Clinical Cardiology Anatomy

Dr. Gary Mumaugh – Campbellsville University

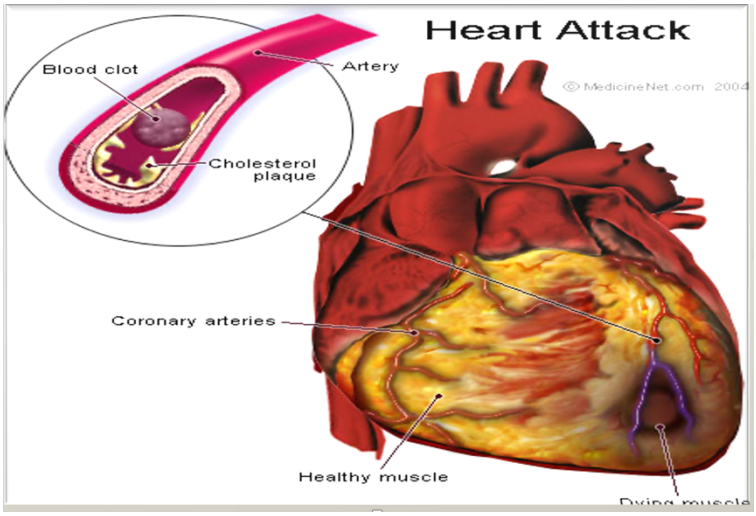
Coronary Artery Disease

CAD Pathophysiology

- Atherosclerotic disease and coronary artery disease accounts for 45% of all USA deaths
- 50% of female deaths are cardiovascular
- Etiology includes the presence of plaques lining the coronary arteries with plaque rupture and coronary artery spasm
- Result is ischemia, angina or MI, cell death and or electrical dysfunction
- 3 Elements of atherogenesis is plaque formation, plaque rupture, vasoregulation creating atherosclerotic disease

CAD Risk Factors

- Older age
- Family history
- Socioeconomic factors
- Overweight with trunk fat deposition
- Blood pressure
- Smoking
- Personality and psychological factors
- Glycemic control
- Increased LDL and triglycerides
- Poor dental hygiene
- Chronic infections
- With several risk factors the risk could be up to 20X



CAD Preventative Therapy to Reduce Heart Attacks

- Preventative therapy to reduce heart attacks
- Specific therapy for those with pre-clinical CAD
    - Lovastatin and strict diet control
    - Proper diabetic control
    - Antihypertensives
    - Folic acid for high homocysteine
    - Temporary antibiotics
    - Maintenance of good oral hygiene
- General therapy for all adults
    - Low dose ASA
    - Smoking cessation & stress management
    - Folic acid, Vitamin C and E, omega-3 fatty acids
    - Increasing aerobic exercise

Coronary Artery Occlusion with MI

- Incidence
  - 1,100,000 American had MI, with 650,000 being the first attack and 450,000 instant deaths
- S & S
  - Crushing chest pain with diaphoresis, dyspnea, weakness, palpitations, vomiting
- Diagnosis
  - Patient presentation with ECG and blood tests
- Treatment
  - Admission to CCU has best survival
  - Oxygen, beta blockers, heparin, tPa
  - Pacemaker insertion or CABG surgery

Famous Cardiac Caveats

- In all men or older women with acute physical distress of any kind, always think, "Is this a myocardial infarction?"
- When a young man complains of pain in his heart, it is usually his stomach. When an old man complains of pain in his stomach, it is usually his heart.
- Such thought has saved thousands of lives

Symptoms of a Female's Heart Attack

- Unusual fatigue 71%
- Sleep disturbances 48%
- Shortness of breath 42%
- Indigestion 39%
- Anxiety 35%
- Chest discomfort 30%

Hypertension

- Up to 50 million in the USA
- 95% diagnosed as essential
- Essential means preventable or likely due to diet, obesity, inactivity, stress and alcohol
- Conventional treatment with lifestyle modifications work well with integrative care
  - According to the 6th Joints Commission of Hypertension, even with a BP of 140/90, the main intervention is lifestyle intervention before starting medication.
  - This includes weight loss, decrease sodium and alcohol and moderate exercise for one year before starting medication.
- Causes of essential hypertension
  - Heredity
  - Obesity
  - Salt intake
  - Stress
  - Alcohol

