Course Pathophysiology

Unit V

Process of Pathology

Essential

Question How preventable is heart disease?

TEKS

§130.208(c) 4A, 4B, 4C, 4D

Prior Student Learning Basic Pathophysiology Lesson

Estimated time

4-5 hours

Rationale

The cardiovascular system is responsible for pumping blood through the body, transporting nutrients and oxygen to cells and removing waste products. Diseases of the cardiovascular system are a major cause of death at all ages.

Objectives

Upon completion of this lesson, the student will be able to

- Define and decipher common terms associated with the cardiovascular system
- Identify the basic anatomy of the cardiovascular system
- Investigate diseases and disorders of the cardiovascular system.

Engage

According to the American Heart Association, over 750,000 people die each year of cardiovascular disease. Heart attacks are occurring in younger patients each year. Have students discuss their lifestyle and list all the risk factors they personally have on paper. Next have students evaluate other risk factors that teenagers face today, and discuss ways to improve heart health.

Or

Have students login to Auscultation Assistant at

<u>http://cleartoauscultation.org/</u> to listen and compare normal and abnormal heart sounds to engage students in the lesson or you can continue to refer to the website after covering each pathology.

Key Points

POWER POINT – Cardiovascular Pathology

- I. General Information
 - A. Cardiovascular disease is the leading cause of death in the U.S.
 - B. More than 2,600 Americans die each day due to cardiovascular diseases
 - C. Over 57,000,000 people have some form of cardiovascular disease
- II. Overview of Anatomy
 - A. The heart is approximately the size of an adult fist
 - 1. Double pump
 - a. The right side pumps low oxygenated blood
 - b. The left side pumps oxygen rich blood
 - B. Pericardium the double membranous sac that surrounds the

heart

- 1. Pericardial fluid the fluid between the layers
- C. Three layers of the heart wall
 - 1. Epicardium outermost layer
 - 2. Myocardium middle muscular layer
 - 3. Endocardium innermost layer
- D. The four chambers
 - 1. Right and left atria (upper chambers)
 - 2. Right and left ventricles (lower chambers)
- E. Heart valves
 - 1. The right heart valves tricuspid, pulmonary
 - 2. The left heart valves mitral, aortic
- F. Great vessels
 - 1. The right heart vessels superior and inferior vena cavae, pulmonary artery
 - 2. The left heart vessels pulmonary veins, aorta
- G. Electrical stimulation causes the heart to contract rhythmically and pump blood
 - 1. **Sinoatrial (SA) node** where the cardiac electrical impulse begins (pacemaker)
 - 2. Atrioventricular (AV) node receives impulses from the SA node
 - 3. Bundle of HIS receives impulses from the AV node
 - 4. **Purkinje fibers** receive impulses from the bundle of HIS
- III. Heart disease in general
 - A. Some common signs and symptoms
 - 1. Angina
 - a. A crushing pressure
 - b. A feeling of constant indigestion
 - c. Radiating pain (down the arm—usually the left) and/or to the jaw
 - 2. Dyspnea especially climbing stairs
 - 3. Tachycardia
 - 4. Fatigue
 - 5. Cardiac palpitations
 - 6. Diaphoresis
 - 7. Edema in the extremities
 - 8. Nausea and/or vomiting
 - 9. Cyanosis
- IV. Common diagnostic tests for cardiovascular disease
 - A. Non-invasive procedures
 - 1. Auscultation use of a stethoscope to listen to blood flow
 - 2. **Doppler** study device placed over the arteries to magnify the sound of blood flow

