

Ministry of Healthcare of Ukraine
Poltava State Medical University

**GUIDELINES
FOR STUDENTS
INDEPENDENT WORK
IN THE PRACTICAL CLASSES PREPARING**

Academic discipline

Internal medicine

Module

Current practice of internal medicine

Content module

Management of the patients with main symptoms and syndromes in cardiology clinic

Study subject

Management of the patients with acute chest pain

Course

VI

Faculty

of foreign students training

1.The aims of the training course:

To Know:

1. Differential diagnosis of acute coronary syndrome, myocardial infarction, angina and others chest pains.
2. Plan examination, additional laboratory and instrumental methods of examination.
3. Tactic of patients curation.

To be able to:

- Conduct surveys and patients examination with major cardiological syndromes
- To draft survey the patients with heart diseases, to justify the use of major invasive and non-invasive diagnostic techniques which are using in cardiology, to identify indications and contraindications for their conduction, possible complications
- Identify different options for the course and complications of heart disease
- Carry out differential diagnosis, justify and formulate diagnoses for major cardiac syndromes based on laboratory analysis and test tool
- Prescribe treatment, determine prognosis, to conduct primary and secondary prevention in heart disease
- Register and interpret the ECG in 12 assignments
- Measure and interpret blood pressure
- Diagnose and assist in syncope
- Diagnose and assist in hypertensive crisis
- Diagnose and assist with arterial hypotension
- Diagnose and assist in the paroxysmal disorders of cardiac rhythm
- Diagnose and assist syndrome Morhany-Edems-Stoks
- Conduct pulmonary heart reanimation
- Demonstrate knowledge of moral principles medical specialist and professional principles of subordination

The contents of topic:

Text

Merck Manual Professional Version <http://www.merckmanuals.com/professional>

Last full review/revision August 2014 by Lyall A. J. Higginson, MD

Chest pain is a very common complaint. Many patients are well aware that it is a warning of potential life-threatening disorders and seek evaluation for minimal symptoms. Other patients, including many with serious disease, minimize or ignore its warnings. Pain perception (both character and severity) varies greatly between individuals as well as between men and women. However described, chest pain should never be dismissed without an explanation of its cause.

Pathophysiology

The heart, lungs, esophagus, and great vessels provide afferent visceral input through the same thoracic autonomic ganglia. A painful stimulus in these organs is typically perceived as originating in the chest, but because afferent nerve fibers overlap in the dorsal ganglia, thoracic pain may be felt (as referred pain) anywhere between the umbilicus and the ear, including the upper extremities.

Painful stimuli from thoracic organs can cause discomfort described as pressure, tearing, gas with the urge to eructate, indigestion, burning, aching, stabbing, and sometimes sharp needle-like pain. When the sensation is visceral in origin, many patients deny they are having pain and insist it is merely “discomfort.”

Etiology

Many disorders cause chest pain or discomfort. These disorders may involve the cardiovascular, GI, pulmonary, neurologic, or musculoskeletal systems.

Some disorders are immediately life threatening:

- Acute coronary syndromes (acute MI/unstable angina)
- Thoracic aortic dissection
- Tension pneumothorax
- Esophageal rupture
- Pulmonary embolism (PE)

Other causes range from serious, potential threats to life to causes that are simply uncomfortable. Often no cause can be confirmed even after full evaluation.

Overall, the most common causes are

- Chest wall disorders (ie, those involving muscle, rib, or cartilage)
- Pleural disorders
- GI disorders (eg, esophageal reflux or spasm, ulcer disease, cholelithiasis)
- Idiopathic
- Acute coronary syndromes and stable angina

Some Causes of Chest Pain

Cause*	Suggestive Findings	Diagnostic Approach †
Cardiovascular		
	Acute, crushing pain radiating to the jaw or arm	Serial ECGs and cardiac markers; admit or observe
¹ Myocardial ischemia (acute MI/unstable angina/angina)	Exertional pain relieved by rest (angina pectoris) S ₄ gallop	Stress imaging test or CT angiography considered in patients with negative ECG findings and no cardiac marker elevation
	Sometimes systolic murmurs of mitral regurgitation	Often heart catheterization and coronary angiography if findings are positive
	Often red flag findings ‡ Sudden, tearing pain radiating to the back	Chest x-ray with findings suggesting diagnosis
¹ Thoracic aortic dissection	Some patients have syncope, stroke, or leg ischemia Pulse or BP that may be unequal in extremities Age > 55	Enhanced CT scan of aorta for confirmation Transesophageal echocardiography

