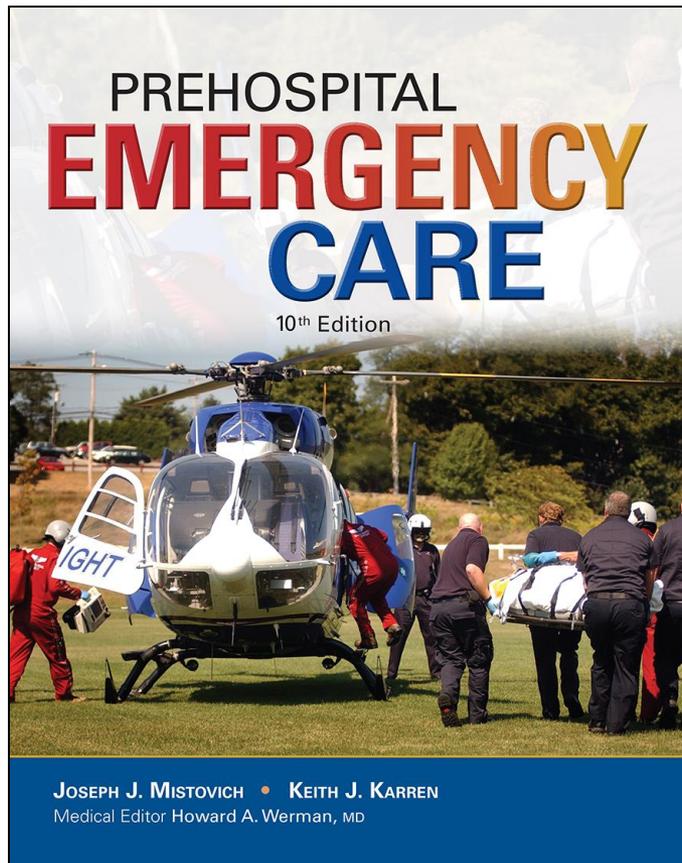


PREHOSPITAL EMERGENCY CARE

TENTH EDITION



CHAPTER 17

Cardiovascular Emergencies

Learning Readiness

- EMS Education Standards, text p. 489

Learning Readiness Objectives

- Please refer to page 489 of your text to view the objectives for this chapter.

Learning Readiness

Key Terms

- Please refer to page 490 of your text to view the key terms for this chapter.

Setting the Stage

- Overview of Lesson Topics
 - Cardiovascular Anatomy and Physiology
 - Cardiac Compromise and Acute Coronary Syndrome
 - Nitroglycerin
 - Age-Related Variations
 - Assessment and Care

Case Study Introduction

EMTs Ella Bray and Lisa Mullins are caring for Bart Frey, a 62-year-old man with a history of angina. Mr. Frey experienced an onset of a "heavy pressure" in the center of his chest, radiating to his left shoulder, and accompanied by profuse sweating. Ella's general impression is of an alert, but anxious, patient who appears pale and diaphoretic and whose facial expression indicates distress.

Case Study

- What is the underlying process that leads to angina?
- Is the patient's presentation consistent with angina, or do you suspect something else?
- What additional information do Ella and Lisa need as they begin patient care?

Introduction

- Heart disease is America's number one killer.
- Heart disease can lead to chest discomfort or cardiac arrest.
- Because of the potential consequences, EMTs treat all patients with signs and symptoms of cardiac compromise as a cardiac emergency.

Circulatory System Anatomy and Physiology

- The circulatory (cardiovascular) system has three major components.
 - Heart
 - Blood vessels
 - Blood

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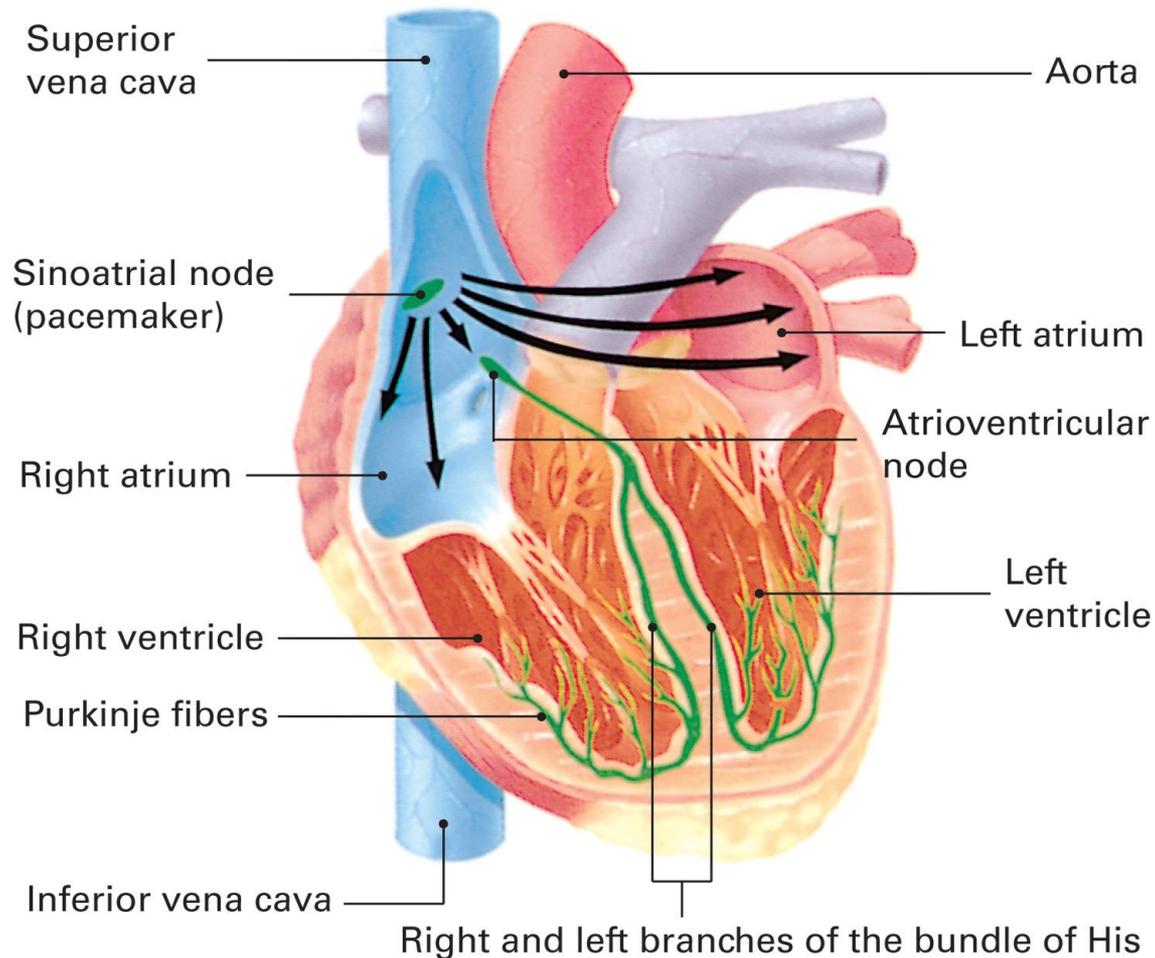
Circulatory System Anatomy and Physiology

- The cardiac conduction system
 - Generates electrical impulses that stimulate contraction of muscle cells
 - Pacemaker sites
 - Sinoatrial node
 - Atrioventricular node
 - Purkinje fibers

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The cardiac conduction system.

THE CONDUCTION SYSTEM



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Circulatory System Anatomy and Physiology

- The heart has the property of automaticity, but heart rate can be influenced by the sympathetic and parasympathetic nervous systems.