- 3. Blood pressure screening use of sphygmomanometer to measure systolic and diastolic pressure
- 4. Electrocardiogram a procedure in which electrical impulses of heart are measured
- 5. Echocardiography a procedure that uses sound waves to produce pictures of the heart and great vessels
- B. Invasive procedures
 - 1. Cardiac **catheterization** a procedure where a catheter is placed into the heart via an artery or vein
 - a. Contrast media (radiopaque dye) is injected through the catheter into the great vessels, heart chambers, or coronary arteries to determine
 - i. Abnormalities of the valves and chambers
 - ii. **Patency** and abnormalities of the great vessels and coronary arteries
 - b. The procedure is performed under **fluoroscopy** to verify the correct catheter placement
 - c. As the contrast media is injected, x-rays are taken
 - Venipuncture blood drawn from the veins in order to test enzyme levels
 - a. After a **myocardial infarction** (MI), part of the heart muscle can die, at which time enzymes are released
 - b. Enzyme levels help determine the time and degree of the infarction
 - c. Common enzymes are creatinine phosphokinase (CPK) and lactic dehydrogenase (LDH)
- V. Common Diseases of the Cardiovascular System
 - A. Hypertension (HTN) a high blood pressure
 - 1. Chronic disease
 - 2. The leading cause of stroke and heart failure
 - 3. Normal BP = 120/80 mm Hg
 - a. The top number is **systolic**, which measures the pressure when ventricles contract
 - b. The bottom number is **diastolic**, which measures the pressure when ventricles relax
 - 4. Causes of hypertension
 - a. Heredity a higher incidence in certain families and ethnic groups
 - b. Diet high salt and fat intake increase the risk of hypertension
 - c. Age BP tends to rise with age
 - d. Obesity
 - 5. Effects of hypertension may take years to develop
 - 6. As a result of hypertension, the left ventricle works harder to pump blood

- a. Results in left ventricle **hypertrophy** (enlargement of the heart)
- b. Extra tissue does not have adequate blood supply can lead to heart failure
- 7. The result of long-term hypertension is referred to as hypertensive heart disease
- Hypertension also has adverse effects on vessels over a period of years vessels become sclerotic and lose elasticity – sclerotic vessels are more likely to form thrombi and rupture
- 9. Treatment of hypertension
 - a. For mild hypertension
 - i. Lifestyle changes
 - ii. Low-salt, low-fat diet
 - iii. Stress reducing exercise
 - iv. Smoking cessation
 - v. Weight reduction
 - b. For extremely high hypertension anti-hypertensive medications
- B. Arteriosclerosis a loss of elasticity and thickening of arterial walls
 - 1. The most common cause of arteriosclerosis is atherosclerosis
 - a. Atherosclerosis is a narrowing of vessel lumen
 - b. This condition is characterized by fatty deposits (**plaque**) in the walls of arteries
 - 2. Plaque can damage the artery and interrupt blood flow by
 - a. Damaging the inner lining of an artery by pushing into the endothelium (damage to the lining allows blood cells to stick to arterial walls and **occlude** lumen)
 - b. Causing an arterial wall to harden or lose elasticity (increases blood pressure and overworks the heart)
 - c. Ulcerating a vessel or breaking lose and forming an **embolus**
 - 3. Narrowing from plaque buildup leads to
 - a. High blood pressure
 - b. Slowing or stoppage of blood flow to tissues and organs
 - i. Organs can become ischemic and eventually die
 - ii. The increased pressure stretches hardened arteries, causing more artery damage
 - 4. Four major areas that are often effected by atherosclerosis
 - a. Coronary arteries arteries that feed the heart muscle damage leads to coronary artery disease (myocardial infarction)
 - b. Cerebral arteries arteries which feed the brain damage leads to cerebrovascular accidents (CVA), also known as strokes
 - c. Aorta the largest artery in body; distributes oxygenated blood to the body damage can lead to an aneurysm

