the necessary precautions to stabilize the patient's condition (aspirin, oxygen, IV saline lock, monitor/12-lead ECG, analgesia), there is no reason to remain any longer at the scene unless a cardiac arrest or arrhythmia requires immediate treatment. Take the rest of the history en route to the hospital. Remember that "time is muscle": Heart cells are being destroyed during the infarction before reperfusion is started in the hospital.

Prehospital 12-lead ECG

An important component of ACS care is performance of out-of-hospital 12-lead ECG with transmission or interpretation by paramedic personnel and advance notification to the receiving facility. The goal is to reduce time to reperfusion, with either fibrinolytic therapy or primary PCI. Out-of-hospital 12-lead ECG has been shown to reduce the time to primary PCI and can help triage patients with acute STEMI to a hospital with interventional cardiac care facilities. When paramedics activate the cardiac care team, reductions in reperfusion times are observed.

Transport the Patient

Once the patient is in stable condition, transport him or her to an appropriate hospital in a semi-Fowler position (unless the patient is in shock, in which case he or she should be supine). Do all you can to ensure that the patient is as relaxed and as comfortable as possible. En route, some additional treatment measures may be worthwhile, especially when transport will take a long time.

Safe and appropriate transport is the name of the game. *Do not rush* and *do not use sirens* when transporting the patient to the hospital, unless absolutely necessary. High speed and sirens send two clear messages to the patient: (1) Something is terribly wrong. (2) The personnel on the ambulance don't feel capable of dealing with the situation. Those are *not* the messages you want to convey to a frightened patient with a damaged heart! The patient needs to feel confident that those caring for him or her are in control of the situation.

If a serious arrhythmia occurs during transport, institute treatment immediately, and notify direct medical control. Except under unusual circumstances, treatment of life-threatening situations should not be attempted in a moving ambulance. Whenever possible, the driver should pull over to the side of the road and go to the back of the vehicle to help the other paramedic.

Reperfusion Techniques for ACS

The majority of AMIs occur as a result of thrombus (fixed blood clot) formation at the site of a preexisting atherosclerotic plaque. The thrombus occludes the coronary artery, preventing further blood flow through it. Thus, it seems reasonable to try to restore circulation through the occluded coronary artery, thereby restoring perfusion to the ischemic myocardium. Simply put, that is reperfusion.

The most immediate forms of reperfusion are fibrinolytic therapy and percutaneous intervention (PCI). All paramedics should be alert for patients who are good candidates for reperfusion, should know which hospitals in their area carry out fibrinolytic therapy and/or PCI, and should provide early notification (along with 12-lead ECG results) to the ED that a candidate for such therapy is en route.

Fibrinolysis

One way in which to reperfuse the blocked coronary artery is to try to dissolve the occluding blood clot, thereby restoring circulation to the ischemic heart. That idea is the essence of fibrinolytic therapy.

In fact, this concept is not altogether new. Attempts to use fibrinolytic agents in the treatment of AMI were reported at least 40 years ago, albeit without success. In retrospect, we realize that one reason the early attempts failed was that fibrinolytic therapy was started too late, after irreversible damage to the myocardium had already occurred. With that realization came the concept that "time is myocardium": The longer a segment of myocardium remains unperfused, the smaller the chances of salvaging that tissue and restoring its normal function. The obvious corollary is that the sooner fibrinolytic therapy can begin with respect to the onset of the blockage, the better the chances for saving the affected distal myocardium. Indeed, fibrinolytic treatment given within 30 to 60 minutes of the onset of symptoms can sometimes abort the MI altogether.

At the Scene

Time is muscle (myocardium)!

In the 1980s, fibrinolytic therapy was given to AMI patients as soon as they reached the ED, rather than waiting until the patient was admitted to the coronary care unit. Inevitably, applying the doctrine that time is myocardium led to the idea of starting fibrinolytic treatment even earlier, in the prehospital phase of care.

Recent clinical trials have shown the benefit of starting fibrinolysis as soon as possible after the onset of ischemic-type chest pain in patients with STEMI or new or presumably new left bundle branch block. Several prospective studies have also documented reduced time to administration of fibrinolytics and decreased mortality rates when out-of-hospital fibrinolytics were given to patients with STEMI and no contraindications to fibrinolytics. Some EMS systems may opt to start fibrinolytic treatment in the prehospital environment, and in rural areas with very long transport times, prehospital initiation of fibrinolytic therapy may make a lot of sense. Even in EMS systems in which paramedics do not give fibrinolytic therapy, their ability to identify candidates for such therapy has a decisive role in helping ED personnel administer fibrinolytic therapy early enough to make a difference. For these reasons, all paramedics should thoroughly understand the principles of fibrinolytic therapy for AMI.

