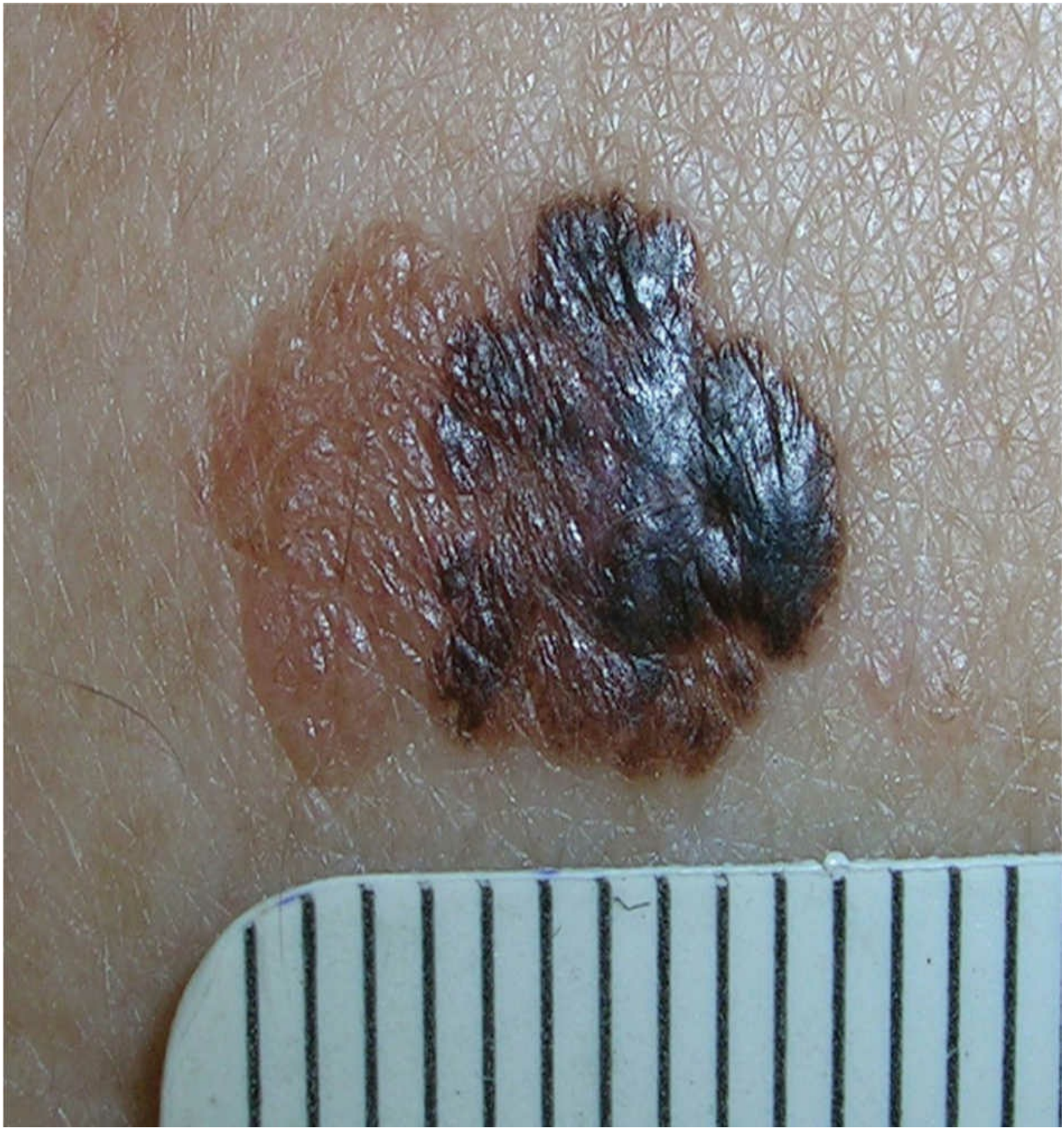


Figure 15-4. Superficial spreading melanoma on the back with ABCDE features of melanoma. (Reproduced, with permission, from Richard P. Usatine, MD, from Usatine RP, Smith MA, Chumley HS, et al, eds. *The Color Atlas of Family Medicine*, 2nd ed. New York: McGraw-Hill; 2013.)

Melanoma is a malignancy of melanocytes or the pigment-producing cells of the body.