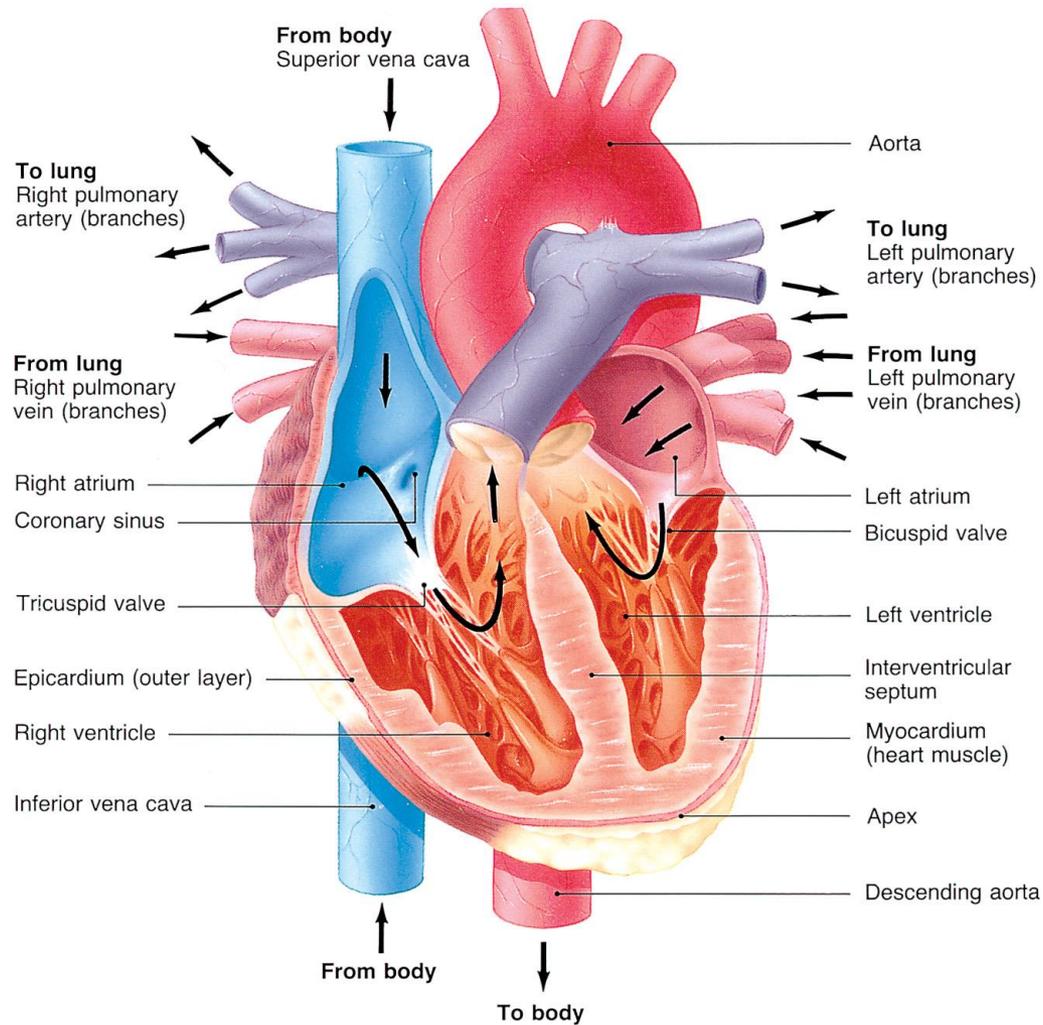
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Circulatory System Anatomy and Physiology

- The heart
 - Pumps blood throughout the body
 - The left ventricle must overcome the pressure in the aorta to eject blood.
 - Excessive pressure in the aorta over time can lead to heart failure with pulmonary edema.

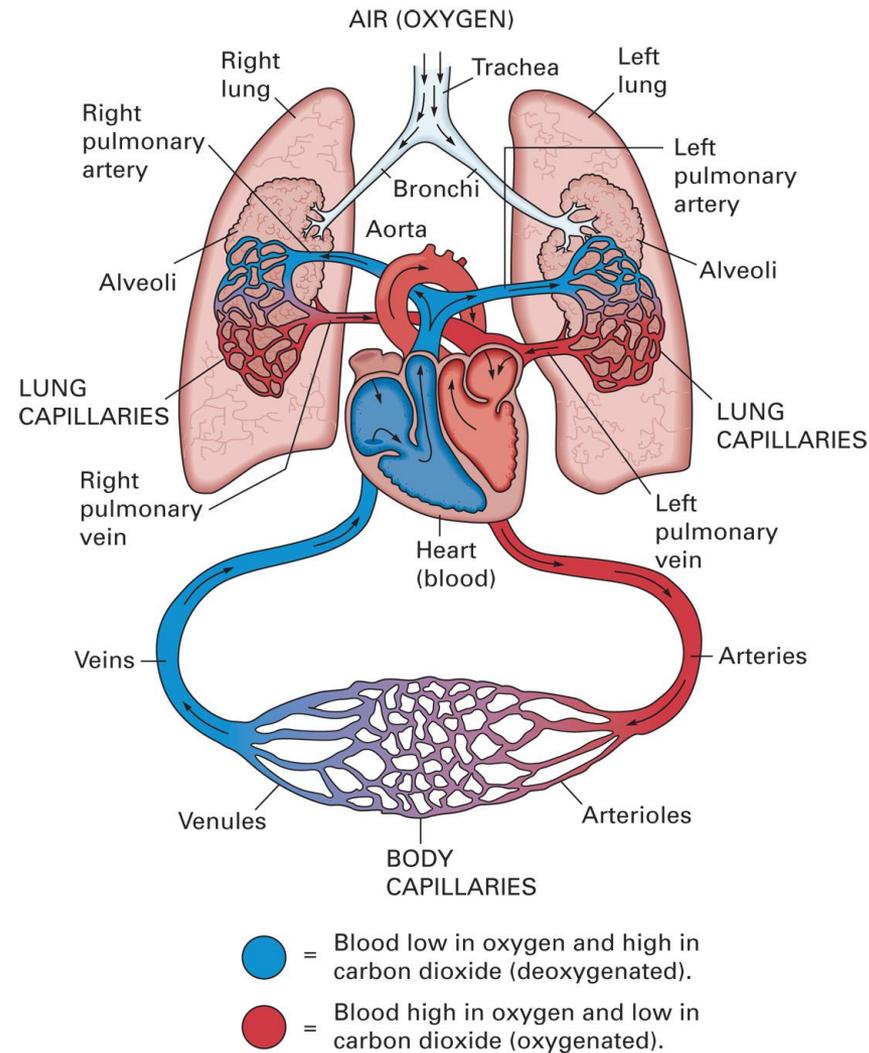
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The heart.



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Circulation of blood through the cardiovascular system.



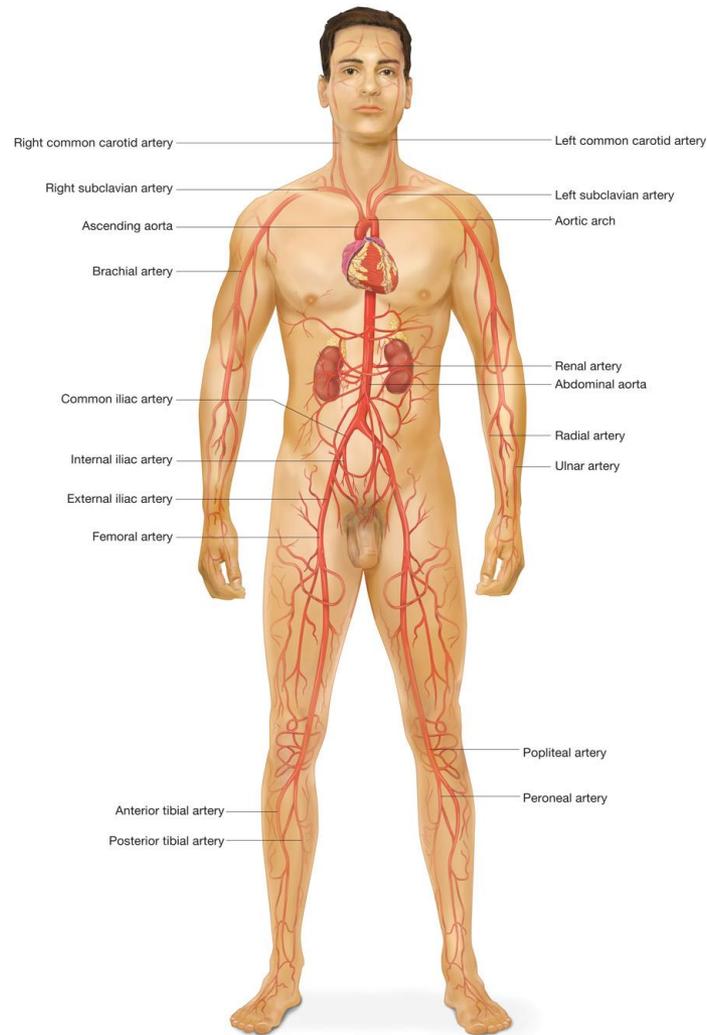
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Circulatory System Anatomy and Physiology

