**Alterations of Cardiovascular Function**

**Pathology 2 - Dr. Gary Mumaugh**

**Diseases of the Veins**

**Varicose veins**

* A vein in which blood has pooled
* Distended, tortuous, and palpable veins
* Caused by trauma or gradual venous distention
* Risk factors:
  + Age, Female gender , Family history, Obesity
  + Pregnancy, Deep Vein Thrombosis, Prior leg injury

**Chronic venous insufficiency**

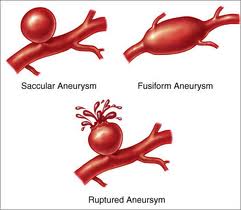
* Inadequate venous return over a long period due to varicose veins or valvular incompetence
* Venous stasis ulcers

**Deep venous thrombosis**

* Obstruction of venous flow leading to increased venous pressure
* Factors:
  + Triad of Virchow
    - Venous stasis
    - Venous endothelial damage
    - Hypercoagulable states
  + Other (cancer, orthopedic surgery/trauma, heart failure, immobility)

**Superior vena cava syndrome**

* Progressive occlusion of the superior vena cava that leads to venous distention of upper extremities and head
* Oncologic emergency



**Diseases of the Arteries and Veins**

**Hypertension**

* Isolated systolic hypertension—becoming prevalent in all age groups
  + Elevations of systolic pressure are caused by increases in cardiac output, total peripheral vascular resistance, or both

**Primary hypertension**

* Essential or idiopathic hypertension
* Genetic and environmental factors
* Affects 92% to 95% of individuals with hypertension
* Risk factors:
  + High sodium intake
  + Obesity
  + Insulin resistance

**Secondary hypertension**

* Caused by a systemic disease process that raises peripheral vascular resistance or cardiac output
* Renal artery stenosis, renal parenchymal disease, pheochromocytosis, drugs

**Complicated hypertension**

* Chronic hypertensive damage to the walls of systemic blood vessels
* Smooth muscle cells undergo hypertrophy and hyperplasia with fibrosis of the tunica intima and media
* Affects heart, kidneys, retina
* Can result in transient ischemic attack/stroke, cerebral thrombosis, aneurysm, dementi

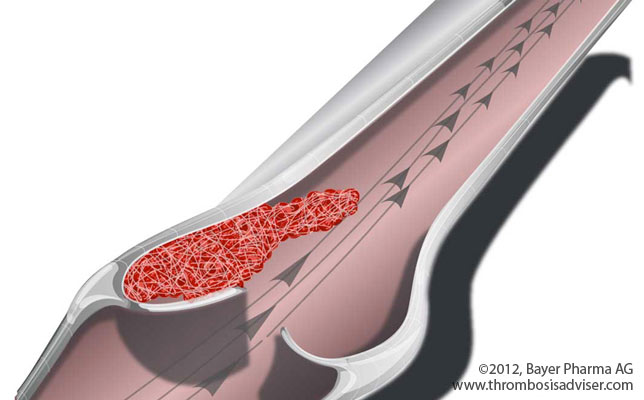
**Malignant hypertension**

* Rapidly progressive hypertension
* Diastolic pressure is usually >140 mm Hg
* Life-threatening organ damage

**Orthostatic (postural) hypotension**

* Decrease in both systolic and diastolic blood pressure upon standing
* Lack of normal blood pressure compensation in response to gravitational changes on the circulation
* Acute orthostatic hypotension
* Chronic orthostatic hypotension

**Aneurysm**

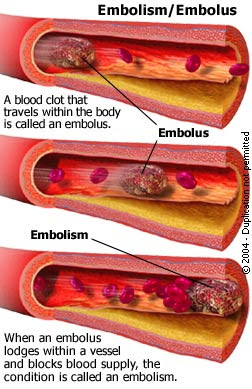
* Local dilation or outpouching of a vessel wall or cardiac chamber
* True aneurysms
  + Fusiform aneurysms
  + Circumferential aneurysms
* False aneurysms
  + Saccular aneurysms
* Aorta most susceptible, especially abdominal
  + Causes include atherosclerosis, hypertension
  + Can lead to aortic dissection or rupture

**Thrombus formation**

* Blood clot that remains attached to the vessel wall
* Risk factors include intimal injury/inflammation, obstruction of flow, pooling (stasis)
* Thromboembolus
* Thrombophlebitis
* Arterial thrombi
* Venous thrombi

