Pathology of the Heart

- All problems are eventually expressed as inadequate cardiac output.
  - Leaks in the system
  - Electrical Conduction, irregular rhythm
  - Obstruction to flow
  - Valve problems, obstruction or incompetence
  - Cardiac muscle weakness and failure

Congenital Heart Disease

- Clinical symptoms come from mixing blood.
  - Right (unoxgenated) blood is shunted to...
  - Systemic output
  - Cyanosis, either immediate or late
- Present at birth
  - Genetic factors are rare
  - Environmental (developmental) are common
    - Maternal infections
    - Fetal alcohol syndrome
**Congenital Heart Disease**

- **Cyanotic heart disease**
  - Child is cyanotic (blue) right from the get-go.
  - Right-sided blood is mixing with systemic.
  - Non-oxygenated blood (venous blood) is coming directly out in the aorta.

- **Tardive cyanotic heart disease**
  - Tardive means late, late developing.
  - Comes several years after birth.
  - Underlying problem has been there all along.
  - Left to right shunt.
  - More blood in the pulmonary circulation can handle.
  - In time the shunt reverses.

**Congenital Heart Disease**

- **Atrial septal defect**
  - Common and may cause severe shunting.
  - Several varieties.
  - Paradoxical embolization.

**Repair of an Atrial Septal Defect**

- **Ventricular Septal Defect**
  - Left to right shunt
  - Depending on size will lead to Eisenmenger reaction.
  - Later becomes right to left shunt.
  - Possible infections.

**Ventricular Septal Defect**
Ventricular Septal Defect
- Colorized Doppler
- Note jet at top of frame.
- Infection on downstream side.
- Eisenmenger?

Tetralogy of Fallot
- Four problems
  - 3 defects
  - 1 compensatory
  - VSD
  - Narrowed pulmonary outflow tract
  - Over-riding aorta
  - RV hypertrophy

Coarctation of Aorta

Heart Failure
- Diminished out volume of either ventricle.
  - Systolic failure
    - Loss of pumping strength.
    - Backup of blood behind weakened ventricle.
    - Atherosclerosis leading to chronic ischemia.
  - Diastolic failure
    - Reduced ability of ventricle to fill.
    - Constriction of trapping of ventricle

Congestive Heart Failure
- Diminished of pumping ability of left ventricle.
- Back up of blood in pulmonary vasculature.
- Pulmonary edema
- Peripheral edema
Back Pressure

CHF and Edema Formation

Pulmonary Edema

Liver Chronic Passive Congestion

Pitting Edema
Ischemic Heart Disease

- This is the biggie in the western world.
- Atherosclerosis of coronary arteries.
- Acute vs. chronic ischemia.
- Four basic patterns
  - Angina pectoris
  - Myocardial infarction
  - Chronic ischemia leading to CHF
  - Sudden death from arrhythmia

Coronary Atherosclerosis

- Focal narrowing

Myocardial Infarction

- Myocardial Infarction
- Acute vs. chronic ischemia
- Chronic ischemia leading to CHF
- Sudden death from arrhythmia
Myocardial Infarction

- Complications of MI
  - Cardiogenic heart failure
  - Sudden loss of pumping strength.
  - Arrhythmias
    - Irritable conduction system.
  - Valvular dysfunction
    - Involvement of papillary muscle
  - Rupture and tamponade

Hypertension

- Many causes
- Essential (majority)
  - No known cause
  - Stress perhaps
- Modifiable causes
  - Endocrine tumors
    - Aldosteronism
  - Cushings Syndrome
  - Vascular related
    - Narrowing of renal a.
  - Primary Renal disease
    - Excess renin production

Cardiovascular Changes with Hypertension

- Left ventricular hypertrophy
- Abnormal orientation of hypertrophied cells.
- Heart failure in time
- Arrhythmias
- Severe atherosclerosis
- Renal disease
- Stroke
- Aortic wall dissection

Left Ventricular Hypertrophy

Cor Pulmonale

- Right-sided failure secondary to intrinsic pulmonary disease.
  - Emphysema
  - Scarring conditions of the lung
  - Chronic embolization
Valvular Disease
- Stenosis (won’t open all the way)
- Incompetent (won’t close all the way)
- Embolization of junk from a valve

Rheumatic Fever
- Streptococcal infection starts it.
- Antibodies are made against Strep wall.
- Antibodies cross react with connective tissue.
  - Type II hypersensitivity.
- Many systems become involved.

Rheumatic Carditis
- All parts of the heart are involved.
  - Endocardium
  - Valves
  - Myocardium
  - Pericardium
- To the right are sterile vegetations on acutely inflamed valves
  - Can embolize
  - Will lead to scaring

Healed Rheumatic Carditis
- Scared and stenotic mitral and aortic valves.
- Old sites of inflammation in myocardium
  - Aschoff nodules
  - Scars of pericarditis
**Healed Rheumatic Mitral Valve**
- Scarred valve.
- Both stenotic and incompetent.
- ‘Fish mouth’
- This valve is a set up for infections.

**Marfan’s Syndrome**
- Inherited disorder of elastic tissue
- Dilated aorta, dissection and rupture.
- Incompetent aortic valve.
- Mitral valve stretches
- Lenses can’t accommodate.

**Mitral Valve Prolapse**
- Myxoid degeneration of valve matrix.
- Stretches under pressure of left ventricle.
  - Parachute deformity
  - The one to the right has a ruptured cordae tendineae

**Infective Endocarditis**
- Living bacteria on the valves
- Previously damaged valves are at greater risk.
- Destroys valve
- Embolize the junk

**Rheumatic Valvular Disease**
- Scarred valve.
- Both stenotic and incompetent.

**Infective Endocarditis**
- Living bacteria on the valves
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- Embolize the junk
**Cardiomyopathy**
- Weakened and, paradoxically, hyperplastic myocardium
- 'Primary' means we don't what causes it.
- Secondary to something else.
  - Alcohol
  - Heavy metals
  - Virus?

**Myocarditis**
- Viruses mostly in US
- Rarely bacteria of TB.
- Parasites
  - Toxoplasmosis gondii
  - Trypanosoma cruzi
- Complications
  - Heart failure
  - Rhythm disturbances
  - Scarring of muscle
  - Mural thrombus and embolization

**Pericardial Disease**
- Inflammation
  - Viral
  - Lyme disease
  - Renal Failure
  - Cancer
- Effusions
  - CHF
  - Cancer
- Fibrosis leading to restriction of heart motion

**Pericarditis**
- Inflammation of epicardium and pericardium
- Effusion (fluid) of pericardial space
  - Tamponade
- May lead to serious scarring and restriction of heart motion.

**Hemopericardium**
- Ruptured or perforated heart
  - MI
  - Penetrating wounds
- Lacerated aortic root
  - Auto accident
  - Rotatory motion unscrews heart from aorta