Peripheral Arterial Disease/Cardiac Surgery

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Test Plan
- Carotid Artery Stenosis (P/C)
- Acute Peripheral Vascular Insufficiency (C)
- Acute Arterial Occlusion
- Minimally Invasive Interventions (P)
- Aneurysms
- Cardiac Surgery (C)
- Valvular Heart Disease (P)
- Septal Defects (P/C)
- Cardiac Trauma (C)
- Cardiac Tamponade (P)
- Monitor patients/follow protocols

PAD Prevalence
- Affects 8 million people in the U.S
- Increases in prevalence with age
  - Usually begins after age 40
  - By age 70, approx. 20% of population affected

Clinical Manifestations of Vascular Disease
- Carotid artery disease
  - Transient ischemic attack
  - Stroke
- Aortic disease
  - Thoracic and abdominal aneurysm
  - Dissection and rupture
- Renovascular disease
  - Hypertension
  - Renal insufficiency
- Peripheral arterial disease
  - Intermittent claudication
  - Critical limb ischemia

Risk Factors
- Non-modifiable
  - Heredity
  - Age
  - Race
  - Sex
- Modifiable
  - Diabetes
  - Smoking
  - Obesity
  - HTN
  - Hyperlipidemia

Long-Term Management
- Lifestyle modifications and/or medication therapy
  - Delay progression
  - Decrease morbidity and mortality
  - Improve quality of life
Carotid Disease

Test Plan
- Carotid Artery Stenosis (P/C)
- Endarterectomy (C)
- Minimally Invasive Interventions (P)
- Stents

Causes
- Atherosclerosis
- Trauma
- Fibromuscular Dysplasia
- Cervical Irradiation
- Arteritis

Pathophysiology
- Plaque accumulation at the bifurcation of internal and external carotid arteries
- Fragments can break away leading to cerebral emboli
- Ischemia or infarction to brain can occur
- Accounts for 15-25% of strokes

First event may be TIA or Stroke
Low Flow
- Brief
- Repetitive
- Stereotypical
Embolic
- Single
- More prolonged
- Atypical
- Symptoms related to area receiving emboli

Signs and Symptoms
- Unilateral symptoms
- Visual Disturbances
- Speech Deficit
- Brux
- Dizziness
- Confusion
- Sudden severe headache
- Vertigo
- Imbalance
- Decreased LOC
- Numbness/tingling

Diagnosis
- History and Physical
- Carotid Duplex
- MRA
- CTA
- Angiogram
Management of Carotid Stenosis

- Medical vs. Surgical vs. Interventional
- Depends on patient presentation and percentage of stenosis
  - <70% stenosis
    - Serial exams to monitor
  - >70% stenosis
    - Surgical/Interventional evaluation

Carotid Revascularization
Endarterectomy vs. Stenting Trials (CREST)

- Compared the efficacy of carotid endarterectomy (CEA) with carotid artery stent (CAS) in
  - Preventing strokes
  - MI and
  - All cause mortality 30 days post-op.

CREST Findings

- Stent outcomes
  - Higher restenosis rate (30% vs 17%).
  - Higher combined stroke and death rates (9.6% vs 3.9%).
  - Higher incidence of hemodynamic instability
  - Lower incidence of post-procedure MI and nerve damage
- 2 year stroke rates were similar

Cranial Nerve Function

- CN VII- Facial- Raise eyebrows, close eyelids, frown, smile and taste
- CN X- Vagus- Check speech and swallow. Patient may have weak voice and dysphagia, decreased gag reflex. More prone to aspirate
- CN XI- Move head laterally, flex neck and shrug shoulders.
- CN XII- Hypoglossal- Tongue strength and ability to protrude equally

Post-Op Care of CEA/CAS

- BP control - too high or too low
- Frequent Neuro exams- know baseline
- Airway- Monitor airway for stridor, voice changes, tracheal deviation, O2 sats, RR
- Report severe HA/ swelling in neck
- Mental Status- GCS/NIHSS
- Incision/ Drain care
- Diet - progress after bedside swallow eval
- Pain Assessment

Question?

What is best medical treatment for stroke prevention in presence of carotid stenosis?