- The blood vessels
 - Arteries
 - Arterioles
 - Capillaries
 - Venules
 - Veins

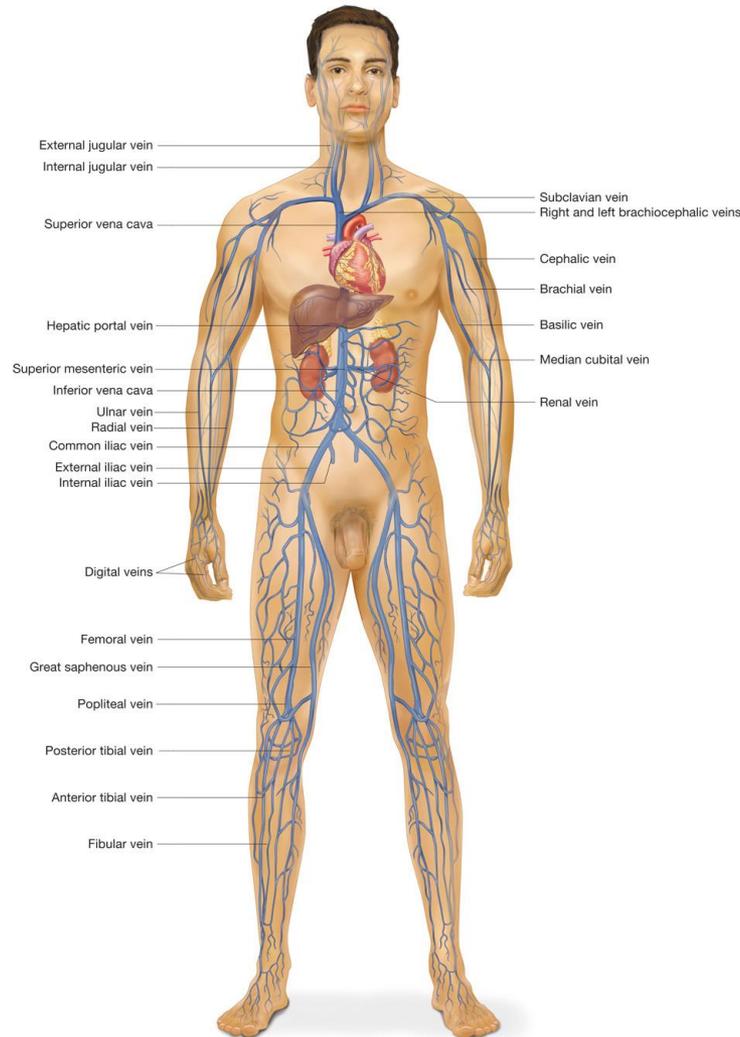
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Major arteries.



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Major veins.



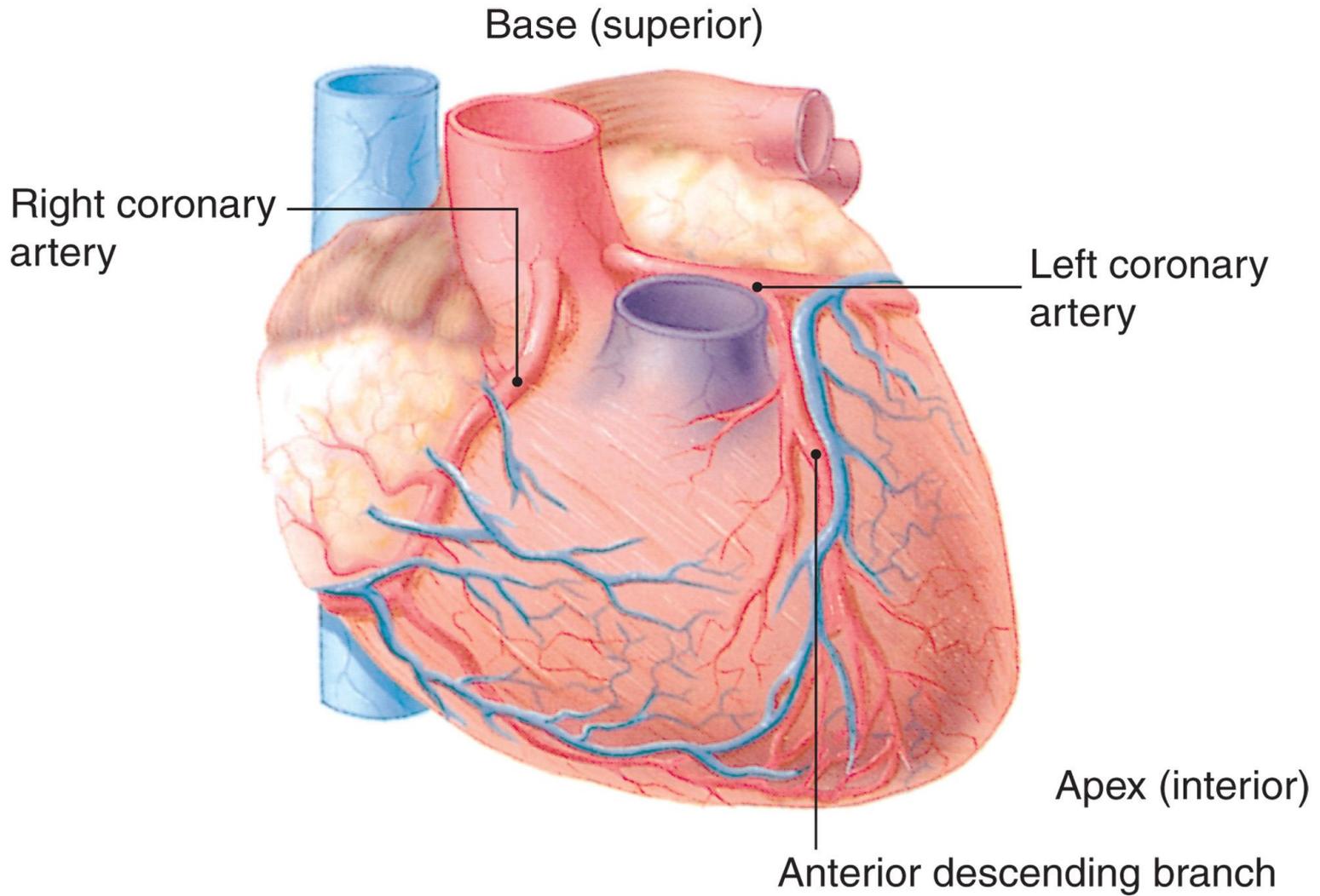
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Circulatory System Anatomy and Physiology

- The heart muscle is perfused by the coronary arteries.
- Occlusion of the coronary arteries deprives the muscle of oxygen.
- Heart attack, heart failure, and abnormal cardiac rhythms may occur.

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The coronary arteries.



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Circulatory System Anatomy and Physiology

- The blood consists of:
 - Red blood cells
 - White blood cells
 - Platelets
 - Plasma

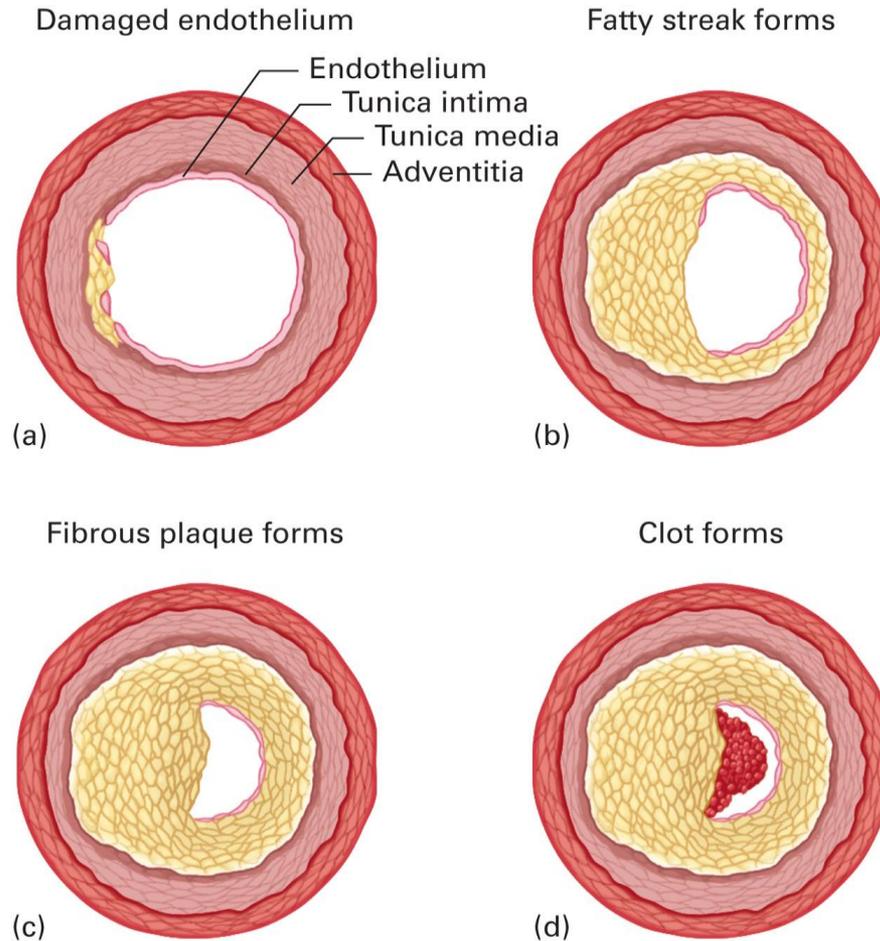
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Circulatory System Anatomy and Physiology

