**Chapter 13
Chest pain and acute coronary syndrome**

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**Introduction**

In the United States, someone experiences a myocardial infarction every 26 seconds, and alarmingly the disease claims one life each minute [1]. Acute myocardial infarction (AMI) accounts for almost five times as many deaths in the United States as are attributed to unintentional injuries, which has major implications for EMS systems [2]. About half of those who suffer acute myocardial infarctions are transported to the hospital by EMS, and many more patients call EMS for help because they are experiencing chest pain [3].

The prehospital management of chest pain has improved with better clinical examination, earlier administration of effective medications, and the broad use of 12-lead ECGs to detect acute coronary syndromes (ACS) and myocardial infarction more accurately before arrival in the emergency department (ED) [4]. Because more rapid reperfusion during acute myocardial infarction improves heart function and patient survival, EMS and health care systems have focused on developing strategies to identify chest pain patients with myocardial infarction quickly and to provide effective treatment while transporting them directly to definitive care [5–7].

The goals of management for patients with chest pain include rapid identification of patients with ACS, relief of their symptoms, and transport to an appropriate hospital. This chapter will cover the assessment and treatment of patients with a chief complaint of chest pain and will focus on the scientific basis for prehospital medical care of those patients. It will also review common conditions that can cause chest pain.

**General approach**

When evaluating a patient with a complaint of chest pain, EMS professionals should begin by assessing the patient’s stability and then obtain a basic clinical history and examination. Early in the assessment, an EMS provider should apply a cardiac monitor to rapidly identify dysrhythmias, perform a diagnostic 12-lead ECG, and administer specific treatment depending on the results of the initial evaluation. Because only a small minority of the patients with chest pain actually have ACS, maintaining vigilance in this assessment and diagnostic routine can be difficult [8].

Complete accuracy in the diagnosis of chest pain is not always possible in any setting, not even in the hospital [9]. The prehospital provider should not expect to diagnose a patient with a complaint of chest pain definitively. A careful history can lead the provider to a correct “category” of diagnosis much of the time. As a general approach, the patient should be treated as if he or she has the most likely serious illness consistent with the signs and symptoms.

Discomfort due to cardiac ischemia is usually, but not always, substernal and may radiate to the shoulder, either arm, both arms, upper abdomen, back, or jaw [9,10]. Other symptoms such as nausea and diaphoresis are commonly present but do not predict the presence or absence of ACS accurately. Cardiac disease is most often seen beginning in middle-aged men and older women. However, even younger adults under the age of 40 with no cardiac risk factors and a normal ECG have a 1–2% risk of ACS [11]. Taking a focused history using the “PQRST method” can be helpful ([Box 13.1](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c13.xhtml?favre=brett#c13-fea-0001)).

**Box 13.1 Historical aspects of chest discomfort: the PQRST method**

1. P: What provoked the pain or what was the patient doing when the pain started?
2. Q: What is the quality of the pain; burning, aching, squeezing, or stabbing?
3. R: Is there any radiation of the pain; does it go to the neck, jaw, arm, or back?
4. S: How severe is the pain? On a scale of 1 to 10, with 10 being the worst pain in one’s life, what is the pain now, and how has it changed?
5. T: What are the temporal aspects of the pain? How long has it been present? Has it occurred before? When?

There are many causes of chest pain and their incidence changes depending on the characteristics of the population being studied. Patients calling on EMS are more likely to have acute myocardial infarction or other serious causes of chest pain than are patients in the general emergency department (ED) population [3]. Although the majority of this chapter focuses on the management of an ACS, other causes of chest pain are present more commonly.

**Role of emergency medical dispatch**

Prehospital care of the patient with a complaint of chest pain begins at emergency medical dispatch. Identification of patients suspected to have ACS allows an EMS system to send advanced-level providers to the patient. Many EMS systems with both basic and advanced-level ambulances use a trained emergency medical call taker who asks the caller a series of questions to determine the nature of the emergency and the likelihood that advanced-level care will be needed (see Volume 2, [Chapter 10](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/Vol2/c10.xhtml)).