- d. Peripheral arteries feed the extremities damage may lead to vascular problems in the arms and legs
- C. Peripheral Vascular Disease (PVD)
 - 1. Caused by plaque in the arteries that supply blood to the legs
 - Activity can lead to muscular cramping this condition of developing muscle cramps that are relieved with rest then increased with activity is called intermittent claudication
 - 3. Chronic occlusion
 - a. Generally related to a progressive narrowing of the femoral and popliteal arteries
 - b. The blood supply to the leg muscles is compromised
 - 4. Acute occlusion
 - a. Usually involves smaller arteries supplying blood to the feet and toes
 - b. Can lead to **necrosis** and **gangrene**
 - 5. Treatment of chronic PVD involves **endarterectomy** (opening the artery and cleaning it out) damaged arteries can also be bypassed with a graph
- D. Aneurysm
 - 1. A weakening of the arterial wall that allows the vessel to balloon and rupture
 - 2. Weakens due to
 - a. Atherosclerosis
 - b. A congenital defect
 - c. Injury
 - 3. Usually asymptomatic and often discovered during a physical examination or x-ray
 - 4. The most common area affected is the abdominal aorta
 - 5. Rupture of the aorta can cause massive hemorrhaging and even death
 - 6. The treatment is surgical resection and grafting
 - 7. Aneurysms can also occur in the left ventricle
- E. **Coronary Artery Disease** a narrowing of the arteries that supply blood to the heart
 - 1. The single leading cause of death in the U.S
 - 2. Commonly due to atherosclerosis
 - 3. This progressive narrowing leads to ischemia and oftentimes angina during exercise
 - a. Ischemia can cause heart muscle to die and form scar tissue
 - b. This scar tissue cannot function and causes an increased workload on the remaining heart muscle
 - 4. Occlusion of a coronary artery may develop slowly (as with progressive atherosclerosis) or develop suddenly from
 - a. Thrombus a blood clot attached to the vessel wall eventually gets so large it stops the flow of blood to tissue

- Embolus a clot or fatty deposit which breaks free from the vessel wall and travels in the circulatory system (eventually getting wedged in the vessel)
 - i. If an embolus occlusion occurs in the heart it is called a myocardial infarction (MI) or heart attack
 - ii. If an embolus occlusion occurs in the brain it is called a cerebrovascular accident (CVA) or stroke
 - iii. If an embolus occlusion occurs in vessels leading to the lungs it is called a pulmonary embolus
- 5. Collateral circulation
 - a. Small arteries that may develop during the course of progressive atherosclerosis
 - b. Assist with the transportation of oxygenated blood
- 6. Diagnosis
 - a. Patient history
 - b. Electrocardiogram (EKG; ECG)
 - c. Selective coronary angiogram
- 7. Treatment (aimed at opening blood vessels and restoring good flow to heart tissue)
 - a. Vasodilators
 - b. Angioplasty
 - c. Coronary stent(s)
 - d. Coronary artery bypass
- F. Cardiomyopathy (primary)
 - 1. Heart muscle becomes dilated enlarged and flabby
 - a. Unable to contract efficiently
 - b. Limits circulation
 - 2. Cause idiopathic
 - 3. Symptoms
 - a. fatigue
 - b. shortness of breath (SOB) when walking or climbing stairs
 - 4. Treatment
 - a. Rest
 - b. Medications
 - c. Heart transplant
 - 5. Secondary cardiomyopathy due to chronic hypertension or coronary artery disease
 - 6. Hypertrophic cardiomyopathy
 - a. Heart muscle is enlarged and thick
 - b. An inherited disease
- G. Carditis
 - 1. A general term that describes inflammation of the heart
 - 2. Different forms of inflammation
 - a. Pericarditis inflammation of the outer membrane of the heart
 - b. Myocarditis inflammation of the heart muscle

- c. Endocarditis inflammation of the inner lining of the heart
- 3. Causes
 - a. Bacteria
 - b. Viruses
 - c. Rheumatic fever
 - d. Secondary infection (respiratory system, urinary tract, gums and teeth)
 - e. Sometimes the cause is unknown
- 4. Treatment
 - a. Bed rest
 - b. Antibiotics
 - c. Analgesic
- H. Valvular heart disease (related to malfunction of the heart valves)
 - 1. Malfunctions due to
 - a. Stenotic valve
 - b. Inability to close properly
 - i. Scarring from infection
 - ii. Prolapsed valve
 - 2. Complications of valve defects
 - a. Tendency to form clots
 - b. Overworks the heart and can lead to congestive heart failure
 - c. Bacterial endocarditis
 - 3. Common causes of defective valves
 - a. Congenital
 - b. Rheumatic fever
 - c. Endocarditis
- I. Arrhythmias
 - 1. Disturbances of the heart's conduction system, leading to abnormal heart rhythm
 - 2. Heartbeats that are too fast
 - a. Normal sinus rhythm is usually between 60 and 100 beats per minute
 - b. Tachycardia is when the heartbeat goes over 100 beats per minute (generally not serious)
 - c. A flutter is when the heartbeat is regular, but gets up to 350 beats per minute
 - d. Fibrillation is when the heart pumps in an uncoordinated, nonproductive fashion
 - i. Atrial fibrillation not deadly
 - ii. Ventricular fibrillation (V-fib; V-tach) very
 - dangerous; requires defibrillation by electrical shock
 - 3. Heart block
 - a. An interruption in the conduction system that causes the heart to skip beats or stop
 - b. Degrees of heart blockage 1st, 2nd, and 3rd