Hypertension

- Three diagnostic components of essential HTN
  - Careful history, family history, organ system review, lifestyle evaluation
  - Thorough physical examination
  - Lab studies
- Treatment of essential HTN
  - Lifestyle changes
    - Weight, exercise, smoking, salt restriction, stress reduction, DASH diet,
  - Medication (only after lifestyle modification)
    - Diuretics
    - Calcium channel blockers
    - ACE inhibitors
    - Alpha blockers
    - Beta-blockers
    - Angiotensin II receptor blockers
- Causes of secondary hypertension
  - “white coat hypertension”
  - Medical noncompliance
  - Exogenous drug usage
    - Oral contraceptives, weight control drugs, NSAIDs, steroids, sympathomimetic cold remedies
  - Renal disease
  - Aldosteronism
  - Endocrine diseases
  - Sleep apnea
  - Congenital stenosis of the aorta
- Treatment of secondary HTN
  - Remove the cause and the HTN is gone

Congestive Heart Failure

- CHF Incidence
  - In the USA, 3 million hospitalizations per year
  - 30-40% are readmitted with six months
  - 4-5 millions current cases
  - 500,000 – 600,000 new cases per year
  - 250,000 deaths per year
  - Half of all CHF diagnosis die within 5 years
    - 10% die in year one
  - Twice as common in African-Americans
  - USA yearly treatment cost - $21 billion

Congestive Heart Failure

- Causes of CHF
  - Coronary artery disease
  - Hypertension
  - Aortic stenosis and insufficiency
  - Mitral regurgitation
  - Atrial fibrillation, flutter or tachycardia
  - Viral myocarditis
  - Septicemia
  - Hyperthyroidism or hypothyroidism
  - Alcohol abuse
  - Chemotherapy
  - Congenital or rheumatic heart disease
  - Chagas' disease – parasitic heart infection
- Pathophysiology of CHF
  - The pumping action of the heart becomes less and less powerful
  - Despite its misleading name, in heart failure the heart doesn't suddenly stop working
  - Heart failure develops slowly as the heart muscle gradually weakens
  - The "failure" refers to the heart's inability to pump enough blood.
  - Blood and fluid do not move efficiently through the circulatory system, and starts to "backup"
  - Eventually, parts of your body (lungs, abdomen, and lower limbs) hold blood and fluid that your heart isn't circulating very well
  - This is called "becoming congested," and is why this condition is called "congestive heart failure"

Left Sided vs. Right Sided Heart Failure

- Can involve the heart's left side, right side or both sides, though CHF much more affects the left heart
- Left-sided heart failure
  - Fluid collects in the lungs - this extra fluid in the lungs ("congestion") makes it more difficult for the airways to expand as you inhale
  - Presents with dyspnea, pulmonary edema, and orthopnea
- Right-sided heart failure
  - Due to failure of the right ventricle
  - Fluid collects in other body tissues especially the lower extremities – pitting edema, liver enlargement
- CHF Symptoms
  - Three cardinal symptoms are dyspnea, fatigue and fluid retention
  - Sudden weight gain, despite loss of appetite
  - Swelling in legs, ankles, feet, or abdomen
  - Tired and short of breath when doing things that are normally easy, such as walking
-

Left Sided vs. Right Sided Heart Failure

- CHF Symptoms
  - Breathing difficulty when lying flat in bed or may wake up with a choking feeling
    - May need to sleep with your head raised up on several pillows
  - Persistent cough, more at night
  - Less frequent urination during the day
  - Irregular heartbeats, feeling of heart pounding
  - Chest pain, pressure or chest discomfort
  - Loss of appetite
  - Dizziness or lightheadedness, inability to concentrate

