

The Nature of Disease
Pathology for the Health Professions

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Chapter 8

Disorders of Blood Vessels

Lecture 8

Overview of Today's Lecture

- Brief Review of Blood Vessels
- Hypertension
- Atherosclerosis
- Aneurysms and Dissections
- Vasculitis and Raynaud's Syndrome
- Diseases of the veins
- Tumors of the blood vessels and lymphatic vessels

Review of Blood Vessels

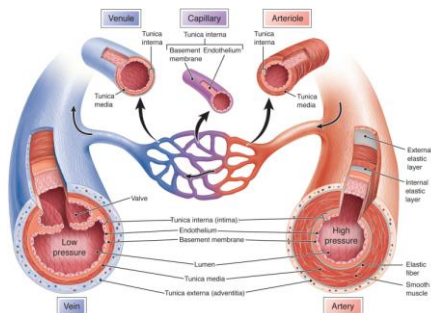
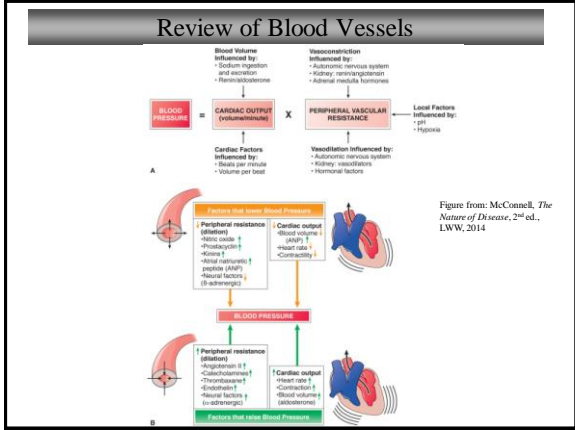


Figure from: McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014



Hypertensive Vascular Disease

- Hypertension (Primary, Secondary)
 - 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
 - Environmental risk factors:
 - High sodium intake
 - Natriuretic peptide (ANP) abnormalities
 - Obesity & Insulin resistance; Lack of Exercise
 - Smoking

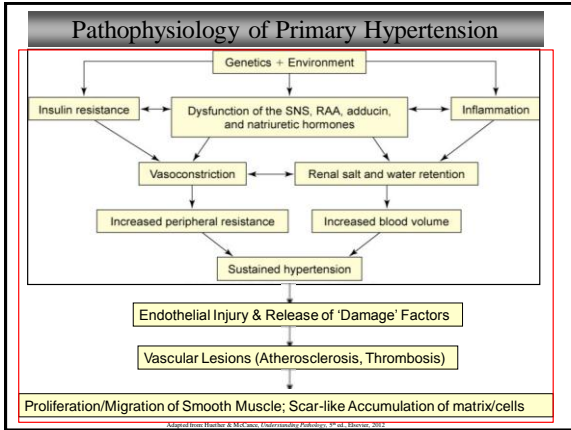
Hypertensive Vascular Disease

Table 8.1 JNC7 Classification of Blood Pressure in Adults

Classification	BP (mm Hg)
Normal	<120 (systolic) and 80 (diastolic)
Prehypertension	120–139 (systolic) or 80–89 (diastolic)
Stage 1	140–159 (systolic) or 90–99 (diastolic)
Stage 2	≥160 (systolic) or ≥100 (diastolic)

JNC, Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.

Table from: McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014



- ### Hypertensive Vascular Disease
- **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
 - **Malignant hypertension**
 - Rapidly progressive hypertension; Life threatening
 - Diastolic pressure is usually >140 mm Hg

Hypertensive Vascular Disease

- Hypertension Damages Arteries and Organs
 - **Adverse effects are directly related to high BP**
 - **Hypertension is a key risk factor for atherosclerosis**
 - Other effects: cardiac hypertrophy, heart failure, kidney failure, retinopathy, stroke
 - **Atherosclerosis** in small blood vessels

Adventitia
Media
Lumen
Markedly thickened intima. Normal endothelium is only one cell thick.

Afferent arteriole with hyaline arteriosclerosis

Figures from:
McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014

Hypotension

- Hypotension
 - Reduced BP (approx. < 90/60 mm Hg)
 - Example: 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
 - Reduced perfusion may cause organ dysfunction or tissue necrosis

Arteriosclerosis

- 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

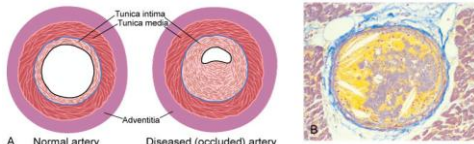


Figure from: Haether & McCance, *Understanding Pathology*, 5th ed., Elsevier, 2012

Atherosclerosis

- Atherosclerosis
 - A form of arteriosclerosis
 - Thickening and hardening caused by accumulation of lipid-laden macrophages in the arterial wall
 - Plaque development (next slide)
 - Begins in CHILDHOOD and progresses

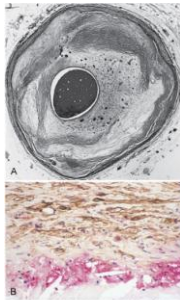


Figure from: Haether & McCance, *Understanding Pathology*, 5th ed., Elsevier, 2012

Progression/Results of Atherosclerosis

- Progression/Pathogenesis (See next slide)

- 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

• Results in inadequate perfusion, ischemia, necrosis:

- Most common: MI, stroke, aortic aneurysm, peripheral vascular disease
- Angina, temporary/transient ischemic attack (TIA), intermittent claudication