1. Blood Pressure Control
2. Diabetes Control
3. Cholesterol Control
4. Smoking Cessation
5. 1, 2 and 4
6. All of the above
Peripheral Vascular - Test Plan

- Acute Peripheral Vascular Insufficiency (C)
- Acute Arterial Occlusion
  - Peripheral stents (C)
  - Fem-Pop bypass (C)
  - Peripheral surgical interventions (P)
  - Peripheral arterial occlusions (P)
  - Peripheral venous thrombosis (P)
  - Lytics
- Minimally Invasive Interventions (P)
  - Stents
  - Endografts
- Monitor patients/follow protocols for patients with arterial/venous sheaths (P)

Peripheral Vascular Disease

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Arterial</th>
<th>Venous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Upon Walking</td>
<td>While Standing</td>
</tr>
<tr>
<td>Pain Relief</td>
<td>On resting, standing or dependent position of lower limb</td>
<td>Elevation of extremities</td>
</tr>
<tr>
<td>Edema</td>
<td>None</td>
<td>Present</td>
</tr>
<tr>
<td>Pulses</td>
<td>Decreased or absent</td>
<td>May be difficult to palpate</td>
</tr>
<tr>
<td>Skin Changes</td>
<td>Hair loss</td>
<td>Brownish pigmentation</td>
</tr>
<tr>
<td></td>
<td>Shiny skin</td>
<td>May be cyanotic when extremities are dependent</td>
</tr>
<tr>
<td></td>
<td>Nail thickening</td>
<td></td>
</tr>
<tr>
<td>Ulcers</td>
<td>Ulcers located on toes</td>
<td>Ulcers located on ankles, medial or pre-tibial areas</td>
</tr>
<tr>
<td>Skin Temperatures</td>
<td>Cool</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Arterial Disease

- Causes
  - Atherosclerosis, HTN, arteritis
- Pathophysiology
  - Occlusions typically occur at bifurcations
  - Damage to intima progresses to thrombosis
- Clinical Presentation
  - Intermittent claudication, pain with activity – decreases with rest
  - Cool, pale skin, hair loss, ulcers to affected extremity
  - Decreased or absent pulses
  - Decreased sensation and motor strength

Arterial Disease

- Management
  - Decrease peripheral oxygen requirements
  - Administer drugs to restore blood flow
    - Anticoagulants
    - Fibrinolytics
  - Prep for percutaneous procedures or surgery
    - Angioplasty
    - Stenting
    - Arterial embolectomy
    - Thromboendoarterectomy
    - Bypass grafting
    - Amputation

Acute Arterial Occlusion

- Causes
  - Arterial Embolization
  - Injury to the intima
  - Compression of Artery (Compartment syndrome)
- Pathophysiology
  - Occlusion leads to ischemia
  - Vasoactive factors released, worsening ischemia
  - Progresses to necrosis if untreated
- Clinical presentation
  - Thc & P's
  - Early: Pain, Pallor, Pulse
  - Late: Paresthesia, Paralysis

Acute Arterial Occlusion

- Management
  - Urgent Interventions
    - Oxygen
    - Limb positioning
    - Notification of team
    - IV access
    - Pain Relief
  - Restoration Artery Patency
    - Fibrinolytics
    - Anticoagulants
    - Surgical Endarterectomy
    - Thromboendoarterectomy
    - Bypass Grafting
Lower Extremity Revascularization

- Failure of exercise and drug therapy
- Lifestyle-limiting symptoms and function
- Limb-threatening ischemia/risk of amputation
- Favorable risk/benefit ratio
- Non-healing ulcerations, gangrene of toes and foot
- Choice of surgical procedure depends on level of arterial disease
- Less invasive endovascular procedures are preferred
  - Preserves option for fall-back surgical procedure

Ankle-Brachial Index

<table>
<thead>
<tr>
<th>ABI</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90–1.30</td>
<td>Normal</td>
</tr>
<tr>
<td>0.70–0.89</td>
<td>Mild</td>
</tr>
<tr>
<td>0.40–0.69</td>
<td>Moderate</td>
</tr>
<tr>
<td>&lt;0.40</td>
<td>Severe</td>
</tr>
<tr>
<td>&gt;1.30</td>
<td>Noncompressible</td>
</tr>
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</table>

Question
A patient with a history of intermittent claudication to the foot with minimal activity reports that the symptoms have worsened at rest. What other assessment findings of the affected foot should the nurse anticipate?