Four Stages of CHF - New York Heart Association Guideline

- Class I (Mild) 35%
  - No limitation of physical activity
  - Ordinary physical activity does not cause symptoms fatigue
- Class II (Mild) 35%
  - Slight limitation of physical activity
  - Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnea
- Class III (Moderate) 25%
  - Marked limitation of physical activity
  - Comfortable at rest, but less than any activity causes fatigue, palpitation, or dyspnea
- Class IV (Severe) 5%
  - Unable to carry out any physical activity without discomfort
  - Symptoms of cardiac insufficiency at rest
  - If any physical activity is undertaken, discomfort is increased

CHF Diagnosis

- Family history
- Medical history
  - HTN, angina, diabetes, high cholesterol, valve disease, PVD, rheumatic disease, chest radiation
- Life style
- Health habits
- Physical exam
  - Peripheral edema, hepatomegaly, ascites, pallor, tachycardia, jugular venous distension
- Chest x-ray
- EKG
- Echocardiogram
- Blood work

CHF Treatment

- Aldosterone antagonists
  - Reduce the stress to the heart
  - Weak diuretic effect
- Angiotensin converting enzyme (ACE) inhibitors
  - Help reduce the stress on your heart
- Beta blockers
  - Help decrease the heart's need for blood and oxygen by reducing its workload
  - Help the heart to beat more regularly
- Digoxin (Lanoxin®)
  - Help increases the strength of the pumping action
- Diuretics (water pills)
  - Help reduce the amount of fluid in your body

Extrinsic Innervation of the Heart

- Heart is stimulated by the sympathetic cardioaccelerator center
- Heart is inhibited by the parasympathetic cardioinhibitory center

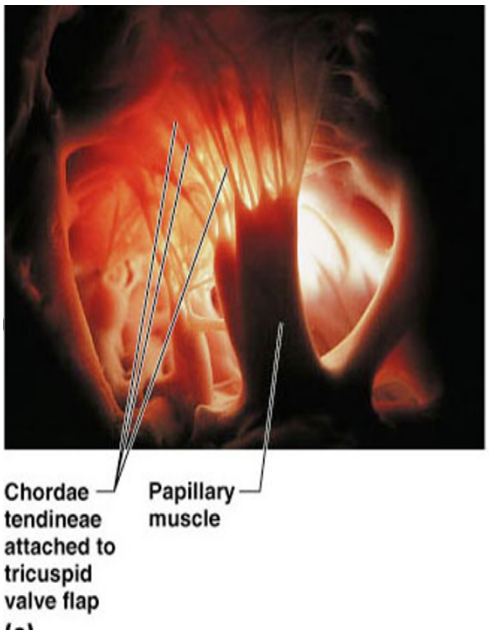
Heart Physiology: Sequence of Excitation

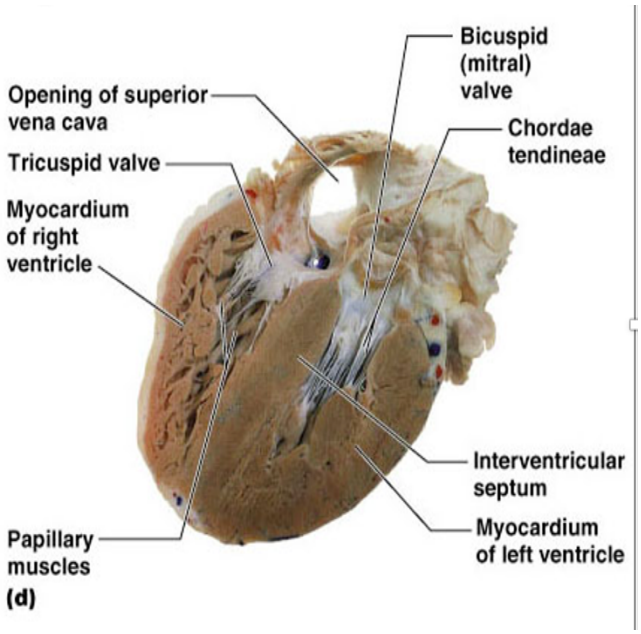
- Sinoatrial (SA) node generates impulses about 75 times/minute
- Atrioventricular (AV) node delays the impulse approximately 0.1 second
- Impulse passes from atria to ventricles via the atrioventricular bundle (bundle of His)
- Heart Block - the only route for impulse transmission from the atria to the ventricles is through the AV node, and damage to the AV node is called heart block

