CMC Certification Review Course:
Handout

Session #: 5
Vascular Diseases, Pulmonary Abnormalities, Neurologic Abnormalities, Behavioral Abnormalities

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CMC Review Course
Session 5:
Vascular Diseases
Pulmonary Abnormalities
Neurologic Abnormalities
Behavioral Abnormalities
Leanna R. Miller
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Peripheral Arterial Disease

- Definition
  - Atherosclerotic obstruction of arteries in lower extremities

- Etiology
  - Atherosclerosis
  - Risk factors of ACS

Peripheral Arterial Disease: Clinical Presentation

- 50% symptom free
- Pain at rest
- Diminished pulses
- Bruits
- Rubor
- Cool skin temperature
- Trophic changes
- Nonhealing ulcers

Peripheral Arterial Disease: Diagnostics

<table>
<thead>
<tr>
<th>Ankle-Brachial Index (ABI)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9 to 1.0</td>
<td>Normal value</td>
</tr>
<tr>
<td>0.75 to 0.9</td>
<td>Moderate disease present</td>
</tr>
<tr>
<td>0.5 to 0.75</td>
<td>Severe disease present</td>
</tr>
<tr>
<td>Less than 0.5</td>
<td>Limb-threatening disease</td>
</tr>
</tbody>
</table>
Peripheral Arterial Disease: Management

- Tobacco cessation
- Diet counseling
- Exercise
- Aspirin
- Pentoxifylline
- Pletal
- Surgical management
- Angioplasty

Carotid Artery Stenosis: Stroke

- Artery becomes extremely narrowed
- Rupture occurs in an artery to the brain that has atherosclerosis
- A piece of plaque breaks off and travels to smaller arteries of the brain
- A blood clot forms and obstructs blood vessel

Carotid Artery Stenosis: Risk Factors

- Same as coronary artery disease (CAD)
Carotid Artery Stenosis: Signs and Symptoms of Stroke

- Sudden loss of vision, blurred vision, or difficulty in seeing out of one or both eyes
- Weakness, tingling, or numbness on one side of face, one side of body, or in one arm or leg
- Sudden difficulty walking, loss of balance, lack of coordination
- Sudden dizziness and/or confusion
- Difficulty speaking
- Confusion
- Sudden severe headache
- Problems with memory
- Difficulty swallowing

Carotid Ultrasound: Standard or Doppler

- Looks for plaques and blood clots
- Determines if arteries are narrowed or blocked
- Shows movement of blood through the blood vessels

Magnetic Resonance Angiography

- Uses radio waves and a powerful magnet to gather accurate information about brain, arteries, and any clots
- Can often detect even small strokes in the brain
Computed Tomography Angiography
- Cross-sectional images of the carotid arteries
- Scan may reveal areas of damage to the brain

Cerebral Angiography
- AKA carotid angiogram
- Considered gold standard for imaging carotid arteries
- Allows visualization of blood flow through carotid arteries in real time
- Allows visualization of narrowing or blockages in carotid arteries
- Provides best information

Carotid Artery Stenosis: Treatment
- Follow recommended lifestyle habits
- Take medications as prescribed
- Procedure to improve blood flow
Carotid Artery Stenosis: Treatment

- Drugs to reduce risk of stroke
  - Aspirin
  - Clopidogrel (Plavix)
  - Coumadin
  - Antihypertensive drugs
  - Cholesterol-lowering drugs

Carotid Artery Stenosis: Interventions

- Carotid Endarterectomy (CEA)
  - Surgical removal of plaque and diseased portions of artery
  - Risks and benefits of CEA depend on age, degree of blockage, and previous stroke or transient ischemic attack (TIA)

- Carotid Artery Stenting (CAS)
  - Conducted in interventional lab
  - Angioplasty, stents, etc.
  - Long-term benefits not known

Venous Thrombosis: Risk Factors

- Sitting for long periods of time
- Genetic blood clotting disorder
- Prolonged bed rest
- Injury or surgery
- Pregnancy
- Cancer
- Heart failure
- Obesity
- Smoking
- Birth control pills or hormone replacement therapy
- History of venous thromboembolism (VTE) or pulmonary embolism (PE)
- Family history of same
Venous Thrombosis: Signs and Symptoms

- Swelling in affected leg
- Pain in leg
  - Often starts in calf
  - Feels like cramping
- Redness and warmth over affected area
- Pain or swelling in arms or neck

Venous Thrombosis: Signs of PE

- Unexplained sudden onset of shortness of breath
- Chest pain or discomfort that worsens on inspiration
- Feeling lightheaded or dizzy, or fainting
- Hemoptysis
- Sense of anxiety or nervousness

Venous Thrombosis: Diagnostics

- Ultrasound
- CT or MRI
- Lab: D-dimer
- Venography
Venous Thrombosis: Treatment Goals
- Stop blood clot from getting any larger
- Prevent clot from breaking loose and causing PE
- Prevent VTE from recurring

Venous Thrombosis: Treatment
- Anticoagulants
- Fibrinolytics
- Inferior vena cava filter
- Compression stockings
- Sequential compression devices