- Platelets play a role in cardiac emergencies through their role in blood clotting.
- Platelets, thrombin, and fibrin are components of clots.
- A thrombus may form at the site of a plaque in a coronary artery.

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The process of artery occlusion (atherosclerosis): (a) The endothelium (inner wall) of the artery is damaged as a result of smoking, diabetes, high blood pressure, high blood cholesterol, or other causes. (b) Fatty streaks begin to form in the damaged vessel walls. (c) Fibrous plaque forms, causing further vessel damage and progressive resistance to blood flow. (d) The plaque deposits begin to ulcerate or rupture, and platelets aggregate and adhere to the surface of the ruptured plaque, forming clots that may nearly or totally block the artery.



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Circulatory System Anatomy and Physiology

- Cardiac contraction
 - Electrical impulse is generated in the SA node and travels first to the atria, causing atrial contraction, then to the ventricles, causing ventricular contraction, or systole.

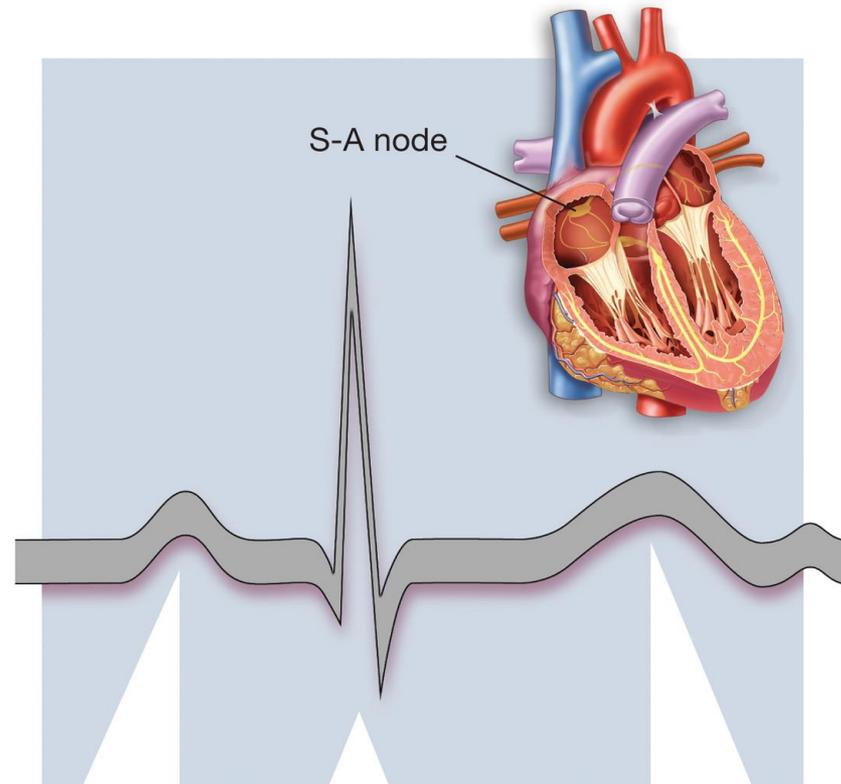
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Circulatory System Anatomy and Physiology

- The electrocardiogram (ECG)
 - Graphic representation of the heart's electrical activity
 - Electrical activity includes depolarization and repolarization.
 - The electrical activity is detected on the skin's surface by electrodes.

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An ECG tracing of normal sinus rhythm.



P wave

corresponds to
contraction of
the atria

QRS complex

correlates
to ventricles
contracting

T wave

represents
preparation for
next series of
complexes

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Circulatory System Anatomy and Physiology

- Hypoxia or damage to the electrical conduction system can cause improper functioning of the heart.
- Uncoordinated firing of ventricular impulses can lead to PVCs, ventricular tachycardia, or ventricular fibrillation.

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Circulatory System Anatomy and Physiology

- Blood pressure
 - Systolic blood pressure is measured during contraction of the heart.
 - Diastolic blood pressure is measured during relaxation of the heart.
 - The degree of resistance of blood vessels affects blood pressure.

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Circulatory System Anatomy and Physiology

- Inadequate circulation
 - Results in hypoperfusion, or shock
 - Cells are deprived of oxygen, nutrients, and waste removal.
 - May result from hypovolemia, heart failure, or vasodilation

Cardiac Compromise and Acute Coronary Syndrome

- Cardiac-related emergencies are a significant problem.
- EMS plays a role in reducing the death rate associated with heart attacks.
- Time is critical; early recognition is key to effective treatment.

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Cardiac Compromise and Acute Coronary Syndrome

- Collectively, cardiac conditions are referred to as cardiac compromise.
- The sooner the patient receives treatment, the better the prognosis.

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Cardiac Compromise and Acute Coronary Syndrome

- Atherosclerosis is an inflammatory disease that affects the arteries.
- The inflammatory process may eventually lead to the development of a thrombus and occlusion of the vessel.
- Atherosclerosis of the coronary vessels is called coronary artery disease (CAD).

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Cardiac Compromise and Acute Coronary Syndrome

- Acute coronary syndrome includes unstable angina and myocardial infarction.
- Narrowed arteries lead to myocardial ischemia.
- The typical response to myocardial ischemia is chest discomfort.

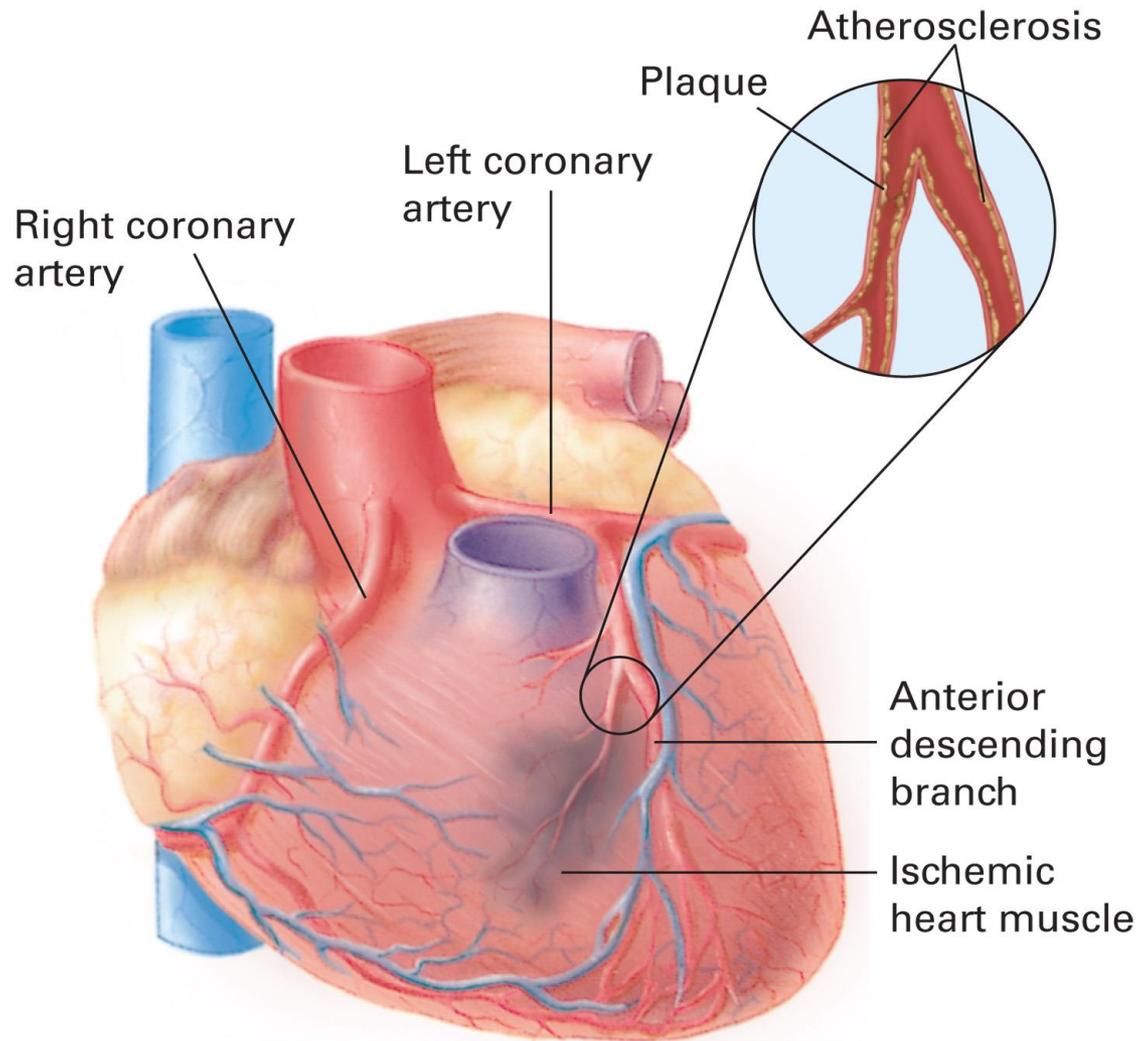
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Cardiac Compromise and Acute Coronary Syndrome

