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## The Approach to the Patient with Chest Pain

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### INTRODUCTION

Chest discomfort is a common symptom, most often caused by benign conditions, but occasionally may be due to life-threatening medical emergencies. The approach to chest pain, therefore, is to exclude the benign conditions, and to rapidly identify and treat the potentially fatal and serious conditions in a “fast track” at every level of healthcare.

Chest pain is a common presentation of cardiac disease, but it can also be caused by conditions affecting organs throughout the thorax and abdomen.

### MEDICAL CONDITIONS PRESENTING WITH CHEST PAIN

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<b>Serious Conditions</b>	<b>Less Serious Conditions</b>
<ul style="list-style-type: none"><li>• acute coronary syndrome</li><li>• aortic dissection</li><li>• pulmonary embolism</li></ul>	<ul style="list-style-type: none"><li>• cardiac — pericarditis</li><li>• pleuritis</li><li>• musculoskeletal</li></ul>

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Serious Conditions	Less Serious Conditions
<ul style="list-style-type: none"> <li>• spontaneous pneumothorax</li> </ul>	<ul style="list-style-type: none"> <li>• GI — reflux esophagitis, esophageal spasm, cholecystitis, peptic ulcer, pancreatitis</li> <li>• early herpes zoster</li> <li>• psychiatric</li> </ul>

In evaluating a patient presenting with chest discomfort, the following sequence of questions are helpful:

**Q1: Could the chest discomfort be due to an acute, potentially life-threatening condition that warrants immediate hospitalization and aggressive evaluation and treatment?** These conditions include acute coronary syndrome, aortic dissection, pulmonary embolism and spontaneous pneumothorax.

**Q2: If not, could the discomfort be due to a chronic condition likely to lead to serious complications?** Examples include stable angina, pulmonary hypertension, aortic stenosis.

**Q3: If not, could the discomfort be due to an acute condition that warrants specific treatment?** These include pericarditis, pneumonitis/pleuritis, herpes zoster.

**Q4: If not, could the discomfort be due to another treatable chronic condition?** Conditions that are not immediately life-threatening include esophageal reflux, esophageal spasm, peptic ulcer disease, gallbladder disease, costochondritis and other musculoskeletal disorders.

## SYMPTOM EVALUATION

The history should include questions about the *quality, location, nature of onset, duration, and associated features* of the discomfort. Typical features of various types of chest pain are summarized below.

### 1) Ischemic cardiac pain

- Pain often diffuses over a wide area of the anterior chest wall and is not localized. Pain that is experienced only at a peripheral site in the chest is rarely of cardiac origin.
- Pain may radiate to left + / - right arm, jaw, neck and back.
- Often described as “dull,” “constricting,” “pressing,” “heavy feeling,” “tearing,” “tightness,” “terrifying,” and sometimes

“intolerable.” However, the severity of the symptom is highly variable, while symptom is poorly correlated with risk of developing serious complications.

- Stable anginal pain is precipitated by exertion and is relieved by resting. It is frequently made worse by large meals or a cold wind. With unstable angina, similar pain may be brought on by minimal exertion and may also occur at rest. In contrast, pain associated with a specific movement (turning, stretching, bending, coughing) is likely to be musculoskeletal in origin.
  - Myocardial infarction pain usually takes several minutes, or longer, to develop. In contrast, the pain of aortic dissection, massive pulmonary embolism or of pneumothorax is usually very sudden in onset. Patient may have nausea and vomiting, and often appears pale, diaphoretic, and is cold to the touch due to associated autonomic nervous system stimulation. Patient shows no response to posture, movement, food.
- 2) Reflux esophagitis and esophageal spasm
- A common cause of chest pain, presenting with heart burn. The pain can mimic that of angina very closely. It is sometimes precipitated by exercise and may be relieved by nitrates.
  - Worse in recumbent position, also during strain. Sometimes pain is related to food or drink intake.
  - No ECG changes.
- 3) Pulmonary embolism
- Most common symptom is dyspnea. Patient may have visceral chest pain believed to be due to distension of the pulmonary artery or pulmonary infarction. Onset is usually sudden if massive.
  - Tachypnea, hypoxemia, hypercarbia; with no pulmonary congestion on chest X-ray. Tachycardia is usually present.
  - May resemble inferior wall infarct: ST elevation in II, III, aVF. Sinus tachycardia common. Rare to have  $S_1 Q_{III} T_{III}$ .
- 4) Pneumothorax
- Dyspnea is the most common symptom.
  - One-sided chest pain and related to respiratory movement.
  - Auscultation and chest X-ray often clinch the diagnosis.
- 5) Aortic dissection
- Pain is severe, sharp and tearing, with changing localization.

