Chapter 17
Chest Pain

Adarsh Katamreddy

Chest Pain

Chest pain is a common clinical presentation encountered in the outpatient setting [1]. A systematic approach is required for timely diagnosis and management. The etiology for chest pain ranges from benign to potentially life-threatening causes [2]. Early identification of life-threatening causes and triaging to a higher level of care from an office setting is vital. In this chapter, we will review essential history, physical exam, and diagnosis strategies in the ambulatory setting. Chest pain is anxiety provoking in patients. Therefore, in addition to making the diagnosis, alleviating the patient's anxiety for benign causes of chest pain is essential.

History

Eliciting an accurate history is a crucial first step in making an accurate diagnosis. Using an open-ended style of questioning gives important clues about the underlying etiology. "Can

A. Katamreddy (✉)
Internal Medicine, Jacobi Medical Center/Albert Einstein College of Medicine, Bronx, NY, USA

E. Sydney et al. (eds.), *Handbook of Outpatient Medicine*,
https://doi.org/10.1007/978-3-031-15353-2_17

you tell me more about the pain?" should be the first question. Then, teasing out further details regarding the onset, duration, precipitating factors, character, radiation, association with food, exertion, respiration, any history of similar pain, and the relation of pain to the movement of the upper extremities and neck are significant to note. After trying open-ended questioning, close-ended questions can be used to further clarify the diagnosis.

Past medical history of cardiovascular risk factors including diabetes, hypertension, hyperlipidemia, chronic inflammatory conditions, and surgical history of cardiac procedures increases the likelihood of coronary artery disease. In addition, smoking and cocaine use history and family history of cardiac disease should also be reviewed.

Physical Exam

Blood pressure, heart rate, temperature, and respiratory rate provide crucial diagnostic information. Jugular venous distention, examination of bilateral pulses, cardiopulmonary auscultation, and assessment of pedal edema are important. Inspection of the skin of the chest, palpation of the chest wall for tenderness, and active movements of the neck and both upper extremities should be performed based on the elicited history.

Differential Diagnosis

The causes can be broadly divided into:

1. Cardiac chest pain (Fig. 17.1)
2. Non-cardiac chest pain (Fig. 17.2)

The clinical features of various chest pain presentations are presented below.

