CV Disorders
Peripheral Vascular Disorders

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Venous: Varicose Veins

Venous dilatation accompanied by vessel elongation and tortuous shaping

Most common: saphenous vein

- Primary (Gravity)
  - Structural weakness
  - Competent or incompetent valves

- Secondary (Trauma)
  - Previous thrombophlebitis
  - Incompetent valves

McCance & Huether, 2014, Figure 32-1
Chronic Venous Insufficiency

Chronic inadequate venous return resulting in:

- Venous hypertension
- Circulatory (venous) stasis
- Tissue hypoxia

Inflammatory Response

Venous stasis ulcerations
Venous Thrombus Formation

Thrombus – clot attached to vessel wall
Thromboembolus – detached and moving

**DVT**
- Iliac
- Femoral
- Popliteal
- Calf
- Tibial

**SVT**
- Greater saphenous
- Lesser saphenous
- Other
Venous Thrombus Formation

Risk Factors:
- Venous stasis
  - Immobility, obesity, prolonged LE dependency
- Venous endothelial damage
  - Trauma
- Hypercoagulapathy
  - Genetics, oral contraceptives, hormone replacement therapy, pregnancy

Prevalence
- DVT Mortality: 300,000 – 600,000 per year (1-2/1,000)
- DVT Morbidity: 60,000 – 100,000
- DVT in persons over 80: 1/100
- DVT/PE - 25% of persons have sudden death as their first symptom
Venous Thrombus Formation

Pathophysiology

- Accumulation of clotting factors and platelets
- Generally form near venous valve

Inflammatory response
↓
↑ platelet aggregation
↓
Thrombus grows proximally

Spontaneous resolution or Pharmacologic intervention
Venous Thrombus Formation

Complications

– Pulmonary embolus

– Death
  • 10-30% in one month of diagnosis

– Post-thrombotic syndrome
  • 50% - Chronic leg pain, swelling, redness and discoloration, scaling, ulcers
  • 33% - recurrence within 10 years
Arterial Aneurysm

Localized dilation or outpouching of vessel wall or cardiac chamber

Atrophy and weakening of arterial wall tunica media
Arterial Aneurysm

**Most common site:** Aorta

- Constant high pressure
- No vasa vasorum in medial arterial layer

**Pathophysiology**

- Stretching of arterial wall
- Expansion of weak, necrotic muscle layer
- Becomes more fibrotic over time, but continues to bulge and serve as blood reservoir
Arterial Aneurysm

True aneurysm
– 3 arterial wall layers are weakened
  • Fusiform
  • Saccular
Arterial Aneurysms

**False aneurysm**
- Saccular aneurysms
- Interruption of arterial wall, layers remain intact

**Dissecting aneurysm**
- Tear in tunica intima
- Disruption of longitudinal arterial layers
- Blood flows through the arterial layers
- Most common in the aorta

McCance & Huether, 2014, Figure 32-10
Arterial Thrombus Formation

Form at sites of coagulation cascade

- Inflammation
  - Hyperlipidemia
  - Hypercholesterolemia
  - Autoimmune
  - Vasculitis
- Traumatic injury
- Infections
- Hypotension /shock
- Arterial pooling

Embolus – circulating in bloodstream
- Thromboembolus
Embolism

**Definition**
- Vessel occlusion by an emboli

**Types**
- Air
- Amniotic fluid
- Bacterial
- Fat

**Outcomes**
- Organ or extremity:
  - Ischemia or infarction in tissue distal to the occlusion
- Coronary, cerebral, or pulmonary artery
  - Death
Peripheral Arterial Disease: Thromboangiitis Obliterans

**Definition**
- Buerger Disease
- Inflammatory disease of peripheral arteries

**Population**
- Young male smokers

**Pathophysiology**
- Nonatherosclerotic lesions obstruct small and medium-sized arteries
  - Digital, tibial, plantar, ulnar, and palmar arteries

**Clinical manifestations**
- Pain, tenderness
- Rubor (capillary dilation)
- Chronic ischemia → thinning of skin, thickened, malformed nails
- Advanced → ischemia and gangrene
Peripheral Arterial Disease: Raynaud Disease

**Definition**
- Episodic vasospasm in arteries and arterioles of the fingers, less commonly the toes

**Pathophysiology**
- Primary vasospastic disorder of unknown origin
- Triggered by brief cold exposure or emotional stress

**Clinical manifestations**
- Cold sensation in hands/feet
- Skin pale and cold to touch
- White or purple appearance
Peripheral Arterial Disease: Raynaud Disease

Raynaud phenomenon
– Reynaud disease symptoms secondary to other systemic diseases or conditions
  • Collagen vascular disease (scleroderma)
  • Smoking
  • Pulmonary hypertension
  • Myxedema
  • Emotional stress
  • Environmental factors - cold, prolonged exposure to vibrating machinery
Peripheral Arterial Disease: Hypertension

- 70 million (30%) American adults
- Only about 50% of people with HTN are controlled.
- 1 of 3 American adults have Pre-HTN
- Contributes significantly to cardiac and cerebral vascular pathology:

  - 69% of people who have a first heart attack...
  - 77% of people who have a first stroke...
  - 74% of people with chronic heart failure...