- c. 3rd is the most serious and may be treated with the placement of a manmade pacemaker
- 4. Premature Ventricular Contractions (PVCs) early ventricular contractions are serious and may lead to ventricular fibrillation
- 5. Causes of conduction problems
 - a. Some are idiopathic
 - b. Known causes
 - i. Medications
 - ii. Ischemia of the myocardium
 - iii. Previous MI
- 6. Diagnostic tests
 - a. Auscultation
 - b. Electrocardiography
 - c. Electrophysiology
- J. Phlebitis (inflammation of the veins)
 - 1. Inflammation that commonly occurs in superficial veins of the extremities
 - 2. Symptoms of phlebitis include: pain, swelling
 - 3. Causes: some are unknown; known causes are:
 - a. Injury
 - b. Obesity
 - c. Poor circulation
 - d. Prolonged bed rest
 - e. Infection
 - 4. Treatment
 - a. Analgesics
 - b. Compression stockings
 - c. Exercise
 - d. Warm compresses
 - e. Elevation of the inflamed part (above heart level)
- K. Deep vein thrombosis (DVT)
 - 1. Complication of phlebitis
 - 2. Development of clot(s) in the inflamed vessel
 - a. Clots will commonly occur in the pelvis, thighs, and lower legs
 - b. Clots are asymptomatic until embolization takes place these clots are often fatal if they embolize circulation to the lungs
 - c. Threatening factors for deep vein thrombosis include
 - i. Prolonged bed rest
 - ii. Dehydration (increases blood viscosity)
 - iii. Varicose veins
 - iv. Leg or pelvic surgery
 - v. Pregnancy
 - vi. Obesity and sedentary lifestyle
 - d. Treatment reduce the formation of clots

- i. Bed rest with elevation of the affected area
- ii. Anticoagulants
- L. Varicose veins
 - 1. Dilated, convoluted veins (usually in the legs)
 - a. Flow of blood back to the heart is slowed and will collect in the veins, causing increased pressure, dilation, and pain – the condition eventually leads to incompetent venous valves (which normally contract to prevent the backflow of blood)
 - b. Initial symptoms
 - i. Leg fatigue
 - ii. Leg cramps
 - c. Later symptoms
 - i. Hardened, distended, tortuous veins
 - ii. Edema and congestion of fluid in the extremities
 - iii. Stasis dermatitis
 - iv. Pinpoint hemorrhages
 - v. Stasis ulcers
 - d. Cause varicose veins appear to be inherited, although activities such as pregnancy, obesity, and prolonged standing or sitting might lead to this disorder
 - e. Treatment use of support hose (improves vascular flow); elevation of legs; waling, surgery ("vein stripping")

Activity

- I. Research and write a report on a rare cardiovascular disease.
- II. Participate in the online interactive activity: *Do An EKG on Grumpy Mr. Blue:* <u>http://nobelprize.org/educational/medicine/ecg/</u>

Assessment

Writing Rubric

Materials

Computer access Medical dictionary <u>Key Terms</u> <u>Answer Sheet for Key Terms</u> <u>Medical History Interview Form</u> <u>http://cleartoauscultation.org/</u> <u>http://nobelprize.org/educational/medicine/ecg/</u> – an interactive site for EKG on a virtual patient.

Accommodations for Learning Differences

For reinforcement, the student will define Key Terms.

For enrichment, the student will interview a family member, neighbor, etc. who has hypertension or coronary artery disease using the <u>Medical History</u> <u>Interview Form</u>. Relate the patient history to personal health risks.