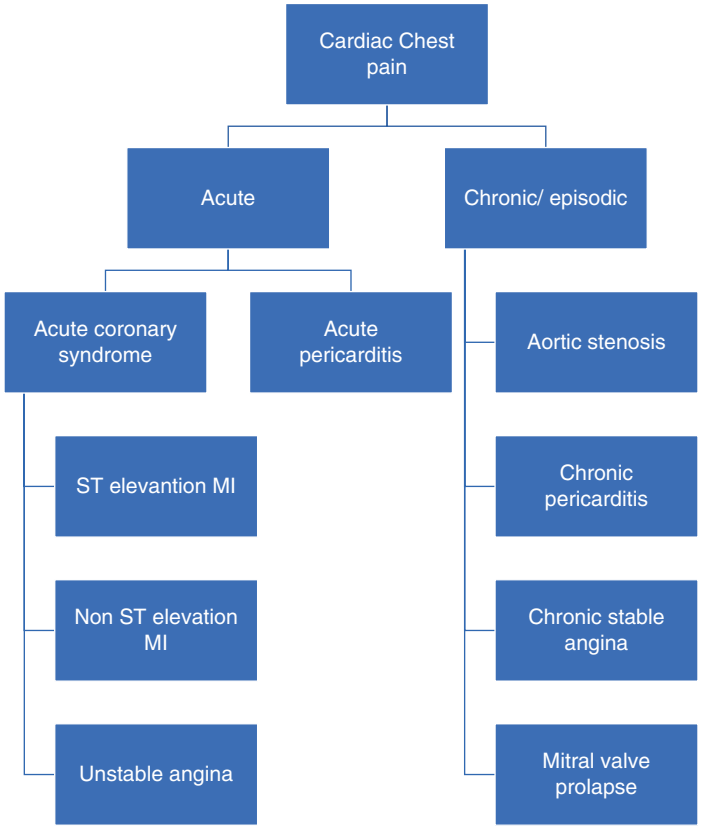

Figure 17.1 Cardiac chest pain causes

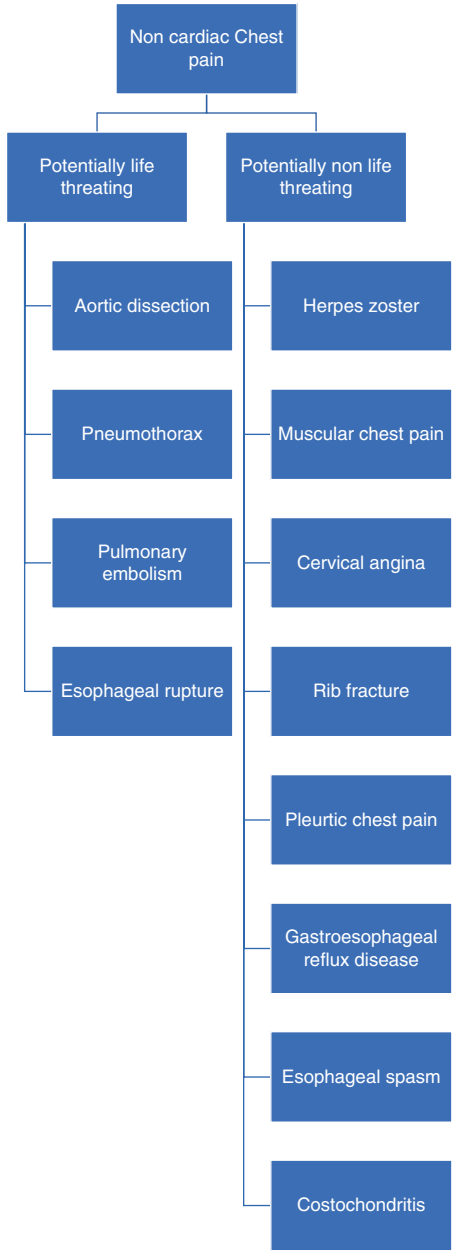

FIGURE 17.2 Non-cardiac chest pain causes

Potentially Life-Threatening

Patients presenting with any of the life-threatening causes should be managed emergently with an aim towards hemodynamic stability, and arrangements should be made to transfer to an emergency room swiftly under advanced cardiac life support staff supervision.

Acute Coronary Syndromes

Chest pain is substernal, dull, an sudden in onset, worsens over seconds to minutes, and worsens with exertion or emotional stress. Chest pain is often associated with shortness of breath and diaphoresis; radiates to the neck, jaw, right/left arm; and is sometimes present in the epigastric region. Chest pain improves with sublingual nitroglycerin (Table 17.1). The exam should pay particular focus on jugular venous distension, crackles on lung auscultation, pulses, and new murmurs.

Table 17.1 Clinical history for the diagnosis of acute myocardial infraction [8]

Pain descriptor	**Likelihood ratio (95% CI)**
Increased likelihood of AMI	
Radiation to right arm or shoulders	4.7 (1.9–12)
Radiation to both arms or shoulders	4.1 (2.5–6.5)
Associated with exertion	2.4 (1.5–3.8)
Radiation to left arm	2.3 (1.7–3.1)
Associated with diaphoresis	2.0 (1.9–2.2)
Associated with nausea and vomiting	1.9 (1.7–2.3)
Worse than previous angina or similar to previous MI	1.8 (1.6–2.0)
Described as pressure	1.3 (1.2–1.5)

(continued)

Table 17.1 (continued)

Pain descriptor	Likelihood ratio (95% CI)
Decreased likelihood of AMI	
Described as pleuritic	0.2 (0.1–0.3)
Described as positional	0.3 (0.2–0.5)
Described as sharp	0.3 (0.2–0.5)
Reproducible with palpation	0.3 (0.2–0.4)
Inframammary location	0.8 (0.7–0.9)
Not associated with exertion	0.8 (0.6–0.9)

Early identification of signs of cardiogenic dysfunction on the exam, including hypotension, tachycardia, elevated jugular venous pressure, and bilateral crackles, is essential. It is also important to note that acute coronary syndromes can present with pressure, tightness, or discomfort in the chest, shoulders, jaw, or upper extremities [3, 4].

