



# Question Set: Cardiothoracic

## Questions

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1. A 63-year-old woman with diabetes is recovering in the ICU after receiving a coronary artery bypass graft (CABG). On the sixth postoperative day, she starts complaining of chest pain. Her temperature is 38.7 °C, blood pressure is 108/72 mmHg, and pulse is 125/min. On physical exam, there is drainage from her sternal wound, and there is a crunching sound heard with a stethoscope over the precordium during systole. The sternum feels somewhat unstable to palpation. Her laboratory examination is significant for an elevated white blood count ( $16.7 \times 10^3/\mu\text{L}$ ). Chest x-ray is pending. What is the most likely diagnosis?
- (A) Acute pericarditis
  - (B) Postoperative myocardial infarction (MI)
  - (C) Empyema
  - (D) Acute mediastinitis
  - (E) Pneumonia
2. A 75-year-old male with severe aortic stenosis has a routine checkup at his primary care doctor. Which of the following symptoms portends the worst prognosis?
- (A) Exertional chest pain
  - (B) Swollen legs
  - (C) Fainting spells
  - (D) Mid-systolic murmur heard loudest at the upper right sternal border
  - (E) Small head nodding movements at each heartbeat
3. Which of the following is the most important risk factor for aortic dissection?
- (A) History of coronary artery bypass grafting (CABG)
  - (B) Giant cell arteritis
  - (C) Pregnancy
  - (D) Hypertension
  - (E) Bicuspid aortic valve
4. A patient is diagnosed with type A aortic dissection, and there is concern for cardiac tamponade. Which of the following findings would be the *most* consistent with cardiac tamponade?
- (A) Pulsus bisferiens
  - (B) Watson's water hammer pulse
  - (C) Peaked T-waves
  - (D) Equalization of central pressures
  - (E) Pulsus alternans
5. A 67-year-old male is diagnosed with a type B aortic dissection. At the time of initial presentation on the previous day, his blood pressure was 178/110 mmHg. He was treated with intravenous beta-blocker, and his blood pressure was reduced to 112/60 mmHg and has remained in that range. However, one day later, he suddenly

develops severe abdominal pain. His blood pressure is measured to be 110/56 mmHg. Which of the following is the most likely explanation?

- (A) *C. difficile* infection
- (B) Occlusion of the superior mesenteric artery
- (C) Pancreatitis
- (D) Aortoenteric fistula
- (E) Diverticulitis

6. An obese 52-year-old man with a 50-pack-year smoking history and hypertension controlled with chlorthalidone presents to a remote hospital without interventional capabilities with 30 min of crushing chest pain radiating to his left arm and jaw. Troponin and CK-MB levels are elevated, and electrocardiogram shows ST-segment elevations in leads V1 through V4. He is treated with thrombolytic therapy, and his symptoms resolve. The next morning, the patient is found dead in his bed. Which of the following is the most likely cause of death?
- (A) Ventricular free wall rupture
  - (B) Embolic stroke
  - (C) Ventricular arrhythmia
  - (D) Post-MI pericarditis
  - (E) Overwhelming infection
7. A 65-year-old female has breast cancer and a remote history of congestive heart failure. Her physician is planning to administer a chemotherapeutic agent that has potential for cardiac toxicity. Which of the following is the most accurate test to measure ejection fraction?
- (A) Multigated acquisition (MUGA) scan
  - (B) Echocardiography
  - (C) Electrocardiogram
  - (D) Coronary angiography
  - (E) Exercise stress test
8. A 76-year-old man is driven to the emergency department by his wife and is complaining of severe chest pain that started 30 minutes prior. He denies abdominal or extremity pain. Pulses in the arms and legs are 2+. His kidney function is normal. CT scan shows an aortic dissection. Which of the following findings on CT scan would most strongly indicate the need for urgent surgery?
- (A) Dissection of the entire descending thoracic aorta
  - (B) Involvement of common iliac arteries
  - (C) Involvement of renal arteries
  - (D) Extension into mesenteric vessels
  - (E) Involvement of origin of innominate artery
9. A 65-year-old female is diagnosed with aortic dissection beginning 2 cm distal to the left subclavian artery and extending distally. Her blood pressure is 180/70 mmHg, and her heart rate is 88/min. Peripheral pulses are all 2+, and her abdomen is soft and nontender. What is the next best step in treatment?
- (A) Surgical repair
  - (B) Aggressive IV fluids
  - (C) Labetalol drip
  - (D) Endovascular repair
  - (E) Nicardipine drip
10. A 65-year-old man is rushed to the emergency department by ambulance after he suddenly lost strength and sensation in his left leg and arm. He was hospitalized 2 months ago with a non-ST elevated myocardial infarction (NSTEMI). He is compliant