The number one risk factor for the development of the skin cancer is ultraviolet B exposure.

What is the best next step in the management of this patient?

a. Shave biopsy
b. Punch biopsy
c. Mohs surgery
d. Dermatology consult

Answer c. Mohs surgery

Mohs micrographic surgery is a technique used to remove the cancer with the least amount of surrounding tissue; the edges are checked immediately to see if tumor is found. Shave or punch biopsies may leave the face disfigured and would still necessitate the need further surgery; therefore, Mohs surgery allows for both immediate diagnosis as well as therapy. Getting a dermatology consult or consultation of any kind is always wrong. Consultation does not address the underlying issue. The consultation will never tell you what to do for the patient.

Layers of the skin:
1. Epidermis (five sublayers)
   - Stratum corneum
   - Stratum lucidum (only in palms and soles)
   - Stratum granulosum
   - Stratum spinosum
   - Stratum basale
2. Dermis
3. Hypodermis

If the surgical biopsy and removal demonstrates a depth greater than the dermis (1 mm), then a computed tomography scan must be done for staging and sentinel lymph node biopsy.

What is the treatment for metastatic melanoma?

a. Ipilimumab
b. Chemotherapy
c. Interleukin-2 (IL-2)
d. All of the above

Answer d. All of the above

Treatment with each of the above agents is indicated in metastatic melanoma but depends on the circumstances. The newest agent, ipilimumab, is a monoclonal antibody that targets CTLA-4. Targeting this receptor starts a toxic immune reaction against the tumor. If the patient cannot receive ipilimumab, then he or she is a candidate for IL-2 treatment, but this is only for patients who have no comorbid cardiovascular or respiratory disease. Cytotoxic chemotherapy is the last resort and is used if the patient is not a candidate for ipilimumab or IL-2.

The mechanism of IL-2 is to stimulate T-cell growth factor, hereby causing an antitumor reaction in the body.

The most common side effect of IL-2 is infection; patients must be on antibiotic prophylaxis.

Orders:

- *Dermatology consult*
- *Mohs surgery*

Surgical excision of the lesion demonstrates malignant melanoma. The margins were completely free of disease, and the depth was limited to 2.5 mm. The patient is currently doing well.

Turn the clock forward, and the case will end.

POSTOPERATIVE COMPLICATIONS

CASE 1: Wind

Setting: *SICU*

CC: *Fever*

VS: *BP, 156/80 mm Hg; R, 20 breaths/min; P,111 beats/min; T, 101.1°F*

HPI: *A 45-year-old woman undergoes a bilateral knee replacement and is being seen by the resident on postoperative day 1. The patient is in a great deal of pain and asks for pain medications. The pain is so great that she refuses to participate in physical therapy. She was intubated during the surgery with a laryngeal mask airway for the procedure.*

ROS:

- *No chest pain*
- *No shortness of breath*
- *Unable to take deep breaths because of pain*

Physical Exam:

- *Warm skin*
- *Flushed face*
- *Decreased breath sounds at bases*

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection
d. Deep venous thrombosis
e. Wound infection

Answer b. Pneumonia

The most likely cause of fever on the first through third postoperative day is pneumonia or wind. The underlying cause of pneumonia can be bacterial infiltration or aspiration.

An incentive spirometer prevents atelectasis but does not prevent pneumonia.

Anterior hypothalamus is responsible for cooling; the posterior is responsible for heating.

What is the best next step in the management of this patient?

a. Chest radiography
b. Blood cultures
c. Start antibiotics
d. Sputum culture
e. Check for a cough

Answer a. Chest radiography

The best next step in the management of this patient is to obtain posterior-anterior and lateral chest radiographs. It is always the wrong answer to obtain a portable chest radiograph for anything other than line or tube placement. Obtaining blood cultures will not help in diagnosis pneumonia but only for bacteremia, and starting antibiotics is only after the pneumonia is confirmed. Sputum is only available in up to one third of patients with pneumonia, and therefore it is not routinely done. Cough is not necessarily seen in all patients with pneumonia and therefore is also not reliable for diagnostic purposes.

Order:
• *PA and lateral chest radiography*

Turn the clock forward to obtain results.

CCS TIP: *The exam will always tell you exactly what time the report will be available.*

The chest radiography reveals a dense consolidation in the right lung base consistent with aspiration pneumonia.