Special populations: Women, patients with diabetes, and the elderly present with atypical symptoms more often. Some of the associated symptoms include shortness of breath, nausea or vomiting, lightheadedness, confusion, abdominal symptoms, syncope, or presyncope [3, 4].

Aortic Dissection

Aortic dissection is an often-missed diagnosis. Patients typically present with sudden, sharp pain radiating to the back. The presentation can be occult, and a high degree of suspicion is required. Palpation of peripheral pulses for symmetry and noting radio-radial and radio-femoral delays is essential. History of hypertension and elevated blood pressure on examination are important risk factors [5].

Pulmonary Embolism

Chest pain is acute in onset, worsens with respiration, and is associated with shortness of breath. Chest pain can be positional and is not consistently associated with exertion. History of prior deep vein thrombosis, prior pulmonary embolism, malignancy, family history of DVT, history of immobility, and fractures are important to note. Special attention should be placed on lower extremity examination; asymmetry, calf tenderness, and swelling should be noted on examination. Peripheral oxygen saturation should be assessed. Tachycardia and accentuated pulmonary component of the second heart sound (P2) may be heard on cardiac auscultation [6].

Pneumothorax

Patients present with sudden-onset chest pain, which is sharp, worsens with cough and deep inspiration, and is associated with shortness of breath. On exam, breath sounds are absent on the side of the pneumothorax. In addition, oxygen saturation, the position of the trachea, blood pressure, and variation with respiration should be noted [7]. Tension pneumothorax is associated with a shift of the trachea to the opposite side and pulsus paradoxus.

Primary pneumothorax is more common in young, tall males [7].

Non-Life-Threatening Causes

For the non-life-threatening causes of chest pain, a systematic approach to consider the various possible etiologies arising from the most superficial to the deepest anatomical structures will help avoid missing key etiologies. Etiologies involving the chest wall (skin, muscles, ribs, cartilage, nerves), pleura, pericardium, heart, trachea, and esophagus should be considered.

Some of the common non-life-threatening causes of chest pain are described below:

Gastroesophageal Reflux Disease

Patients with gastroesophageal reflux disease present with burning pain in the epigastric region with radiation to the chest and is usually associated with eating food and worsens with recumbency. Chest pain improves with antacid use and sitting upright [9]. Of note, inferior myocardial ischemia/infarction can occasionally present with epigastric pain and should be considered in all patients with sudden-onset epigastric pain [3].

Pleuritic Chest Pain

Pleuritic chest pain is sharp and localized and worsens with deep inspiration and cough. The pain is typically lateral to the midline. Patients can point to the site of pain with one finger. Pleuritic pain can be present with several conditions noted above, including pulmonary embolism, tension pneumothorax, and pericarditis. After evaluating the above etiologies, consideration should be given to pneumonia and viral pleurisy [10].

Cervical Angina

Cervical spondylosis is an often-missed cause of chest pain. Movement of the neck from side to side reproduces the pain. The pain is often described as sharp and radiates from the neck to the chest on the movement of the neck from side to side. Spurling's test should be performed if there is suspicion of cervical cause of chest pain [11].

Pericarditis

Chest pain is substernal and sharp, worsens with inspiration, gets better with sitting up, is not clearly associated with exertion, and often radiates to the right shoulder. On examination, a diastolic friction rub can be heard. Patients with a prior diagnosis of pericarditis often have the same characteristics of chest pain across episodes [12].