National and State Education Standards

National Healthcare Foundation Standards and Accountability Criteria: Foundation Standard 1: Academic Foundation

1.1 Human Structure and Function

1.11 Classify the basic structural and functional organization of the human body (tissue, organ, and system).

1.12 Recognize body planes, directional terms, quadrants, and cavities.

1.13 Analyze the basic structure and function of the human body.

1.2 Diseases and Disorders

1.21 Describe common diseases and disorders of each body system (prevention, pathology, diagnosis, and treatment).

1.22 Recognize emerging diseases and disorders.

1.23 Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease.

1.3 Medical Mathematics

1.32 Analyze diagrams, charts, graphs, and tables to interpret healthcare results.

TEKS

§130.208 (c)(4)(A) identify biological and chemical processes at the cellular level;

§130.208 (c)(4)(B) detect changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;

130.208 (c)(4)(C) identify factors that contribute to disease such as age, gender, environment, lifestyle, and heredity; and

130.208 (c)(4)(D) examine the body's compensating mechanisms occurring under various conditions;

Texas College and Career Readiness Standards Science

V. Cross-Disciplinary Themes

E. Classification and Taxonomy

1. Know ways in which living things can be external structure,

development, and relatedness of DNA sequences.

F. Systems and homeostasis

1. Know that organisms possess various structures and processes (feedback loops) that maintain steady internal conditions.

2. Describe, compare, and contrast structures and processes that allow gas exchange, nutrient uptake and processing, waste excretion, nervous and hormonal regulation, and reproduction in plants, animals, and fungi; give examples of each.

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Key Terms—Cardiovascular Pathology

Key Term	Meaning
Acute	
Aneurysm	
Angina	
Angiogram	
Angioplasty	
Anticoagulant	
Arrhythmia	
Atherosclerosis	
Atrioventricular node (AV)	
Auscultation	
BP	
Bundle of HIS	
САВ	
Catheterization	
Chronic	
Claudication	
Collateral circulation	
Coronary artery disease	
Cyanosis	
Defibrillation	
Diaphoresis	
Diastolic	

Doppler	
Dyspnea	
Edema	
Embolus	
Endarterectomy	
Fibrillation	
Gangrene	
Hypertension	
Hypertrophy	
Ischemia	
Lumen	
Myocardial infarction (MI)	
Necrosis	
Occlusion	
Palpitations	
Patency	
Pericardium	
Peripheral Vascular Disease (PVD)	
Plaque	
Purkinje fibers	
Sclerosis	
Sinoatrial (SA) node	
Stenosis	
Stent	

Systolic	
Tachycardia	
Thrombus	
Vasodilator	
Venipuncture	

Answers: Key Terms—Cardiovascular Pathology

Acute	disease that is short term (often of sudden, sometimes severe onset)
Aneurysm	weakening and ballooning of vessel wall that could result in a rupture
Angina	a medical condition in which lack of blood to the heart causes chest pain
Angiogram	a radiographic procedure that involves passing a catheter into an artery,
	injecting a contrast media, and taking radiography to determine the
	patency of vessels
Angioplasty	a procedure that involves passing a special catheter into an artery and
	inflating a balloon on the catheter in order to widen the lumen of the vessel
Anticoagulant	medication which prevents blood clotting
Arrhythmia	irregularity in normal rhythm (or force) of heartbeat
Atherosclerosis	a common arterial disease in which cholesterol deposits form on the inner
	surface of arteries
Atrioventricular node	a bundle of fibers that are located within the septum of the heart – the AV
(AV)	node carries cardiac impulses down the septum to the ventricles via the
	Purkinje fibers.
Auscultation	listening to sounds (usually with a stethoscope) made by a patient's
	internal organs (especially the heart, lungs, and abdominal organs)
BP	acronym for blood pressure
Bundle of HIS	specialized cells located in the proximal intraventicular septum which
	emerge from the AV node to begin the conduction of impulses from the AV
	node to the ventricles
САВ	acronym for coronary artery bypass
Catheterization	a procedure by which a catheter is introduced into a vessel or hollow
	organ, frequently done under a fluoroscope with contrast media in order to
	visualize the size of the organs and patency of the vessels
Chronic	a condition that lasts over a long period of time; sometimes causes long-
	term changes in the body
Claudication	a pain in the calf or thigh muscle that occurs after walking; the pain stops
	after the sufferer rests for a while – each time the pain occurs, it takes
	about the same amount of time for the pain to go away after he or she
	stops walking
Collateral circulation	development of a small set of arteries when a larger artery gradually
<u>Concernentem</u>	becomes occiuded
Coronary artery	narrowing of the arteries that supply blood to the myocardium
Cisease	a condition in which the skin and muceus membranes take on a bluich
Cyanosis	a condition in which the skin and mucous membranes take on a bluish
Defibrillation	color because there is not enough oxygenated blood getting to the tissues
Denormation	application of electric shock to the chest (sometimes directly to the heart)
Dianhoracia	
Diaphoresis	sweduling profusely
DIASIONIC	chambers fill with blood
Dopplor	a popinyasiya ultrasound mothod used to measure the flow of blood
Duppier	difficult or labored breathing
Edomo	
Edema	sweining