Aortic Aneurysm: Definition
- Dilation of the aorta > 1.5 times normal
- Usually an underlying weakness in wall of aorta
- Greatest concern is rupture
Aortic Aneurysm: Risk of Rupture
- Severe pain
- Massive internal hemorrhage
- Death

Aortic Aneurysm: Classifications
- Arch
  - Known as Tatatatum
- Aortic root
  - Sinus of Valsalva
- Thoracic
  - Ascending
  - Aortic arch
  - Descending
- Abdominal
  - Most common form
  - Less elastin in the thoracic aorta

Aortic Aneurysm: Risk Factors
- CAD
- Hypertension
- Elevated C-reactive protein
- Peripheral vascular disease
- Smoking
- Marfan syndrome
- Bicuspid aortic valve
Aortic Aneurysm: Signs and Symptoms

- **Pain**
  - Severe, acute, constant
  - Back or abdominal
- **Leg pain or numbness**
  - Compression of nerve roots
- **Anxiety**
- **Nausea and vomiting**
- **Rapid heart rate**
- **Hoarse voice**
  - Arch of the aorta
  - Left recurrent laryngeal nerve is stretched

Aortic Aneurysm: Diagnosis

- **Physical symptoms**
- **X-rays**
  - Chest
  - Abdominal
- **Aortogram**

Aortic Aneurysm: Treatment

- **Medical**
  - Control blood pressure
- **Surgical**
  - Open repair
  - Endovascular repair
Practice Exam Questions

The ankle-brachial index (ABI) is 0.5. This would indicate the patient has:

A. No peripheral arterial disease
B. Moderate peripheral arterial disease
C. Severe peripheral arterial disease. Normal ABI is 0.9–1.0; moderate peripheral arterial disease is 0.75–0.9; severe peripheral arterial disease is 0.5–0.75, and limb-threatening disease is < 0.5.
D. Limb-threatening peripheral arterial disease

Question #1 - Answer

The "gold standard" for the diagnosis of carotid artery stenosis is:

A. Carotid ultrasound
B. Magnetic resonance angiography
C. Computed tomography angiography
D. Cerebral angiography. Allows visualization of blood flow in real time and provides the best information for the diagnosis of carotid artery stenosis.
A compressive symptom related to an expanding thoracic aortic aneurysm is:

A. Heart failure
B. Intrascapular pain
C. Aortic valve regurgitation
D. Hoarseness. Compression of the left recurrent laryngeal nerve causes hoarseness.

Indicators of a thoracic aortic aneurysm on chest radiograph include:

A. Small aortic knob
B. Midline trachea
C. Widened mediastinum. The aortic knob is usually enlarged. Midline trachea is a normal finding. The mass presents as a widened mediastinum.
D. Pulsatile mass
Acute Lung Injury (ALI)
- Diffuse heterogeneous lung injury characterized by:
  - Hypoxemia
  - Noncardiogenic pulmonary edema
  - Low lung compliance
  - Capillary leakage
- ALI is caused by any stimulus of local or systemic inflammation—sepsis

ALI and Acute Respiratory Distress Syndrome (ARDS)
- Refractory hypoxemia
- Bilateral pulmonary infiltrates
- PAOP < 18 mm Hg
- ALI = partial pressure of arterial oxygen
  \[ \text{PaO}_2/F_i\text{O}_2 < 300 \text{ mm Hg} \]
- ARDS = \[ \text{PaO}_2/F_i\text{O}_2 < 200 \text{ mm Hg} \]

ALI
- Primary ALI is caused by a direct insult
  — pneumonia
- Secondary ALI is caused by an indirect insult
  — pancreatitis
ALI: Characteristics
- Low lung volumes
- Atelectasis
- Loss of compliance
- Ventilation-perfusion mismatch
  - Increase in dead space
- Right-to-left shunt

ALI: Management Strategies
- Adjunct therapies (have not proven effective)
  - Inhaled nitric oxide
  - Prone positioning
- Current ventilation strategies involve:
  - Volume ventilation
  - Low tidal volumes
  - Positive-end expiratory pressure (PEEP)
  - Conservative or high

ALI: Management
- A: Establish airway
- B: Mechanical ventilation
  - Adequate minute ventilation
  - Tidal volume not to exceed 6 mL/kg
  - Plateau pressure not to exceed 30 cm H₂O
- C: Fluid resuscitation and vasopressors as necessary
- D: Find underlying problem, control the source
- E: Empiric therapy
- FG: Feed the gut
  - Prevent atrophy and bacterial translocation
Ali: Case Studies

Acute Respiratory Failure: Definition
- \( \text{PaO}_2 < 60 \text{ mm Hg} \)
- \( \text{PaCO}_2 > 50 \text{ mm Hg} \)
- Alveolar-arterial oxygen difference (AaDO\(_2\))
  - 5–10 on room air
  - 50 on 100% \( \text{O}_2 \)
  - P/F ratio < 250

