Chapter 16
Cardiovascular Emergencies

Lecture
Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.
Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.
National EMS Education
Standard Competencies (3 of 5)

Cardiovascular

• Anatomy, signs, symptoms, and management of
  – Chest pain
  – Cardiac arrest
• Anatomy, physiology, pathophysiology, assessment, and management of
  – Acute coronary syndrome
    • Angina pectoris
    • Myocardial infarction
  – Aortic aneurysm/dissection
Anatomy, physiology, pathophysiology, assessment, and management of:

- Thromboembolism
- Heart failure
- Hypertensive emergencies
Introduction (1 of 3)

• Cardiovascular disease has been the leading killer of Americans since 1900.
• Accounts for 1 of every 3 deaths
Introduction (2 of 3)

- EMS can help reduce deaths by:
  - Encouraging healthy lifestyle
  - Early access to medical care
  - More CPR training of laypeople
  - Increased use of evolving technology in dispatch and cardiac arrest response
Introduction (3 of 3)

• EMS can help reduce deaths by (cont’d):
  – Public access to defibrillation devices
  – Recognizing need for advanced life support (ALS)
  – The use of cardiac specialty centers when they are available
Anatomy and Physiology

• Heart’s job is to pump blood to supply oxygen-enriched red blood cells to tissues.
• Divided into left and right sides
• One-way valves keep blood flowing in the proper direction.
• Aorta, body’s main artery, receives blood ejected from left ventricle.
Anatomy and Physiology

Superior vena cava (oxygen-poor blood from head and upper body)
Right pulmonary artery (blood to right lung)
Right atrium
Inferior vena cava (oxygen-poor blood from lower body)
Right ventricle

Left pulmonary artery (blood to left lung)

Right pulmonary veins (oxygen-rich blood from right lung)
Left pulmonary veins (oxygen-rich blood from left lung)
Left atrium
Left ventricle

Oxygen-rich blood to head and upper body
Oxygen-rich blood to lower body

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• Heart’s electrical system controls heart rate and coordinates atria and ventricles.
• Automaticity allows spontaneous contraction without a stimulus from a nerve source.
  – If impulses come from the SA node, the other myocardial cells will contract.
  – If no impulse arrives, the other cells are capable of creating their own impulses and stimulating a contraction.
Anatomy and Physiology (6 of 17)

Electrical conduction system of the heart
• Autonomic nervous system (ANS) controls involuntary activities.

• The ANS has two parts:
  – Sympathetic nervous system
    • “Fight-or-flight” system
  – Parasympathetic nervous system
    • Slows various bodily functions
Anatomy and Physiology (8 of 17)

• The myocardium must have a continuous supply of oxygen and nutrients to pump blood.

• Increased oxygen demand by myocardium is supplied by dilation (widening) of coronary arteries.

• Stroke volume is the volume of blood ejected with each ventricular contraction.
Anatomy and Physiology  (9 of 17)

- Coronary arteries are blood vessels that supply blood to heart muscle.
- Coronary arteries start at the first part of the aorta:
  - Right coronary artery
  - Left coronary artery
Arteries supply oxygen to different parts of the body:

- Right and left carotid
- Right and left subclavian
- Brachial
- Radial and ulnar
- Right and left iliac
- Right and left femoral
- Anterior and posterior tibial and peroneal
• Arterioles and capillaries are smaller vessels.
  – Capillaries connect arterioles to venules.
• Venules are the smallest branches of the veins.
  – Vena cavae return blood to the heart.
    • Superior vena cava
    • Inferior vena cava
• Blood consists of:
  – Red blood cells, which carry oxygen
  – White blood cells, which fight infection
  – Platelets, which help blood to clot
  – Plasma, which is the fluid cells float in
• Blood pressure is the force of circulating blood against artery walls.
  – Systolic blood pressure
    • The maximum pressure generated by left ventricle
  – Diastolic blood pressure
    • The pressure against artery walls while the left ventricle is at rest
A pulse is felt when blood passes through an artery during systole.