- Type A dissection may cause unequal upper limb pulses, new aortic regurgitation, and may involve coronary ostium, usually the right coronary artery, causing inferoposterior infarction.
  - Sometimes widened mediastinum on chest X-ray.
- 6) Musculoskeletal and costochondral pain
- Costochondral and chondrosternal syndromes are the most common causes of anterior chest musculoskeletal discomfort.
  - Very variable in site and intensity, usually accompanied by local tenderness.
  - Posture or movement of chest influences the pain.
- 7) Pleuritis
- “Jabbing,” “sharp,” and “catching” pain on breathing, coughing or movement. Pain is usually unilateral, and often localized.
- 8) Peptic ulcer, cholecystitis, pancreatitis
- Clinical examination.
  - Inferior wall ischemia sometimes may resemble acute abdomen.

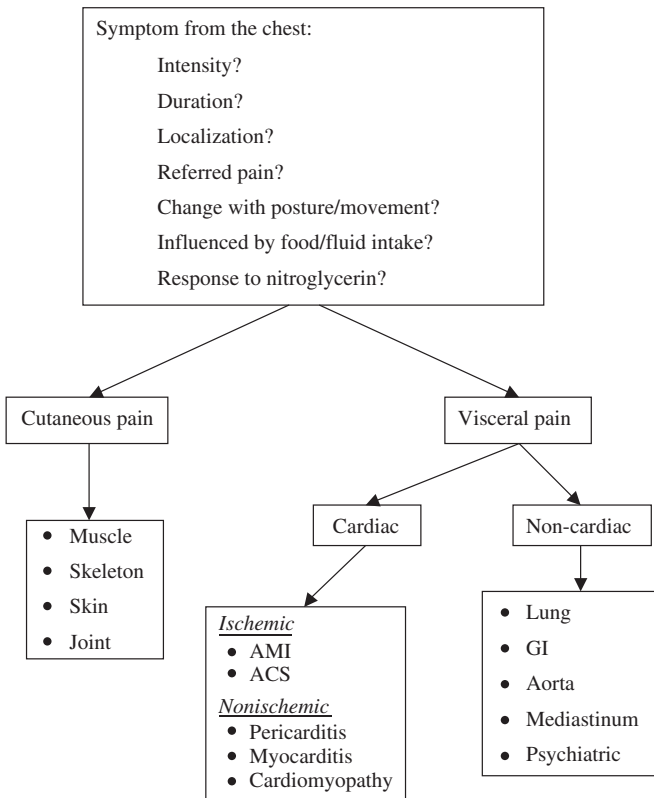
Clinicians frequently employ “therapeutic trials” with sublingual nitroglycerin or antacids, and a common error is to assume that a response to either of these interventions clarifies the diagnosis. While such information is helpful, the patient’s response may be due to placebo effect. Response to antacid, or failure of nitroglycerin to relieve chest pain, do not exclude the diagnosis of coronary disease.

Figure 1 presents an algorithm for the diagnosis of chest pain.

## PHYSICAL EXAMINATION

Careful history taking is essential before proceeding to physical examination, as the physical examination can be apparently normal even with underlying serious condition.

- 1) Patient’s respiratory and hemodynamic status must first be assessed. If either of these is compromised, initial management should focus on stabilizing the patient before pursuing diagnostic evaluation.
- 2) Physical examination should also include:
  - a) evaluation of BP in both arms and pulses in both legs;
  - b) cardiac murmurs; third and fourth heart sounds; pericardial rub;
  - c) intensity of breath sounds; pleural rub; evidence of pneumothorax, pulmonary embolism, pneumonia, or pleurisy.



**Fig. 1** Algorithm for diagnosis of chest pain.

The physical features of myocardial infarction are those of the accompanying autonomic disturbances (sweating, pallor) or those of heart failure (pulmonary congestion or edema, fourth heart sound), or diminished output (cold periphery). The patient looks systemically “ill,” although the absence of such signs does not exclude the diagnosis. Similar autonomic disturbance may accompany any cause of severe pain.