Cause*	Suggestive Findings	Diagnostic Approach †
	Hypertension	
	Red flag findings ‡	
² Pericarditis	Constant or intermittent sharp pain often aggravated by breathing, swallowing food, or supine position and relieved by sitting leaning forward	ECG usually diagnostic
	Pericardial friction rub	Serum cardiac markers (sometimes showing minimal elevation of troponin and CPK levels)
	Jugular venous distention	Transthoracic echocardiography
		ECG
² Myocarditis	Fever, dyspnea, fatigue, chest pain (if myopericarditis), recent viral or other infection	Serum cardiac markers
		ESR
	Sometimes findings of heart failure, pericarditis, or both	C-reactive protein
GI		Usually echocardiography
	Sudden, severe pain following vomiting or instrumentation (eg, esophagogastrosocopy or transesophageal echocardiography)	Chest x-ray
	¹ Esophageal rupture	Esophagography with water-soluble contrast for confirmation
	Subcutaneous crepitus detected during auscultation	
² Pancreatitis	Multiple red flag findings ‡	
	Pain in the epigastrium or lower chest that is often worse when lying flat and is relieved by leaning forward	
	Vomiting	Serum lipase
	Upper abdominal tenderness	Sometimes abdominal CT
³ Peptic ulcer	Shock	
	Often history of alcohol abuse or biliary tract disease	
	Recurrent, vague epigastric or right upper quadrant discomfort in a patient who smokes or uses alcohol excessively that is relieved by food, antacids, or both	Clinical evaluation
		Sometimes endoscopy
		Sometimes testing for <i>Helicobacter pylori</i>

Cause*	Suggestive Findings	Diagnostic Approach †
	No red flag findings ‡	
³ Esophageal reflux (GERD)	Recurrent burning pain radiating from epigastrium to throat that is exacerbated by bending down or lying down and relieved by antacids	Clinical evaluation Sometimes endoscopy Sometimes motility studies
³ Biliary tract disease	Recurrent right upper quadrant or epigastric discomfort following meals (but not exertion)	Ultrasonography of gallbladder
³ Esophageal motility disorders	Long-standing pain of insidious onset that may or may not accompany swallowing	Barium swallow
Pulmonary	Usually also difficulty swallowing	
	Often pleuritic pain, dyspnea, tachycardia	
¹ Pulmonary embolism	Sometimes mild fever, hemoptysis, shock	Varies with clinical suspicion
	More likely when risk factors are present	
¹ Tension pneumothorax	Significant dyspnea, hypotension, neck vein distention, unilateral diminished breath sounds and hyperresonance to percussion	Usually clinical Obvious on chest x-ray
² Pneumonia	Sometimes subcutaneous air Fever, chills, cough, and purulent sputum	Chest x-ray
² Pneumothorax	Often dyspnea, tachycardia, signs of consolidation	
	Sometimes, unilateral diminished breath sounds, subcutaneous air	Chest x-ray
³ Pleuritis	May have preceding pneumonia, pulmonary embolism, or viral respiratory infection	
	Pain with breathing, cough	Usually clinical evaluation
	Examination unremarkable	
Other		
³ Musculoskeletal chest wall pain (eg, due to trauma, overuse, or costochondritis)	Often suggested by history Pain typically persistent (typically days or longer), worsened with passive	Clinical evaluation

Cause*	Suggestive Findings and active motion	Diagnostic Approach †
	Diffuse or focal tenderness Nearly constant pain, affecting multiple areas of the body as well as the chest	
³ Fibromyalgia	Typically, fatigue and poor sleep Multiple trigger points Variable	Clinical evaluation Chest x-ray
² Various thoracic cancers	Sometimes chronic cough, smoking history, signs of chronic illness (weight loss, fever), cervical lymphadenopathy Sharp, band-like pain in the midthorax unilaterally	Chest CT if x-ray findings are suggestive Bone scan considered for persistent, focal rib pain
³ Herpes zoster infection	Classic linear, vesicular rash Pain may precede rash by several days Various features	Clinical evaluation
³ Idiopathic	No red flag findings ‡	Diagnosis of exclusion

*Seriousness of causes varies as indicated:

¹ Immediate life threats.

² Potential life threats.

³ Uncomfortable but usually not dangerous.

† Most patients with chest pain should have pulse oximetry, ECG, and chest x-ray (basic tests). If there is suspicion of coronary ischemia, serum cardiac markers (troponin, CPK) should also be checked.