Cardiac Arrhythmias

- Premature atrial contractions (PAC)
  - Seen in normal people with to much caffeine, anxiety, alcohol, electrolytes, vomiting or diarrhea
- Premature ventricular contractions (PVC)
  - Often seen in middle age and of no concern
  - Can also occur with MI, CHF, hypoxia
- Paroxysmal atrial tachycardia (PAT)
  - Usually in women 20-25
  - May be congenital and start in first year of life
    - Called Wolf Parkinson White Syndrome which requires a catheter radio-ablation
- Atrial fibrillation and flutter (AF)
  - Not life-threatening, yet it is a common cause of hospitalization
  - Causes the heart to be sporadically with no rhythmic pattern
  - May be caused by COPD, alcohol, cardiac surgery, hyperthyroidism, or idiopathic
  - The inefficiency of the atrial contraction leads to a potential buildup of clots in the wall of the atria

- **Cardiac Arrhythmias**
  - Treated with electrical cardioversion with anticoagulation meds
  - Some are resistant to cardioversion which puts them at risk for strokes, ventricular fibrillation and sudden death
- Ventricular tachycardia (VT)
  - A normal response to exercise, stress reactions and sexual activity causing the heart to elevate up to 200/minute
  - In patients with structural heart disease, VT can occur without provocation
  - S & S – pounding heart and lightheadedness
  - Treated with electrical cardioversion and beta blockers
- Bradycardia
  - Pulse less than 60/min or 46/min for athletes
  - Extrinsic causes by drugs, hypothyroidism, CNS disorders
  - Intrinsic causes by SA or AV node dysfunction
  - Treat the cause, such as a pacemaker
- Heart block
  - Often caused by ischemia due to CAD or may be idiopathic
  - Three degrees possible
    - 1st degree – impulses reach the ventricles and slow in the AV node – no treatment needed
    - 2nd degree – impulse slows so that not all beats get through the ventricle, causing bradycardia – may or may not need a pacemaker
    - 3rd degree (complete) – all impulses from the atria to the ventricles are blocked at the AV node – all need external pacemaker
  - Sick sinus syndrome - a wide variety of alternate bradycardia and tachycardia





Cardiac Valve Disease

- Heart valve malfunction comes in two forms:
  - Valves that do not open well
    - This constricts the flow and is called stenosis
  - Valves that do not close well
    - This causes backwards leakage and is called regurgitation or insufficiency
- Four most common valve problems
  - Mitral regurgitation
  - Aortic regurgitation
  - Mitral stenosis
  - Aortic stenosis

Heart Valves

- Mitral regurgitation (insufficiency)
  - In the past, was caused by rheumatic fever
- Mitral stenosis
  - Caused by rheumatic fever, congenital abnormalities, lupus, or tumor
- Aortic regurgitation (insufficiency)
  - The 3 cusps leak after contraction
  - Caused by rheumatic heart disease, congenital defects, endocarditis or degeneration
  - Causes ventricular enlargement
- Aortic stenosis
  - Most common valve problem in adults
  - Most caused by arteriosclerosis of flaps – normal aging