Chronic Angina

Chronic stable angina typically presents with substernal chest tightness, heaviness, or pain and is generally brought on by exertion and improves with nitroglycerin. Chest pain is often associated with shortness of breath. Typically, the characteristic of chest pain does not change across episodes [3]. Patients often have multiple cardiovascular risk factors. Examination of peripheral pulses is vital in these patients. Evidence of peripheral artery disease increases the risk of having coronary artery [13]. Patients with aortic stenosis can have exertional anginal symptoms late in the disease course. Presence of an ejection systolic murmur or absence of aortic component of second heart sound on auscultation are critical diagnostic clues that should prompt further evaluation [14].

Herpes Zoster

Patients present with vesicular rash in one or two dermatomes associated with burning pain. It is important to note that chest pain can precede the rash. Some patients have viral prodromal symptoms, including headache and malaise [15].

Muscular Pain

Muscular pain presents as a dull pain that is insidious in onset and positional and worsens with the movement of the arm and can be associated with localized tenderness. This pain is not associated with exertion.

Rib Fracture

Pain due to rib fractures worsens with deep breathing, and the patients typically take shallow breaths to avoid pain. History of trauma gives an important clue. Severe tenderness at the location of the fracture is observed. Metastatic malignancy to the rib should be considered in patients with known malignancy, with other histories suggestive of metastatic disease, including weight loss, poor appetite, and low energy.

Costochondritis

Chest pain due to costochondritis presents as anterior chest pain. Patients typically report worsening pain with movements of the upper extremities and deep breathing. Some patients have a history of severe exertional physical activity on the preceding days. Tenderness is present at the costochondral junctions on palpation [16].

Esophageal Spasm

Severe chest pain is associated with intake of food. In addition, patients report associated dysphagia and symptoms of gastroesophageal reflux disease. Chest pain due to esophageal spasms is also relieved by nitroglycerin, and there is no association with exertion.

Approach to Management in the Primary Care Setting

In the office setting, the approach to chest pain involves rapid evaluation based on history and physical exam for life-threatening causes and triaging to the appropriate level of care. Patients with non-life-threatening causes can be evaluated based on the possible etiology (Fig. 17.3).

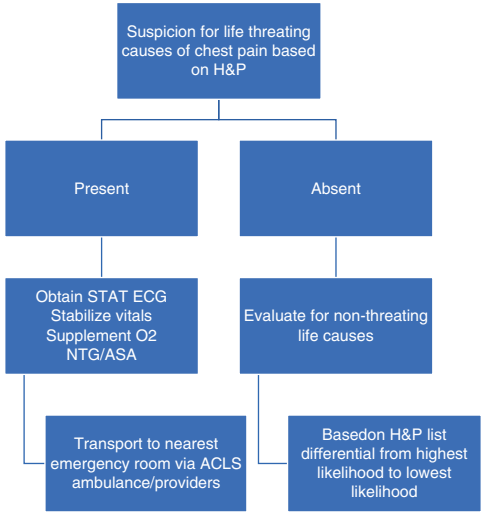

FIGURE 17.3 Approach to management in the primary care setting

Diagnostic Testing

Electrocardiogram

A 12-lead electrocardiogram is a simple, noninvasive diagnostic test that can be easily performed in the office setting and should be performed on most patients with cardiovascular risk factors unless suspicion for cardiac etiology is very low based on history and physical exam. The electrocardiogram should be compared to prior electrocardiograms to evaluate for any changes [3].

Blood Testing

Blood testing does not add additional diagnostic information for chest wall pain and gastroesophageal reflux disease. Serum troponin, natriuretic peptide, and creatinine should be ordered if cardiac etiology of chest pain is suspected. Complete blood count, blood urea nitrogen, and creatinine should be ordered for patients with high suspicion for community-acquired pneumonia, which helps calculate the CURB-65 score. CURB-65 gives 1 point each for confusion, BUN >19 mg/dL, respiratory rate ≥30/min, systolic BP <90 mmHg or diastolic BP ≤60 mmHg, or age ≥65. Patients with scores 0 and 1 can be discharged home to receive oral therapy [17].