‡ Red flag findings include abnormal vital signs (tachycardia, bradycardia, tachypnea, hypotension), signs of hypoperfusion (eg, confusion, ashen color, diaphoresis), shortness of breath, asymmetric breath sounds or pulses, new heart murmurs, or pulsus paradoxus > 10 mm Hg.

S₄ = 4th heart sound.

Evaluation

History

History of present illness should note the location, duration, character, and quality of the pain. The patient should be asked about any precipitating events (eg, straining or overuse of chest muscles), as well as any triggering and relieving factors. Specific factors to note include whether

pain is present during exertion or at rest, presence of psychologic stress, whether pain occurs during respiration or coughing, difficulty swallowing, relationship to meals, and positions that relieve or exacerbate pain (eg, lying flat, leaning forward). Previous similar episodes and their circumstances should be noted with attention to the similarity or lack thereof. Important associated symptoms to seek include dyspnea, palpitations, syncope, diaphoresis, nausea or vomiting, cough, fever, and chills.

Review of systems should seek symptoms of possible causes, including leg pain, swelling, or both (deep venous thrombosis [DVT] and therefore possible PE) and chronic weakness, malaise, and weight loss (cancer).

Past medical history should document known causes, particularly cardiovascular and GI disorders, and any cardiac investigations or procedures (eg, stress testing, catheterization). Risk factors for coronary artery disease (CAD—eg, hypertension, hyperlipidemia, diabetes, cerebrovascular disease, tobacco use) or PE (eg, lower extremity injury, recent surgery, immobilization, known cancer, pregnancy) should also be noted.

Drug history should note use of drugs that can trigger coronary artery spasm (eg, cocaine, triptans, phosphodiesterase inhibitors) or GI disease (particularly alcohol, NSAIDs).

Family history should note history of MI (particularly among 1st-degree relatives at an early age—< 55 in men and < 60 in women) and hyperlipidemia.

Physical examination

Vital signs and weight are measured, and body mass index (BMI) is calculated. Pulses are palpated in both arms and both legs, BP is measured in both arms, and pulsus paradoxus is measured.

General appearance is noted (eg, pallor, diaphoresis, cyanosis, anxiety).

Neck is inspected for venous distention and hepatjugular reflux, and the venous wave forms are noted. The neck is palpated for carotid pulses, lymphadenopathy, or thyroid abnormality. The carotid arteries are auscultated for bruit.

Lungs are percussed and auscultated for presence and symmetry of breath sounds, signs of congestion (dry or wet rales, rhonchi), consolidation (pectoriloquy), pleural friction rubs, and effusion (decreased breath sounds, dullness to percussion).

The cardiac examination notes the intensity and timing of the 1st heart sound (S_1) and 2nd heart sound (S_2), the respiratory movement of the pulmonic component of S_2 , clicks and snap of the mitral apparatus, pericardial friction rubs, murmurs, and gallops. When murmurs are detected, the timing, duration, pitch, shape, and intensity and the response to changes of position, handgrip, and the Valsalva maneuver should be noted. When gallops are detected, differentiation should be made between the 4th heart sound (S_4), which is often present with diastolic dysfunction or myocardial ischemia, and the 3rd heart sound (S_3), which is present with systolic dysfunction.

The chest is inspected for skin lesions of trauma or herpes zoster infection and palpated for crepitation (suggesting subcutaneous air) and tenderness. The abdomen is palpated for tenderness, organomegaly, and masses or tenderness, particularly in the epigastric and right upper quadrant regions.

The legs are examined for arterial pulses, adequacy of perfusion, edema, varicose veins, and signs of DVT (eg, swelling, erythema, tenderness).

Red flags

Certain findings raise suspicion of a more serious etiology of chest pain:

- Abnormal vital signs (tachycardia, bradycardia, tachypnea, hypotension)
- Signs of hypoperfusion (eg, confusion, ashen color, diaphoresis)
- Shortness of breath
- Hypoxemia on pulse oximetry
- Asymmetric breath sounds or pulses
- New heart murmurs
- Pulsus paradoxus > 10 mm Hg

Interpretation of findings

Symptoms and signs of thoracic disorders vary greatly, and those of serious and nonserious conditions often overlap. Although red flag findings indicate a high likelihood of serious disease, and many disorders have “classic” manifestations, many patients who have serious illness do not present with these classic symptoms and signs. For example, patients with myocardial ischemia may complain only of indigestion or have a very tender chest wall on palpation. A high index of suspicion is important when evaluating patients with chest pain. Nonetheless, some distinctions and generalizations are possible.