- Peripheral pulses felt in the extremities
- Central pulses felt near the body’s trunk
Anatomy and Physiology (17 of 17)

• Cardiac output is the volume of blood that passes through the heart in 1 minute.
  – Heart rate \times \text{volume of blood ejected with each contraction (stroke volume)}

• Perfusion is the constant flow of oxygenated blood to tissues

• Requirements of good perfusion

• If perfusion fails, cellular and eventually patient death occur.
• Chest pain usually stems from ischemia, which is decreased blood flow.
  – Ischemic heart disease involves a decreased blood flow to one or more portions of the heart.
  – If blood flow is not restored, the tissue dies.
Atherosclerosis is the buildup of calcium and cholesterol in the arteries. - Can cause occlusion of arteries - Fatty material accumulates with age.
• A thromboembolism is a blood clot floating through blood vessels.

• If a clot lodges in a coronary artery, acute myocardial infarction (AMI) results.
Coronary artery disease is the leading cause of death in the United States.

Controllable AMI risk factors:
- Cigarette smoking, high blood pressure, high cholesterol, high blood glucose level (diabetes), lack of exercise, and obesity

Uncontrollable AMI risk factors:
- Older age, family history, atherosclerotic coronary artery disease, race, ethnicity, and being male
• Acute coronary syndrome (ACS) is caused by myocardial ischemia.
  – Angina pectoris
  – Acute myocardial infarction (AMI)
Angina pectoris occurs when the heart’s need for oxygen exceeds supply.

- Crushing or squeezing pain
- Does not usually lead to death or permanent heart damage
- Should be taken as a serious warning sign
• Unstable angina
  – In response to fewer stimuli than normal
• Stable angina
  – Is relieved by rest or nitroglycerin
• Treat angina patients like AMI patients.
• AMI pain signals actual death of cells in heart muscle.
  – Once dead, cells cannot be revived.
  – “Clot-busting” (thrombolytic) drugs or angioplasty within the first few hours prevent damage.
  – Immediate transport is essential.
Pathophysiology (9 of 22)

- Signs and symptoms of AMI
  - Weakness, nausea, sweating
  - Chest pain, discomfort, or pressure
  - Lower jaw, arm, back, abdomen, or neck pain
  - Irregular heartbeat and syncope (fainting)
  - Shortness of breath (dyspnea)
  - Nausea/vomiting
  - Pink, frothy sputum
  - Sudden death
AMI pain differs from angina pain
  - Not always due to exertion
  - Lasts 30 minutes to several hours
  - Not always relieved by rest or nitroglycerin

AMI patients may not realize they are experiencing a heart attack.
• AMI and cardiac compromise physical findings:
  – Fear, nausea, poor circulation
  – Faster, irregular, or bradycardic pulse
  – Decreased, normal, or elevated blood pressure
  – Normal or rapid and labored respirations
  – Patients express feelings of impending doom.
Pathophysiology (12 of 22)

• Three serious consequences of AMI:
  – Sudden death
    • Resulting from cardiac arrest
  – Cardiogenic shock
  – Congestive heart failure (CHF)
Pathophysiology (13 of 22)

• Dysrhythmia: heart rhythm abnormalities
  – Premature ventricular contractions
  – Tachycardia
  – Bradycardia
  – Ventricular tachycardia
  – Ventricular fibrillation
Defibrillation restores cardiac rhythms.
- Can save lives
- Initiate CPR until a defibrillator is available.

Asystole
- Absence of all heart electrical activity
- Reflects a long period of ischemia
- Nearly all patients will die.
Cardiogenic shock
- Often caused by heart attack
- Heart lacks power to force enough blood through circulatory system
- Inadequate oxygen to body tissues causes organs to malfunction.
- Often caused by a heart attack
- Heart lacks the power to pump
- Recognize shock in its early stages.
• Congestive heart failure
  – Often occurs a few days following heart attack
  – Increased heart rate and enlargement of left ventricle no longer make up for decreased heart function
  – Lungs become congested with fluid.
  – May cause dependent edema.
• Hypertensive emergencies
  – Systolic pressure greater than 180 mm Hg
  – Common symptoms
    • Sudden, severe headache
    • Strong, bounding pulse
    • Ringing in the ears
Hypertensive emergencies (cont’d)