Imaging

Chest X-Ray

The chest x-ray is a simple, noninvasive diagnostic test with minimal radiation exposure. It helps assess for pneumonia, cardiac silhouette, pulmonary vascular congestion, rib pathology, pneumothorax, and pleural effusion [3].

X-Ray C-Spine

For patients suspected of cervical angina, X-ray C-spine in AP and lateral views may show degenerative disease [11].

Transthoracic Echocardiogram

Patients with intermediate and high pretest probability for coronary artery disease and patients with suspicion for cardiac etiology of chest pain should undergo a transthoracic echocardiogram. Wall motion abnormalities, pericardiac effusion, systolic dysfunction, and valvular abnormalities can be detected. When point-of-care ultrasonography (POCUS) is

available and the providers have adequate experience, cardiac POCUS can help in further triaging patients with suspicion of acute coronary syndrome [3, 4, 12].

Diagnostic Testing for Obstructive Coronary Artery Disease

In the office setting, patients presenting with chronic stable angina should undergo further testing to evaluate for obstructive coronary artery disease, which is defined as ≥50% obstruction of any one of the epicardial coronary arteries. The approach to diagnostic testing is based on the pretest probability of coronary artery disease. Patients with low pretest probability do not need further testing. Patients with intermediate and high pretest probability need further testing. Patients with symptoms and high pretest probability should be given a cardiology referral to undergo invasive cardiac angiography.

In patients with intermediate pretest probability, the testing choice is based on local expertise, cost, and availability of testing [3]. Here, we briefly discuss the various testing modalities and discuss their use. Sensitivities and specificities of testing are noted in Table 17.2 [18].

Table 17.2 Sensitivity and specificity of diagnostic testing for obstructive coronary artery disease

Test	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)
Exercise treadmill ECG test	58 (46–69)	62 (54–69)
Stress echocardiogram	85 (80–89)	82 (72–89)
CCTA	97 (93–99)	78 (67–86)
SPECT	87 (83–90)	70 (63–76)
PET	90 (78–96)	85 (78–90)
Stress CMR	90 (83–94)	80 (69–88)

In patients without baseline electrocardiographic abnormalities and ability to exercise ≥5 metabolic equivalents (METs) without limitations due to body habitus or underlying medical conditions such as osteoarthritis, peripheral artery disease, frailty, or severe pulmonary disease, exercise electrocardiography can be performed. Patients able to exercise to stage III on the Bruce protocol with a negative ECG have a low risk for CAD. Thus, exercise ECG provides important prognostic information [3].

CT coronary angiography (CCTA) is a noninvasive test that uses computed tomography to obtain high-resolution images of the coronary arteries. CCTA has higher sensitivity compared to stress imaging in detecting obstructive CAD. However, performing CCTA in patients with a BMI of more than 40 kg/m^2 is technically challenging. Stress testing can be achieved with stress echocardiography and stress SPECT/PET myocardial perfusion imaging (nuclear stress test). Stress testing can be performed with exercise or with pharmacologic agents. If the patient can exercise, exercise is preferred over pharmacologic agents as this provides additional prognostic information (Fig. 17.4). Patients undergoing CCTA vs. stress testing have similar outcomes at 2–3 years in randomized trials. If the choice of preferred testing modality is unclear, patients can be referred to cardiology [3].