A retrospective cohort study from England took a rigorous approach to determining the accuracy of one set of dispatcher questions in identifying patients with ACS [12]. About 8% of calls at the “9-9-9” center were classified as “chest pain.” Subsequent chart review at the hospital identified all patients with the ultimate diagnosis of ACS and found that this represented only 0.6% of all 9-9-9 patients. About 80% of the ACS patients were classified correctly as chest pain at the dispatch level. Another 7% were classified in a variety of other categories that still received a paramedic level response (e.g. severe respiratory distress). Sensitivity of the dispatch system for detecting ACS was 71% and specificity was 93%. However, a great deal of overtriage occurred, and the positive predictive value of the dispatch system for detecting ACS was only 6%. Additional refinement of the dispatch question sequence to reduce overtriage seems possible. The emergency dispatch question sequence for stroke performs much better, with a positive predictive value of 42% and a similar sensitivity to ACS at 83% [13].

The American Heart Association (AHA) and American College of Cardiology (ACC) recommend that emergency medical dispatchers prompt patients with non-traumatic chest pain to take aspirin if they have no contraindications while awaiting EMS arrival [14,15]. This recommendation is based on extrapolation from data showing that patients who take aspirin before hospital arrival are less likely to die and that the practice is likely quite safe [16].

**The 12-lead electrocardiogram**

The 12-lead ECG remains the quickest method of detecting myocardial ischemia or infarction. Although ECGs have been used to diagnose ACS since 1932, the technology has now advanced to the point that a prehospital ECG can be done quickly and accurately and can be sent wirelessly to the receiving hospital at a relatively low cost. Additional benefit can be gained by having the prehospital ECG become the first of a series of ECGs, increasing the sensitivity of diagnosis of coronary syndromes [17].

Performing a prehospital ECG on a patient exhibiting signs and symptoms of ACS is a Class I AHA/ACC recommendation [14,15]. This recommendation is based on evidence demonstrating that, despite at most slightly increased time spent on scene for patients receiving ECGs, the time to definitive treatment for ST-elevation myocardial infarction (STEMI) with fibrinolysis or percutaneous coronary intervention (PCI) is shortened overall, with a significant reduction in mortality [18].

**Prehospital electrocardiogram: interpretation**

With the ease of obtaining a prehospital 12-lead ECG comes the need for its accurate interpretation. Precise interpretations can influence decisions to transport patients to more appropriate but more distant facilities, as well as immediate management strategies on hospital arrival. A 12-lead ECG is required to diagnose STEMI and can often provide evidence that ACS is present.

Currently three methods of out-of-hospital ECG interpretation exist: computer algorithms integrated into the ECG machine, direct interpretation by paramedics, or wireless transmission of the ECG to a physician for interpretation. One, two, or all three can be used in a given EMS system.

All prehospital 12-lead ECG machines contain computer programs that will interpret the ECG, and the machines can be configured to print the interpretation on the ECG. If this technology is sufficiently sensitive and specific for STEMI, the EMS professionals would theoretically not require education in interpretation, which would allow EMS systems to use advanced- and basic-level providers to acquire 12-lead ECGs. Additional benefits of using the computer’s interpretation include avoidance of the technical issues and cost of establishing base stations dedicated to receiving incoming ECGs, as well as the provision of consistent interpretation that does not depend on the variable skills and experience of EMS providers. Many prehospital 12-lead ECG systems use computerized interpretation systems which have high specificity, but the computer interpretation alone can miss up to 20% of true STEMI events [19].

Despite the high specificity, many emergency physicians and cardiologists do not place enough trust in the computer interpretation alone to routinely activate the cardiac catheterization PCI team that can provide rapid reperfusion treatment for a STEMI patient [20]. EMS provider interpretation is another option. More extensive training is required, and interpretation accuracy can be affected by both experience and interest in the subject matter [21]. Although several studies have shown that trained paramedics can accurately interpret the presence of STEMI, experience also plays an important role [22–24]. Having a paramedic identify and report “tombstones” on the 12-lead is a powerful motivator for action by experienced physicians.

The third method of interpretation is by transmission of the acquired ECG to a base station for interpretation by a physician. This method has generally been used as the gold standard when comparing other methods of interpretation, and its accuracy has been shown to be slightly better than other methods. It relies both on the availability of the interpreting physician and on an infrastructure that allows reliable transmission of the ECG.

In one observational cohort study, positive predictive value of prehospital 12-lead ECGs was improved by transmitting them to emergency physicians compared with interpretation solely by paramedics [24]. In some cases automated systems have been developed that allow simultaneous transmission of the 12-lead ECG to the receiving ED and to an invasive cardiologist on call [25]. These systems have the potential to decrease treatment times further because both the ED staff and the PCI team are activated early.

