Heart: Pathology of the Malfunctioning Corazón

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Objectives
- Define and describe hypertension and its complications
- Define ischemic heart disease
- Describe the pathogenesis of a myocardial infarct and its complications
- Define acute and chronic rheumatic heart disease and describe its pathogenesis and complications
- Define and describe congestive heart failure

Overview of Pathology
- Etiology or cause
- Pathogenesis
- Morphologic changes
- Functional derangements and clinical significance

Critical Variables of the Cardiovascular System
- Pressure (blood pressure)
- Volume (intravascular volume)
- Contractility (heart muscle and vascular muscle)
- Compliance (amount of stiffness)

Hypertension
- Defined as an elevated blood pressure leading to end-organ damage
- A sustained diastolic pressure greater than 90 mm Hg and/or systolic pressure greater than 140 mm Hg
- Hypertension is very common
- Complications of hypertension can be devastating and usually remains asymptomatic until late in the course of the disease
- No organ is spared
Pathogenesis of Hypertension

**Cardiovascular System: Blood Vessels**

**Atherosclerosis**

**Normal Heart**

**Normal Myocardium**
Hypertensive Heart Disease

Cardiac Myocyte Hypertrophy

Intracerebral Hemorrhage

Hypertension

Causes
- Essential (idiopathic or primary) hypertension - 90-95%
- Benign
- Malignant (accelerated)

Secondary hypertension (5-10%)
- Renal
  - Acute glomerulonephritis
  - Chronic pyelonephritis
  - Polycystic kidney disease
  - Renal artery stenosis
  - Renal amyloidosis
  - Urinary tract obstruction

Endocrine
- Pheochromocytoma
- Primary aldosteronism
- Cushing syndrome
- Exogenous hormones (glucocorticoids, estrogen, etc.)
- Pituitary adenoma
Causes
- Secondary hypertension (5-10%)
- Cardiovascular
  - Coarctation of the aorta
  - Polyarteritis nodosa
- Pregnancy-induced (pre-eclampsia)
- Neurogenic (psychogenic)

Pathology of Benign Hypertension
- Gross
  - Kidneys are either normal, or small in size
  - Cortical surfaces have a fine granular texture ("leather grain")

Pathology of Malignant Hypertension
- Gross
  - Size is dependent upon the duration and severity of the hypertensive disease
  - Cortical surfaces may have small, pinpoint hemorrhages (petechiae) that represent rupture of the arterioles, or glomerular capillaries ("flea-bitten" appearance)
Pathology of Malignant Hypertension

- Light microscopy
- Hyperplastic arteriolosclerosis ("onion skinning") is the proliferation of concentrically arranged smooth muscle cells
- Fibrinoid necrosis of the arterioles

Components of Immunity

- Peripheral Blood
  - Basophil
  - Band
  - Eosinophil
  - Lymphocyte
  - Monocyte
  - PMN
  - Platelets
  - RBCs

Skin Abscess
Acute Pneumonia

Intravascular and Extravascular Spaces

Vasodilatation

Margination and Adhesion

Margination

Intravital Microscopy of Venules in Hamster Cheek Pouch
Immune Response to Necrotic Tissue

Ischemic Heart Disease

Normal Heart

Myocardial Circulation

Ischemic Heart Disease

- Angina pectoris
- Myocardial infarction
- Chronic ischemic heart disease
- Sudden cardiac death
Atherosclerotic Coronary Artery Disease

Ischemic Heart Disease

- Coronary blood flow is not reduced until 75% occlusion of the lumen
- Atherosclerotic plaque involves the epicardial coronary arteries
- Most common & most severe atherosclerotic plaque - proximal anterior descending artery
- 50% of myocardial infarcts involves a thrombus; 90% of transmural infarcts are associated with a thrombus

Clinical symptoms and laboratory findings for MI
- Chest pain
- Leukocytosis
- Electrocardiographic changes
- Elevated serum levels of serum cardiac enzymes (CPK-MB fraction, troponin I)

Complications
- Arrhythmias (90%)
- Cardiogenic shock
- Congestive heart failure
Wavy Fibers

Contraction Band Necrosis

3-5 days Post-myocardial Infarction

Acute Myocardial Infarct

Myocardial Infarction
Acute Subendocardial Myocardial Infarct

Acute Transmural Myocardial Infarct

Acute Myocardial Infarct of the Left Anterior Papillary Muscle

Ischemic Heart Disease

- Complications
  - Cardiac rupture
    - Most likely within two weeks and greatest within one week following an acute infarct
    - Incidence - 5-8% of infarcts

Sites of Cardiac Rupture

Cardiac Rupture
Cardiac Rupture: Left Anterior Papillary Muscle

Complications

Ventricular aneurysm

Incidence - varies from 5-35% of infarcts

Ischemic Heart Disease

Complications

Ventricular aneurysm

Incidence - varies from 5-35% of infarcts

Left Ventricular Wall Aneurysm

Complications

Mural thrombus

Predisposing factors - ventricular aneurysm, extension of the infarct to the endocardium, congestive heart failure

Complication - increased risk of embolization after myocardial infarction (6%)

Massive pulmonary embolism
Rheumatic Heart Disease

Definition

An acute, recurrent, inflammatory disease that follows a pharyngeal infection due to beta hemolytic Group A streptococci

Over period of years, the mitral, or mitral and aortic valves may become permanently damaged (fibrosis)
Acute Rheumatic Fever
- Heart - foci of fibrinoid necrosis surrounded by lymphocytes and macrophages are called Aschoff bodies
- Involve all three layers of the heart including valves
- Joints - acute nonspecific arthritis, large joints, especially the knees
- Skin - subcutaneous nodes (erythema marginatum)
- Arteries - arteritis

Endocardial Aschoff Body

Myocardial Aschoff Bodies

Rheumatic Heart Disease
- Mitral stenosis
- Fibrous adhesion between the free edges of the cusps, & thickening and fusion of mitral valve leaflets
- Shortening, thickening and fusion of chordae tendineae
- Dilatation of left atrium
- Mural thrombosis of left atrium
- Increased risk for bacterial endocarditis

Chronic Rheumatic Valvular Heart Disease
Chronic Rheumatic Valvular Heart Disease

**Rheumatic Heart Disease**
- Pathologic changes in the lungs
- Congestion and edema
- Hemorrhages and infarct(s)
- Hemosiderosis
- Hyperplasia of pulmonary arteries
- Fibrosis of alveolar septa
- Right ventricular hypertrophy and failure

**Rheumatic Heart Disease**
- Mitral insufficiency (regurgitation)
- Aortic stenosis
- Aortic insufficiency

**Congestive Heart Failure**
- **Definition**
  - Group of clinical symptoms and signs reflecting when the heart is unable to pump an adequate amount of blood, or meet the metabolic needs of the body
- **Causes**
  - Intrinsic heart diseases
  - Non-cardiac diseases
Congestive Heart Failure
- High output vs. low output failure
- Forward vs. backward failure
- Left-sided vs. right-sided failure

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