Acute Respiratory Failure: Definition
- Hypoxemia associated with a normal AaDO\(_2\) indicates that the cause of hypoxemia is alveolar hypoventilation
- P/F Ratio
  - Estimation of shunt
  - Normal > 300 mm Hg
  - Respiratory failure < 250 mm Hg
  - ARDS < 200 mm Hg
  - \( \text{PaO}_2 \) 78 mm Hg, FiO\(_2\) 0.4, so 78/0.4 = P/F ratio 195
Acute Respiratory Failure: Types

- Hypoxemia without hypercapnia
- V/Q (ventilation/perfusion) mismatch
  - Most common cause of hypoxemia
  - COPD, pneumonia, CHF
- Right-to-left shunt
- Pulmonary edema
- Atelectasis
- Airway occlusion

Acute Lung Injury: Types

- Hypoxemia With Hypercapnia
  - Decreased respiratory rate
  - Increased physiologic dead space
  - Decreased tidal volume
  - Decreased pulmonary compliance
  - Decreased chest wall compliance
  - Neuromuscular disorders
  - Increased CO₂ production

Acute Respiratory Failure: Management

- \( \text{PaO}_2 > 60 \text{ mm Hg} \) & \( \text{SaO}_2 > 90\% \)
- Treat underlying cause
- PEEP or CPAP
- Antibiotics
- Diuretics
- Improve ventilation
- Responds to \( \text{O}_2 \)
- Mechanical ventilation
- Low-flow \( \text{O}_2 \)
Pulmonary Embolus: Introduction
- Most common pulmonary complication
- 500,000 new cases
- High mortality
- 50,000 deaths/year

Pulmonary Embolus: Types
- Massive
  - Lobar or larger artery
  - Hemodynamically significant
- Submassive
  - Can be symptomatic if preexisting heart or lung disease

Pulmonary Embolus: Hypercoagulability
- Antithrombin III (ATIII) deficiency
- Malignancy
- Oral contraceptive use
- Sickle cell disease
- Thrombocytopenia
- Pregnancy
- Dehydration
- Fever
- Sepsis
Pulmonary Embolus: Vessel Injury
- Trauma
- Aging process
- Varicose veins
- Atherosclerosis
- Diabetes mellitus
- IV drug use
- Vasculitis
- Immune inflammatory response (IIR)

Pulmonary Embolus: Venous Stasis
- Immobilization
- Advanced age
- Pregnancy
- MI
- Dysrhythmias
- Cardioversion
- Recent surgery
- Obesity
- Burns
- CHF

Pulmonary Embolus: Pulmonary Infarction
- Hemorrhage
- Consolidation and necrosis
- Pleural effusion
- Lung abscess
- Pulmonary fibrosis
Pulmonary Embolus: Pathophysiology

- Humoral mediators (histamine, serotonin, prostaglandin) are released by the thrombus
- Bronchoconstriction, vasoconstriction, and increased capillary permeability
- Decreased oxygen delivery to the pulmonary tissue
- Hypoxia and hyperventilation

Pulmonary Abnormalities

- Decreased alveolar surfactant production (within 2-3 hours, severe at 12-15 hours)
- Underventilation of alveolus
- Alveolar collapse and increased dead space

Pulmonary Abnormalities

- Vasculature responds by constricting vessels perfusing the underventilated alveoli
- Elevation of pulmonary artery systolic (PAS) & pulmonary artery diastolic (PAD), increased pulmonary vascular resistance (PVR) — depending on size of pulmonary emboli
- Increased resistance to right ventricular (RV) output → increased RV stroke work index
Pulmonary Embolus: Diagnostic Indicators

**Small Embolus**
- Asymptomatic patient
- Small to medium embolus
  - Tachypnea
  - Dyspnea
  - Chest pain
  - Tachycardia
  - Accentuated pulmonic valve component of second heart sound (P₂)
  - Anxiety
  - Cough
  - Right-sided S₃ S₄

**Large to Massive**
- All symptoms as in small to medium
- Hypotension
- Cyanosis
- RV failure
- Sudden shock
- Mental confusion
- Pulseless electrical activity (PEA)

**Pulmonary Infarction**
- Fever
- Pleuritic chest pain
- Hemoptysis
- Pleural friction rub

**Hemodynamic Changes**
- BP
- SVR
- PVR
- CVP
- PAP
- PAOP
- CI
- SvO₂
ABGs
- \( \text{PaO}_2, \text{SaO}_2, \text{PaCO}_2 \) decreased
- Respiratory alkalosis
- Metabolic acidosis
- Respiratory acidosis

ECG
- Dysrhythmias
- New right bundle branch block
- Right axis deviation
- Tall, peaked P wave in lead II
- S wave in lead I and Q wave in lead III (\( S_1Q_3 \))

Diagnostics

Pulmonary Abnormalities

Pulmonary Embolus: ECG Pattern

Pulmonary Embolus: Chest X-Ray
- Initially normal
- Rule out other abnormalities
- At 24 hours will see small infiltrates, elevated hemidiaphragm, and decreased vascularity
- Infarction = infiltrates, ? effusion
Pulmonary Embolus: Chest X-Ray Pattern