1. Cool toes and minimal edema
2. Cool toes and severe edema
3. Diminished pulses and reddish pigmentation
4. Normal pulses and reddish pigmentation

Question
A patient with hypertension, dyslipidemia and coronary artery disease has leg pain and decreased skin temperature of the legs and feet. The patient’s legs have pallor and decreased pulses that become fainter when the legs are elevated. The nurse should suspect

1. Deep vein thrombosis
2. Chronic venous insufficiency
3. Acute arterial occlusion
4. Peripheral arterial disease

Peripheral Intervention Options

- Surgical
  - <70 yrs old
  - Non-diabetic
  - Disease above popliteal
- Percutaneous/Endovascular
  - Single short blockages
  - Higher risk population

Endovascular Procedures

Atherectomy
- Catheter w/ cutting blade or laser light

Cryoplasty
- Angioplasty catheter w/ nitrous oxide

Thrombolitics

Stenting
Thrombolytic Therapy

- Used to break up clot inside of a blood vessel or graft
  - Thrombus in vascular bed of extremities or graft
  - DVT (Deep Vein Thrombus)
  - Emboli
  - Thrombus of dialysis fistula or graft
  - Pulmonary Embolism
  - Thrombosis of portal vein and/or other mesenteric veins
- Benefits:
  - Improve blood flow
  - Less Invasive than surgery
  - Decreased Length of Stay
  - No surgical incision to heal

Thrombolytic Therapy

- Nursing Care
  - Bleeding Precautions
  - Frequent Circulation Checks
  - Frequent Neurologic Exams
  - Monitor labs- Fibrinogen, PTT, H&H

Surgical Bypass

- Aortoiliac Disease (Inflow)
  - Aortofemoral bypass
  - Axillofemoral-femoral bypass
  - Femorofemoral bypass

- Infrainguinal Disease (Outflow)
  - Femoropopliteal bypass
  - Infrapopliteal bypasses
  - (femorotibial, axillopopliteal)

Nursing Care

- Prevent/Identify Complications
  - Myocardial Ischemia
  - Cerebrovascular Ischemia
  - Graft Closure
  - Bleeding / Hematoma Formation
  - Compartment Syndrome
  - Wound infection

Compartment Syndrome

- Pathophysiology
  - Most commonly due to rapid reperfusion
  - Inflammatory response of injured tissue causes localized increase in capillary permeability which leads to edema
  - Increased interstitial pressure inhibits perfusion at the capillary level
  - Ischemia ensues
  - Can occur anytime between several hours to several days after initial injury and reperfusion. Median time is 15 hrs.

Compartment Syndrome

- Signs and Symptoms:
  - Pain out of proportion to injury
    - Pain with passive extension of the toes
  - Anesthesia of nerves in the compartment
  - Decrease in simple touch perception
    - Loss of feeling between 1st and 2nd toes
  - Tenseness/fullness of the compartment
  - Decreased muscle strength within the compartment
    - Weakened dorsiflexion of the foot
  - Pulsae: normal or diminished, LATE SIGN
Aneurysmal Disease

- Permanent localized dilation of an artery
- An increase in diameter of greater than 50% or 1.5 times its normal diameter.