Interleukin 1 (IL-1) release causes fever by stimulating the hypothalamus.

Benefits of fever:
• Increased mobility of leukocytes
• Enhanced leukocyte phagocytosis
• Decreased endotoxin effects
• Increased proliferation of T cells

Order:

- *Antibiotics to cover for health care–associated pneumonia (HCAP) regardless of the postoperative day.*

Surgery or intubation makes HCAP possible even before the 48-hour mark.

CCS TIP: *After you order the correct antibiotics, turn the clock forward, and the case will end.*

Treating HCAP when pseudomonas is likely requires vancomycin with two of the following:
- Antipseudomonal cephalosporin (cefepime, ceftaroline)
- Carbapenem (imipenem, meropenem)
- β-Lactam/β-lactamase inhibitor (piperacillin–tazobactam, ticarcillin–clavulanic acid)
- Fluoroquinolone (levofloxacin, moxifloxacin)
- Aminoglycoside
- Monobactam (aztreonam)

CASE 2: Water

Setting: *SICU*

CC: *Fever*

VS: *BP, 110/57 mm Hg; R, 16 breaths/min; P, 101 beats/min; T, 100.4°F*

HPI:
A 65-year-old woman develops a fever on postoperative day 3 after having had a laparoscopic total abdominal hysterectomy with bilateral salpingo-oophorectomy. She is able to use the bedpan to pass stool and is able to sit in a chair for up to 45 minutes at time before becoming fatigued.

ROS:
- *No chest pain*
- *No shortness of breath*

Physical Exam:
- *Incisions are clear, dry, and intact*
- *Warm skin*
- *Flushed face*
- *Foley catheter in place; urine in bag appears cloudy*

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection (UTI)
d. Deep venous thrombosis (DVT)
e. Wound infection

Answer c. Urinary tract infection (UTI)

The most likely diagnosis for fever on the third postoperative day is a catheter-associated urinary tract infection (CAUTI). A Foley catheter is a foreign body and therefore is a nidus for infection. The risk of a CAUTI increases with the duration of catheterization. Common misconceptions regarding prevention of CAUTI include prophylactic antibiotics, using iodine-based sterile techniques for insertion, and flushing the catheter. The only way of preventing a CAUTI is early removal of the catheter.

UTI is more common in patients who have undergone a genitourinary procedure.

What is the best next step in the management of this patient?

a. Urinalysis (UA)
b. Urine culture
c. Start antibiotics
d. Remove the Foley catheter
e. Flush the Foley line with vancomycin

Answer d. Remove the Foley catheter

The best next step in the management of this patient is the removal of the Foley catheter. The patient is able to sit in a chair, is ambulatory, and no longer requires a Foley catheter. Obtaining UA and urine culture is important for diagnostic purposes, but removing the Foley catheter is more important. Otherwise, you are not treating the true underlying cause of the UTI. After obtaining urine for analysis, it is then paramount to start antibiotics. Flushing the line with vancomycin or any antibiotic has never been shown to treat a UTI.

Orders:
- *Remove the Foley catheter.*
- *Obtain UA.*
- *Obtain urine culture.*

Turn the clock forward 30 minutes to obtain the results of the UA.

The UA shows a specific gravity of 1.003, no protein, no glucose, positive leukocyte esterase, nitrates, no red blood cells, and 50 to 100 white blood cells (WBCs) in the urine. The urine is foul smelling and cloudy. Culture is still pending.

The most common organisms in CAUTI are *Escherichia coli* #1 and enterococci #2.
The most common organism for UTI after coitus is *Staphylococcus saprophyticus*.

Leukocyte esterase is surrogate marker for WBCs in the urine.

Order:
- *Start empiric antibiotics, such as ciprofloxacin, to treat for the most common cause of UTI, E. coli.*

CCS TIP: *Turn the clock forward after starting antibiotics, and the case will end. However, if the case does not end, turn the clock forward 3 days. This will give you a culture result. Tailor antibiotics to the given sensitivities and organism and then turn the clock forward.*

The case will end.

CASE 3: Walking

Setting: *Telemetry step-down unit*

CC: *Fever*

VS: *BP, 112/67 mm Hg; R, 18 breaths/min; P, 108 beats/min; T, 100.9°F*

HPI: *A 23-year-old man on postoperative day 5 develops a fever. He was admitted for total colectomy after a recent colonoscopy revealed high-grade dysplasia on biopsy of a polyp found in the cecum. The patient refused to take subcutaneous heparin because he read of its side effects on Google. Pain is elicited upon dorsiflexion of the foot.*

PMH: *Familial adenomatous polyposis (FAP)*

FH: *Father had colon cancer*

Physical Exam:

- *Incisions are clean, dry, and intact*
- *No discharge*
- *Right leg swollen >3 cm more than the left leg*
- *No palpable cord, nonerythematous, 1+ edema up to the knee*

Genetic testing for a germline mutation in the *APC* gene is required for a definitive diagnosis of FAP.

Most patients with FAP will have a prophylactic colectomy by age 25 years because there is near 100% chance of cancer by age 40 years.

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection (UTI)
d. Deep venous thrombosis (DVT)
e. Wound infection

Answer d. Deep venous thrombosis (DVT)

The most common cause of fever on postoperative day 5 is DVT, thus the "walking" in the classic mnemonic. Thrombotic risk is greatly increased during surgery, particularly orthopedic, major

vascular, abdominal or pelvic, neurosurgery, and cancer surgery. Signs of a DVT are unilateral swelling and edema in the lower extremity. In many patients, a palpable indurated, cordlike subcutaneous venous segment can be felt. Migratory thrombophlebitis or Trousseau's sign of malignancy is associated with pancreatic cancer. In patients with DVT, pain can occur on dorsiflexion of the foot, also known as Homan's sign.

The Well's score for DVT must be calculated to decide the diagnostic approach (Table 16-1).

Table 16-1 Well's Score for Deep Venous Thrombosis

Finding	Points
Active cancer	1
Calf swelling ≥3 cm	1
Swollen unilateral superficial veins	1
Pitting edema	1
Previous documented deep venous thrombosis	1
Swelling of entire leg	1
Localized tenderness	1
Paralysis, paresis, or recent cast immobilization of lower extremities	1
Recently bedridden ≥3 days or major surgery	1
Alternative diagnosis at least as likely	–2

What is the best next step?

a. Order D-dimer testing
b. Order lower extremity duplex ultrasonography
c. Start low-molecular-weight heparin (LMWH)

d. Start a vitamin K antagonist
e. Perform thrombectomy

Answer b. Order lower extremity duplex ultrasonography

The correct answer here is to order lower extremity duplex ultrasonography because of this patient's high Well's score being 4. Well's scores that are higher than 2 require advanced imaging; scores below 2 can adequately be assessed by D-dimer testing. Starting heparin before the establishment of the diagnosis is only done empirically in pulmonary embolism; starting a vitamin K antagonist should wait for confirmation of a clot. You do not have to start heparin before warfarin if it is just for atrial fibrillation. You use heparin first when there is a clot right now such as a DVT or pulmonary embolism. Thrombectomy is only indicated for severe DVT with limb ischemia or phlegmasia cerulea dolens. It is characterized by severe pain, swelling, cyanosis, and edema of the affected limb.

Prevention of DVT is performed by combined pharmacologic and mechanical methods such as pneumatic compression devices and low-dose unfractionated heparin (UFH).

Orders:
- *Lower extremity duplex ultrasonography*
- *D-Dimer*

Turn the clock forward 30 minutes to obtain a result.

Doppler image with transducer compression applied shows flow in the femoral artery and very minimal flow in the distal femoral vein. The femoral vein does not compress with transducer pressure, indicating intraluminal thrombus. A D-dimer level of 754 ng/mL (elevated) was found.

What is the best next step in the management of this patient?

a. Order thrombolytics
b. Start LMWH
c. Start a vitamin K antagonist
d. Place an inferior vena cava filter (IVC)

Answer b. Start LMWH

Treatment with LMW heparin, fondaparinux, or UFH should be instituted for at least 5 days and oral anticoagulation with a vitamin K antagonist such as warfarin. LMW heparin is easier to use at home. No overlap is needed if rivaroxaban, apixaban, or dabigatran is chosen. IVC filter placement is recommended when there is a contraindication to, or failure of, anticoagulant therapy. Thrombolytic therapy is reserved for patients with phlegmasia cerulea dolens who are not amenable

to thrombectomy.

Order:

- *Rivaroxaban*

Turn the clock forward, and the case will end.