- Ventricular dilation and hypokinesis
- Mitral regurgitation
- Bulging interventricular septum
- D-shaped left ventricle

Pulmonary Embolus: Echocardiogram

- Abnormal perfusion and normal ventilation
- Match defects with infiltrates on chest x-ray
- Defects on perfusion not seen on ventilation = possible sites of pulmonary emboli

- Low probability
  - 10%-20% chance
- Intermediate probability
  - 30%-50% chance
- High probability
  - 80%-90% chance

- Intermediate to low probability V/Q scan with + D-dimer is an indication for pulmonary angiography

Pulmonary Embolus: V/Q Scan
Pulmonary Embolus: Magnetic Resonance Angiography

- Type of pulmonary angiography
- Highly accurate
- Can be done outpatient without
  - PA catheter
  - Nephrotoxic contrast media
  - Ionizing radiation

Pulmonary Embolus: Pulmonary Angiography

- Definitive diagnostic tool
- Show cutoff of vessel within 24–72 hours from onset of symptoms

Pulmonary Embolus: Management

- Prevention
  - Ambulate
  - Elastic stockings
  - Deep breathing
  - Range of motion
  - Compression device
  - Frequent positioning
  - Mini-heparin
  - Hydration
- Arrest thrombosis and reestablish perfusion
  - Thrombolytic agent
  - Anticoagulant
  - Pulmonary embolectomy
  - Inferior vena cava (IVC) filter

Pulmonary Abnormalities
Pulmonary Abnormalities

Pulmonary Embolus: Complications
- Dyshrhythmias or blocks
- Pulmonary abscess
- Disseminated Intravascular Coagulopathy (DIC)
- Shock
- Complications of therapy
  - Bleeding
  - Oxygen toxicity

Cor Pulmonale: Definition
- Failure of the right side of the heart due to long-term pulmonary hypertension

Cor Pulmonale: Causes
- COPD
- Chronic blood clots in the lungs
- Cystic fibrosis
- Interstitial lung disease
- Obstructive sleep apnea
Cor Pulmonale: Symptoms
- Shortness of breath
- Light-headedness
- Fainting spells with activity
- Chest pain
- Peripheral edema

Cor Pulmonale: Physical Exam
- Ascites
- Abnormal heart sounds
- Cyanosis
- Hepatomegaly
- JVD
- Peripheral edema

Cor Pulmonale: Diagnostic Tests
- ABGs
- Pulmonary function tests
- Right heart catheterization
- V/Q scan
- Lung biopsy
Cor Pulmonale: Treatments

- Goal is to control symptoms
- Treat the diseases that cause pulmonary hypertension
- Ambrisentan (Letairis)
- Bosentan (Tracleer)
- Calcium channel blockers
- Diuretics
- Prostacyclin
- Sildenafil
- Anticoagulants
- Oxygen
- Lung or heart-lung transplant

Cor Pulmonale: Important Tips

- Avoid strenuous activities and heavy lifting
- Avoid high altitudes
- Yearly flu and pneumonia vaccines
- Smoking cessation

Cor Pulmonale: Complications

- Respiratory distress
- Severe fluid retention
- Shock
- Death
Pneumothorax: Definition
- Abnormal collection of air or gas in the pleural space
- Classifications
  - Primary
  - Secondary
  - Tension

Pneumothorax: Etiology
- Primary—unknown
- Risk factors include
  - Male sex
  - Smoking
  - Family history

Pneumothorax: Etiology
- Secondary—Severe
  - Lung Disease
    - Airway disease
    - COPD
    - Asthma
    - Cystic fibrosis
    - Lung infections
      - Pneumocystis pneumonia
      - Tuberculosis
      - Necrotizing pneumonia
  - Connective Tissue Diseases
    - Marfan syndrome
    - Rheumatoid arthritis
    - Lung Cancer

Pulmonary Abnormalities
Pneumothorax: Etiology

- Traumatic
  - Blunt or penetrating trauma
  - Medical procedures
  - Positive-pressure ventilation
  - Diving

Pneumothorax: Signs and Symptoms

- Sharp pain made worse by a deep breath or a cough
- Shortness of breath
- Tachycardia
- Larger pneumothorax will cause more severe symptoms including
  - Cyanosis due to lack of oxygen
  - Chest tightness
  - Increased work of breathing

Pneumothorax: Diagnostics & Treatment

- Diagnostics
  - ABGs
  - Chest x-ray

- Treatment
  - Needle thoracentesis
  - Chest tube
  - Thoracotomy
Hemothorax: Definition
- Collection of blood in the pleural cavity
- Classification
  - Small
  - Moderate
  - Massive

Hemothorax: Etiology
- Trauma
- Coagulopathy
- Pulmonary infarction
- Lung or pleural cancer
- Central venous catheter placement
- Thoracic or cardiac surgery
- Tuberculosis