Duration of pain can provide clues to the severity of the disorder. Long-standing pain (ie, for weeks or months) is not a manifestation of a disorder that is immediately life threatening. Such pain is often musculoskeletal in origin, although GI origin or a cancer should be considered, particularly in patients who are elderly. Similarly, brief (< 5 sec), sharp, intermittent pains rarely result from serious disorders. Serious disorders typically manifest pain lasting minutes to hours, although episodes may be recurrent (eg, unstable angina may cause several bouts of pain over 1 or more days).

Patient age is helpful in evaluating chest pain. Chest pain in children and young adults (< 30 yr) is less likely to result from myocardial ischemia, although MI can occur in people in their 20s. Musculoskeletal and pulmonary disorders are more common causes in these age groups.

Exacerbation and relief of symptoms also are helpful in evaluating chest pain. Although angina can be felt anywhere between the ear and the umbilicus (and often not in the chest), it is typically consistently related to physical or emotional stress, ie, patients do not experience angina from climbing one flight of stairs one day and tolerate 3 flights the next day. Nocturnal angina is characteristic of acute coronary syndromes, heart failure, or coronary artery spasm.

Pain from many disorders, both serious and minor, can be exacerbated by respiration, movement, or palpation of the chest. These findings are not specific for origin in the chest wall; about 15% of patients with acute MI have chest tenderness on palpation.

Nitroglycerin may relieve pain of both myocardial ischemia and noncardiac smooth muscle spasm (eg, esophageal or biliary disorders); its efficacy or lack thereof should not be used for diagnosis.

Associated findings may also suggest a cause. Fever is nonspecific but, if accompanied by cough, suggests a pulmonary cause. Patients with Raynaud syndrome or migraine headaches sometimes have coronary spasm.

The presence or absence of risk factors for CAD (eg, hypertension, hypercholesterolemia, smoking, obesity, diabetes, positive family history) alters the probability of underlying CAD but does not help diagnose the cause of a given episode of acute chest pain. Patients with those factors may well have another cause of chest pain, and patients without them may have an acute coronary syndrome. However, known CAD in a patient with chest pain raises the likelihood of that diagnosis as the cause (particularly if the patient describes the symptoms as “like my angina” or “like my last heart attack”). A history of peripheral vascular disease also raises the likelihood that angina is the cause of chest pain.

Testing

For adults with acute chest pain, immediate life threats must be ruled out. Most patients should initially have pulse oximetry, ECG, and chest x-ray. If symptoms suggest an acute coronary syndrome or if no other cause is clear (particularly in at-risk patients), troponin levels are measured. If a PE is considered possible, D-dimer testing is done. Expedient evaluation is essential because if MI or other acute coronary syndrome is present, the patient should be considered for urgent heart catheterization (when available).

Some abnormal findings on these tests confirm a diagnosis (eg, acute MI, pneumothorax, pneumonia). Other abnormalities suggest a diagnosis or at least the need to pursue further investigation (eg, abnormal aortic contour on chest x-ray suggests need for testing for thoracic aortic dissection). Thus, if these initial test results are normal, thoracic aortic dissection, tension pneumothorax, and esophageal rupture are highly unlikely. However, in acute coronary syndromes, ECG may not change for several hours or sometimes not at all, and in PE, oxygenation may be normal. Thus, other studies may need to be obtained based on findings from the history and physical examination.

Because a single normal set of cardiac markers does not rule out a cardiac cause, patients whose symptoms suggest an acute coronary syndrome should have serial measurement of the cardiac marker troponin and ECGs at least 6 h apart. Some clinicians follow these tests (acutely or within several days) with a stress ECG or a stress imaging test. Drug treatment is begun while awaiting results of the 2nd troponin level unless there is a clear contraindication. A diagnostic trial of sublingual nitroglycerin or an oral liquid antacid does not adequately differentiate myocardial ischemia from gastroesophageal reflux disease or gastritis. Either drug may relieve symptoms of either disorder. Troponin will be elevated in all acute coronary syndromes causing cardiac injury and often in other disorders that damage the myocardium (eg, myocarditis, pericarditis, aortic dissection involving coronary artery flow, PE, heart failure, severe sepsis). CPK may be elevated due to damage to any muscle tissue, but CPK-MB elevation is specific to damage to the myocardium. However, troponin is now the standard marker of cardiac muscle injury. ST-segment abnormality on the ECG may be nonspecific or due to antecedent disorders, so comparison with previous ECGs is important.

The likelihood of PE is affected by a number of factors, which can be used in an algorithm to derive an approach to testing.

In patients with chronic chest pain, immediate threats to life are unlikely. Most clinicians initially obtain a chest x-ray and do other tests based on symptoms and signs.