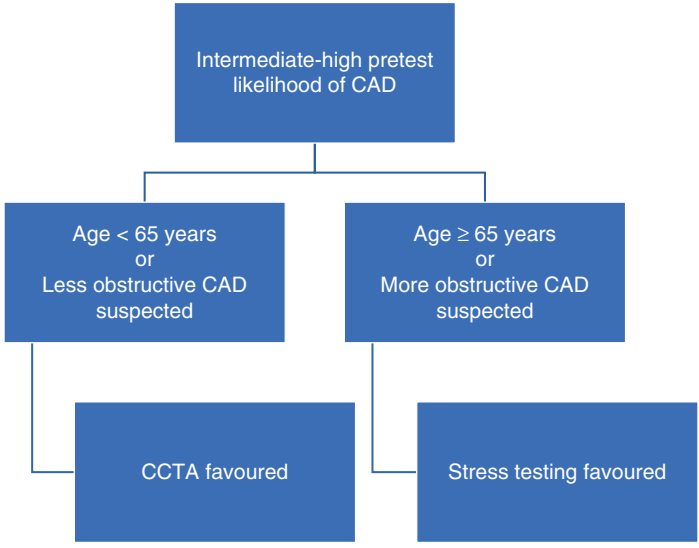

FIGURE 17.4 Approach to testing in intermediate–high pretest likelihood of coronary artery disease

Treatment of Non-Life-Threatening Causes of Chest Pain

Treatment is based on the underlying etiology.

Chest wall pain: Treatment of most causes of chest wall pain is conservative with pain control with acetaminophen or NSAIDs. Patients rarely need opioids to manage pain. Patients with herpes zoster symptom onset within 72 h or new skin lesions should receive antiviral therapy. Patients with cervical spondylosis benefit from physiotherapy to strengthen the muscles around the neck (Fig. 17.5a) [11, 15, 16].

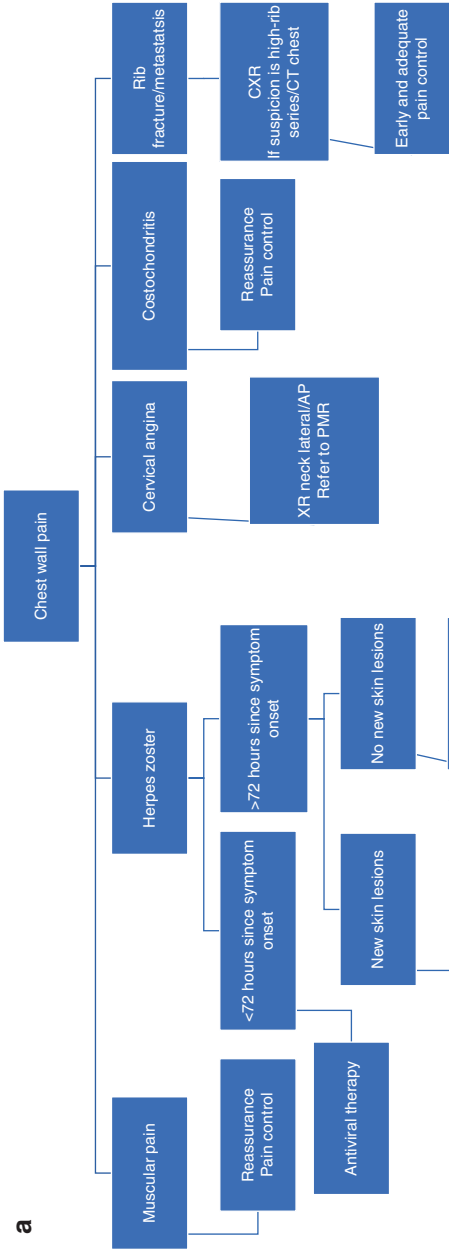

FIGURE 17.5 (**a**) Approach to chest wall pain, (**b**) Approach to gastroesophageal reflux disease, (**c**) Approach to pleuritic chest pain, (**d**) Approach to life-threatening cardiac causes of chest pain

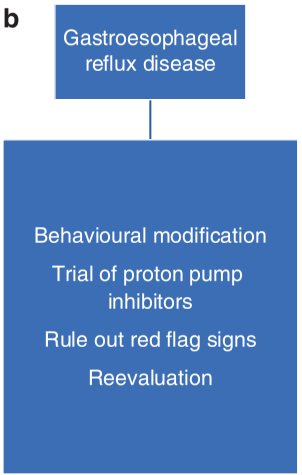

FIG.URE 17.5 (continued)