CDC
Peripheral Arterial Disease: Hypertension

- Sustained SBP ≥ 140 mmHg
- Sustained DBP ≥ 90 mmHg

<table>
<thead>
<tr>
<th>Blood Pressure Category</th>
<th>Systolic mm Hg (upper #)</th>
<th>Diastolic mm Hg (lower #)</th>
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<tbody>
<tr>
<td>Normal</td>
<td>less than 120</td>
<td>and less than 80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120 – 139</td>
<td>or 80 – 89</td>
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<tr>
<td>High Blood Pressure (Hypertension) Stage 1</td>
<td>140 – 159</td>
<td>or 90 – 99</td>
</tr>
<tr>
<td>High Blood Pressure (Hypertension) Stage 2</td>
<td>160 or higher</td>
<td>or 100 or higher</td>
</tr>
<tr>
<td>Hypertensive Crisis (Emergency care needed)</td>
<td>Higher than 180</td>
<td>or Higher than 110</td>
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Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
Peripheral Arterial Disease: Primary (Essential) Hypertension

- 90-95% of HTN cases
- Late 30s – early 50s
- Unknown cause

Genetic
Environmental
↑ vascular tone
↑ blood volume

Genetics + Environment

Insulin resistance
Dysfunction of the SNS, RAA, adducin, and natriuretic hormones
Inflammation

Vasoconstriction
Renal salt and water retention

Increased peripheral resistance
Increased blood volume

Sustained hypertension
Peripheral Arterial Disease: Secondary Hypertension

- 5-10% of HTN cases
- Associated with specific cause

<table>
<thead>
<tr>
<th>Renal</th>
<th>Endocrine</th>
<th>Vascular</th>
<th>Gestational</th>
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<tbody>
<tr>
<td></td>
<td>Thyroid</td>
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<td>Adrenal</td>
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<td>Neurologic</td>
<td>Acute Stress</td>
<td>Drugs</td>
<td>Other Substances</td>
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Genetic Environmental

↑ vascular tone
↑ blood volume
Peripheral Arterial Disease: Complications of Hypertension

Main complications of persistent High blood pressure

Brain:
- Cerebrovascular accident (strokes)
- Hypertensive encephalopathy:
  - confusion
  - headache
  - convulsion

Retina of eye:
- Hypertensive retinopathy

Heart:
- Myocardial infarction (heart attack)
- Hypertensive cardiomyopathy:
  - heart failure

Blood:
- Elevated sugar levels

Kidneys:
- Hypertensive nephropathy:
  - chronic renal failure
Peripheral Arterial Disease: Atherosclerosis

Word Origin
- Athere – fatty mush
- Skleros – hard

Definition
- Gradual thickening of the intima and media, leading to a narrowing of the vessel.
- Complicated lesion containing several blood components and cellular debris

Contributing Factors
- Hypertension
- Smoking
- Hyperlipidemia
- Hyperhomocysteinemia
- Toxins
- Viruses
- Immune reactions
Peripheral Arterial Disease

Atherosclerosis – Progressive Pathophysiology

– Deposition of small fatty streaks
  • Lipid cells
  • Present by age 15

– Development of raised fibrous plaques
  • Chronic endothelial injury
  • Smooth muscle damage (from lipids)
  • Present by age 30

– Development of complicated lesion
  • Cholesterol core
  • Structure
    – Fibrous tissue
    – Collagen
    – Calcium
    – Cellular debris
  • Necrotic tissue appears within arteries
Peripheral Arterial Disease

Atherosclerosis

Gradual thickening of the tunica intima and media, leading to narrowing of the vessel

McCance & Huether, 2014, Figure 32-12
Peripheral Arterial Disease

Atherosclerosis: Consequences

- Partial or total vessel obstruction
  - Ischemia → Infarction
- Microthrombi formation
  - Thromboembolus
- Aneurysm
CV Disorders
Peripheral Vascular Disorders

Normal Artery
“Plaque”
Build up of fatty substances in the wall of the artery