Clinical Prediction Rule for Diagnosing Pulmonary Embolism

I. Establish clinical probability—add points to determine total score and thus probability.

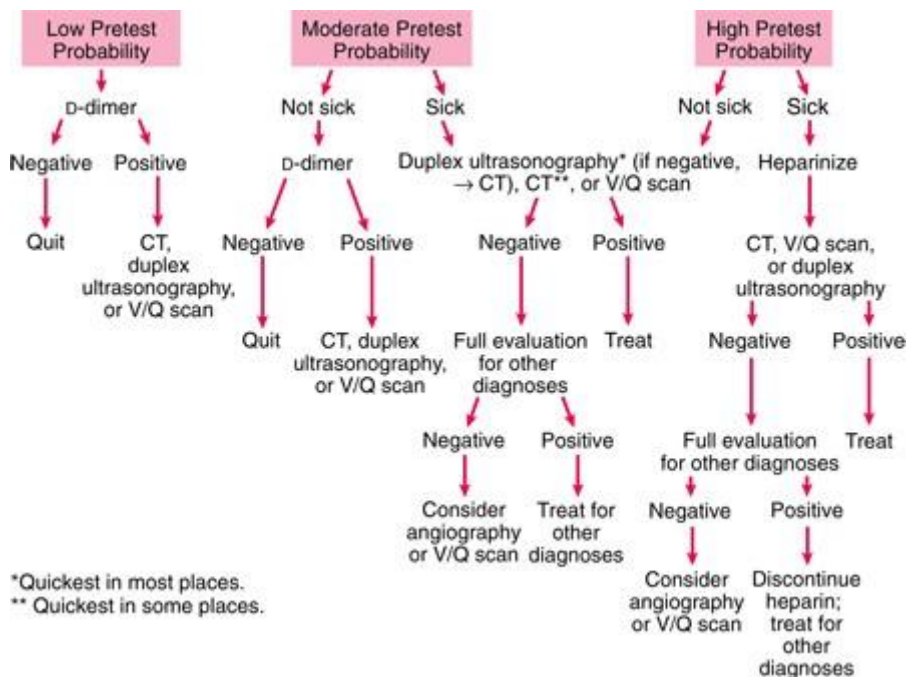
Clinical Risk	Points
Clinical signs and symptoms of DVT (objective leg swelling, pain with palpation)	3
PE as likely as or more likely than alternative diagnosis	3
Heart rate > 100 beats/min	1.5
Immobilization ≥ 3 days	1.5
Surgery in previous 4 wk	1.5
Previous DVT or PE	1.5
Hemoptysis	1
Malignancy (including in patients stopping cancer treatment within 6 mo)	1
Total Score	Probability
> 6	High
2–6	Moderate
< 2	Low

II. Use pretest probability to determine testing.

DVT = deep venous thrombosis; PE = pulmonary embolism; V/Q = ventilation/perfusion.

PE testing algorithm.

Use pretest probability to determine testing.



Treatment

Specific identified disorders are treated. If etiology is not clearly benign, patients are usually admitted to the hospital or an observation unit for cardiac monitoring and more extensive evaluation. Symptoms are treated with acetaminophen or opioids as needed, pending a diagnosis. Pain relief following opioid treatment should not diminish the urgency of ruling out serious and life-threatening disease.

Geriatrics Essentials

The probability of serious and life-threatening disease increases with age. Many elderly patients recover more slowly than younger patients but survive for significant time if properly diagnosed and treated. Drug doses are usually lower, and rapidity of dose escalation is slower. Chronic disorders (eg, decreased renal function) are often present and may complicate diagnosis and treatment.

Key Points

- Immediate life threats must be ruled out first.
- Some serious disorders, particularly coronary ischemia and PE, often do not have a classic presentation.
- Most patients should have pulse oximetry, ECG, cardiac markers, and chest x-ray.
- Evaluation must be prompt so that patients with ST-elevation MI can be in the heart catheterization laboratory (or have thrombolysis) within the 90-min standard.
- If PE is highly likely, antithrombin drugs should be given while the diagnosis is pursued; another embolus in a patient who is not receiving anticoagulants may be fatal.

Last full review/revision August 2014 by Lyall A. J. Higginson, MD

Self preparation at class:

Listen information;

Work with patients (with cardiac pathology);

Ask about the problems that have not been found in information given.