- · ·			
Embolus	abnormal mass (usually a blood clot) that gets into the circulatory system		
	and eventually becomes lodged in a blood vessel, causing an obstruction		
Endarterectomy	a procedure in which a diseased artery is opened so that plaque can be		
	cleaned out		
Fibrillation	a rapid chaotic beating of the heart muscle in a nonsynchronous way that		
	can result in the stopping of the heart's pumping blood		
Gangrene	death and decay of soft tissues as the result of a lack of oxygenated blood		
Cangione	to an area		
Hypertension	high blood pressure		
Hypertrophy	increase in the size of an organ		
Ischomia	inadequate supply of blood to a part of body caused by the partial or total		
Ischenna	headequate supply of blood to a part of body caused by the partial of total		
1			
	space inside vessels		
	stoppage of arterial blood going to the neart muscle; a neart attack		
Necrosis	death of cells in a tissue or organ caused by disease or injury		
Occlusion	obstruction		
Palpitations	a rapid, forceful beating of the heart due to a medical condition, exertion,		
	fear, or anxiety		
Patency	refers to a naturally open and unblocked vessel		
Pericardium	the fibrous membrane that forms a sac surrounding the heart and attached		
	portions of the main blood vessels		
Peripheral Vascular	refers to a disease state in the vessels of outside the heart and the great		
Disease (PCD)	vessels		
Plaque	residual deposits of cholesterol, which build up and cause atherosclerosis		
Purkinje fibers	thin filaments embedded in the ventricular walls that distribute electrical		
_	impulses to the ventricular muscle to promote contraction		
Sclerosis	hardening and thickening of body tissues as a result of unwarranted		
	growth, degeneration of nerve fibers, or deposition of minerals		
Sinoatrial (SA) node	a section of nodal tissue that is located in the upper wall of the right		
	atrium: also referred to as the pacemaker of the heart; sets the rate of		
	contraction for the heart		
Stenosis	narrowing of a vessel or valve		
Stent	a small spring-like device that is inserted into a constricted vessel via		
	catheter in order to restore patency		
Systolic	contraction of the heart during which blood is pumped into the arteries		
Tachycardia	rapid heartbeat (usually above 100 beats per minute)		
Thrombus	a blood clot that forms in the blood vessels and remains at the site of		
	formation		
Vasodilator	a medication which opens the vessels to restore good flow of oxvgenated		
	blood		
Venipuncture	the process by which a needle is inserted into a superficial vein to		
	withdraw blood for laboratory testing		
	wither and block for habitatory tooting		

Patient History Interview Form

Patient Name	_ DOB	

Sex F M

FAMILY HISTORY:

	Hypertension	Coronary Artery Disease	Other
Mother Father Sibling(s) Maternal Grandmother Maternal Grandfather Paternal Grandmother Paternal Grandfather			
 CARDIOVASCULAR HISTOR Shortness of breath General fatigue on exertion Chest pain Heart palpitations Rapid heart beat Episodes of fainting Swelling of hands and/or feed to be and the service of the service	Y Yes 	No 	

CHIEF COMPLAINT (upon seeing physician):

DIAGNOSED AS:

TREATMENT:

YOUR PRESENT HEALTH STATUS: