**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