Self preparation at home:

Compose the plan of your answer;

Answer the questions to the topic;

Do the test given above

1. A 67-year-old woman with a mechanical mitral valve presented to the emergency department with fever for two days, a sudden onset of crushing, substernal chest pain, and this electrocardiograph (ECG) reading (*Figure 1*). Of note, she had been admitted to the hospital one month earlier for evaluation of a transient ischemic attack (TIA), which manifested as right arm weakness and numbness. A head computed tomography scan during that admission was normal, and a transthoracic echocardiogram showed a normally functioning mechanical mitral valve, which had been placed two years earlier. Review of her anticoagulation monitoring revealed that all recent international normalized ratio measurements were within the therapeutic range.

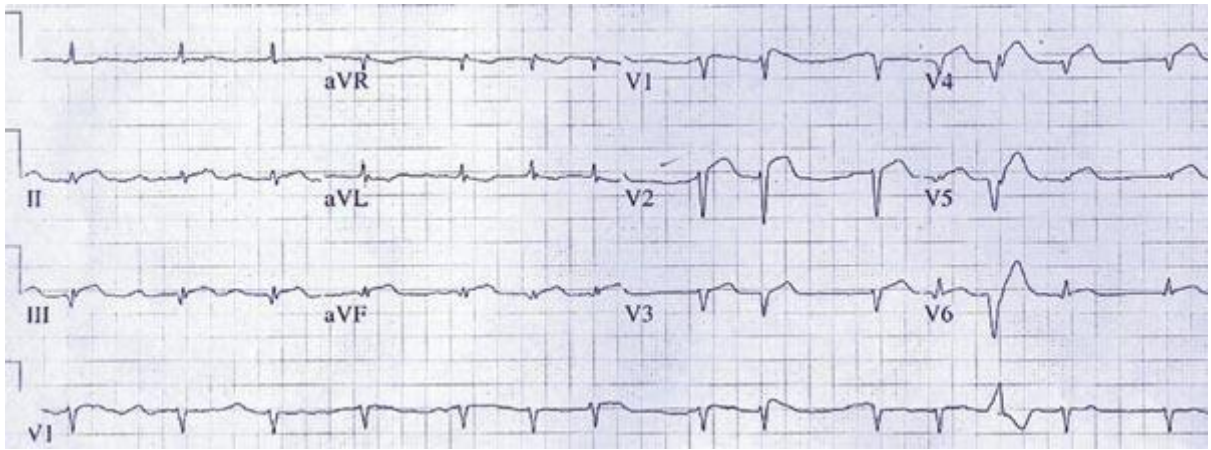


FIGURE 1.

Question

Based on the patient's history, physical examination, and ECG, which one of the following is the most likely diagnosis?

- A. Thrombotic acute myocardial infarction.
- B. Prosthetic valve endocarditis with coronary embolization.
- C. Prosthetic valve failure.
- D. Aortic dissection.
- E. Pericarditis.

2. A 16-year-old patient presented to the emergency department with sudden onset of chest pain and shortness of breath while playing basketball. There was no history of trauma. Physical examination revealed an otherwise healthy male in no acute distress with a blood pressure of 129/66 mm Hg, heart rate of 71 beats per minute, respiratory rate of 20 breaths per minute, and a pulse oximetry reading of 97 percent. Swelling and crepitus were noted in the neck. On auscultation, a crunching sound was noted over the precordium with each heartbeat. Pulmonary examination was unremarkable, and results of electrocardiography were normal. Chest radiography was performed (*see accompanying figure*).



Question

Based on the patient's history and physical examination, which one of the following is the most likely diagnosis?

- A. Aortic dissection.
- B. Pneumomediastinum.
- C. Atypical chest pain.
- D. Reactive airways disease.
- E. Esophageal rupture.

Recommended literature:

I. Main:

1. Internal Medicine: in 2 books. Book 1. Diseases of the Cardiovascular and Respiratory Systems: textbook / N.M. Seredyuk, I.P. Vakaliuk, R.I. Yatsyshyn et al. Київ, Медицина., 2019. - 664 + 48 кольор. вкл.).
2. Internal medicine: Part 1 (cardiology, rheumatology, haematology): textbook for English-speaking students of higher medical schools / edited by Professor M.A. Stanislavchuk and Professor V.A. Serkova. - Vinnytsia: Nova Knyha, 2019. - 392 p.
3. Медицина за Девідсоном: принципи і практика / Навчальний посібник: пер. 23-го англ. вид.: у 3 т. Т.3 С. Ралстона, Я. Пенмана, М. Стрекена, Р. Гобсона; К.: ВСВ «Медицина», 2021. – 642 с.
4. CURRENT Medical Diagnosis and Treatment 2012, Fifty-First Edition (LANGE CURRENT Series) by Stephen McPhee, Maxine Papadakis and Michael W. Rabow (Paperback - Sep 12, 2011)/
5. Побічна дія ліків – Side Effects of Medications: навчальний посібник 2 т. / за заг. ред. В.М. Бобирьова, М.М. Потяженка. – Вінниця:
6. Cardiovascular diseases. Classification, standards of diagnosis and treatment / Edited by Academician Kovalenko V.M., Prof. Lutaia M.I., Prof. Sirenko Yu.M., Prof. Sychova O.S. – Kyiv. – 2020.
7. Perederii V.H., Tkach S.M. Principles of internal medicine. – Vol.2 / Textbook for students of higher educational institutions. – Vinnytsia: Nova knyha. – 2018.
8. Internal diseases. The textbook based on the principles of evidentiary medicine, 2018.