Atheroma Formation

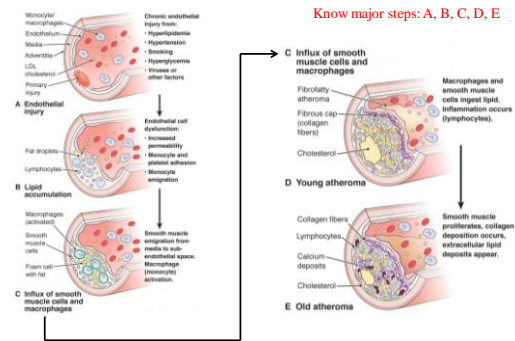


Figure from: McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014

Blood Flow and Progression of Atherosclerosis

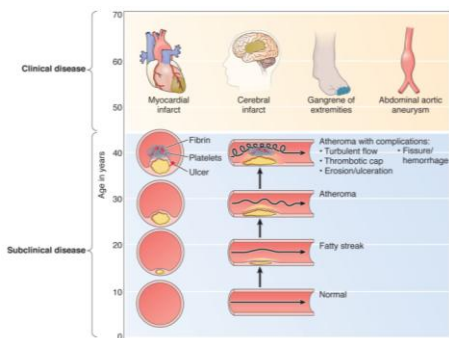


Figure from: McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014

Atherosclerosis: Best Treatment is Prevention

Lipid	Optimal/near-optimal serum concentration	Borderline serum concentration	High-risk/very high-risk serum concentration
TC, mg/dL	<200	200-239	≥240
HDL-C, mg/dL	≥60 (negative risk factor)	40-59 (men) 50-59 (women)	<40 men <50 women ^a
LDL-C, mg/dL	<100 optimal (100-129 near-optimal)	130-159	160-189 high ≥190 very high
TG ^a , mg/dL	<150	150-199	200-499 high ≥500 very high
Apo B, mg/dL	<90 (patients at risk of CAD, including those with diabetes) <80 (patients with established CAD or diabetes plus ≥1 additional risk factor)		

Abbreviations: apo, apolipoprotein; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides.
^a Both borderline and high-risk values may signify familial combined dyslipidemia or dyslipidemia of diabetes; values ≥100 indicate high risk for pancreatitis.
^b Moderate reductions of high-density lipoprotein cholesterol in women may indicate insulin resistance syndrome.

<https://www.aace.com/files/lipid-guidelines.pdf>, 2012

Aneurysms

• Aneurysm

- Local dilation or outpouching of a vessel wall or cardiac chamber
- True aneurysms (all three layers)
 - Berry; saccular (A)
 - Fusiform aneurysms ; elongated (B)
- Vascular dissection (dissecting hematoma)
 - Longitudinal tearing (C)
- Aorta most susceptible, especially abdominal
 - Causes include atherosclerosis, hypertension; trauma; syphilis; congenital
 - Can lead to aortic dissection or rupture
 - Death occurs in seconds

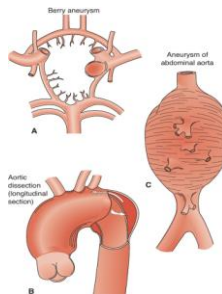
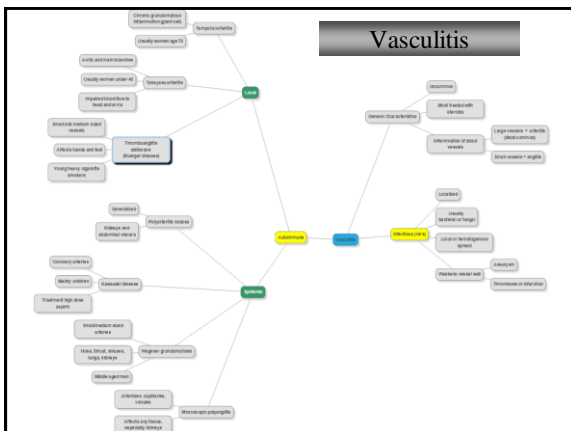


Figure from: Porth, C.M., *Essential Pathophysiology*, 4th ed., Elsevier, 2015

Vasculitis



Raynaud Syndrome

- Common condition
- Exaggerated vasomotor activity
 - Small arteries and arterioles
 - Hands and feet
 - Functional disease, not anatomical
 - Occasionally affects nose, earlobe, lips
 - Women more than men
 - Blanching of affected parts
 - May become cyanotic, numb
 - Rewarmed part becomes hyperemic



Figure from McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014

- Primary Raynaud Syndrome accounts for 80%
- Secondary usually in conjunction with autoimmune disease, e.g. systemic sclerosis, SLE

Diseases of Veins - Varicose 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
 - Standing for long periods
- Hemorrhoids – varicose veins of anus



Fig. 20-1. Varicose Veins of the Leg (arrow)

Diseases of Veins - Thrombophlebitis

Thrombophlebitis

- Formation of venous thrombi accompanied by inflammation
- Deep veins of leg about 90% of cases
 - Deep venous thrombosis (DVT)
 - Risk factors:
 - Increased venous pressure; sluggish blood flow
 - Prolonged immobilization most common cause
- Usually silent (can grow up to two feet long w/o problems appearing)
- Thrombi embolize to lungs; infarcts/death

Tumors of Blood Vessels and Lymphatic Vessels

- **Blood vessel tumors – hemangiomas**

- Usually found in skin as small, red, blood-filled lesions
- Usually capillary-sized blood vessels
- Often appear in skin of children
- Spider angiomas – pulsatile; assoc with high estrogen
- Cavernous angiomas; deep: brain, liver

From: <http://www.drmkoth.com/>



Figure from: McConnell, *The Nature of Disease*, 2nd ed., LWW, 2014

- **Lymphatic vessel tumors - lymphangiomas**

- Kaposi Sarcoma (intermediate; immunosuppressed patients)

– **Angiosarcoma – rare malignant tumor of endothelium**