Hemothorax: Symptoms
- Anxiety
- Chest pain
- Hypotension
- Pale, cool, and clammy skin
- Tachycardia
- Rapid, shallow breathing
- Restlessness
- Shortness of breath
Hemothorax: Diagnostics
- Chest x-ray
- CT scan
- Pleural fluid analysis
- Thoracentesis

Hemothorax: Treatment
- Goals of treatment
  - Stabilize the patient
  - Stop the bleeding
  - Remove the blood and air from the pleural space
- Chest tube insertion
- Thoracotomy

Hemothorax: Complications
- Pneumothorax leading to respiratory failure
- Empyema
- Fibrosis or scarring of the pleural membranes
- Shock
- Death
Practice Exam Questions

Pulmonary Abnormalities

Question #1 - Answer
The most important indicator of respiratory depression due to sedative or analgesic agents is:

A. Hypoxemia
B. Respiratory depth
C. Respiratory rate
D. Hypercapnia. The most important indicator of impending respiratory depression is an increasing PaCO₂.

Question #2 - Answer
The criteria consistent with a diagnosis of ARDS is:

A. Gradual onset of symptoms
B. Infiltrates isolated to 1 lung on anteroposterior (AP) chest film
C. PAOP > 22 mm Hg
D. P/F ratio < 200 mm Hg. The criteria for the diagnosis of ARDS include bilateral pulmonary infiltrates, diminished lung compliance, PAOP < 20 mm Hg, refractory hypoxemia, and P/F ratio < 200 mm Hg.
Question #3 - Answer
The most common cause of secondary pneumothorax is:
A. COPD. COPD accounts for 70% of the secondary pneumothoraces. It occurs most commonly with emphysema as a bleb rupture.
B. Central line insertion
C. Positive-pressure ventilation
D. Traumatic injury

Question #4 - Answer
ECG change consistent with pulmonary emboli is:
A. Left bundle branch block pattern
B. Right axis deviation. ECG changes seen with pulmonary emboli include right bundle branch pattern; right axis deviation; atrial fibrillation; tall, peaked P waves in lead II; and S, Q, T.
C. Ventricular tachycardia
D. Tall, peaked P wave in lead I

Question #5 - Answer
The definitive diagnostic for pulmonary emboli is:
A. Pulmonary angiography. Visualization of the emboli is seen with pulmonary angiography. V/Q scan is high probability or low probability. Chest x-ray is used to rule out other pulmonary problems. Echocardiogram shows atrial enlargement.
B. V/Q scan
C. Chest x-ray
D. Echocardiogram
Question #6 - Answer

A decision is made to intubate and mechanically ventilate the patient. PEEP is added to reduce intrapulmonary shunt. The major complication associated with PEEP is:

A. Elevated CVP
B. Increased urinary output
C. Decreased CI. A PEEP > 5 cm H₂O results in a decrease in preload that will decrease CI, decrease CVP, reduce urinary output, and increase heart rate.
D. Bradycardia

Neurologic Abnormalities

- Interruption of blood supply to any part of the brain
- Third leading cause of death in the United States

Stroke
Stroke: Definition
- Stroke = cerebrovascular accident (CVA) —brain attack
- Disruption of blood flow to part of brain
- Acute onset of neurologic deficits
- Vessels rupture or occlude

Stroke: Prognosis
- 40% of patients have minor neurologic impairment
  - Independent
- 10%–15% or patients have severe impairment
  - Long-term institutionalization
- 30%–50% moderate impairment
  - Require some supportive assistance

Stroke: Types
- Ischemic (84%)
  - Thrombotic (53%)
  - Embolic (31%)
- Hemorrhagic (16%)
  - Intracerebral (30%)
  - Subarachnoid (6%)
Ischemic Strokes

- Larger artery atherosclerosis
- Cardioembolism
- Small vessel occlusion (lacunar stroke)
- Strokes of other etiologies
  - Cardiac arrest
  - Pulmonary embolism

Ischemic Stroke: Risk Factors

- Age
  - Most significant risk factor for stroke
  - Increases with age
    - 75% occur in patients ≥ 65
    - Doubles each decade after age 55
- Gender
  - More males than females
  - Females over age 65
  - African-American females

Ischemic Stroke: Risk Factors

- Ethnicity
  - 50% higher in African-American males
  - 130% higher in African-American females
- Geographic
  - "Stroke belt"
  - 10% higher than national average
Ischemic Stroke: Risk Factors

- Hypertension = 6x increase in risk
- Heart disease = 2x–6x increase in risk
- Atrial fibrillation + rheumatic heart disease = 17x increase in risk
- Previous CVA, TIA = 10x increase in risk
- Carotid bruit = 3x increase in risk
- Diabetes mellitus = 2x–4x increase in risk
- Smoking = 2x increase in risk

Ischemic Stroke: Etiology

- Thrombotic stroke
  - Clot may form in an artery that is already very narrow
- Embolic stroke
  - Clot may break off from another location and travel up to the brain to block a smaller artery