II. Additional literature:

1. Recommendations of the Association of Cardiologists of Ukraine for the diagnosis and treatment of chronic heart failure / Voronkov L.H. – moderator, working group of the Ukrainian Association of Heart Failure Specialists. – 2017.
2. Respiratory diseases / Ghanei M. - In Tech, 2012. - 242 p.
3. Clinical respiratory medicine / Spiro S., Silvestri G., Agusti A. - Saunders, 2012. - 1000 p.
4. Principles and practice of interventional pulmonology / Ernst A., Herth F. -Springer, 2012. - 757 p.
5. Clinical respiratory medicine / Spiro S., Silvestri G., Agusti A. - Saunders, 2012. - 1000 p.
6. Petrov Y. The chief symptoms and syndromes in patients with cardiovascular pathology : The practical handbook for medical students / Ye. Petrov, Yu. Goldenberg, N. Chekalina; UMSA. - Poltava : TexcepBic, 2010. - 143 .
7. Gastroenterology and Hepatology Board Review: Pearls of Wisdom, Third Edition (Pearls of Wisdom Medicine) by John K. DiBaise (May 11, 2012)
8. Clinical Pulmonology 2012 (The Clinical Medicine Series) by M.D., C. G. Weber (Oct 30, 2011) - Kindle eBook
9. Clinical Nephrology 2012 (The Clinical Medicine Series) by M.D., C. G. Weber (Sep 19, 2011) - Kindle eBook

10. Clinical Nephrology 2012 (The Clinical Medicine Series) by M.D., C. G. Weber (Sep 19, 2011) - Kindle eBook
11. Hematology: Clinical Principles and Applications, 4e by Bernadette F. Rodak MS MLS (Feb 18, 2017)
12. Rheumatology, 2-Volume Set: EXPERT CONSULT - ENHANCED ONLINE FEATURES AND PRINT, 5e by Marc C. Hochberg MD MPH, Alan J. Silman MD, Josef S. Smolen MD and Michael E. Weinblatt MD (Oct 19, 2019)
13. Endocrine Pathology: Differential Diagnosis and Molecular Advances by Ricardo V. Lloyd (Nov 5, 2018)
14. Clinical Endocrinology 2012 (The Clinical Medicine Series) by M.D., C. G. Weber (Sep 19, 2017) - Kindle eBook
15. Williams Textbook of Endocrinology: Expert Consult-Online and Print, 12e by Shlomo Melmed, Kenneth S. Polonsky MD, P. Reed MD Larsen and Henry M. Kronenberg MD (May 27, 2016)
16. Electrocardiography, 3e with Student CD (Booth, Electrocardiography for Health Care Personnel) by Kathryn A. Booth (Jan 27, 2017)
17. Echocardiography Review Guide: Companion to the Textbook of Clinical Echocardiography: Expert Consult: Online and Print, 2e (Expert Consult Title: Online + Print) by Catherine M. Otto (Mar 7, 2017).

Discussion 1

The correct answer is B: prosthetic valve endocarditis with coronary embolization. The quality and sudden onset of the patient's chest pain, in combination with the ECG findings of anterolateral and inferior ST elevations, strongly suggested an acute myocardial infarction. The history of a recent TIA raised the possibility of a previous embolic event. The patient was taken emergently to cardiac catheterization, which revealed 100 percent occlusion of the distal left anterior descending artery but otherwise normal coronary arteries. Attempts to reduce the thrombus via angioplasty resulted in distal migration of the blockage, suggesting an embolic etiology. Transesophageal echocardiogram was performed, revealing a 3-cm vegetation on the anterior portion of the mitral valve ([Figure 2](#)). During emergent surgery to replace the prosthetic valve, large vegetations adherent to the valve were seen ([Figure 3](#)).