**Embolism**

* Bolus of matter that is circulating in the bloodstream
  + Dislodged thrombus
  + Air bubble
  + Amniotic fluid
  + Aggregate of fat
  + Bacteria
  + Cancer cells
  + Foreign substance



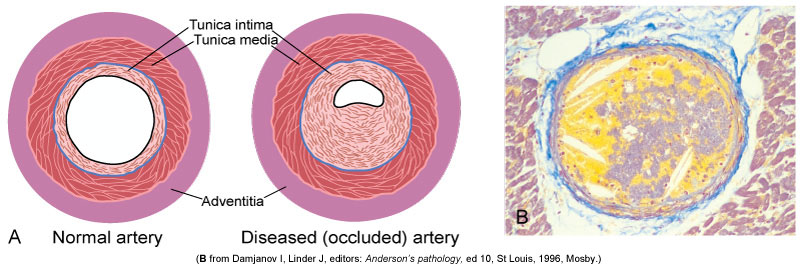
**Thromboangiitis obliterans (Buerger disease)**

* Occurs mainly in young men who smoke
* Inflammatory disease of peripheral arteries resulting in the formation of nonatherosclerotic lesions
  + Digital, tibial, plantar, ulnar, and palmar arteries
* Obliterates the small and medium-sized arteries
* Causes pain, tenderness, and hair loss in the affected area
* Symptoms are caused by slow, sluggish blood flow
* Can often lead to gangrenous lesions

**Raynaud phenomenon and Raynaud disease**

* Episodic vasospasm in arteries and arterioles of the fingers, less commonly the toes
* Raynaud disease is a primary vasospastic disorder of unknown origin
* Raynaud phenomenon is secondary to other systemic diseases or conditions:
  + Collagen vascular disease
  + Smoking
  + Pulmonary hypertension
  + Myxedema
  + Cold environment
* Manifestations include pallor, cyanosis, cold, pain

**Arteriosclerosis**

* Chronic disease of the arterial system
  + Abnormal thickening and hardening of the vessel walls
  + Smooth muscle cells and collagen fibers migrate to the tunica intima
* Form of arteriosclerosis
* Thickening and hardening caused by accumulation of lipid-laden macrophages in the arterial wall
* Plaque development
* Progression
  + Inflammation of endothelium
  + Cellular proliferation
  + Macrophage migration and adherence
  + LDL oxidation (foam cell formation)
  + Fatty streak
  + Fibrous plaque
  + Complicated plaque
* Risk factors include hyperlipidemia/dyslipidemia, diabetes, smoking, hypertension
* Result in—inadequate perfusion, ischemia, necrosis

**Peripheral Arterial Disease**

* Atherosclerotic disease of arteries that perfuse limbs
* Intermittent claudication

**Coronary Artery Disease**

* Any vascular disorder that narrows or occludes the coronary arteries leading to myocardial ischemia
* Atherosclerosis is the most common cause
* Risk Factors
  + Major:
    - Increased age
    - Family history
    - Male gender or female gender post menopause
  + Modifiable:
    - Dyslipidemia
    - Hypertension
    - Cigarette smoking
    - Diabetes mellitus
    - Obesity/sedentary lifestyle
    - Atherogenic diet
  + Nontraditional risk factors:
    - Markers of inflammation and thrombosis
      * High density C-reactive protein, erythrocyte sedimentation rate, von Willebrand factor concentration, interleukin-6, interleukin-18, tumor necrosis factor, fibrinogen, and CD 40 ligand
      * Hyperhomocysteinemia
      * Adipokines
      * Infection

**Myocardial ischemia**

* Local, temporary deprivation of the coronary blood supply
* Stable angina
* Prinzmetal angina
* Silent ischemia

**Acute coronary syndromes:**

* Transient ischemia
* Unstable angina
* Sustained ischemia
* Myocardial infarction
  + STEMI or non-STEMI
* Myocardial inflammation and necrosis

**Myocardial infarction**

* Sudden and extended obstruction of the myocardial blood supply
* Subendocardial infarction
* Transmural infarction
* Cellular injury
* Cellular death
* Structural and functional changes:
  + Myocardial stunning
  + Hibernating myocardium
  + Myocardial remodeling
  + Repair
* Manifestations:
  + Sudden severe chest pain; may radiate
  + Nausea, vomiting
  + Diaphoresis
  + Dyspnea
* Complications:
  + Sudden cardiac arrest due to ischemia, left ventricular dysfunction, and electrical instability