The AHA guidelines state that the ECG may be transmitted for remote interpretation by a physician or screened for STEMI by properly trained paramedics, with or without the assistance of computer interpretation [14]. Advance notification should be provided to the receiving hospital for patients identified as having STEMI. Implementation of 12-lead ECG diagnostic programs with concurrent medically directed quality assurance is recommended.

No diagnostic test is perfect, and the 12-lead ECG is no exception. There are a number of conditions other than acute myocardial infarction that can cause ST-segment elevation, such as left bundle branch block and hyperkalemia [26] ([Box 13.2](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c13.xhtml?favre=brett#c13-fea-0002)). Some of the differences between STEMI and the mimics of acute ST-segment elevation are subtle and missed easily.

**Box 13.2 The most common prehospital causes of ST-segment elevation**

* ST-segment elevation acute myocardial infarction
* Early repolarization
* Left bundle branch block
* Acute pericarditis

**Medications**

Several medications are important for EMS management of the patient with chest pain. Providing the chest pain patient with medication for relief of pain whenever safe and feasible and regardless of the etiology of the pain is fundamental. Treatment of pain reduces anxiety in addition to relieving the patient’s discomfort. For ACS patients, treatment of pain can reduce catecholamine levels and thus improve the balance between oxygen demand and supply for ischemic cardiac muscle.

**Oxygen**

Despite its historical use, the evidence review leading up to the 2010 AHA guidelines did not find sufficient evidence to recommend the routine use of oxygen therapy in patients with uncomplicated AMI or ACS who have no signs of hypoxemia or heart failure [14]. The guidelines do, however, recommend oxygen administration if the patient is dyspneic, or has an arterial oxyhemoglobin saturation <94%, signs of heart failure, or shock.

**Aspirin**

Aspirin is inexpensive, readily available, and has been shown to benefit patients having myocardial infarction or other ACS. The ISIS-2 study established that the absolute benefit of aspirin administration for myocardial infarction patients results in 26 fewer deaths per 1,000 patients treated, with the maximum benefit occurring in the first 4 hours [27]. Prehospital administration of aspirin is safe [28] and may improve outcome [29,30], and should be given as soon as possible to patients with suspected ACS unless contraindicated [14,15].

Varying doses of aspirin have been proposed, but for ACS the most widely used dose is four 81 mg baby aspirin tablets. These tablets are well tolerated, easy to swallow, and more rapidly absorbed than other preparations [31]. Rectal preparations (300 mg) should be considered in patients unable to swallow. Acceptable contraindications to aspirin administration include definitive aspirin allergy or a history of active gastrointestinal bleeding.

**Nitroglycerin**

Nitroglycerin is a time-honored treatment to relieve chest pain due to angina by decreasing myocardial oxygen demand and increasing collateral blood flow to ischemic areas of the heart. Somewhat surprisingly, nitroglycerin is not effective at reducing STEMI patient mortality [32], nor is the response, or lack thereof, to nitroglycerin administration an accurate diagnostic test to determine whether cardiac ischemia is the underlying cause of a patient’s chest pain [33]. For example, because it relaxes smooth muscle, nitroglycerin may also relieve pain in patients with esophageal spasm.

Nitroglycerin can be administered as sublingual tablets or an oral spray. The usual dose of either method of delivery is 0.4 mg. Although up to three doses can be given at an interval of 5 minutes between doses, current AHA/ACC recommendations for self-administered patient use of nitroglycerin is for them to call EMS if chest pain is not improved 5 minutes after only a single dose of nitroglycerin to avoid a 15–20-minute delay before activating the EMS system among STEMI patients [14,15].

Nitroglycerin should be avoided in several groups of patients with chest pain. Patients who have used phosphodiesterase inhibitors and then take nitrates can have profound, refractory hypotension. Nitrates generally should be avoided for 24 hours following sildenafil or vardenafil use, and for 48 hours following tadalafil use.

Patients with right ventricular infarction are dependent on right ventricular filling pressure to maintain cardiac output and a normal systolic blood pressure. If the patient has a systolic blood pressure below 100 mmHg or a heart rate below 60 beats per minute, nitroglycerin should be avoided until a 12-lead ECG, including right-sided leads, documents the absence of a right ventricular infarction. Nitroglycerin should also be avoided in patients who already have systolic blood pressures <90 mmHg or heart rates <50 or >100 beats per minute.