with all of his medications and had been recovering well until the present episode. Electrocardiogram shows normal sinus rhythm without evidence of ischemia. Chest x-ray is unremarkable. Carotid ultrasound demonstrates <30% stenosis bilaterally. What is the most likely etiology of the patient's present symptoms?

- (A) Ventricular thromboembolism
  - (B) Septic embolism to the brain
  - (C) Type A dissection involving the right carotid artery
  - (D) Thromboembolism from the left atrial appendage
  - (E) Paradoxical venous thromboembolism
11. A 66-year-old man is recovering in the ICU after receiving a coronary artery bypass graft (CABG). On the fourth postoperative day, he complains of chest pain. He is sweating, anxious, short of breath, and nauseated. Electrocardiogram shows evidence of right-sided myocardial infarction (MI). His blood pressure is 98/65 mmHg. What is the next best step in management?
- (A) Administer 1 liter of normal saline
  - (B) Nitroglycerin
  - (C) Nitroprusside
  - (D) Nifedipine
  - (E) Lisinopril
12. A 65-year-old male presents with a painful nodule in his wrist that is determined to be a ganglion cyst. Despite attempts at aspiration, it recurs. He is unable to work as a computer programmer, is on disability, and is feeling depressed. He is scheduled for wrist surgery. He reports having been discharged 1 week ago for an episode of chest pain. Troponins were elevated at that time, but there was no elevation of his ST segment. Which of the following is the best recommendation?
- (A) Proceed with surgery with intraoperative transesophageal echocardiography
  - (B) Proceed with surgery but perform under local anesthesia with sedation
  - (C) Proceed with surgery only if echocardiogram shows normal ejection fraction
  - (D) Proceed with surgery after aggressive beta blockade to get heart rate into low 60s
  - (E) Postpone surgery for at least 4 weeks
13. A 65-year-old male is about to undergo an elective inguinal hernia repair. Which of the following findings on history or physical would portend the highest operative risk?
- (A) Systolic, crescendo-decrescendo murmur at the sternal border of the right second intercostal space radiating into the neck
  - (B) A history of myocardial infarction 10 years ago
  - (C) Insulin-dependent diabetes mellitus with an elevated Hgb-A1C
  - (D) Renal insufficiency not yet on dialysis
  - (E) Smoking
14. A 65-year-old male undergoes a videoscopic right upper lobectomy for squamous cell lung cancer. On postoperative day 1, he suddenly develops chest pain and diaphoresis. Blood pressure is 120/60 mmHg, and heart rate is 80/min. Serial highly sensitive troponin-I assays demonstrate levels of 0.4, 0.3, and 0.01 ng/dL. Electrocardiogram demonstrates nonspecific T-wave changes with no ST-segment elevation. Following the administration of oxygen, morphine, aspirin, and a beta-blocker, his symptoms resolve. What is the next step in the management?
- (A) Intravenous thrombolytic therapy
  - (B) Percutaneous coronary intervention (PCI) with stenting
  - (C) PCI without stenting
  - (D) Coronary artery bypass graft (CABG)
  - (E) Continue medical management and reevaluate as outpatient in 4–6 weeks