## DIAGNOSTIC TESTS IN ACUTE CHEST PAIN

The tests serve: 1) to determine the diagnosis; 2) to quickly identify the high risk patients for the fast track, and 3) to delineate patients with little or no risk of having life-threatening conditions. It must be recognized that

although cardiac investigations may be specific when abnormal, lack of sensitivity means that a normal or nonspecific result does not exclude the diagnosis.

## Electrocardiogram

- Essential first screening test for adults with chest pain, aimed mainly to identify patient with myocardial ischemia.
- New ST elevation is sensitive and specific for myocardial infarction. Usually appears within minutes after symptom onset. However, this is present on initial admission ECG in only ~30–40% of hospitalized patients with AMI.
- ST depression indicates ischemia, but has poor power to identify ongoing myocardial infarction (only ~50% of patients with ST depression develop MI).
- T-wave inversion is nonspecific. Multiple differential diagnoses. Only about one-third of patients with chest pain and T-wave inversion on admission ECG develops MI.
- About one-third of patients admitted to emergency department with acute chest pain have normal ECG. Of these, 5–40% may have evolving MI. Serial ECGs, aided by other tests (biochemical markers, stress test, etc), are essential in the chest pain evaluation if the initial ECG is not diagnostic.

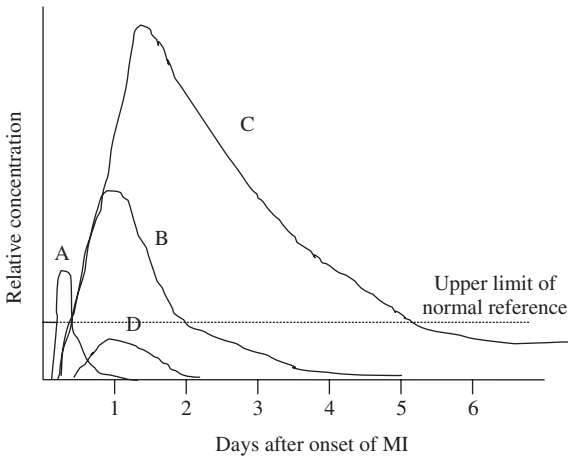
## Biochemical Markers

Biochemical markers in serum are measured to detect or exclude myocardial necrosis. This identifies the subgroup of patients at higher risk of developing major adverse cardiac event. Troponin T and troponin I, myoglobin and creatine kinase (CK) MB, are the most frequently used. Their specificity and release profile are summarized in Table 2 and Fig. 2.

- Single values of these biochemical markers do not have high sensitivity for AMI or for prediction of complications. Also, because of the time-frame constraints, the use of a single necrosis marker determination is not generally advised in GP/primary care settings.
- For ruling out of myocardial necrosis, myoglobin is a better marker from 3 to 6 hrs after the onset of symptoms compared with CK-MB mass and troponin. Maximal negative predictive value of myoglobin

Table 2

Marker	Cardiac Specificity?	First Rise after Necrosis (h)	Mean Time to Peak Elevation (h)	Time to Return to Normal Range
Myoglobin	No	1-3	6-7	12-24 hrs
CK total	No	4-8	24	36-48 hrs
CK-MB	++	3-4	24	24-36 hrs
Troponin T	++++	3-4	12-48	10-14 days
Troponin I	++++	4-6	24	4-7 days



Peak A — early release of myoglobin or CK-MB isoform after AMI.  
 Peak B — CK-MB after AMI.  
 Peak C — cardiac troponin after AMI.  
 Peak D — cardiac troponin after unstable angina.

Fig. 2 Plot of the appearance of cardiac markers in blood vs. time after onset of symptoms.

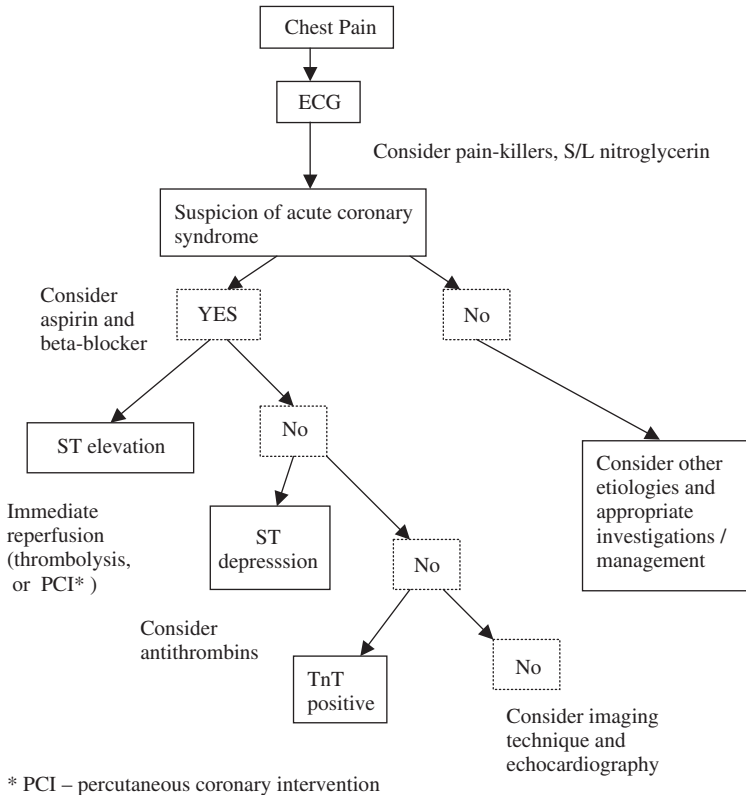
reaches ~90% during this time frame. Because of its lack of cardiac specificity, an isolated measurement of myoglobin in patients with nondiagnostic ECG should not be relied on to make the diagnosis of AMI, but should be supplemented by a more cardiac-specific marker such as troponin.

- From 7 hr after onset of symptoms, CK–MB and troponin T seem to have a higher negative predictive value than myoglobin.
- In AMI, the magnitude of the rise of troponin is typically more than 20 times above the reference range, much higher than the 5- to 20-fold increase of CK–MB above the upper limit of the reference range.
- Routine diagnosis of AMI can be accomplished within 12 hr of using CK–MB, cTnT, or cTnI by obtaining measurements approximately every 6 to 12 hr. In chest pain unit/emergency department, a combination of assays of myoglobin, troponin, and/or CK–MB at 0 hr, 3–6 hr, 6–12 hr after presentation, will be able to detect >95% of myocardial necrosis after the onset of symptoms.
- Elevated troponin is an independent predictor of adverse cardiac outcome in patients presenting with chest pain, with or without diagnostic ECG changes.

## Imaging Techniques

- Chest X-Ray
  - ◆ Often performed as a routine in the evaluation of patients suspected of having cardiac symptom, though its value has not been established in patients defined as low risk from history or physical examination.
  - ◆ One-quarter of these may show some abnormalities, e.g. cardiomegaly, pneumonia and pulmonary edema.
- If aortic dissection is suspected, imaging studies of the aorta must be pursued promptly. Appropriate tests include a chest computer tomography (CT) scan with contrast, or a magnetic resonance imaging in hemodynamically stable patients, or a transesophageal echocardiogram in patients who are less stable. A chest X-ray is not sufficient to exclude this diagnosis.
- If pulmonary embolism is suspected, initial tests usually include ventilation-perfusion scan, or a spiral chest CT scan, and/or pulmonary arteriography.
- In conditions where the clinical history, ECG and biochemical measurements for myocardial damage are equivocal or unavailable, imaging techniques (with rest myocardial perfusion scans or 2-D echocardiography) may be helpful. If normal, they help identify low-risk patients, who can be eligible for early discharge or undergo early stress testing

and avoiding hospital admission. Early use of treadmill exercise testing for such patients is now an accepted management strategy for low-risk patients. Exercise testing is not appropriate, however, for patients who: 1) report pain that is believed to be ischemic, occurring at rest; or 2) have ECG changes consistent with ischemia not known to be old.



**Fig. 3** Evaluation and management of chest pain in emergency department.

## CONCLUSION

With careful history taking and physical examination, supplemented by targeted diagnostic tests, chest pain caused by serious conditions can often be quickly identified for early and immediate treatment.

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