**Morphine sulfate**

A large retrospective case series of hospitalized patients with non-ST segment elevation ACS found that patients who received morphine had a higher mortality than those who did not [34]. It is unclear whether this was a causal effect or simply indicated that those who required morphine may have had more severe disease. The AHA/ACC treatment guidelines for patients with unstable angina or non-ST-elevation MI (NSTEMI) reduce the strength of recommendation for morphine from Class I to Class IIa for patients with NSTEMI [35]. The 2013 AHA/ACC STEMI guidelines give morphine a Class I recommendation in STEMI patients because those patients are going to have reperfusion therapy [15]. The recommended dose of morphine in the patient with chest pain is 2–4 mg intravenously with increments of 2–8 mg intravenously repeated at 5–15-minute intervals when pain is not adequately controlled with nitroglycerin.

**Beta-blockers**

Older guidelines recommended IV beta-blocker (typically metoprolol) administration early in the course of acute myocardial infarction because of data suggesting reduced rates of reinfarction and recurrent ischemia when patients received both fibrinolytics and IV beta-blockers. A large placebo-controlled randomized trial showed that the effect of beta-blockers in reducing arrhythmic events is equally offset by an increase in development of cardiogenic shock, and survival is similar regardless of early administration of intravenous beta-blockers [36]. Current AHA/ACC recommendations for administration of intravenous beta-blockers in the setting of STEMI are limited to patients who are hypertensive or have ongoing ischemia with no contraindications to their use [15]. On balance, the guidelines suggest that the need for prehospital administration of beta-blockers to patients with STEMI is limited.

**Prehospital fibrinolysis**

Since fibrinolytics were introduced to emergency cardiac care in the mid-1980s, some have proposed initiating these drugs in the prehospital setting. Several studies published in the early 1990s showed that the strategy was feasible [37] and that it could decrease mortality from STEMI in settings that had relatively long EMS response and/or transport time intervals [38]. Additional studies reinforced the original findings, and a metaanalysis of pooled results from six randomized trials enrolling more than 6,000 subjects concluded that prehospital initiation of fibrinolytics decreased all-cause mortality by shortening initiation of treatment by 58 minutes [39].

Few systems in the United States have implemented prehospital fibrinolysis, although additional research has continued to show time savings over in-hospital treatment. In Europe, particularly where there are often physician-staffed ambulances, prehospital fibrinolysis is used more frequently.

A primary reason why prehospital fibrinolysis is not used regularly in the United States has been a shift in favor of primary PCI for treatment of STEMI. In a prospective observational cohort study of 26,205 consecutive patients with STEMI in Sweden, representing about 95% of the population of STEMI patients in the country, those who were treated with primary PCI had lower 30-day mortality than those treated with fibrinolytics in the hospital (4.9% versus 11.4%) [40]. Primary PCI patients also had lower mortality than those treated with prehospital fibrinolytics (4.9% versus 7.6%).

Several large clinical trials have examined the strategy of transferring patients to a PCI-capable institution from a local hospital compared with administration of fibrinolytics at the local hospital [41,42]. A metaanalysis of six large studies involving 3,750 patients showed that timely transfer for primary PCI strategy is superior in reducing rates of reinfarction, stroke, and the combined end-point criteria of death, reinfarction, or stroke [29].

For situations in which transfer directly to a center capable of primary PCI is not possible in a timely fashion, a strategy of prehospital or non-PCI hospital-based fibrinolysis is reasonable. The available science suggests that the drugs can be safely administered by full-time paramedics or EMS physicians in the field. The EMS system should have a medical director with experience in STEMI management and a well-organized quality assurance program.

**Systems of care for ST-elevation myocardial infarction**

The EMS system plays a key role in shortening the process of caring for patients with STEMI. Patients who are transported by EMS have shorter treatment intervals than those of patients who arrive at the hospital by other means [43]. Patients can be encouraged to use EMS appropriately. A community intervention to shorten the time interval from symptom onset to ED arrival was shown to increase the proportion of ACS patients who used EMS for transport to the ED [44].

**Prehospital notification and field cardiac catheterization laboratory activation**

A key benefit of a prehospital 12-lead ECG is notification of the receiving facility of an impending STEMI patient’s arrival. Shortening door-to-balloon time by 30 minutes reduces in-hospital mortality from STEMI by about 1% [45]. Implementation of a prehospital 12-lead ECG program with prehospital notification shortened door-to-balloon times by about 60 minutes in San Diego [46]. In an evaluation of a large patient registry, prehospital notification with ED activation of the catheterization team before patient arrival at the hospital shortened door-to-balloon time by about 15 minutes [47].