**Disorders of the Heart Wall**

**Disorders of the Pericardium:**

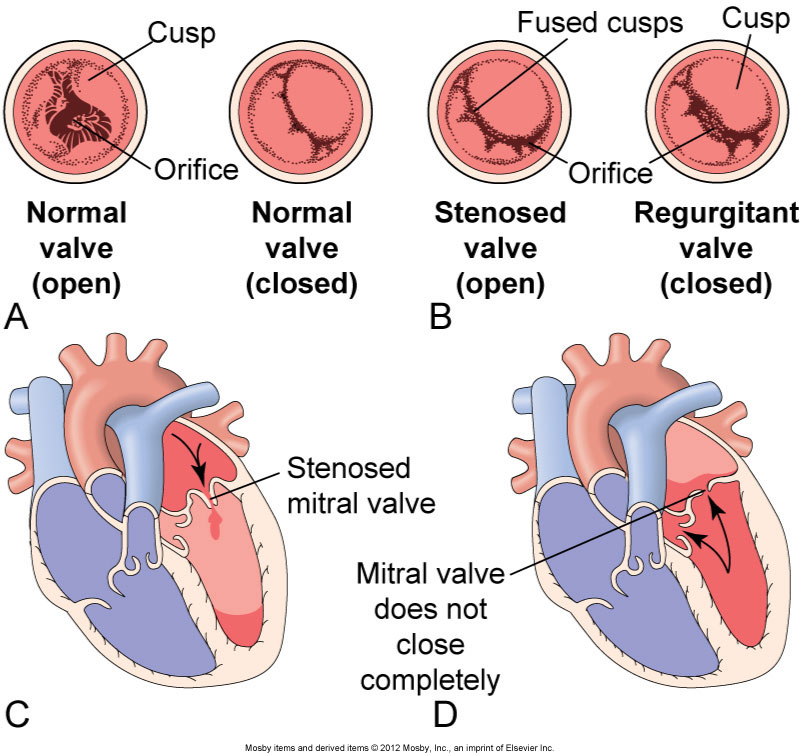
* Acute pericarditis
* Pericardial effusion
  + Tamponade
* Constrictive pericarditis

**Disorders of the Myocardium**

* Cardiomyopathies:
  + Dilated cardiomyopathy (congestive cardiomyopathy)
  + Hypertrophic cardiomyopathy
    - Asymmetrical septal hypertrophy
    - Hypertensive (valvular hypertrophic) cardiomyopathy
  + Restrictive cardiomyopathy

**Disorders of the Endocardium**

* Valvular dysfunctions:
  + Valvular stenosis
    - Aortic stenosis
    - Mitral stenosis
  + Valvular regurgitation
    - Aortic regurgitation
    - Mitral regurgitation
    - Tricuspid regurgitation
  + Mitral valve prolapse syndrome (MVPS)

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**Acute Rheumatic Fever and Rheumatic Heart Disease**

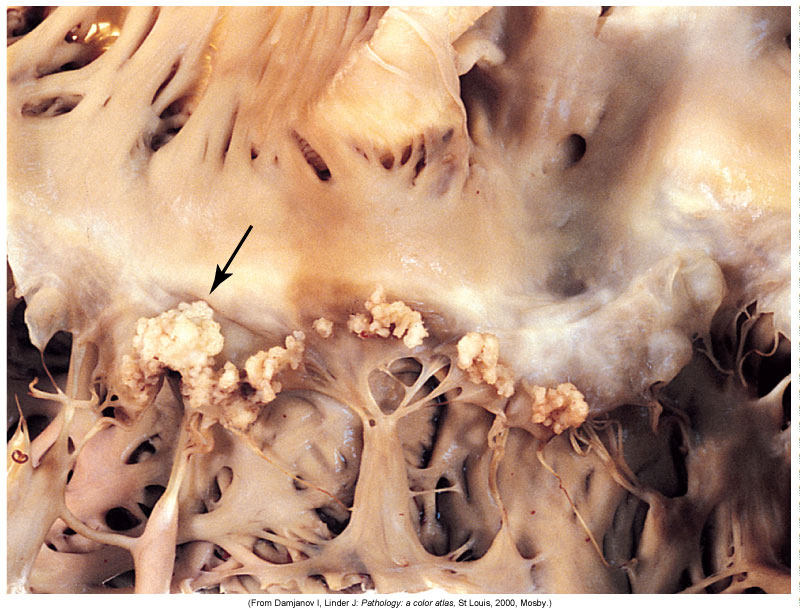
**Rheumatic fever**

* Systemic, inflammatory disease caused by a delayed immune response to pharyngeal infection by the group A beta-hemolytic streptococci
* Febrile illness
  + Inflammation of the joints, skin, nervous system, and heart
* If left untreated, rheumatic fever causes rheumatic heart disease