- Common symptoms
  - Nausea and vomiting
  - Dizziness
  - Warm skin (dry or moist)
  - Nosebleed
  - Altered mental status
  - Sudden pulmonary edema
• Hypertensive emergencies (cont’d)
  – If untreated, can lead to stroke or dissecting aortic aneurysm.
  – Transport patients quickly and safely.
  – Consider ALS assistance.
Aortic aneurysm is weakness in the wall of the aorta.
- Susceptible to rupture
- Dissecting aneurysm occurs when inner layers of aorta become separated.
- Primary cause: uncontrolled hypertension
<table>
<thead>
<tr>
<th></th>
<th>AMI</th>
<th>Dissecting Aneurysm</th>
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</thead>
<tbody>
<tr>
<td>Onset of pain</td>
<td>Gradual, with additional symptoms</td>
<td>Abrupt, without additional symptoms</td>
</tr>
<tr>
<td>Quality of pain</td>
<td>Tightness or pressure</td>
<td>Sharp or tearing</td>
</tr>
<tr>
<td>Severity of pain</td>
<td>Increases with time</td>
<td>Maximal from onset</td>
</tr>
<tr>
<td>Timing of pain</td>
<td>May wax and wane</td>
<td>Does not abate once it has started</td>
</tr>
<tr>
<td>Region/radiation</td>
<td>Substernal; back is rarely involved</td>
<td>Back possibly involved, between the shoulder blades</td>
</tr>
<tr>
<td>Clinical signs</td>
<td>Peripheral pulses equal</td>
<td>Blood pressure discrepancy between arms or decrease in a femoral or carotid pulse</td>
</tr>
</tbody>
</table>
• Aortic aneurysm (cont’d)
  – Signs and symptoms
    • Very sudden chest pain
    • Comes on full force
    • Different blood pressures
  – Transport patients quickly and safely.
Scene Size-up

• Scene safety
  – Ensure the scene is safe.
  – Follow standard precautions.

• Nature of illness (NOI)
  – Obtain clues from dispatch, the scene, patient, family members, bystanders
Primary Assessment (1 of 2)

- Form a general impression.
  - If unresponsive and not breathing, begin CPR and call for AED.

- Airway and breathing
  - Oxygen saturation less than 95%: apply oxygen with nonrebreathing mask at 15 L/min
  - Not breathing or inadequate breathing: 100% oxygen with BVM
  - Pulmonary edema: BVM or CPAP
Primary Assessment (2 of 2)

- Circulation
  - Check pulse, skin, capillary refill.
  - Consider treatment for cardiogenic shock.

- Transport decision
  - Decision based on ability to stabilize life threats during primary assessment
  - Transport in a stress-relieving manner.
History Taking (1 of 2)

• Investigate the chief complaint (eg, chest pain, difficulty breathing).

• Obtain a SAMPLE history from a responsive patient.
  – Use OPQRST.
## Table 16-2: OPQRST Mnemonic for Assessing Pain

<table>
<thead>
<tr>
<th>OPQRST</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onset</strong></td>
<td>When did the problem begin, and what does the patient think may have caused it?</td>
</tr>
<tr>
<td><strong>Provocation/palliation</strong></td>
<td>Ask what makes the pain or discomfort better or worse. Is it positional? Does a deep breath or palpation of the chest make it worse? Did you take anything for it (including anything nonprescribed)?</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>Ask the patient to describe his or her pain. Let the patient use his or her own words to describe what is happening. If the patient is unable to describe the pain, try to avoid supplying only one option. Do not ask, “Does it feel like an elephant is sitting on your chest?” Instead, say, “Tell me what the pain feels like.” If the patient cannot answer an open-ended question, then provide a list of alternatives: “There are lots of different kinds of pain. Is your pain more like heaviness, pressure, burning, tearing, dull ache, stabbing, or needlelike?”</td>
</tr>
<tr>
<td><strong>Region/radiation</strong></td>
<td>Ask where the pain is located and whether the pain has spread to another part of the body.</td>
</tr>
<tr>
<td><strong>Severity</strong></td>
<td>Ask the patient to rate the pain on a simple scale. Often, a scale ranging from 0 to 10 is used; a 10 represents the worst pain imaginable. Do not use the patient’s answer to determine whether the pain has a serious cause. Instead, use it to check whether the pain is getting better or worse. After a few minutes of oxygen or administration of nitroglycerin, ask the patient to rate the pain again.</td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td>Find out how long the pain lasts when it is present and whether it has been intermittent or continuous.</td>
</tr>
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Secondary Assessment

• Physical examination
  – Focus on cardiac and respiratory systems.
    • Circulation
    • Respirations

• Vital signs
  – Measure and record the patient’s vital signs.
  – If available, use pulse oximetry.
Reassessment

- Reassess vital signs at least every 5 minutes or when patient’s condition changes significantly.
- Sudden cardiac arrest is always a risk.
  - If cardiac arrest occurs, perform CPR immediately until an AED is available.
- Reassess your interventions.
- Provide rapid patient transport.
- Communication and documentation
Emergency Medical Care for Chest Pain or Discomfort (1 of 7)

- Ensure a proper position of comfort.
- Give oxygen if indicated.
- Depending on protocol, prepare to administer low-dose aspirin and assist with prescribed nitroglycerin.
Emergency Medical Care for Chest Pain or Discomfort (2 of 7)

- Aspirin
  - Effects:
    - Prevents blood clots from forming or getting bigger
    - 81-mg chewable tablets
    - Recommended dose: 162 mg (two tablets) to 324 mg (four tablets)
Emergency Medical Care for Chest Pain or Discomfort (3 of 7)

- Nitroglycerin
  - Available forms
    - Sublingual pill
    - Sublingual spray
    - Skin patch applied to chest
Nitroglycerin

- Mechanism of action:
  - Relaxes blood vessel walls
  - Increases blood flow and oxygen supply to heart
  - Decreases workload of heart
  - Dilates blood vessels
Emergency Medical Care for Chest Pain or Discomfort (5 of 7)

• Nitroglycerin
  – Side effects:
    • Severe headache
    • Change in pulse rate
Nitroglycerin

- Contraindications:
  - Systolic blood pressure <100 mm Hg
  - Head injury
  - Use of erectile dysfunction drugs within 24 hours
  - Maximum prescribed dose has already been given (usually three doses)
Emergency Medical Care for Chest Pain or Discomfort (7 of 7)

- Administering nitroglycerin
  - Ensure medication is not expired nor contaminated.
  - Ensure medication is prescribed for patient.
  - Wear gloves.
For an ECG to be reliable and useful, electrodes must be placed in consistent positions.

Basic principles should be followed to minimize artifact in the signal

- Artifact: ECG tracing that is the result of interference
Cardiac Monitoring (2 of 4)

• Guiding principles:
  – May need to shave body hair
  – Rub electrode site with alcohol swab before application.
  – Attach electrodes to ECG cables before placement.
  – Confirm electrode placement.
Cardiac Monitoring (3 of 4)

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Once electrodes are in place, switch on the monitor.

- Print a sample rhythm strip.
- If strip shows artifact, confirm electrodes are firmly applied and cable is plugged in.
Heart Surgeries and Cardiac Assistive Devices (1 of 7)

• Many open-heart operations have been performed in the last 30 years.

• Coronary artery bypass graft
  – Chest or leg blood vessel is sewn from the aorta to a coronary artery beyond the point of obstruction.

• Percutaneous transluminal coronary angioplasty
  – A tiny balloon is inflated inside a narrowed coronary artery.
Heart Surgeries and Cardiac Assistive Devices (2 of 7)

- Patients who have had open-heart procedures may or may not have long chest scars.
- Treat chest pain in a patient who has had any of these procedures the same as a patient who has never had heart surgery.
- Others have implanted cardiac pacemakers.
• Cardiac pacemakers
  – Maintain regular cardiac rhythm and rate
  – Deliver electrical impulse through wires in direct contact with the myocardium
  – Implanted under a heavy muscle or fold of skin in the upper left portion of the chest
Heart Surgeries and Cardiac Assistive Devices (4 of 7)

• Cardiac pacemakers (cont’d)
  – This technology is very reliable.
  – Pacemaker malfunction can cause syncope, dizziness, or weakness due to an excessively slow heart rate.

• Transport patients promptly.

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Automatic implantable cardiac defibrillators
- Used by some patients who have survived cardiac arrest due to ventricular fibrillation
- Monitor heart rhythm and shock as needed.
- Treat chest pain patients with these devices like other patients having an AMI.
- Electricity is low; it will not affect rescuers.
External defibrillator vest
- A vest with built-in monitoring electrodes and defibrillation pads worn by the patient.
- Attached to a monitor
- Uses high-energy shocks
  - Do not touch the patient if devices warns it is about to deliver a shock.
- Vest should remain in place while CPR is being performed unless it interferes with compressions.
• Left ventricular assist devices (LVADs)
  – Used to enhance the pumping of the left ventricle.
  – May be pulsatile or continuous
  – The patient or family can tell you more about the device.
  – Transport all supplies and battery packs with the patient.
Cardiac Arrest

- The complete cessation of cardiac activity
- Absence of a carotid pulse
- Was terminal before CPR and external defibrillation were developed in the 1960s
Automated External Defibrillation (1 of 11)

• Analyzes electrical signals from heart
  – Identifies ventricular fibrillation
  – Administers shock to heart when needed

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Automated External Defibrillation (2 of 11)

• AED models:
  – All require some operator interaction.
  – Most have a computer voice synthesizer advising steps to take.
  – Most are semiautomated.

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Automated External Defibrillation

Advantages of AED use:
- Quick delivery of shock
- Easy to operate
- ALS providers do not need to be on scene
- Remote, adhesive pads safe to use
- Larger pad area = more efficient shocks
Other considerations

- Though all cardiac arrest patients should be analyzed, not all require shock.
- All patients in cardiac arrest should be analyzed with an AED.
- Asystole (flatline) = no electrical activity
- Pulseless electrical activity usually refers to a state of cardiac arrest.
Automated External Defibrillation (5 of 11)

• Early defibrillation
  – Few cardiac arrest patients survive outside a hospital without a rapid sequence of events.
  – Chain of survival:
    • Early recognition and activation of EMS
    • Immediate bystander CPR
    • Rapid defibrillation
    • Basic and advanced EMS
    • ALS and postarrest care
• Early defibrillation (cont’d)
  – CPR prolongs period during which defibrillation can be effective.
  – Has resuscitated patients with cardiac arrest from ventricular fibrillation
  – Nontraditional first responders are being trained in AED use.
Automated External Defibrillation (8 of 11)

- ALS and postarrest care
  - Continue ventilation.
  - Maintain oxygen saturation.
  - Assure blood pressure >90 mm Hg.
  - Maintain glucose levels.
  - Rapid transport to appropriate hospital
• Integrating the AED and CPR
  – Work the AED and CPR in sequence.
  – Do not touch the patient during analysis and defibrillation.
  – CPR must stop while AED performs its job.
• **AED maintenance**
  – Maintain as manufacturer recommends.
  – Read the operator’s manual.
  – Check equipment daily at beginning of shift.
  – Ask manufacturer for maintenance checklist.
Automated External Defibrillation

- AED maintenance (cont’d)
  - Report AED failures to manufacturer and US Food and Drug Administration (FDA).
    - Follow local protocol for notifying.
- Medical direction should approve written protocol for AED use
- Continuing education with skill competency review is generally required for EMS providers.
Emergency Medical Care for Cardiac Arrest (1 of 7)

• Preparation
  – Make sure the electricity injures no one.
  – Do not defibrillate patients in pooled water.
  – Do not defibrillate patients touching metal.
• Preparation (cont’d)
  – Carefully remove nitroglycerin patch and wipe with dry towel before shocking.
  – Shave hairy chest to increase conductivity.
  – Determine the NOI and/or MOI.
    • Perform spinal immobilization for trauma patients.

• Call for ALS assistance in a tiered system.
Emergency Medical Care for Cardiac Arrest (3 of 7)

Arrive on scene
- Check responsiveness
- Get AED

Unresponsive

Assess the ABCs simultaneously
- With the airway open, check for pulse and breathing simultaneously for no more than 10 seconds.

Circulation NO

Begin chest compressions until AED is available
- Deliver compressions at a rate of 100 to 120/minute.
- Do not provide ventilations until 30 compressions have been given.
- Ratio 30:2 compression:ventilation.

Apply AED as soon as available
- Analyze
- Shock

After AED completes shock
- Begin 5 cycles of CPR (approximately 2 minutes)
- After 2 minutes, check for pulse for no more than 10 seconds

Circulation YES

If breathing is adequate give oxygen via nonrebreathing mask: place in recovery position
- If breathing is inadequate: ventilate once every 5 to 6 seconds
- Check for pulse

Circulation YES

Support ventilations
- Recheck pulse every 2 minutes

Circulation NO

Reanalyze and shock if indicated.
After AED completes shock
- Begin 5 cycles of CPR (approximately 2 minutes)

Circulation NO

If no shock advised, resume CPR

Shock if indicated and repeat last steps
Note: additional shock sequences are by local protocol

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Emergency Medical Care for Cardiac Arrest (4 of 7)

• Begin chest compressions and attach AED as soon as available with witnessed cardiac arrests.

• Follow local protocol for patient care after AED use.
  – After AED protocol is completed, one of the following is likely:
    • Pulse regained
    • No pulse regained and no shock advised
    • No pulse regained and shock advised
Emergency Medical Care for Cardiac Arrest (5 of 7)

• Wait for ALS, and continue shocks and CPR on scene.

• If ALS is not responding and protocols agree, begin transport when:
  – The patient regains a pulse.
  – 6 to 9 shocks are delivered.
  – AED gives three consecutive messages (every 2 min of CPR) advising no shock.
• Cardiac arrest during transport:
  – Stop the vehicle.
  – Begin CPR if AED is not immediately available
  – Call for ALS support.
  – Analyze rhythm.
  – Deliver shock, if indicated, and resume CPR
  – Continue resuscitation per local protocol.
Emergency Medical Care for Cardiac Arrest (7 of 7)

• Coordination with ALS personnel
  – If AED available, do not wait for ALS.
  – Notify ALS of cardiac arrest.
  – Do not delay defibrillation.
  – Follow local protocols for coordination.
Management of Return of Spontaneous Circulation

• Monitor for respirations.
• Provide oxygen via BVM at 10 to 12 breaths/min.
• Maintain oxygen saturation between 95% and 99%.
• Assess blood pressure.
• See if patient can follow simple commands.
• Immediately begin transport if ALS is not en route per local protocol.
1. All of the following are common signs and symptoms of cardiac ischemia, EXCEPT:
   A. headache.
   B. chest pressure.
   C. shortness of breath.
   D. anxiety or restlessness.
Answer: A

Rationale: Cardiac ischemia occurs when the heart’s demand for oxygen exceeds the available supply. Common signs and symptoms of cardiac ischemia include chest pain or discomfort, shortness of breath (dyspnea), and anxiety or restlessness. Headache is not a common symptom of cardiac ischemia.
1. All of the following are common signs and symptoms of cardiac ischemia, EXCEPT:

A. headache.
   **Rationale:** Correct answer

B. chest pressure.
   **Rationale:** Chest pressure is a definite symptom of a cardiac event.
1. All of the following are common signs and symptoms of cardiac ischemia, EXCEPT:

   C. shortness of breath.
   **Rationale:** This is a response to decreased cardiac output and hypoxia.

   D. anxiety or restlessness.
   **Rationale:** This is caused by a fear of death and is a result of hypoxia, decreased cardiac output, and ischemia.
2. While palpating the radial pulse of a 56-year-old man with chest pain, you note that the pulse rate is 86 beats/min and irregular. This indicates:

A. pain.
B. fear.
C. anxiety.
D. dysrhythmia.
Answer: D

Rationale: An irregular pulse in a patient with a cardiac problem suggests dysrhythmia — an abnormality in the heart’s electrical conduction system. Patients with signs of cardiac compromise, who have an irregular pulse, must be monitored closely for cardiac arrest.
2. While palpating the radial pulse of a 56-year-old man with chest pain, you note that the pulse rate is 86 beats/min and irregular. This indicates:

A. pain.
   **Rationale:** Pain could be a result or symptom of cardiac ischemia.

B. fear.
   **Rationale:** Fear of impending death is usually the psychological result of having chest pain.
2. While palpating the radial pulse of a 56-year-old man with chest pain, you note that the pulse rate is 86 beats/min and irregular. This indicates:

C. anxiety.
   **Rationale:** Anxiety is also a symptom of a cardiac event.

D. dysrhythmia.
   **Rationale:** Correct answer
3. A 56-year-old man has an acute myocardial infarction. Which of the following blood vessels became blocked and led to his condition?
   
   A. Coronary veins
   B. Coronary arteries
   C. Pulmonary veins
   D. Pulmonary arteries
Answer: B

Rationale: The coronary arteries, which branch off the aorta, supply the myocardium (heart muscle) with oxygen-rich blood. Occlusion of one or more of these arteries results in a cessation of oxygenated blood beyond the area of occlusion and results in acute myocardial infarction (AMI).
3. A 56-year-old man has an acute myocardial infarction. Which of the following blood vessels became blocked and led to his condition?

A. Coronary veins  
Rationale: Coronary veins do not carry oxygen and would not be the direct cause of an AMI.

B. Coronary arteries  
Rationale: Correct answer
3. A 56-year-old man has an acute myocardial infarction. Which of the following blood vessels became blocked and led to his condition?

C. Pulmonary veins
   **Rationale:** Pulmonary veins are the primary blood supply to the lungs and not the heart.

D. Pulmonary arteries
   **Rationale:** Pulmonary arteries are the route of blood return to the left atrium from the lungs. An obstruction would not cause an AMI.
Review

4. Major controllable risk factors for an AMI include:
   A. older age.
   B. family history.
   C. cigarette smoking.
   D. male sex.
Answer: C

Rationale: Smoking is a major controllable risk factor for any cardiovascular disease.
4. A major controllable risk factor for an AMI includes:

A. older age.  
   **Rationale:** This is an uncontrollable risk factor.

B. family history.  
   **Rationale:** This is an uncontrollable risk factor.
4. A major controllable risk factor for an AMI includes:

C. cigarette smoking.  
   **Rationale:** Correct answer.

D. male sex.  
   **Rationale:** This is an uncontrollable risk factor.
5. A patient with cardiac arrest secondary to ventricular fibrillation has the greatest chance for survival if:

A. CPR is initiated within 10 minutes.
B. oxygen and rapid transport are provided.
C. defibrillation is provided within 2 minutes.
D. paramedics arrive at the scene within 5 minutes.
Answer: C

Rationale: Survival from cardiac arrest secondary to ventricular fibrillation is highest if CPR is provided immediately and defibrillation is provided within 2 minutes of the patient’s cardiac arrest. Early high-quality CPR and defibrillation are the two most important factors that influence survival from cardiac arrest.
5. A patient with cardiac arrest secondary to ventricular fibrillation has the greatest chance for survival if:

A. CPR is initiated within 10 minutes.  
**Rationale:** CPR needs to be initiated immediately.

B. oxygen and rapid transport are provided.  
**Rationale:** Oxygen therapy and transport are important parts of resuscitation, but CPR and early defibrillation afford the greatest chance of survivability.
5. A patient with cardiac arrest secondary to ventricular fibrillation has the greatest chance for survival if:

C. defibrillation is provided within 2 minutes.  
**Rationale:** Correct answer

D. paramedics arrive at the scene within 5 minutes.  
**Rationale:** Not necessarily; CPR and early defibrillation will provide the greatest chance of survivability.
6. A 59-year-old woman presents with chest pressure. She is conscious and alert, but her skin is cool, pale, and clammy. Your first step in providing care (treatment) should be:

A. apply the AED.
B. administer oxygen.
C. ask her if she takes nitroglycerin.
D. take a complete set of vital signs.
**Answer:** B

**Rationale:** Any patient with suspected cardiac compromise should be given oxygen as soon as possible. Obtaining vital signs and inquiring about the use of nitroglycerin are appropriate; however, you should administer oxygen first. The AED is only applied to patients in cardiac arrest.
6. A 59-year-old woman presents with chest pressure. She is conscious and alert, but her skin is cool, pale, and clammy. Your first step in providing care (treatment) should be:

A. apply the AED.  
**Rationale:** The AED is only applied to patients in cardiac arrest.

B. administer oxygen.  
**Rationale:** Correct answer
A 59-year-old woman presents with chest pressure. She is conscious and alert, but her skin is cool, pale, and clammy. Your first step in providing care (treatment) should be:

C. ask her if she takes nitroglycerin.  
**Rationale:** Inquiring about the use of nitroglycerin is appropriate, but not the first step.

D. take a complete set of vital signs.  
**Rationale:** Obtaining vital signs is important, but not the first step.
7. If a patient with an implanted pacemaker is in cardiac arrest, the EMT should:
   A. avoid defibrillation with the AED and transport at once.
   B. not apply the AED until he or she contacts medical control.
   C. place the AED pads away from the pacemaker.
   D. apply the AED pads directly over the implanted pacemaker.
Answer: C

Rationale: The only modification required for cardiac arrest patients with an implanted pacemaker is to ensure that the AED pads are away from the pacemaker. Placing the AED pads directly over the pacemaker will result in a less effective defibrillation and may damage the pacemaker.
7. If a patient with an implanted pacemaker is in cardiac arrest, the EMT should:

   A. avoid defibrillation with the AED and transport at once.
   **Rationale:** AEDs can be used with pacemakers, but avoid placing pads over pacemakers.

   B. not apply the AED until he or she contacts medical control.
   **Rationale:** EMTs are trained in the use of AEDs.
7. If a patient with an implanted pacemaker is in cardiac arrest, the EMT should:

C. place the AED away from the pacemaker.  
   **Rationale:** Correct answer

D. apply the AED pads directly over the implanted pacemaker.  
   **Rationale:** AEDs should not be placed over pacemakers.
8. The main advantage of the AED is:
   A. it provides quick delivery of a shock.
   B. it is easier than performing CPR.
   C. there is no need for ALS providers to be on scene.
   D. All of the above.
Answer: D

Rationale: The AED provides quick delivery of a shock, is easier to perform than CPR, and does not require ALS providers to operate it.
8. The main advantage of the AED is:

A. it provides quick delivery of a shock.  
**Rationale:** The AED provides quick delivery of a shock.

B. it is easier than performing CPR.  
**Rationale:** The AED is easier to perform than CPR.
8. The main advantage of the AED is:
   C. there is no need for ALS providers to be on scene.
   **Rationale:** ALS providers do not need to be on scene to put the AED to use.
   
   D. All of the above.
   **Rationale:** Correct answer.
9. After administering a nitroglycerin tablet to a patient, the EMT should:
   A. check the expiration date of the nitroglycerin.
   B. reassess the patient’s blood pressure within 5 minutes.
   C. instruct the patient to chew the tablet until it is dissolved.
   D. ensure that the nitroglycerin is prescribed to the patient.
**Answer:** B

**Rationale:** Nitroglycerin is a vasodilator and can lower the patient’s BP; therefore, you should reassess the patient’s BP within 5 minutes after giving nitroglycerin. Instruct the patient to allow the nitroglycerin to dissolve under his or her tongue; it should not be chewed. You should check the drug’s expiration date and ensure that it is prescribed to the patient before administering it.
9. After administering a nitroglycerin tablet to a patient, the EMT should:

A. check the expiration date of the nitroglycerin.  
   **Rationale:** This is checked before medication administration.

B. reassess the patient’s blood pressure within 5 minutes.  
   **Rationale:** Correct answer
9. After administering a nitroglycerin tablet to a patient, the EMT should:

C. instruct the patient to chew the tablet until it is dissolved.
   **Rationale:** The tablet is placed under the patient’s tongue and allowed to dissolve.

D. ensure that the nitroglycerin is prescribed to the patient.
   **Rationale:** This is checked before medication administration.
10. Nitroglycerin is contraindicated in patients:
   A. with a systolic blood pressure less than 100 mm Hg.
   B. with chest pain of greater than 30 minutes duration.
   C. who are currently taking antibiotics for an infection.
   D. who are younger than 40 years of age and have diabetes.
Answer: A

Rationale: Nitroglycerin is a vasodilator and may cause a drop in BP; therefore, it is contraindicated in patients with a systolic BP of less than 100 mm Hg and in patients who have taken erectile dysfunction (ED) drugs within the past 24 to 48 hours. ED drugs are also vasodilators; if given in combination with nitroglycerin, severe hypotension may occur.
10. Nitroglycerin is contraindicated in patients:

A. with a systolic blood pressure less than 100 mm Hg.
   **Rationale:** Correct answer

B. with chest pain of greater than 30 minutes duration.
   **Rationale:** Cardiac chest pain is the primary indication for the use of nitroglycerin.
10. Nitroglycerin is contraindicated in patients:
   
   C. who are currently taking antibiotics for an infection.

   **Rationale:** Antibiotics are not a contraindication for nitroglycerin use. Prior adverse reactions to the drug and the use of other nitrates would be a contraindication.

   D. who are younger than 40 years of age and have diabetes.

   **Rationale:** While the patient’s age must be considered, it is not a contraindication.