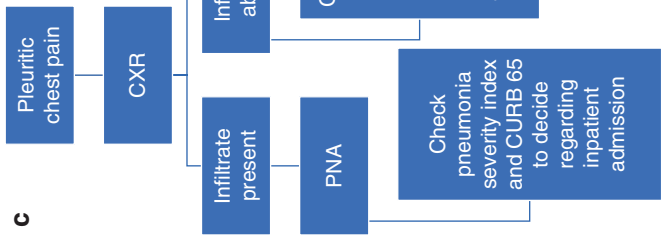

FIGURE 17.5 (continued)

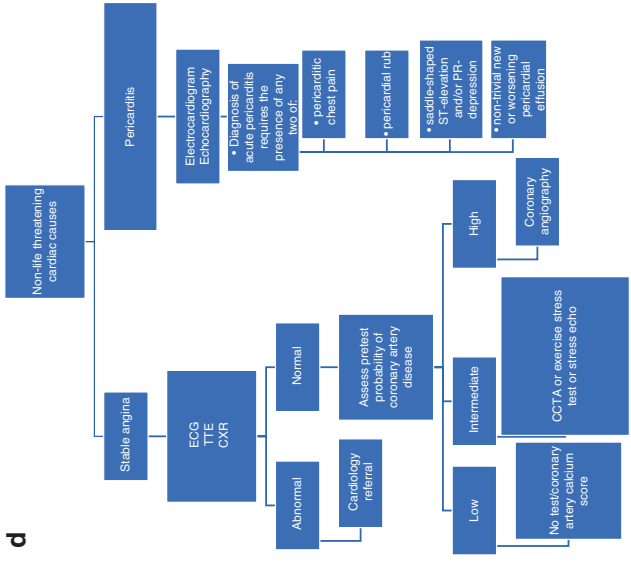

FIGURE 17.5 (continued)

Gastroesophageal reflux disease: Patients with typical features of gastroesophageal reflux disease should be evaluated for red flag signs such as dysphagia, odynophagia, GI bleeding, weight loss, and early satiety. A trial of proton pump inhibitors can be prescribed in the absence of red flags signs. Refer to gastroenterology if red flag signs are present or if esophageal dysmotility is suspected (Fig. 17.5b) [9].

Pneumonia: For patients presenting with community-acquired pneumonia, pneumonia severity based on CURB-65 or pneumonia severity index needs to be assessed. These prognostic tools will help decide if patients need inpatient admission for the management of community-acquired pneumonia [17]. CURB-65 score of 0 or 1 can be considered for treatment at home. Beta-lactams, alone or combined with macrolides, can be considered for empiric antibiotic coverage (Fig. 17.5c). Detailed discussion about the choice of antibiotics is available at the Infectious Disease Society of America (IDSA) guidelines [17].

Chronic stable angina: Patients with chronic stable angina should have 10-year atherosclerotic cardiovascular disease risk calculated, and cardiovascular risk factors such as diabetes and hypertension should be aggressively controlled. LDL cholesterol should be managed using statins. Nitrates are the cornerstone for symptom relief. Patients should be referred to cardiology if there is role for revascularization based on the diagnostic testing with CCTA or stress tests (Fig. 17.5d) [3].

Clinical Pearls

- A thorough history and physical examination are vital for an accurate diagnosis and management of patients presenting with chest pain.
- Having a broad differential diagnosis is essential for an accurate diagnosis of chest pain.
- Patients presenting with chest pain should be rapidly evaluated for life-threatening causes and triaged to the appropriate level of care.
- Cardiovascular risk factors should be evaluated in patients presenting with chest pain.

Don't Miss

- Inferior myocardial infarction can present as epigastric discomfort.
- Women, patients with diabetes, and elderly patients can present with atypical symptoms such as abdominal discomfort, fatigue, syncope, or presyncope in the setting of acute coronary syndrome.