Ischemic Stroke: Triage-Stroke Warning Signs

- Sudden weakness, paralysis, or numbness
- Speech abnormalities
- Vision disturbances
- Dizziness
Hemorrhagic Stroke
- Blood vessel in part of brain becomes weak and ruptures
- Accounts for 16% of all strokes
- Intracerebral and subarachnoid hemorrhage

Hemorrhagic Stroke: Risk Factors
- Alcohol use
- Bleeding disorders
- Cocaine use
- Head injury

Hemorrhagic Stroke: Symptoms
- Headache
  - Starts suddenly and may be severe
  - Occurs when lying flat
  - Wakes from sleep
  - Gets worse with change in position, bending, straining, or coughing
- Other Symptoms
  - Change in level of consciousness
  - Alterations in taste, hearing, or vision
  - Confusion or loss of memory
  - Difficulty swallowing
  - Loss of balance/coordination
  - Dizziness
  - Hemiparesis
  - Brudzinski or Kernig sign
Stroke: Diagnostic Tests
- CT scan
- Echo
- Carotid duplex
- Angiogram
- Lab tests:
  - CBC, PT, aPTT
  - ECG
    - Atrial fibrillation

Stroke: Assessment Scales
- National Institutes of Health Stroke Scale (NIHSS)
- Glasgow Coma Scale
- Barthel Index
  - Functional Scale

Stroke: Treatment
- Stabilize airway
- Optimize cardiovascular function
  - Manage BP
- Manage hyperthermia
- Manage hyperglycemia
- Monitor for signs of increased intracranial pressure (ICP) and seizures
- Prevent complications
Stroke: Treatment
- Prevention: medical management
- Prevention: surgical management
- Fibrinolytics
- Angioplasty

Neurologic Abnormalities

Practice Exam Questions

Neurologic Abnormalities

Question #1 - Answer
Strokes caused by cardioembolism often occur as a result of:
A. Atrial fibrillation. The most common cause of a cardioembolism is atrial fibrillation. Other etiologies include MI, infection, trauma, and valve abnormalities. Hypertension, diabetes, and high cholesterol are all causes of thrombotic strokes—not embolic.
B. Hypertension
C. Diabetes
D. High serum cholesterol
Neurologic Abnormalities

Question #2 - Answer
Lacunar strokes are common in people who:
A. Have endocarditis
B. Have a prosthetic valve
C. Smoke. Smoking, hypertension, and diabetes are the main risk factors for development of lacunar strokes. Endocarditis and the presence of a prosthetic valve are risk factors for an embolic stroke, while a high fat diet is a risk factor for a thrombotic stroke.
D. Diet high in fat content

Question #3 - Answer
The diagnostic study that should be ordered first when a stroke is suspected is:
A. CT scan. Noncontrast CT scan should be performed first to rule out ischemic vs. hemorrhagic stroke. MRI, EEG, and cerebral angiography may be conducted after CT has been evaluated.
B. MRI
C. EEG
D. Cerebral angiography

Question #4 - Answer
If a patient has an intracerebral bleed, signs of increased ICP include:
A. Hypotension
B. Hypothermia
C. Bradycardia. Cushing's triad is a group of vital sign changes seen with increased ICP. They are late findings. Bradycardia, widened pulse pressure with elevated systolic pressure, and diminishing respirations make up the triad of changes noted.
D. Hyperglycemia
Neurologic Abnormalities

Question #5 - Answer
The recommended intravenous fluid in the management of a patient with an intracerebral hemorrhage is:

A. 5% dextrose in water
B. Fresh-frozen plasma
C. Lactated ringer’s solution
D. Normal saline. Fluid restriction is usually the recommended strategy. If fluids are needed, normal saline is a safe isotonic fluid that will not promote cerebral edema.

Question #6 - Answer
The blood glucose level that should be treated in a patient with stroke is:

A. 82 mg/dL
B. 110 mg/dL
C. 140 mg/dL
D. 160 mg/dL. The therapeutic range for glucose in a patient with stroke is a blood glucose between 80–140 mg/dL.

Behavioral Abnormalities
Abuse of recreational drugs is common. Recreational drugs are complex and can induce profound changes in cardiovascular function, both acute and chronic. Often taken together, which can result in complex synergistic interactions with potentially detrimental effects. High index of suspicion with early intervention and management is often key to successful treatment.

Substance Abuse: Overview

- Sympathetic nervous system activation
- Cocaine and crack (free-base form) act by inhibiting the reuptake of norepinephrine and dopamine
- Circulating catecholamine can be elevated 5-fold in cocaine users
- At high doses, cocaine can impair myocyte electrical conduction and contractility

Substance Abuse: Cocaine, Amphetamine, and Ecstasy

- Tachycardia
- Vasoconstriction
- Unpredictable effect on BP
- Dysrhythmias

Cocaine, Amphetamine, and Ecstasy: Clinical Effects
Cocaine, Amphetamine, and Ecstasy: Mechanism for Hypotension

- Paradoxical suppression of the central sympathetic nervous system
- Relative catecholamine depletion
- Acute myocardia depression (ischemia, direct toxic effect of drug)
- Mechanical complications
  - Acute aortic rupture
  - Tension pneumothorax
  - Pneumopericardium