15. A 17-year-old black male presents for a pre-participation physical before track season. A harsh systolic murmur is heard at the second right intercostal space. He denies ever experiencing chest pain, dizziness, or difficulty breathing. Which of the following would be expected on further workup?
- (A) T-wave inversion on electrocardiogram
  - (B) Laterally displaced point of maximum impulse (PMI) on palpation
  - (C) Weak femoral pulses compared to brachial pulses
  - (D) Increased intensity of the murmur with Valsalva maneuver
  - (E) Increased intensity of the murmur with squatting
16. A 65-year-old woman arrives to the emergency department complaining of chest pain. Her past medical history includes hypertension, atherosclerosis, and coronary artery disease. She underwent a coronary artery bypass graft (CABG) 3 weeks ago for three-vessel disease. She reports that her chest pain worsens with inspiration and lessens when leaning forward. A friction rub is heard on auscultation. Electrocardiogram shows global ST elevation. What is the most likely diagnosis?
- (A) Myocarditis
  - (B) Myocardial infarction
  - (C) Cardiac tamponade
  - (D) Acute pericarditis
  - (E) Pulmonary embolism
17. A 40-year-old male presents with acute chest pain and nausea. Serum troponin levels are elevated, and the electrocardiogram demonstrates ST-segment elevation. Which of the following would be the strongest contraindication to intravenous thrombolytic therapy?
- (A) Right knee arthroscopic surgery 1 month ago
  - (B) Recently completed antibiotic course for *H. pylori* infection
  - (C) Wide mediastinum on chest x-ray
  - (D) History of alcohol abuse
  - (E) Endovascular aortic aneurysm repair 1 month ago

## Answers

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1. Answer D  
 This patient's presentation is most concerning for acute mediastinitis. This is a life-threatening infection of the mediastinum with a very high mortality rate that is most commonly associated with cardiac surgery. The incidence rate is 1–2% following CABG. The source of infection may be a sternal wound infection, combined with instability of the sternum that permits bacteria to enter the mediastinum. *Hamman's sign* is a crunching sound heard with a stethoscope over the precordium during systole and is suggestive of acute mediastinitis. Patients will frequently present with chest pain, increased drainage from the sternal wound, fevers, and leukocytosis. Chest radiograph findings include a widened mediastinum with or without pneumomediastinum or air-fluid levels within the mediastinum. A CT scan can also support the diagnosis by demonstrating dehiscence of the sternum and stranding, fluid and air pockets within the anterior mediastinum. Management includes surgical debridement, drainage, antibiotics, and rewiring the sternum. Acute pericarditis will present with pleuritic chest pain that lessens when leaning forward, friction rub heard on auscultation, and characteristic electrocardiogram findings (global ST elevation) (A). Pneumonia would present with shortness of breath, productive cough, and abnormal lung sounds (E). Postoperative MI would not be expected to present with evidence of systemic inflammation (B). Empyema is defined as pus in the pleural space and would not explain the physical exam findings of sternal instability and Hamman's sign (C). CT scan would demonstrate a loculated fluid collection within the right or left pleural cavity.



- ✓ 2. Answer B  
The classic signs of severe aortic stenosis are angina, syncope, and congestive heart failure (which may manifest as swollen legs) (A, C). Of the three, congestive heart failure portends the worst prognosis, with median survival as low as 2 years. A loud mid-systolic murmur indicates hemodynamically significant obstruction but is a better prognostic sign than an absent murmur, which indicates low blood flow across the valve (D). Small head nodding movements with each heartbeat are known as de Musset's sign and is found in aortic regurgitation (E).
- ✓ 3. Answer D  
All of the above are risk factors for aortic dissection. However, the most significant risk factor for aortic dissection is systemic hypertension (A–C, E).
- ✓ 4. Answer D  
In cardiac tamponade, fluid (blood or effusion) in the pericardial space externally compresses the heart, which limits diastolic filling and reduces stroke volume. Since pericardial fluid is free flowing, the pressure is distributed equally along the pericardium. As this continues the rising pressure in the pericardium is transmitted to all four cardiac chambers resulting in equalization of central pressures. Pulsus bisferiens, also known as a biphasic pulse, refers to two strong systolic pulses with a mid-systolic dip, in other words, two pulses during systole (A). It can be seen in aortic regurgitation with or without aortic stenosis and hypertrophic cardiomyopathy. Watson's water hammer pulse is a pulse with a rapid upstroke and descent seen in patients with aortic regurgitation (B). Peaked T-waves are most often associated with hyperkalemia (C). It is unlikely to be seen in patients with cardiac tamponade since their electrocardiogram findings are characteristically low voltage. Pulsus alternans is a physical exam finding wherein the amplitude of a peripheral pulse changes from beat to beat associated with changing systolic blood pressure (E). It is most commonly caused by left ventricular failure.
- ✓ 5. Answer B  
Sudden onset of severe abdominal pain in association with an aortic dissection should always raise suspicion for malperfusion of the bowel which can lead to bowel ischemia, gangrene, and death. This most likely would occur if the dissection extends into, and suddenly occludes, the superior mesenteric artery, which supplies blood to the bowel from the ligament of Treitz to the mid-transverse colon. It is also important to recognize that bowel ischemia early on causes excruciating pain in the absence of peritonitis ("pain out of proportion to physical exam"). He has not been on broad-spectrum antibiotics and has no reason to have *C. difficile* infection, which most often presents with vague abdominal pain and diarrhea (A). Pancreatitis presents with epigastric pain radiating to the back, nausea, vomiting, anorexia, fever, and tachycardia and is most commonly associated with cholelithiasis and alcohol abuse (C). Aortoenteric fistula is a possible long-term sequela in patients who have had an intra-aortic synthetic graft placed (D). Diverticulitis is a common cause of left lower quadrant abdominal pain in elderly patients and does not typically cause such sudden severe pain (E).
- ✓ 6. Answer C  
This patient is presenting with ST-elevation myocardial infarction (MI). It is important to know the timing of causes of death after MI. In the first 48 h after MI, death is likely due to ventricular arrhythmia. If arrhythmia occurs after 48 h, an implantable defibrillator should be placed. Ruptures of the myocardium, either as a ventricular septal rupture or free wall rupture, usually do not occur until 4–5 days after MI, at which point the dead myocardium has been weakened by the body's inflammatory response (A). Post-MI pericarditis, also known as *Dressler's syndrome*, usually occurs weeks or months after MI or cardiac surgery (D). An embolic stroke would present with sudden onset

of numbness on one side of the body, cranial nerve deficits, and/or aphasia (B). It is unlikely to cause death so quickly. There is no reason to believe the patient has sustained an overwhelming infection (E).

✓ 7. Answer A

The MUGA scan is the most accurate test in measuring ejection fraction. It is a non-invasive nuclear test that uses a radioactive isotope (technetium) to evaluate the function of the ventricles. Though not as accurate, an echocardiogram is used more commonly because it is cheaper and more readily available and can look for valve function as well as focal areas of wall motion abnormality (B). Electrocardiogram and exercise stress test are unable to measure a patient's ejection fraction (C). Coronary angiography is considered the gold standard in identifying coronary artery disease and can estimate ejection fraction but is not as accurate (D). In an exercise stress test, the patient typically walks on a treadmill while monitored with an electrocardiogram to look for changes suggestive of coronary ischemia (E).

✓ 8. Answer E

It is important to rapidly identify Stanford type A dissections, as they require urgent surgical intervention due to the fact that they can lead to cardiac tamponade, acute aortic valve insufficiency, acute myocardial infarction, and stroke. A Stanford type A dissection involves the ascending aorta and/or the aortic arch. Thus, an aortic dissection involving the innominate artery is a Stanford type A (A–D). Stanford type B aortic dissection is more common. It begins in the descending aorta, distal to the takeoff of the left subclavian artery. Stanford type B dissections are much less likely to cause acute complications since the ascending aorta/aortic arch is not involved. A type B dissection may involve the mesenteric, renal, or iliac arteries, but not occlude them, as blood may continue to flow normally (either through the true or the false lumen). Most can be managed medically with blood pressure control (beta-blockers). Surgical intervention is needed if the involvement of these vessels leads to malperfusion (such as leg ischemia, bowel ischemia, or renal failure).

✓ 9. Answer C

Based on the description of the site of the dissection, this is a type B aortic dissection. These are usually managed medically unless the patient has evidence of malperfusion (A). Since her peripheral pulses are all 2+ and her abdomen is soft and non-tender, there is no evidence of malperfusion. The goal is to maintain a relatively low blood pressure in order to minimize stress on the aorta. Aggressive IV fluids will not reduce blood pressure and may actually raise it (B). Nicardipine will lower blood pressure, but intravenous beta-blocker is the treatment of choice because it also reduces the rate of pressure increase with each beat of the heart, which lowers the stress on the aortic wall (E). Endovascular therapy is not routinely needed for most type B dissections (D).

✓ 10. Answer A

Patients with a recent history of myocardial infarction are at risk of thrombus formation on the scarred endocardium, which can then embolize to the brain and cause a stroke. Patients with a recent history of MI and evidence of thrombus on echocardiography should be treated with warfarin to maintain an INR of 2–3 and followed up within 3 months. Thromboembolism from the left atrial appendage is a concern in patients with atrial fibrillation (D). Paradoxical venous thromboembolism is a concern in patients with an atrial septal defect or patent foramen ovale, wherein a deep venous thrombus can travel through the defect into the left heart and ultimately to the brain (E). Septic embolism is a concern in IV drug abusers and can lead to cerebral abscess (B). Type A dissection would usually present with severe chest pain radiating to the back (C).