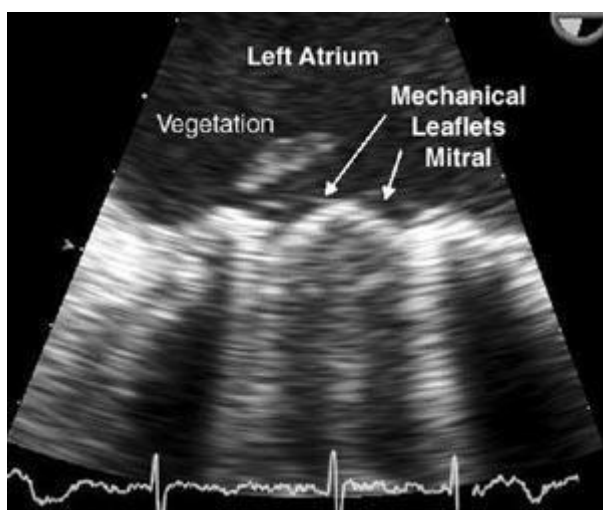


FIGURE 2.

Coronary artery emboli are uncommon, but when they do occur, infectious endocarditis is the most frequent cause. Peripheral embolization occurs in up to 50 percent of patients with infectious endocarditis, and these emboli often lodge in cerebral vessels, causing TIA or stroke.

Endocarditis is a feared complication of prosthetic valve implantation, involving 1 to 4 percent of all prosthetic valves. Transthoracic echocardiogram has poor sensitivity (less than 60 percent) in detecting valve vegetations, and in this case, may have missed a vegetation that caused the patient's TIA one month earlier.

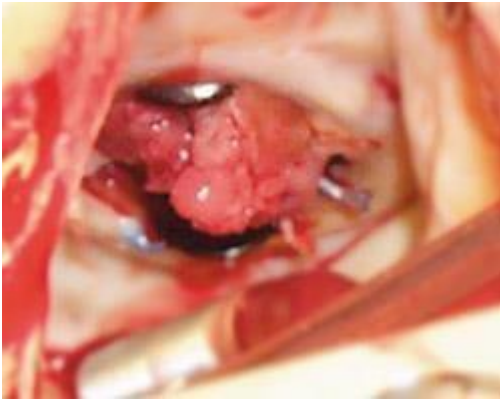


FIGURE 3.

Thrombotic acute myocardial infarction represents the most common cause of acute myocardial infarction in the United States. While this patient did experience a myocardial infarction, the

preceding TIA and presence of a mechanical valve are important clues, raising the possibility of an embolic source of infarction.

Prosthetic heart valve failure may be chronic, subacute, or acute. Chronic or subacute failure of the mitral valve typically would lead to pulmonary edema, presenting with fatigue, dyspnea on exertion, and auscultation of crackles at the lung bases. Acute mitral valve failure leads to more sudden and severe pulmonary edema, characterized by marked shortness of breath, cardiogenic shock, and respiratory failure. Valve failure typically would not present with the crushing, substernal chest pain noted in this patient.

Aortic dissection usually presents with tearing chest pain that radiates to the back. An ascending dissection occasionally can occlude the ostium of a coronary artery and lead to myocardial infarction. The previous TIA and mechanical valve in this case make the rare likelihood of an embolic source for the myocardial infarction somewhat more likely than the even more rare chance of an ascending dissection. Emergent angiography would provide helpful information in arriving at a diagnosis.

Pericarditis does not present with crushing, substernal chest pain. Though it may lead to ST-segment elevation, this usually can be differentiated from ischemia by its more widespread distribution and the tendency for the elevated ST segment to retain some of its usual concavity, unlike the convex, dome-shaped elevations seen with ischemia.

Discussion 2

The answer is B: pneumomediastinum. Physical examination demonstrated subcutaneous emphysema and Hamman's sign, the audible crunching accompanying each heartbeat. These findings are characteristic of pneumomediastinum. Chest pain and dyspnea are the most common symptoms. The chest radiograph shows a radiolucent outline of the mediastinum as well as the continuous diaphragm sign.

Pneumomediastinum is extra-alveolar air within the mediastinum. Numerous etiologies have been identified, including penetrating or crushing chest trauma, rapid shearing of the fixed carina, and increased intrabronchial pressure. Other causes include esophageal rupture in Boerhaave's syndrome, repeated Valsalva maneuver during inhalation drug use, or colonic perforation during colonoscopy.

Methodical recommendations consisted by



Kullishov S.K.