References

1. Santo L, Okeyode T. National Ambulatory Medical Care Survey: 2018 National Summary Tables. 2021
2. Klinkman MS, Stevens D, Gorenflo DW. Episodes of care for chest pain: a preliminary report from MIRNET. J Fam Pract. 1994;38:345–52.
3. Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, Blankstein R, Boyd J, Bullock-Palmer RP, Conejo T, Diercks DB, Gentile F, Greenwood JP, Hess EP, Hollenberg SM, Jaber WA, Jneid H, Joglar JA, Morrow DA, O'Connor RE, Ross MA, Shaw LJ. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR guideline for the evaluation and diagnosis of chest pain: a report of the American College of Cardiology/American Heart Association Joint Committee on clinical practice guidelines. Circulation. 2021;144:e368–454.
4. Amsterdam Ezra A, Wenger Nanette K, Brindis Ralph G, Casey Donald E, Ganiats Theodore G, Holmes David R, Jaffe Allan S, Jneid H, Kelly Rosemary F, Kontos Michael C, Levine Glenn N, Liebson Philip R, Mukherjee D, Peterson Eric D, Sabatine Marc S, Smalling Richard W, Zieman SJ. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes. J Am Coll Cardiol. 2014;64:e139–228.
5. Fukui T. Management of acute aortic dissection and thoracic aortic rupture. J Intensive Care. 2018;6:15.
6. Huisman MV, Barco S, Cannegieter SC, Le Gal G, Konstantinides SV, Reitsma PH, Rodger M, Noordegraaf AV, Klok FA. Pulmonary embolism. Nat Rev Dis Primers. 2018;4:18028.
7. Sahn SA, Heffner JE. Spontaneous pneumothorax. N Engl J Med. 2000;342:868–74.

8. Swap CJ, Nagurney JT. Value and limitations of chest pain history in the evaluation of patients with suspected acute coronary syndromes. JAMA. 2005;294:2623–9.
9. Maret-Ouda J, Markar SR, Lagergren J. Gastroesophageal reflux disease: a review. JAMA. 2020;324:2536–47.
10. Reamy BV, Williams PM, Odom MR. Pleuritic chest pain: sorting through the differential diagnosis. Am Fam Physician. 2017;96:306–12.
11. Sussman WI, Makovitch SA, Merchant SH, Phadke J. Cervical angina: an overlooked source of noncardiac chest pain. Neurohospitalist. 2015;5:22–7.
12. Ismail TF. Acute pericarditis: update on diagnosis and management. Clin Med (Lond). 2020;20:48–51.
13. Valentine RJ, Verstraete R, Clagett GP, Cohen JC. Premature cardiovascular disease is common in relatives of patients with premature peripheral atherosclerosis. Arch Intern Med. 2000;160:1343–8.
14. Otto CM, Prendergast B. Aortic-valve stenosis–from patients at risk to severe valve obstruction. N Engl J Med. 2014;371:744–56.
15. Johnson RW, Bouhassira D, Kassianos G, Leplège A, Schmader KE, Weinke T. The impact of herpes zoster and post-herpetic neuralgia on quality-of-life. BMC Med. 2010;8:37.
16. McConaghy JR, Oza RS. Outpatient diagnosis of acute chest pain in adults. Am Fam Physician. 2013;87:177–82.
17. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K, Cooley LA, Dean NC, Fine MJ, Flanders SA, Griffin MR, Metersky ML, Musher DM, Restrepo MI, Whitney CG. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019;200:e45–67.
18. Knuuti J, Ballo H, Juarez-Orozco LE, Saraste A, Kolh P, Rutjes AWS, Jüni P, Windecker S, Bax JJ, Wijns W. The performance of non-invasive tests to rule-in and rule-out significant coronary artery stenosis in patients with stable angina: a meta-analysis focused on post-test disease probability. Eur Heart J. 2018;39:3322–30.