Fibrinolytic therapy seeks to administer, during the early hours of AMI, an agent that will activate the body's own internal system for dissolving clots, the fibrinolytic system. Once activated, that system can begin to dissolve the clot that has formed within the coronary artery, thereby reopening the artery (recanalization) and allowing the resumption of blood flow through it (reperfusion). Unfortunately, if an agent capable of promoting clot dissolution is given intravenously, its effects cannot be limited to the clot in the coronary artery; it can also act

Table 27-12 ST-Segment Elevation or New or Presumably New LBBB: Evaluation for Reperfusion

Step 1: Assess time and risk

- Time since onset of symptoms
- Risk of STEMI
- Risk of fibrinolysis
- Time required to transport to skilled PCI catheterization suite

Step 2: Select reperfusion (fibrinolysis or invasive) strategy

Note: If presentation < 3 hours and no delay for PCI, then no preference for either strategy.

Fibrinolysis is generally preferred if:

- Early presentation (≤ 3 hours from symptom onset)
- Invasive strategy is not an option (eg, lack of access to skilled PCI facility or difficult vascular access) or would be delayed
  —Medical contact-to-balloon or door-balloon > 90 min
  —(Door-to-balloon) minus (door-to-needle) is > 1 hour
- No contraindications to fibrinolysis

An invasive strategy is generally preferred if:

- Late presentation (symptom onset > 3 hours ago)
- Skilled PCI facility available with surgical backup
- Medical contact-to-balloon or door-balloon < 90 min
- (Door-to-balloon) minus (door-to-needle) is < 1 hour
- Contraindications to fibrinolysis, including increased risk of bleeding and ICH
- High risk from STEMI (CHF, Killip class is ≥ 3)
- Diagnosis of STEMI is in doubt

anywhere else in the body where clots are being formed and, therefore, may lead to bleeding. Thus, the benefit of fibrinolytic therapy—the possible salvage of myocardium—must always be weighed against its risks—principally, the risk of bleeding.

To determine the appropriate candidates for fibrinolytic agents, we need to be as certain as possible that we are really dealing with a patient who is having an AMI. A patient having chest pain from another source would receive no potential benefit from fibrinolytic therapy—so he or she would be subjected to this therapy's risks for no reason. Although it is difficult in the early hours of an AMI to be certain of the diagnosis, inclusion criteria have been established to help select patients most likely to be having an AMI. At the same time, exclusion criteria are used to identify patients for whom the risk of fibrinolytic therapy is unacceptably high—for example, patients most likely to experience hemorrhagic complications. Table 27-12 ▲ summarizes typical inclusion and exclusion criteria for fibrinolytic therapy.

Most treatment regimens for fibrinolysis include one of three agents: tenecteplase, alteplase (Activase; a tissue plasminogen activator), or reteplase (Retavase; recombinant tissue). All of them work by converting, in one way or another, the body's own clot-dissolving enzyme from its inactive form, plasminogen, to its active form, plasmin.

The key to realizing the benefits of fibrinolysis is to start early. A prehospital fibrinolytic program is recommended only in systems with well-established protocols, checklists, experience in ACLS, ability to communicate with the receiving institution, and a medical director with training and experience in the management of STEMI.

Percutaneous Intervention

Many institutions now perform emergent primary PCI as an alternative to fibrinolysis. Primary PCI involves emergent opening of the blocked coronary artery by mechanical means with a balloon-tipped catheter, instead of delivering a fibrinolytic agent. Studies have shown that patients undergoing rapid primary PCI have better outcomes than those receiving fibrinolytic therapy. This is true for patients with STEMI and cardiogenic shock. The key to better outcomes is rapid response—the artery is opened by a balloon within 90 minutes of first contacting the health care system. This is only possible in well-organized hospital systems with interventional cardiac care facilities available and standing by for such a patient.

Canadian studies have also demonstrated that paramedics can reliably identify patients with STEMI with 12-lead ECG, utilize a hospital bypass protocol, and transport patients with STEMI directly to a hospital with interventional cardiac care facilities. Programs that integrate EMS, emergency department, and cardiology services are improving patient outcomes. Paramedics should be aware of their local or regional protocols for ACS and STEMI patients, including 12-lead ECG interpretation and hospital bypass.

Congestive Heart Failure

Congestive heart failure (also known as chronic heart failure) occurs when the heart is unable, for any reason, to pump powerfully enough or fast enough to empty its chambers; as a result, blood backs up into the systemic circuit, the pulmonary circuit, or both. Although CHF may develop in situations other than AMI—for example, in a patient with chronic high blood pressure—the basic principles of diagnosis and treatment are similar, whatever the precipitating factors. It is estimated that 400,000 Canadians are living with congestive heart failure. Depending on the symptom severity, heart dysfunction, age, and other factors, congestive heart failure can be associated with an annual mortality of between 5% and 50%. The average annual mortality rate for congestive heart failure is 10% per year, with a 50% 5-year survival rate. Up to 40% to 50%