Cocaine, Amphetamine, and Ecstasy: Myocardial Ischemia and Infarction

- Elevated catecholamine concentration
  - Increases mixed venous oxygen saturation ($MVO_2$)
- Coronary artery spasm
- Platelet aggregation
- Thrombus formation

Cocaine, Amphetamine, and Ecstasy: Clinical Effects

- Aortic dissection
- Valvular damage
- Endocarditis
  - Candida
  - Pseudomonas
  - Klebsiella
- Cardiomyopathy
  - Prolonged administration
  - Repeated episodes of subendocardial ischemia & fibrosis & myocyte necrosis
  - Excessive catecholamines
  - Infectious agents
  - Heavy metal contaminants (manganese in cocaine preparations)
Cocaine, Amphetamine, and Ecstasy: Clinical Effects

- Pulmonary edema and pulmonary hypertension
- Dysrhythmias
  - Myocardial electrical instability
  - Supraventricular and ventricular tachydysrhythmias
- Pneumothorax and pneumopericardium
- Cocaine inhalation in association with forced Valsalva maneuver
- Positive ventilatory pressure increases drug absorption and enhances drug effect

Lysergic Acid Diethylamide (LSD) and Psilocybin (“Magic Mushrooms”)

- Hallucinogenic agents
- LSD is 100x more potent than psilocybin
- Adrenergic effects are mild and cause increased sympathetic response
  - Dilated pupils
  - Tachycardia
  - Hypertension
  - Hyperreflexia

Lysergic Acid Diethylamide (LSD) and Psilocybin (“Magic Mushrooms”)

- Cardiovascular complications are rarely serious
  - Supraventricular tachydysrhythmias
  - MI
  - Serotonin-induced platelet aggregation
  - Sympathetically induced arterial vasospasm
Most commonly used recreational narcotic drugs
Act centrally on the vasomotor center to increase parasympathetic and reduce sympathetic activity

Bradycardia and Hypotension
  - Autonomic changes
  - Histamine release from mast cell degeneration

Dysrhythmias
  - Premature atrial and ventricular ectopic activity
  - Atrial fibrillation
  - Idioventricular rhythm
  - Ventricular tachycardia

Bacterial Endocarditis
  - Common complication of IV narcotic abuse
  - Affects right-sided cardiac structures
  - Heroin overdose can cause noncardiogenic pulmonary edema
    - Disruption in alveolar-capillary membrane integrity
Volatile Substance Abuse

- Following inhalation, experience feelings of:
  - Euphoria
  - Excitement
  - Invulnerability

Volatile Substance Abuse: Clinical Effects

- Dysrhythmias
  - Main cause of death from volatile substance abuse
  - Supraventricular or ventricular tachydysrhythmias
  - Bradycardia
- Myocardial ischemia and infarction
  - Coronary vasospasm
  - Hypoxia due to formation of carboxyhemoglobin or methemoglobinemia
  - Excessive sympathetic stimulation
- Cardiomyopathy—long-term misuse

Cannabis

- Low or moderate doses can increase sympathetic and reduce parasympathetic activity
  - Tachycardia
  - Increase CO
- Higher doses inhibit sympathetic and increase parasympathetic activity
  - Bradycardia
  - Hypotension
In patients with ischemic heart disease, cannabis increases frequency of anginal symptoms at low levels of exercise
- Drug-induced increase in HR and myocardial contractility
- Increase in myocardial oxygen demand

Cannabis: Clinical Effects

- Increases the level of dopamine in the reward pathways of the brain
- Its short half-life makes it addictive
  - Need to smoke another to maintain pleasure
- Major cardiovascular effect of nicotine is sympathetic neural stimulation

Nicotine

- Enhances the release of various neurotransmitters including:
  - Epinephrine
  - Norepinephrine
  - Dopamine
  - Acetylcholine
  - Serotonin
  - Vasopressin
  - Glutamate
  - Nitric oxide
  - Calcitonin growth-related peptide
  - Beta-endorphin
Nicotine
- May contribute to increased risk of cardiovascular events seen with cigarette smoking
- Transient increase in BP
- Causes coronary artery vasoconstriction and/or impaired endothelial function

Alcohol Abuse
- More than 2 drinks/day in women and 3 drinks/day in men are associated with increased mortality
- Heavy alcohol consumption (≥ 6 drinks/day) or binge drinking increases the risk of sudden death

Alcohol Abuse: Clinical Effects
- Hypertension
- Heart failure → cardiomyopathy
- Diabetes
- Stroke risk
Alcohol Abuse: Smoking Cessation

- Immediate health benefits
  - Within 24 hours → reduction in BP and chance of MI
  - Long-term benefits → reduced stroke risk, lung and other cancers, and heart disease

- Behavioral interventions
  - Recognize high-risk situations
  - Develop alternative coping strategies
  - Manage stress
  - Improve problem-solving skills
  - Pharmacotherapy