**Acute Rheumatic Fever and Rheumatic Heart Disease**

* Common manifestations:
  + Fever
  + Lymphadenopathy
  + Arthralgia
  + Nausea/vomiting
  + Tachycardia
  + Abdominal pain
  + Epistaxis
* Major clinical manifestations:
  + Carditis
  + Polyarthritis
  + Chorea
  + Erythema marginatum

**Infective Endocarditis**

* Inflammation of the endocardium
* Agents:
  + Bacteria, Viruses, Fungi, Rickettsiae, Parasites
* Pathogenesis
  + Damaged (prepared) endocardium
  + Blood-borne microorganism adherence
  + Proliferation of the microorganism (vegetations)
* Manifestations:
  + Classic finding:s
    - Fever
    - New or changed cardiac murmur
    - Petechial lesions of the skin, conjunctiva, and oral mucosa
  + Characteristic physical findings:
    - Osler nodes (painful erythematous nodules on the pads of the fingers and toes)
    - Janeway lesions (nonpainful hemorrhagic lesions on the palms and soles)
  + Other: weight loss, back pain, night sweats, and heart failure

**Cardiac Complications of AIDS**

* Myocarditis
* Endocarditis
* Pericarditis
* Cardiomyopathy
* Pericardial effusion
* Pulmonary hypertension
* Antiviral drug-related cardiotoxicity

**Dysrhythmias (Arrhythmias)**

* Disturbance of the heart rhythm
* Range from occasional “missed” or rapid beats to severe disturbances that affect the pumping ability of the heart
* Can be caused by an abnormal rate of impulse generation or abnormal impulse conduction
* Examples:
  + Tachycardia
  + Flutter
  + Fibrillation
  + Bradycardia
  + Premature ventricular contractions (PVCs)
  + Premature atrial contractions (PACs)
  + Asystole

**Heart Failure**

* General term used to describe several types of cardiac dysfunction that result in inadequate perfusion of tissues with blood-borne nutrients

**Left heart failure (Congestive heart failure)**

* Systolic heart failure
  + Inability of the heart to generate adequate cardiac output to perfuse tissues
  + Ventricular remodeling
  + Causes include myocardial infarction, myocarditis, cardiomyopathy
* Diastolic heart failure
  + Pulmonary congestion despite normal stroke volume and cardiac output
  + Causes include myocardial hypertrophy and ischemia, diabetes, valvular and pericardial disease
* Manifestations of left heart failure:
  + Result of pulmonary vascular congestion and inadequate perfusion of the systemic circulation
  + Include dyspnea, orthopnea, cough of frothy sputum, fatigue, decreased urine output, and edema
  + Physical examination often reveals pulmonary edema (cyanosis, inspiratory crackles, pleural effusions), hypotension or hypertension, an S3 gallop, and evidence of underlying CAD or hypertension

**Right heart failure**

* Most commonly caused by a diffuse hypoxic pulmonary disease
* Can result from an increase in left ventricular filling pressure that is reflected back into the pulmonary circulation

**High-output failure**

* Inability of the heart to supply the body with blood-borne nutrients, despite adequate blood volume and normal or elevated myocardial contractility
* Causes include anemia, hyperthyroidism, septicemia

**Shock**

* Cardiovascular system fails to perfuse the tissues adequately
* Leads to impaired cellular metabolism
  + Impaired oxygen use
  + Impaired glucose use
* Manifestations vary based on stage but often include hypotension, tachycardia, increased respiratory rate
* Types of Shock
  + Cardiogenic
  + Hypovolemic
  + Neurogenic
  + Anaphylactic
  + Septic

**Multiple Organ Dysfunction Syndrome**

* Causes:
  + Most common: sepsis, septic shock
  + Other: any severe injury (trauma, burns, major surgery)
* Manifestations:
  + Respiratory
  + Hepatic
  + Renal
  + GI
  + Myocardial failure