Pericarditis

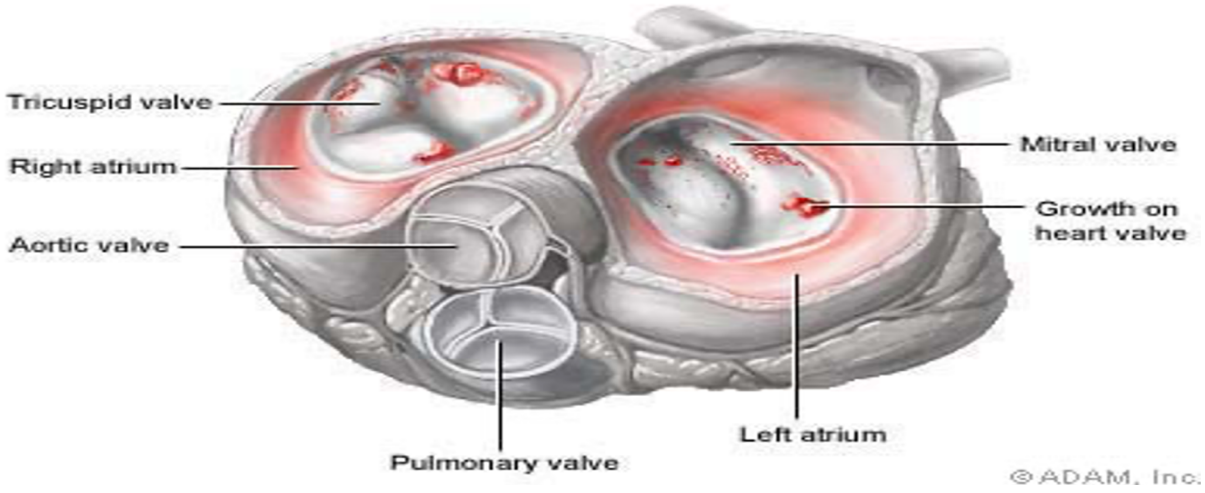
- Has a triad of chest pain, ECG changes and pericardial friction rub – the patient must have 2 of the 3 to make the diagnosis
- Major causes
  - Viral infections, myocardial infarction, drug side effect, connective tissue disorders, blunt or penetrating trauma
- S & S
  - Chest pain radiating to back or left shoulder
  - Fatigue or dyspnea
- Diagnosis
  - High intensity friction rub and ECHO
- Treatment
  - NSAIDs and steroids
  - Pericardiocentesis to avoid cardiac tamponade from effusion
    - Tamponade is fatal it not relieved
- Prognosis
  - Most resolve in four weeks

Pericarditis

- Some cases become chronic which require surgery to remove the thickened constrictive heart layer

Endocarditis

- Infection of inner heart lining, usually bacterial
  - Can be acute or subacute
  - Usually occur on damaged valves in which the bacteria accumulates and forms blood clots on the valves
    - Bacteria in the bloodstream comes from mouth, dental work, gingivitis, skin infections, medical procedures (*Streptococcus, staphlococcus, enterococcus)*
  - Heart valve vegetations can and easily embolize throughout the body causing satellite abscesses
  - Diagnosis with ECHO and blood culture
    - Consider in any patient with fever heart murmur
  - Treatment – IV antibiotics and possible valve replacement



Aortic Artery Disease

- Ruptured aortic aneurysms are responsible for 15,000 deaths per year (half die in surgery)
  - (> 4 cm diameter with normal at 2.5 to 3 cm)
- S & S
  - Often no symptoms when they are small
  - When they enlarge, they cause low back pain and powerful abdominal pulse sensation
- Diagnosis
  - Pulsating aneurysm palpated and seen on ultrasound
- Treatment
  - Surgical resection > 5 cm diameter

Peripheral Artery Disease

- Arteriosclerosis
  - Generalized narrowing and stiffening of arteries occurring over 65 year years old
- Atherosclerosis
  - The process of plaque formations over the age of 35
  - Plaques build up where vessels split and can lead to strokes, gangrene and heart attacks
  - Very common in diabetes
  - Risk factors
    - Tobacco (3-4X), age, HTN, diabetes, cholesterol, sedentary lifestyle, high homocysteine
- S & S
  - Blood flow restricted to lower extremities
  - Severe claudication
  - Sharp pain with exercise that stops with lack of movement
- Diagnosis
  - Diminished or absent peripheral pulses
  - Doppler flowmeter changes
  - Ischemic limbs have purple-red color
  - Glove-like distribution of nerve loss
- Treatment
  - Vasodilators
  - Vascular surgery