- Angina pectoris results from reduced oxygen delivered to the myocardium.
- Results in chest discomfort
- Usually occurs during physical or emotional stress
- Generally relieved with rest and nitroglycerin

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Atherosclerotic plaque formation in the coronary arteries results in ischemia distal to the blockage, which causes angina (chest pain).



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Cardiac Compromise and Acute Coronary Syndrome

- When angina discomfort is prolonged and worsening, or occurs without exertion, it is called *unstable angina*.

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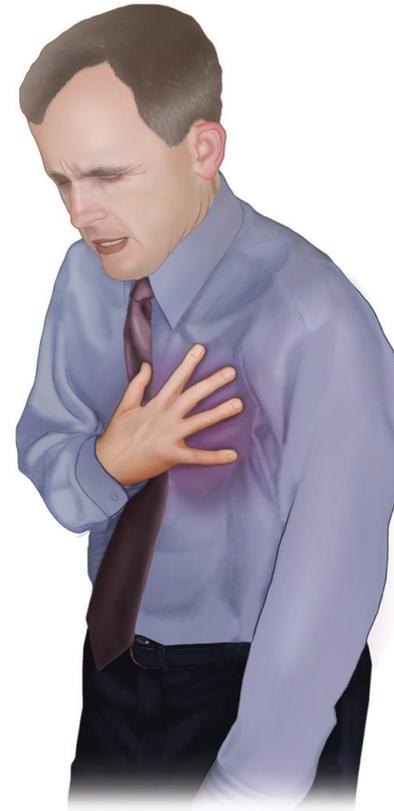
Both myocardial infarction and less serious angina can present symptoms of severe chest pain. Treat all cases of chest pain as cardiac emergencies.

DISTINGUISHING ANGINA PECTORIS FROM MYOCARDIAL INFARCTION

Angina Pectoris

Myocardial Infarction

Location of Discomfort	Substernal or across chest	Same
Radiation of Discomfort	Neck, jaw, arms, back, shoulders	Same
Nature of Discomfort	Dull or heavy discomfort with a pressure or squeezing sensation	Same, but maybe more intense
Duration	Usually 2 to 15 minutes, subsides after activity stops	Lasts longer than 10 minutes
Other symptoms	Usually none	Perspiration, pale gray color, nausea, weakness, dizziness, lightheadedness
Precipitating Factors	Extremes in weather, exertion, stress, meals	Often none
Factors Giving Relief	Stopping physical activity, reducing stress, nitroglycerin	Nitroglycerin may give incomplete or no relief



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Cardiac Compromise and Acute Coronary Syndrome

- Women, diabetics, and the elderly may not have a typical presentation of angina.
- Discomfort is more diffuse, or does not occur.
- Patient may complain of shortness of breath, fainting, weakness, or lightheadedness.

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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care for angina
 - Manage airway and breathing.
 - Supplemental oxygen at 2 to 4 lpm if the SpO₂ is <94%, or there are signs and symptoms of dyspnea, hypoxemia, or heart failure (2010 AHA Guidelines)

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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care for angina
 - Assist the patient with nitroglycerin if his systolic BP is >90 mmHg.
 - If protocols allow, administer 160 to 325 mg aspirin.

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Cardiac Compromise and Acute Coronary Syndrome

- Acute myocardial infarction
 - Typically occurs when a plaque ruptures and a thrombus forms
 - Within 20 to 30 minutes of inadequate perfusion, heart muscle begins to die.
 - Ischemia may lead to dysrhythmias and sudden cardiac death.

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Cardiac Compromise and Acute Coronary Syndrome

- Acute myocardial infarction
 - Treatments are available to restore myocardial perfusion.
 - Success of treatments is time-dependent.

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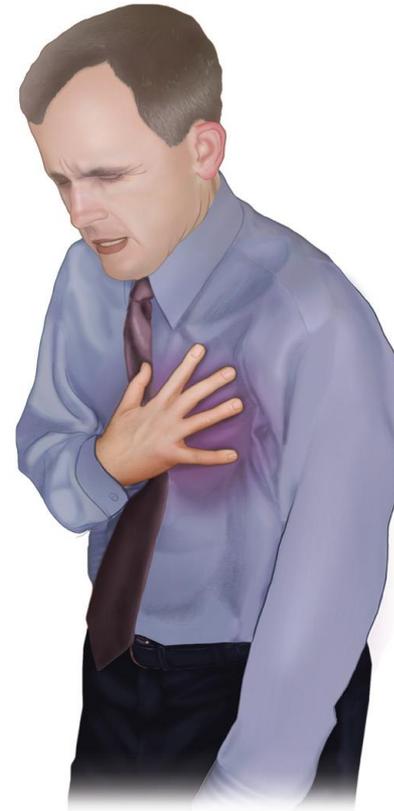
Both myocardial infarction and less serious angina can present symptoms of severe chest pain. Treat all cases of chest pain as cardiac emergencies.

DISTINGUISHING ANGINA PECTORIS FROM MYOCARDIAL INFARCTION

Angina Pectoris

Myocardial Infarction

Location of Discomfort	Substernal or across chest	Same
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Precipitating Factors	Extremes in weather, exertion, stress, meals	Often none
Factors Giving Relief	Stopping physical activity, reducing stress, nitroglycerin	Nitroglycerin may give incomplete or no relief



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Cardiac Compromise and Acute Coronary Syndrome

- Diabetics, the elderly, and women are more prone to atypical or silent myocardial infarction.
- They may complain only of shortness of breath, nausea, light-headedness, or weakness.

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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care
 - Recognize the potential for cardiac arrest and have the AED available.
 - Manage the airway and breathing.
 - Administer O₂ according to the 2010 AHA Guidelines.

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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care
 - If the patient has a prescription for nitroglycerin and a systolic BP >90 mmHg, administer nitroglycerin.
 - One tablet every 3 to 5 minutes, up to 3 tablets
 - Be sure the systolic BP remains >90 mmHg.
 - Administer 160 to 325 mg aspirin.

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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care
 - Notify the receiving facility early.
 - Request ALS, if available.

Case Study

Ella obtains a history from Mr. Frey as Lisa conducts a focused physical exam and takes baseline vital signs. Mr. Frey's discomfort came on 20 minutes ago while he was riding a stationary bike, but it was not relieved with rest or after taking a nitroglycerin tablet. He rates the discomfort a 7 on a scale from 1 to 10, and says the sensation is worse than he normally has with angina.

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Case Study

His vital signs are: pulse 80, strong, and regular; BP 132/84; respirations 16; SpO₂ 99%.

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Case Study

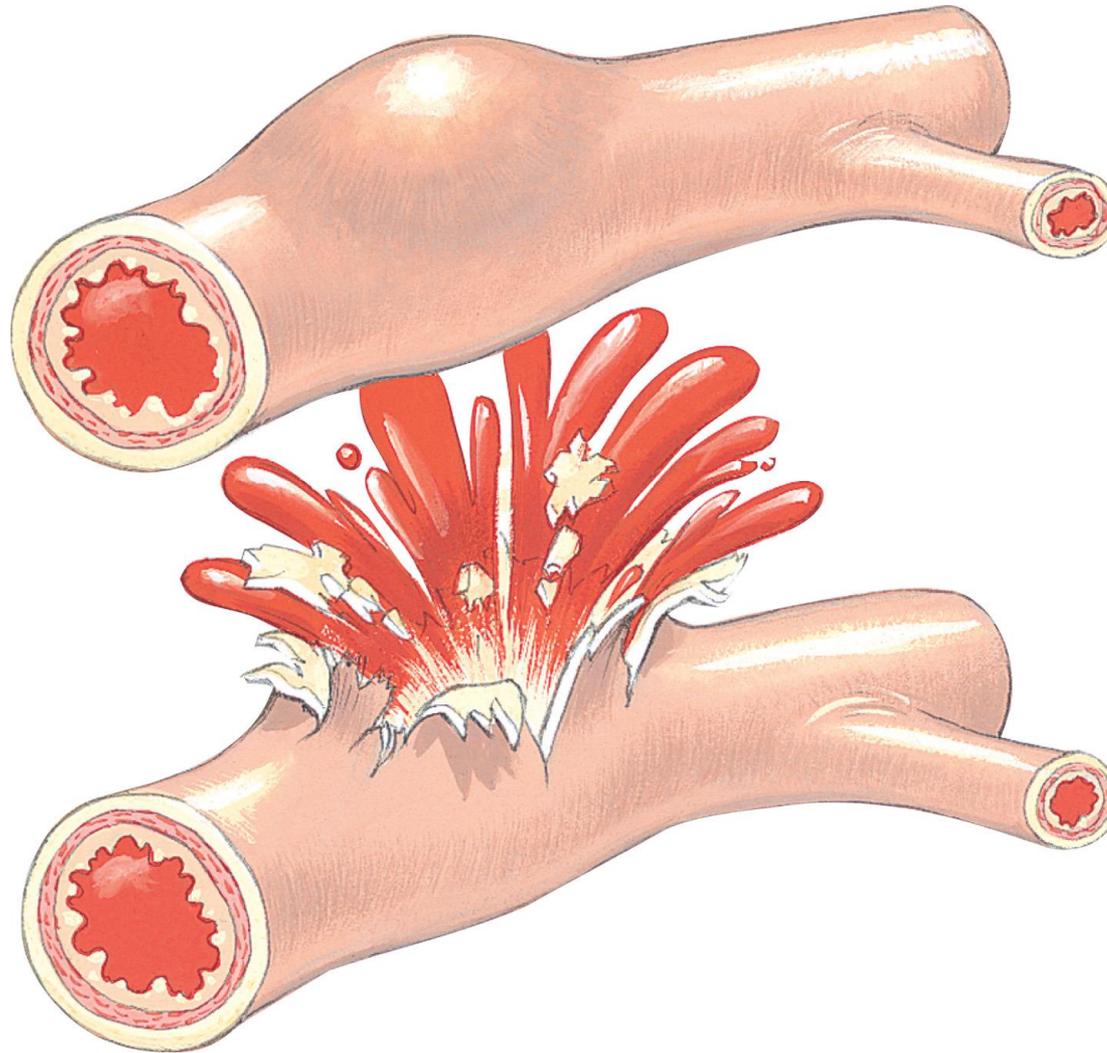
- What treatment should be implemented for this patient?
- What additional information will be helpful for the receiving hospital to know?

Cardiac Compromise and Acute Coronary Syndrome

- Aortic aneurysm
 - A weakened area of the aortic wall dilates.
 - Rupture may occur with rapid, fatal internal bleeding.
 - Often occurs in the abdominal region

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Aortic aneurysm leading to aortic rupture.



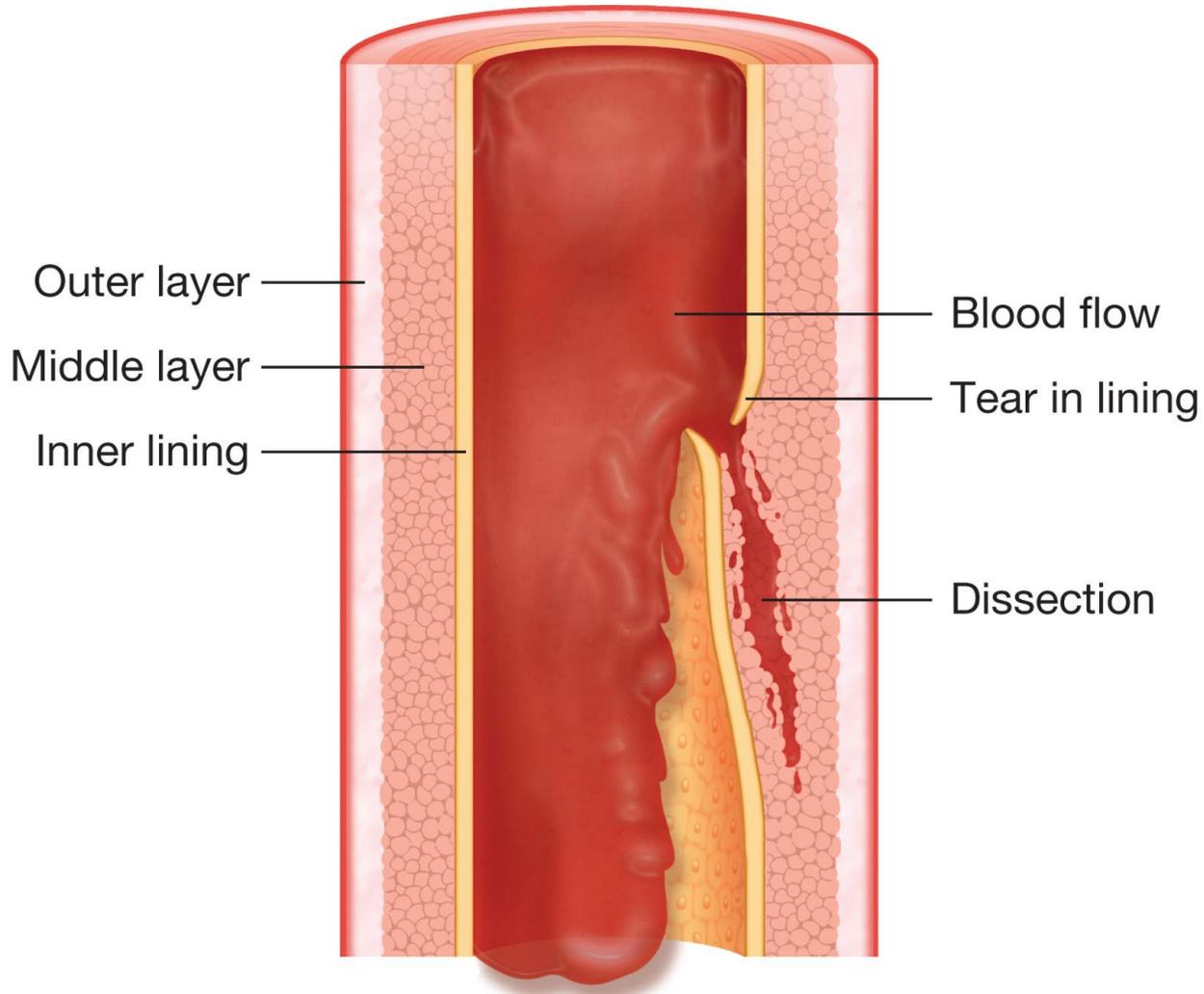
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Cardiac Compromise and Acute Coronary Syndrome

- Aortic dissection
 - Blood enters a tear in the inner lining of the aorta and separates the layers of the aortic wall.
 - Often occurs in the thoracic region
 - Pain is severe, sharp, tearing in nature; often experienced in back, flank, or arm.

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Aortic dissection.



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Cardiac Compromise and Acute Coronary Syndrome

- Aortic aneurysm or dissection emergency medical care
 - Conditions require immediate surgery.
 - Do not administer aspirin.

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Cardiac Compromise and Acute Coronary Syndrome

- ACS in females
 - Often occurs at older age than in males, with twice the likelihood of death
 - Signs and symptoms may be different than in males.

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Cardiac Compromise and Acute Coronary Syndrome

- ACS in females
 - "Classical" findings
 - Chest pain or discomfort
 - Respiratory distress
 - Nausea, vomiting
 - Diaphoresis

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- ACS in females
 - "Nonclassical" findings
 - Neck ache
 - Pressure in chest
 - Pains in back, breast, upper abdomen
 - Tingling in fingers
 - Unexplained fatigue or weight gain
 - Insomnia

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Cardiac Compromise and Acute Coronary Syndrome

- Dangers of too much oxygen in ACS
 - Too much oxygen can increase cell damage in certain situations.
 - The return of oxygen to ischemic tissues increases free radical production.
 - Give oxygen only when the SpO₂ is <94%.

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Cardiac Compromise and Acute Coronary Syndrome

- Heart failure
 - Occurs when the ventricle cannot adequately eject blood
 - May be caused by heart attack, heart valve problems, hypertension, pulmonary embolism, cardiac rhythm disturbances, and some drugs

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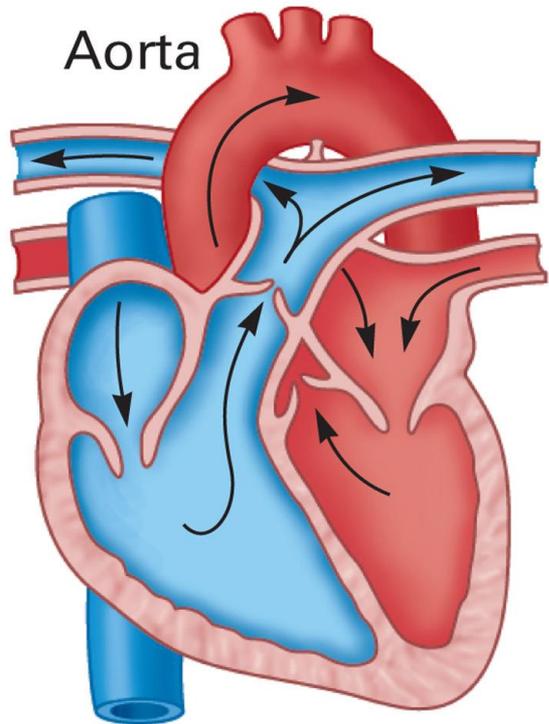
Cardiac Compromise and Acute Coronary Syndrome

- Heart failure
 - Left ventricular failure reduces blood flow and perfusion throughout the body.
 - Blood backs up behind the left atrium, increasing pressure in the pulmonary veins.
 - Pulmonary capillaries leak fluid, resulting in pulmonary edema and impaired gas exchange.

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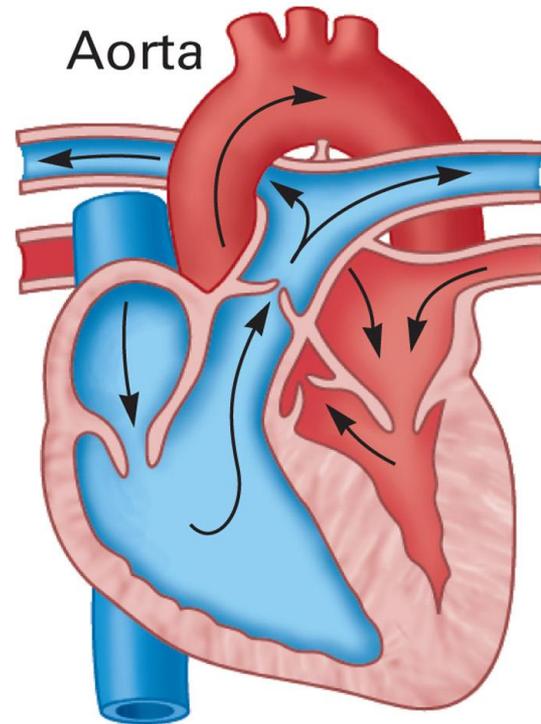
Left ventricular hypertrophy (enlargement of the heart muscle) compromises the ability of the left ventricle to pump adequately, causing a decrease in cardiac output and a decrease in blood pressure.

Normal cardiac output
Normal blood pressure



Normal heart

Decreased cardiac output
Decreased blood pressure



Left ventricular hypertrophy

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Heart failure
 - Right ventricular failure
 - May be caused by failure of left ventricle or COPD
 - Signs include peripheral edema, JVD, enlarged liver.

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Cardiogenic shock can occur with left or right ventricular failure.
 - Left ventricular failure
 - Decreased cardiac output
 - Decreased perfusion
 - Decreased systolic blood pressure
 - Altered mental status
 - Respiratory distress

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Cardiogenic shock can occur with left or right ventricular failure.
 - Right ventricular failure
 - Decreased lung perfusion
 - Hypoxia and respiratory distress
 - JVD, peripheral edema
 - Decreased blood return to left ventricle, decreased cardiac output

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TABLE 17-1 Findings in Right and Left Heart Failure

	Pure Right Heart Failure	Pure Left Heart Failure
<i>Systolic blood pressure</i>	Low to normal	Normal to high
<i>Breath sounds</i>	Clear sounds	Inspiratory rales
<i>Peripheral edema</i>	JVD and peripheral edema	No JVD or peripheral edema

continued on next slide

Signs and symptoms of congestive heart failure.

SIGNS AND SYMPTOMS OF CONGESTIVE HEART FAILURE

Mild to severe confusion.

Cyanosis.

Tachypnea.

May cough up pink sputum.

Low, normal, or high
blood pressure.

Rapid heart rate.

A desire to sit upright.



Anxiety.

Distended neck veins. (Late)

Crackles.

Shortness of breath (dyspnea).

Pale, cool, clammy skin.

Abdominal distention.

Pedal and lower
extremity edema.

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Edema to the lower extremities is a classic sign of congestive heart failure.



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Jugular vein distention is a late sign of congestive heart failure. (© David Effron, MD)



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Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care for heart failure
 - Treat as for AMI.
 - Positive pressure ventilation may be required.
 - Supplemental oxygen according to 2010 AHA Guidelines
 - Consider the need for CPAP.

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Cardiac Compromise and Acute Coronary Syndrome

- Hypertensive emergencies
 - Systolic BP >160 mmHg and/or diastolic BP >94 mmHg
 - In assessment, consider the patient's usual blood pressure.

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Cardiac Compromise and Acute Coronary Syndrome

- Signs and symptoms
 - Strong, bounding pulse
 - Warm skin, dry or moist
 - Severe headache
 - Ringing in the ears
 - Nausea or vomiting
 - Elevated blood pressure

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Signs and symptoms
 - Respiratory distress
 - Chest pain
 - Seizures
 - Focal neural deficits
 - Organ dysfunction
 - Nosebleed

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Emergency medical care
 - Support airway, breathing, oxygenation, and circulation as needed.
 - Place in position of comfort.
 - Consider requesting ALS.

continued on next slide

Cardiac Compromise and Acute Coronary Syndrome

- Cardiac arrest
 - The heart is pumping inadequately or not at all and no pulses can be felt.
 - May be caused by acute coronary syndrome or other causes

Nitroglycerin

- Potent vasodilator that increases coronary blood flow and reduces the workload of the heart
- EMTs may assist a patient with nitroglycerin tablets or spray.

continued on next slide

Nitroglycerin

- Systolic BP must remain >90 mmHg or no more than 30 mmHg less than the baseline to administer nitroglycerin.
- Nitroglycerin must not be given to patients who have taken a drug for erectile dysfunction within 24 hours (longer for some drugs).

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Nitroglycerin

- Do not administer if the heart rate is <50 or >100 .
- Up to three doses, total, may be administered in three to five minute intervals if pain is not relieved.

Click on the condition that would make a patient with chest discomfort ineligible to receive nitroglycerin.

A. Age over 65 years

B. Heart rate of 60

C. Viagra taken one week ago

D. Systolic BP of 88 mmHg

EMT SKILLS 17-1

Assisting a Patient with Prescribed Nitroglycerin

Have the patient sit or lie down. Assess blood pressure. Systolic pressure must be greater than 90 mmHg.



Obtain an order from medical direction to administer the nitroglycerin.



Check the medication to ensure that it is prescribed to the patient, it is the proper medication, and it has not expired.



Place the nitroglycerin tablet under the patient's tongue.



To administer nitroglycerin spray, depress the container and deliver one spray under the tongue.



Reassess blood pressure within 2 minutes of administering the nitroglycerin.



Age-Related Variations

- Pediatrics
 - Problems are usually due to congenital heart conditions, not ACS.
 - Cardiac arrest is usually due to airway compromise or respiratory failure.

TABLE 17-2 Special Considerations in Geriatric Cardiac Events

History of diabetes mellitus

A geriatric patient with diabetes has long-term damage to the nerve endings in the body. This causes the typical pain from an MI to be perceived poorly, if at all, by the diabetic patient. Therefore, the diabetic patient experiencing an MI may complain only of respiratory distress or dizziness when standing or even excessive weakness and dyspnea on exertion. It is important for the EMT to identify the patient with diabetes as potentially having an acute coronary event and to treat him appropriately. Contact ALS early, follow your local protocol, and ascertain if additional or alternative therapies are desired by medical direction.

History of trauma

If the geriatric patient is a trauma patient, there must be a high index of suspicion for cardiac involvement as well. Geriatric patients who are traumatized can slip quickly into cardiac arrest and do not respond well to typical interventions. Geriatric patients with head trauma, chest trauma, abdominal trauma, or extremity trauma with severe bleeding are especially susceptible to cardiac arrest.

History of asthma

If a patient with a history of asthma goes into cardiac arrest, the cause may be acute bronchoconstriction that led to hypoxemia, acidosis, and cardiac arrest. Until the bronchoconstriction is reversed, the patient will not regain a pulse or breathing. Early intercept or backup by an ALS unit will allow the administration of medications that may help reverse this condition.

History of COPD

Elderly patients commonly have some form of COPD (emphysema or chronic bronchitis). The arrest may have been caused by an exacerbation of the COPD, which led to hypoxemia, acidosis, and then arrest. ALS backup is needed during the resuscitation of this patient. Remember also that COPD disorders can weaken the lung tissue and cause the development of a pneumothorax and collapse of the lung. (This too may precipitate a cardiac arrest.) Be alert for the presence or the development of a pneumothorax during positive pressure ventilation, which may cause a bleb on the lung tissue to rupture.

Assessment and Care

- Consider dispatch information.
- Scene size-up

continued on next slide

Assessment and Care

- Primary assessment
 - Categorize as unresponsive/cardiac arrest or responsive in minor, moderate, or severe distress.
 - Begin CPR for cardiac arrest and apply the AED.
 - For responsive patients, assess airway, breathing, circulation, and oxygenation.

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Assessment and Care

- Secondary assessment
 - Obtain the history, use OPQRST.
 - Ask about contraindications to fibrinolytic therapy.
 - Anticipate that patients may downplay their symptoms.

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Assessment and Care

- Treat the following as cardiac compromise:
 - Patient with angina lasting >20 minutes
 - Recent onset of progressively worsening angina
 - Nocturnal angina

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Assessment and Care

- Treat the following as cardiac compromise:
 - Angina unrelieved by rest or three nitroglycerin tablets over 10 minutes
 - Chest discomfort lasting >5 to 10 minutes after rest

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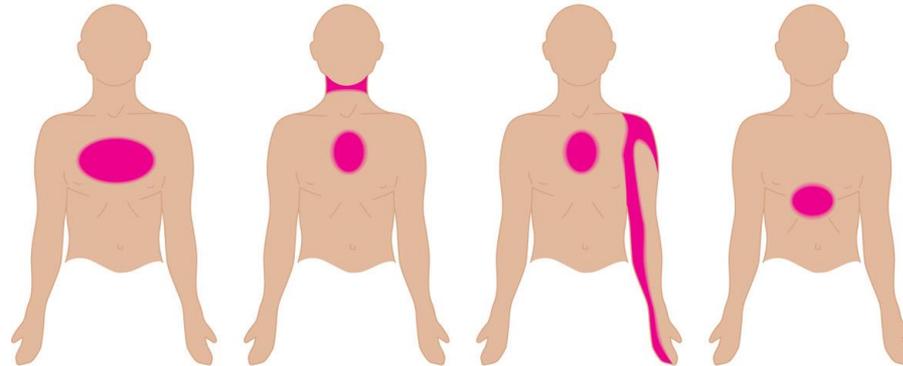
Assessment and Care

- Consider atypical presentations.
- Not all symptoms have to be present for ACS to be present.

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Typical locations and radiation of chest discomfort associated with cardiac emergencies.

EARLY SIGNS OF ACUTE CORONARY SYNDROME (HEART ATTACK)

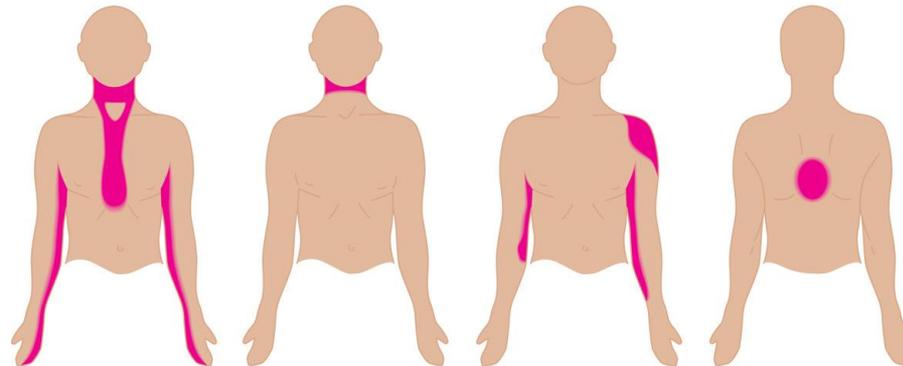


Just under sternum, midchest, or the entire upper chest.

Midchest, neck, and jaw.

Midchest and the shoulder and inside arms (more frequently the left).

Upper abdomen, often mistaken for indigestion.



Larger area of the chest, plus neck, jaw, and inside arms.

Jaw from ear to ear, in both sides of upper neck, and in lower center neck.

Shoulder (usually left) and inside arm to the waist, plus opposite arm, inside to the elbow.

Between the shoulder blades.

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Assessment and Care

- Physical exam and baseline vital signs
 - Pupils
 - Oral cavity
 - Neck
 - Chest
 - Upper and lower extremities
 - Posterior body
 - Vital signs

continued on next slide

Assessment and Care

- Signs and symptoms
 - Chest discomfort or pain, which may radiate; epigastric pain
 - Sudden onset of sweating
 - Cool, pale, skin
 - Difficulty breathing
 - Light-headedness or dizziness

continued on next slide

Assessment and Care

- Signs and symptoms
 - Anxiety or irritability
 - Feeling of impending doom
 - Abnormal pulse
 - Nausea or vomiting

continued on next slide

Assessment and Care

- Emergency medical care
 - Recognize cardiac arrest immediately.
 - Begin CPR with chest compressions.
 - AED

continued on next slide

Assessment and Care

- Emergency medical care
 - For responsive patients, provide reassurance and place patient in a position of comfort.
 - Apply oxygen according to 2010 AHA Guidelines.

continued on next slide

Assessment and Care

- Emergency medical care
 - Assist a patient who has prescribed nitroglycerin.
 - Administer aspirin according to protocol.
 - Call for ALS backup; initiate early transport.

continued on next slide

Assessment and Care

- Reassessment
 - Patients with ACS can deteriorate to cardiac arrest.
 - Closely reassess breathing and pulse.

Case Study Conclusion

As Lisa prepares the stretcher so that they can begin transport without delay, Ella assists Mr. Frey in taking an additional nitroglycerin tablet and, according to protocol, administers 325 mg aspirin. En route, Ella reassesses Mr. Frey's pain level and vital signs. With a BP of 128/80 and discomfort rated a 4 out of 10, Mr. Frey is a candidate for another dose of nitroglycerin. Ella advises the receiving hospital of Mr. Frey's condition.

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Case Study Conclusion

Upon arrival, a nurse performs a 12-lead ECG, and the physician begins his assessment and history. It is determined that Mr. Frey is having an AMI, and he is immediately prepared to receive fibrinolytic medications.

Lesson Summary

- Cardiovascular disease is a significant problem.
- Presentations can range from atypical symptoms to cardiac arrest.
- Time is of the utmost essence in treating ACS.

continued on next slide

Lesson Summary

- For cardiac arrest, remember the Chain of Survival.
- Oxygen, nitroglycerin, and aspirin are drugs the EMT may use in the treatment of ACS.