CCS TIP: *To speed up your efficiency on the exam, use highly selective direct factor Xa inhibitor to avoid having to institute overlap therapy with heparin.*

CASE 4: Wound

Setting: *SICU*

CC: *Fever*

VS: *BP, 112/67 mm Hg; R, 18 breaths/min; P, 108 beats/min; T, 100.9°F*

HPI: *A 69-year-old man undergoes right-sided hemicolectomy for colon cancer discovered recently on colon cancer. On postoperative day 7, he has a fever, chills, and rigors. The surgical approach was laparoscopic, but because of multiple adhesions, the procedure was converted to open incisions.*

PMH:

- *Appendicitis at age 12 years*
- *Diverticulitis 2 years ago*
- *Colon cancer diagnosed 2 weeks ago by colonoscopy*

ROS:

- *Chills*
- *Rigors*

Physical Exam:

- *Warm, flushed skin*
- *The incision is 3 cm long, erythematous, indurated, and painful to palpation. No fluctuance is noted.*
- *Cloudy fluid is seen draining from the incision.*

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection (UTI)
d. Deep venous thrombosis (DVT)
e. Wound infection

Answer e. Wound infection

The most likely diagnosis and most common cause of fever on postoperative day 7 is cellulitis or a surgical site infection (SSI) secondary to gram-positive bacteria, most commonly caused by methicillin-resistant *Staphylococcus aureus* (MRSA). The findings of an erythematous incision and draining a cloudy serosanguineous fluid are very commonly seen in wound cellulitis.

SSIs are the most common type of nosocomial infection in surgical patients.

What is the best next step in the management of this patient?

a. Topical antibiotics
b. Intravenous (IV) vancomycin
c. IV nafcillin
d. Surgical debridement

Answer d. Surgical debridement

Infected wounds are opened, debrided, and dressed open. After the infection has cleared and granulation tissue is apparent, the wound can be closed through secondary intent. Antibiotics are correct, but without debridement of the infection and removal of dead tissue, antibiotics will not help. Vancomycin is the first-line agent to use. Nafcillin is the wrong antibiotic because these infections are resistant to penicillin. Topical antibiotics have no role in the treatment of skin infections in the postoperative period.

The mechanism of action of vancomycin is inhibition of cell wall synthesis in gram-positive bacteria through binding to D-alanyl-D-alanine moieties of the NAM/NAG-peptides needed in the cell wall.

The most common organism seen in SSI is MRSA.

Orders:
- *Surgery consult*
- *Debridement*

CCS TIP: *Turn the clock forward, and the case will end.*

CASE 5: Deep Wound

Setting: *SICU*

CC: *Fever*

VS: *BP, 100/67 mm Hg; R, 18 breaths/min; P, 118 beats/min; T, 103.9°F*

HPI: *A 75-year-old man develops a fever of 103.9°F on postoperative day 10. He presented initially with diverticulitis and was found to have free air on computed tomography (CT) scan; he subsequently underwent segmental resection of the descending colon with maintenance of the rectum.*

ROS:
- *Rigors*
- *Chills*

Physical Exam:
- *AAO × 3*
- *Pain to palpation of the left lower quadrant*
- *Incision is clean dry and intact*

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection (UTI)
d. Deep venous thrombosis (DVT)
e. Deep wound infection

Answer e. Deep wound infection

The most likely cause of fever on postoperative day 10 or greater is typically a deep abscess. The most common types of surgeries in which these abscess develop are in abdominal and pelvic procedures. Clues that direct you to a deep abdominal or pelvic abscess are 10 or more days in the postoperative period and high spiking fevers. Intraabdominal abscesses are collections of pus that are confined by an inflammatory barrier such as the omentum, inflammatory adhesions, or bowel. Abscesses are serious medical conditions that can lead to bacteremia and shock.

Abscesses usually contain both aerobic and anaerobic bacteria; the most common aerobic organism is *Escherichia coli*, and the most common anaerobic organism is *Bacteroides fragilis*.

What is the best next step in the management of this patient?

a. Computed tomography (CT) scan of the abdomen
b. Ultrasonography of the abdomen
c. Magnetic resonance imaging (MRI) of the abdomen
d. Radiography of the abdomen
e. Complete blood count (CBC)

Answer a. Computed tomography (CT) scan of the abdomen

CT scan of the abdomen should be done because it has a high sensitivity and specificity for fluid collections when done with intravenous (IV) contrast. Plain abdominal radiographs are rarely diagnostic and simply show nonspecific findings. Ultrasonography is useful for immobile, critically ill intensive care unit patients to diagnose abdominal abscesses and fluid collections but has numerous drawbacks and high rates of false-negative results if the operator is not experienced with the device. MRI of the abdomen is always the wrong answer for everything except liver malignancies. A CBC is nonspecific and simply offers an indication of infection but no information regarding where the infection is.