Occasional false-positive activation of the PCI team is a necessary byproduct of an aggressive field approach to alerting hospitals about patients with suspected STEMI. One report suggests that up to 15–20% of team activations may not result in any intervention [48]. The rate of false-positive activations depends on the pretest probability of finding a STEMI. If EMS providers perform 12-lead ECGs broadly (e.g. everyone over the age of 30 with any of the following characteristics: chest pain, shortness of breath, abdominal pain, diabetes, or cardiac history), such that the prevalence of actual STEMI is between 0.5% and 5%, then the positive predictive value of a “STEMI-positive” prehospital 12-lead ECG may be around 50% [49]. Such a system would result in more false-positive than true-positive activations of the PCI team.

When patients have a reasonable likelihood of STEMI based on their clinical presentations and 12-lead ECG findings, prehospital cardiac catheterization PCI team activation has consistently been shown to shorten time to definitive treatment of STEMI patients considerably. For example, Nestler et al. showed that prehospital activation of the catheterization laboratory reduced the median door-to-balloon times from 59 to 32 minutes [50]. Cone et al. found that field activation of the catheterization laboratory was associated with 37 and 35 minute shorter door-to-balloon times than ED activation for walk-in STEMI patients or STEMI patients arriving by EMS without field activation, respectively [51]. In addition, field activation of the catheterization laboratory was associated with better compliance with 90-minute STEMI treatment benchmarks. Finally, Horvath et al. found similar reduction in the door-to-balloon times (44 versus 57 minutes) in EMS-transported STEMI patients who had prehospital activation of the cardiac catheterization laboratory compared to those who had the laboratory activated after ED arrival [52].

In summary, field activation of the cardiac catheterization laboratory when a prehospital ECG shows evidence of STEMI is strongly supported by published data. EMS systems should work with their PCI-capable hospitals to establish cardiac catheterization laboratory prehospital STEMI activation protocols and quality improvement monitoring.

**Emergency medical services transport**

Despite the benefits of EMS for chest pain patients, many patients misinterpret their symptoms, delay calling EMS, or use personal transportation to go to the hospital. Public education campaigns attempted to date have not shortened the overall time interval from symptom onset to hospital arrival, but they have increased the proportion of ACS patients who use EMS [53].

**Destination protocols**

Almost 80% of the adult population of the United States lives within 60 driving minutes of a PCI-capable center [54]. Of those patients whose closest hospital is not capable of PCI, 74% require additional transport time less than 30 minutes to reach a PCI-capable institution.

Therefore, several urban communities have developed protocols to encourage EMS to transport STEMI patients directly to hospitals with 24/7 capability to perform PCI. In Ottawa, a STEMI bypass protocol for EMS was implemented in May 2005 [55]. Paramedics performed a 12-lead ECG, and if STEMI was identified in a hemodynamically stable patient, the patient was transported directly to the region’s single cardiac center catheterization lab with prehospital notification of the impending arrival of the STEMI patient, often bypassing one of the four other EDs in the city. The median first door-to-balloon time was 69 minutes for patients brought to the catheterization lab directly by EMS, compared with 123 minutes for those needing interhospital transfer. In The Netherlands, prehospital identification of patients with STEMI and transport to a PCI-capable center bypassing other EDs was associated with improved left ventricular function [56].

Some systems are directing EMS to take STEMI patients directly to the heart catheterization lab, bypassing the ED. The strategy reduces door-to-balloon time up to 60 minutes [57]. In more rural settings without available PCI centers, coordinated programs with regional STEMI receiving centers can achieve remarkable door-to-balloon times, even when measuring from the first door (i.e. the door of the rural ED). Two reports from Minnesota show that excellent treatment times can be achieved. In the Minneapolis area, the median first door-to-balloon time was 95 minutes if the referring hospital was less than 60 miles from the PCI center and 120 minutes if the referring hospital was further away [58]. In the Mayo Clinic STEMI system, patients were transferred from 28 regional hospitals up to 150 miles away from the PCI center. The median first door-to-balloon time for the transferred patients was 116 minutes [59].

**Air medical evacuation of ST-elevation myocardial infarction patients**

A key to a successful regional STEMI system is ready access to air medical transport. Rapid transport of the patient by highly skilled teams in medical helicopters can save significant time from the first door to balloon. Some air medical programs are working closely with referring hospitals and ground EMS systems to dispatch helicopters before arrival of a STEMI patient at a referring hospital [60].