Drug Withdrawal

- Onset of drug withdrawal can start within a few hours to several days after cessation of use
- Drug withdrawal symptoms may be more pronounced when long-term drug use has caused malnutrition, disease, chronic pain, or sleep deprivation

Drug Withdrawal: Symptoms

- Anxiety
- Insomnia
- Depression
- Paranoia
- Fatigue
- Muscle pain
- Nausea and vomiting
- Chills
- Cramps
- Sweats
- Tremors
Alcohol Withdrawal
- Symptoms typically occur within 5–10 hours after consuming alcohol but can occur days later
- Symptoms may get worse and persist for weeks in most extreme cases
- Those less dependent on alcohol might experience mild withdrawal symptoms
  - Shakes
  - Sweating
  - Nausea
  - Headache
  - Anxiety
  - Tachycardia
  - Increased BP
  - Uncomfortable and irritating but not necessarily life-threatening

Alcohol Withdrawal
- Heavy drinkers have symptoms that may progress to delirium tremens (DTs)
- DTs can cause:
  - Confusion
  - Disorientation
  - Hallucinations
  - Hyperactivity
  - Extreme cardiovascular disturbances
- Once DTs set in there is no known medical treatment to stop them
- Tonic-clonic seizures, MI, and stroke may occur during DTs
  - May be fatal

Cocaine Withdrawal
- Cocaine is one of the most addictive drugs that exist
- Extremely easy for an individual to become addicted even after first dose
- Extreme risk of suicide or overdose for someone experiencing cocaine withdrawal
Cocaine Withdrawal
- About 30%–40% of cocaine addicts turn to other substances, such as medication and alcohol, after giving up cocaine
- Some cocaine users have symptoms similar to schizophrenia and experience a crawling sensation on the skin known as “coke bugs”

Ecstasy Withdrawal
- Most common symptom of ecstasy withdrawal is depression
- Other symptoms
  - Fatigue
  - Loss of appetite
  - Feelings of depression
  - Trouble concentrating

Heroin Withdrawal
- May begin within 6–24 hours of cessation of use
- Signs and symptoms
  - Extreme pain
  - Tremors
  - Cramps
  - Chills
  - Perspiration
  - Tachycardia
Cannabis Withdrawal
- Symptoms typically begin within 1–3 days of abstinence and may last for 10–14 days
- Symptoms include:
  - Loss of appetite
  - Inability to sleep
  - Depression
  - Headache
  - Excessive sweating
  - Loose stools
  - Nausea
  - Anxiety
  - Paranoia
  - Irritability or aggression

Methamphetamine Withdrawal
- Increased wakefulness
- Increased physical activity
- Decreased appetite
- Increased respiration
- Rapid HR
- Irregular heartbeat
- Increased BP
- Hyperthermia
- Long-term abuse can have severe health consequences:
  - Extreme weight loss
  - Severe dental problems
  - Anxiety
  - Confusion
  - Insomnia
  - Mood disturbances
  - Violent behavior

Methamphetamine Withdrawal
- Chronic methamphetamine abusers tend to experience bouts of paranoia, visual and auditory hallucinations, and delusions
- Methamphetamine addiction is one of the most difficult forms of addiction to treat
Practice Exam Questions

Adjunct pharmacotherapy for nicotine dependence should be performed for:

A. All clients whether or not there is an indication of nicotine dependence
B. All clients who appear to use nicotine or have nicotine dependence
C. All clients with nicotine dependence who have a goal of abstinence from nicotine use. Nicotine cessation can be successful without drug therapy; however, drugs can be beneficial if the patient wants to stop smoking.
D. None of the above

Question #1 - Answer

A sign or symptom consistent with alcohol withdrawal is:

A. Hunger
B. Flaccid muscles
C. Hypotension
D. Tachycardia. Symptoms such as getting the shakes or sweats, nausea, headache, anxiety, rapid heartbeat, and increased BP are seen in mild withdrawal.

Question #2 - Answer
The drugs of choice to manage moderate-to-severe alcohol withdrawal:

A. Catecholamines
B. Opioids
C. Benzodiazepines. The drugs of choice for moderate-to-severe alcohol withdrawal are benzodiazepines. Other drugs include β-blockers and anticonvulsants.
D. Corticosteroids

In a typical protocol, the Clinical Institute Withdrawal Assessment-Alcohol, Revised (CIWA-Ar) scale is repeated hourly until the score is less than:

A. 6
B. 8
C. 10. If the CIWA-Ar score is > 9 a benzodiazepine is suggested. If the score is < 10, hourly assessment is required. When the score is < 9 for 4 consecutive measurements, the frequency can be decreased to every 8 hours.
D. 11

Intermediate-acting benzodiazepines may be indicated for:

A. Critically ill patients. Intermediate-acting benzodiazepines are indicated for older patients, patients with hepatic dysfunction, and those who are critically ill.
B. Young adults
C. Patients with renal dysfunction
D. Patients who are sedated
Low or moderate doses of cannabis can cause:

A. Hypotension
B. Bradycardia
C. Decreased CO
D. Tachycardia. Low to moderate doses will cause tachycardia and increased CO.