Order:

• *CT scan of the abdomen and pelvis with IV contrast*

Turn the clock forward 15 minutes to obtain a result.

The CT scan of the abdomen reveals a 3-cm fluid collection in the left lower quadrant adjacent to the descending colon and abutting the abdominal wall.

What is most accurate therapy for this patient?

a. Antibiotic therapy
b. Percutaneous drainage
c. Laparoscopic drainage
d. Open abscess drainage

Answer b. Percutaneous drainage

Drainage of pus is best next step in the management and is the first line in therapy. Percutaneous CT-guided catheter drainage has become the standard treatment for intraabdominal abscesses; a drain can be left after to aid in further resolution. If the drainage fails, then laparoscopic or open abscess drainage is the next step to attempt. Antibiotic therapy is correct and should be started along with drainage but is not the most accurate therapy. Because of the walled-off structure of an abscess, antibiotics will have no effect.

Orders:

- *Percutaneous CT-guided catheter drainage*
- *IV ciprofloxacin*
- *IV metronidazole*

Fluoroquinolones inhibit the topoisomerase II ligase domain.
Metronidazole is reduced and causes breakdown of bacterial DNA.

CCS TIP: *After any major intervention, check on the patient's vital signs for interval improvements.*

Drainage of the abscess was successful and yielded 10 cc of purulent material that was sent for culture. The patient's vital signs have improved, and he has defervesced.

CCS TIP: *After any successful procedure, turn the clock forward, and the case will end.*

CASE 6: Wonder

Setting: *SICU*

CC: *Fever*

VS: *BP, 110/67 mm Hg; R, 18 breaths/min; P, 85 beats/min; T, 100.9°F*

HPI: *A 45-year-old obese woman with four children presented with right upper quadrant pain, fever, jaundice, and confusion. She was found to have acute cholangitis diagnosed and successfully treated by endoscopic retrograde cholangiopancreatography (ERCP). She had been improving but developed heparin-induced thrombocytopenia, extending her hospital course. She is currently taking lepirudin and piperacillin–tazobactam. The patient has had fevers of 100.4°F for the past 2 days.*

ROS:

- *Mild chills*
- *No rigors*
- *No shortness of breath*
- *No difficulty swallowing*

Physical Exam: *Widespread pink-to-red flat spots (macules) and raised bumps (papules) that blanch with pressure*

What is the most likely diagnosis?

a. Atelectasis
b. Pneumonia
c. Urinary tract infection (UTI)
d. Deep venous thrombosis (DVT)
e. Deep wound Infection
f. Drug fever

Answer f. Drug fever

Drug fever is usually a diagnosis of exclusion, and the first thought should always be that the fever is due to infection. However, given the absence of clinical findings suggesting another source and the presence of a morbilliform rash, medication-induced fever is more likely. The occurrence of drug rash does not correlate with the number of days postoperative and is due to a hypersensitivity reaction.

Formation of circulating antibody–antigen complexes after administration of a drug causes the release of pyrogens from granulocytes, resulting in fever.

What is the best next step in the management of this patient?

a. Corticosteroids
b. Diphenhydramine
c. Discontinue the drug
d. Change to a different β lactam/lactamase drug
e. Call an immunology consult

Answer c. Discontinue the drug

The best next step in a patient with a drug-induced fever is to discontinue the offending agent and not use any other drugs with the potential to cause fever. The use of steroids or diphenhydramine has not been shown to help while the drug is still being given, and steroids are only used as pretreatment in patients being sensitized to absolutely critical medications. Changing to a different drug of the same class will likely cause fever and more rash, and calling an immunology consult is always the wrong answer on the boards. Calling Conrad Fischer is always the right answer.

INDEX

Please note that index links point to page beginnings from the print edition. Locations are approximate in e-readers, and you may need to page down one or more times after clicking a link to get to the indexed material.

Page numbers followed by *f* or *t* indicate figures or tables, respectively.

B

D

E

F

G

M

N

O

T

U