**Expanding the role of Basic Life Support providers**

Many prearrival 9-1-1 instructions already direct callers to take aspirin if they have chest pain. Allowing BLS providers to administer aspirin, if not contraindicated, and if permitted by EMS laws and regulations, seems the next logical step. One reason stated for the lack of aspirin administration to eligible ACS patients is the inability of BLS providers to administer it based on local protocols or regulations [61].

Basic Life Support providers can be taught to acquire and transmit 12-lead ECGs. This approach may be particularly beneficial in rural areas, with scant ALS coverage and long transport times to definitive care. Using the 12-lead ECG to triage STEMI patients to air transport from the scene may lead to improved cardiac care in rural areas and more efficient use of available resources [62].

**Other common causes of chest discomfort**

Although most of the available prehospital interventions for chest pain are focused on the identification and treatment of ischemic cardiac disease, the majority of EMS chest pain patients will have other causes for their symptoms, some of which are also immediate threats to life ([Box 13.3](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c13.xhtml?favre=brett#c13-fea-0003)). A chest pain protocol should focus on treatments that may benefit the ACS/STEMI patient while considering the effects of these treatments on other causes of chest pain.

**Box 13.3 Causes of chest discomfort that are immediate life threats**

* Acute coronary syndrome
* Pericardial tamponade
* Pulmonary embolism
* Tension pneumothorax
* Thoracic aortic dissection

**Aortic dissection**

Acute aortic dissection classically causes sudden pain in the chest, sometimes radiating to the back. The dissection is caused by a tear in the intimal lining of the aorta with entry of high-pressure blood into the wall of the aorta. The dissection propagates distally and sometimes also proximally. If the dissection extends around the origin of a peripheral artery, then that vessel can be partially or completely occluded, creating a >15–20 mmHg difference in blood pressures between both patient arms. If the origin of a carotid or vertebral artery is occluded, then the patient may develop neurological signs suggesting a stroke. Occlusion of a spinal artery off the aorta can cause acute paralysis of both legs. Most patients with dissection have long-standing hypertension, but the problem can occur in younger patients with other conditions such as Marfan syndrome.

In the majority of cases of aortic dissection, the12-lead ECG will be abnormal, but will not show ST-segment elevation unless the origin of a coronary artery is occluded by the dissection [63]. Without imaging capability that exists in the hospital, EMS providers may suspect, but cannot identify, aortic dissection definitively [64,65]. If aortic dissection is suspected, morphine can be used for pain control but aspirin should be avoided since patients with acute aortic syndrome who receive antithrombotic agents such as aspirin or fibrinolytics are more likely to bleed [66].

**Pericarditis**

Individuals with pericarditis may present to EMS with ST-segment elevation on an ECG that looks similar to an extensive myocardial infarction. Administration of fibrinolytics in this condition may be fatal because these patients can bleed into the pericardial sac, resulting in pericardial tamponade. Aspirin administration is somewhat less concerning because antiinflammatory medications are part of the recommended treatment.

**Pneumothorax**

A pneumothorax may cause chest pain, shortness of breath, hypoxia, and diaphoresis. Clinical signs may point more to this diagnosis than to acute myocardial infarction. EMS systems should have a separate protocol for management of a pneumothorax. Oxygen and morphine may help the patient. Nitroglycerin should be avoided because it can cause hypotension by further decreasing venous return if the patient is developing a tension pneumothorax. If a developing tension pneumothorax is evident, needle decompression is required.

**Pulmonary embolism**

Pulmonary embolism is a great masquerader because its symptoms may be similar to those of other causes of chest pain and shortness of breath. Its presentation can easily be confused with myocardial infarction or anxiety. Treatment should focus on maximizing oxygenation to the patient. If pulmonary embolism is suspected, nitroglycerin should be avoided because it can cause significant hypotension. Administration of fibrinolytics may potentially benefit the patient, but it is preferable to delay administration until the patient has reached a hospital and undergone a definitive diagnostic imaging study.

**Esophageal perforation**

A patient with a perforated esophagus may present with chest pain. A careful and focused history and examination will often help differentiate this condition from other causes of chest pain. Nitroglycerin should be avoided because it may cause significant hypotension, and fibrinolytics are contraindicated because of the need for immediate surgery.

**Conclusion**

Quality prehospital care of patients with chest pain can relieve discomfort and improve outcome. EMS systems should have the capability to perform prehospital 12-lead ECGs and regional protocols should focus on delivering patients with STEMI to PCI centers promptly. Prehospital activation of the cardiac catheterization laboratory is highly effective at shortening the time to definitive reperfusion treatment and should be encouraged.

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