- ✓ 11. Answer A  
This patient has a postoperative right-sided MI, resulting in compromised cardiac output secondary to decreased preload. One of the steps in management of *right-sided* MI is to administer fluids to help increase filling of the heart. Avoid nitrates in these patients as it may further reduce preload (B–C). Acutely, patients with MI need oxygen, aspirin, analgesics, and beta-blockers. Oxygen should be used selectively as it is considered a systemic vasoconstrictor and can further reduce coronary blood flow. Dihydropyridine calcium channel blockers, such as nifedipine, are contraindicated in MI because of the associated peripheral vasodilation that may lead to reactive tachycardia and subsequently result in even more stress on the heart (D). ACE inhibitors (e.g., lisinopril) should be considered for long-term treatment after the acute episode has resolved (E).
- ✓ 12. Answer E  
This patient has a NSTEMI. Proceeding with elective surgery 1 week after an acute MI is inappropriate (A–D). Patients with a recent MI are at significantly increased cardiac risk during non-cardiac surgery, particularly within the first month after MI. Although performing the operation under local anesthesia with sedation seems appealing, there is still considerable stress and cardiac risk with such an approach (B). The best recommendation for this patient is to postpone surgery for at least 4 weeks. At that point, consideration should still be given to cardiac stress testing prior to surgery or even further surgical delay, as the cardiac risk persists for at least 6 months after an MI.
- ✓ 13. Answer A  
Major predictors of adverse postoperative cardiac events must be identified prior to elective non-cardiac surgery. These include recent (within 1 month) myocardial infarction, unstable or severe angina, decompensated congestive heart failure, and significant arrhythmias. Such cardiac conditions require postponing surgery and performing further cardiac workup. A systolic, crescendo-decrescendo murmur at the sternal border of the right second intercostal space radiating into the neck is highly suggestive of aortic stenosis and would require an echocardiogram to rule out severe aortic stenosis. Aortic stenosis impairs coronary perfusion, which can become further exacerbated during induction of anesthesia. From all the choices listed, it portends the highest operative risk. Lee's revised cardiac risk index identifies intermediate risk factors; these include known coronary artery disease, history of CHF, history of stroke or transient ischemic attack, insulin-dependent diabetes, creatinine >2.0 mg/dL, and high-risk surgery (i.e., aortic) (B–D). Adding a point for each factor and assigning a score (from 0 to 6) are highly effective in stratifying cardiac risk. Interestingly, smoking has not been shown to be an independent risk factor for adverse perioperative cardiac events in most studies (E).
- ✓ 14. Answer E  
The patient has suffered a postoperative NSTEMI. Most NSTEMI (as opposed to a STEMI) in the postoperative setting are managed without PCI with a combination of oxygen, morphine for pain relief, aspirin, and a beta-blocker. Optimally, an additional antiplatelet agent (such as clopidogrel) and intravenous heparin are also given, but this depends on how recent the operation was and the potential for postoperative bleeding. Consideration should be given to stress testing at 4–6 weeks after surgery, and depending on the results, PCI is then considered. Urgent PCI is indicated in the setting of a STEMI, and in certain high-risk NSTEMIs (continued rise in troponins, ongoing chest pain), but will require clopidogrel (again may not be desirable so soon after surgery) if a stent is placed (B–C). The patient described has a down trend of troponins and relief of symptoms, further supporting medical management. Emergent CABG would be considered if PCI fails or is not technically feasible with severe three-vessel disease (D). Emergent operations for acute MI continue to have a high mortality despite many technological advances in myocardial protection. Thrombolytic therapy is an alternative when PCI is not available but would be contraindicated within 2–3 weeks of major surgery (A).

✓ 15. Answer D

The patient likely has hypertrophic obstructive cardiomyopathy, an asymmetric thickening of the ventricular septum that creates a narrowing of the left ventricular outflow tract. Vigorous exercise places him at increased risk of sudden cardiac death. T-wave inversion would be found in ischemic heart disease and would be very unlikely in an otherwise healthy 17-year-old (A). Laterally displaced PMI would be found in patients with congestive heart failure, also very unlikely in this patient (B). Weak femoral pulses compared to brachial pulses are a finding in coarctation of the aorta and would not create a harsh systolic murmur (C). Murmurs due to aortic regurgitation, mitral regurgitation, and ventricular septal defect increase in intensity with squatting (E).

✓ 16. Answer D

Acute pericarditis is inflammation in the pericardial sac accompanied by pericardial effusion. It can occur following post-MI (termed Dressler's syndrome), chest radiation, or recent heart surgery. Patients present with pleuritic chest pain that lessens when leaning forward, friction rub heard on auscultation, global ST elevation, and PR depression. Patients with myocarditis (A) usually present with signs and symptoms of acute decompensating heart failure (e.g., tachycardia, gallop, mitral regurgitation, and edema) (A). Chest pain accompanied with MI would not be expected to lessen with leaning forward (B). Furthermore, *global* ST elevation would not be expected. Cardiac tamponade can occur once the effusion reaches a critical mass in which cardiac output is compromised (C). Pulmonary embolism can present with pleuritic chest pain, but it will not be influenced by positioning and is more likely to have electrocardiogram findings suggestive of right heart failure (E).

✓ 17. Answer C

Wide mediastinum on chest x-ray is concerning for aortic dissection. Patients with type A aortic dissection can present with coronary artery malperfusion and thus have a similar presentation as an acute myocardial infarction. Suspected aortic dissection is considered an absolute contraindication to thrombolysis in patients with myocardial infarction. The remaining choices are all relative contraindications for intravenous thrombolytics (A–B, D–E).