Occurrence

- Abdominal Aortic Aneurysms (AAA) is the third leading cause of sudden death in men over 60 years old. (15,000/yr)
- 13th leading cause of death overall
- 3-5% of population over 65 have Aneurysmal disease.
- Four times greater in males

Possible Causes:

- Atherosclerotic process*
- Marfan Syndrome
- Crack Cocaine Usage
- Inflammatory processes
  - elastin and collagen degradation by proteases cause arterial wall thinning and weakness
- Hypertension
- May have genetic predisposition
- Smoking
- Trauma

Classifications

- Classified by shape, location along aorta
- Shape
  - Fusiform
  - Saccular
- Thoracic
  - Ascending
  - Descending
- Thoraco-Abdominal (12% incidence)
- Abdominal
  - Supra-renal
  - Intra-renal (80% incidence)

Symptoms

- Subjective Findings
  - "Silent killer": Most AAA are asymptomatic, unless rapid expansion or rupture.
  - Diffuse mid-abdominal pain
  - AAA may have back, flank or groin pain.
  - Constant vs. intermittent
  - Small pulsatile mass near umbilicus
- Found on X-rays done for other reasons
- Distal embolization
Diagnostic Testing
- Abdominal Ultrasound
- CT
- MRI
- Angiogram

Pre-Surgical Long-term Management
- Risk of rupture
- Natural progression of AAA is enlargement and rupture.
- The greater the size of the aneurysm, the greater the risk of rupture.
- Growth rate 0.2-0.4 cm/yr
- Goal: repair the aneurysm prior to rupture.
- Monitor every 6 months with CT scan
- Control BP and HR
- Smoking Cessation

Risk of Rupture
- <5.5 cm: <1% chance of rupture
- 5.5-5.9 cm: 9.4% chance of rupture
- 6.0-6.9 cm: 10.2% chance of rupture
- >7 cm: 32.5% chance of rupture
  - Ruptures:
    - 30-50% die before reaching the hospital
    - 30-40% die before they reach the OR
    - 40-50% die post-op

Indications for Surgery
- Size > 5.5 cm
- Symptomatic
- Rapid enlargement
- Distal Emboli
- GI hemorrhage
- Rupture/tear/dissection

Aortic Dissection
- Dissection
  - Layers of the aortic wall separate - tear an opening into the vessel lumen
  - Blood flows between the layers of the wall, and "dissects" this space further along the vessel
  - Creates a "false lumen", a second blood filled tube
  - Usually associated with severe "tearing" chest pain radiating to the back

Dissecting Aneurysmal Disease
- Type A
  - Involves ascending aorta
  - Immediate surgical repair
- Type B
  - Descending aorta
  - Medically treated
  - BP control
  - Monitor complications
Aortic Rupture

- Sudden Catastrophic Structural Failure
  - Traumatic vs Medical
- Sym Triad:
  - Abdominal or back pain
  - Hypotension
  - Pulsatile mass
- Dx: CXR, US, CT
- Treatment: Controlled hypotensive resuscitation until surgery

Question

The chest pain associated with a dissecting aortic aneurysm differs for the chest pain associated with an AMI in that the aneurysm pain usually is

1. A squeezing tight pressure
2. Relieved by rest
3. An intermittent dull aching pain
4. A sudden sharp stabbing, tearing pain

Question

Which of the following findings is MOST indicative of a leaking abdominal aortic aneurysm?

1. Back pain
2. Bounding peripheral pulses
3. Intermittent claudication
4. Warm, flushed skin

AAA Repair Options

Open vs Endovascular (EVAR)

- Goal of AAA Repair
  - Reconstitution of the aorta with interposition of a synthetic vascular graft
- Goal related to AAA Dissection
  - Excision of the intimal tear
  - Obliteration of entry into the false lumen proximally
  - Prevent progression to Rupture

- Mortality/Morbidity
  - Short term: EVAR better
  - Long term: No difference r/t graft complications

EVAR: Endovascular Aortic Repair

- Potential complications
  - Need for open repair
  - Graft migration
  - Endovascular leak
  - Graft Kinking
  - Graft Occlusion
  - Injury to access arteries
  - Embolization
  - Lower extremity ischemia
  - Renal failure

- Pros
  - Decreased length of stay
  - Decreased recovery time

- Cons
  - Frequent monitoring
    - Yearly CT for endoleak
  - Further intervention
  - Long term results unclear

Post-Op Care AAA Repair

- Consider level of aneurysm
- BP control (SBP 100 – 120)
  - Beta blockers
- Urine Output
- Pain Assessment
- Compartment syndrome
  - Abdominal Compartment Syndrome (dead gut)
    - Bladder Pressure monitoring
  - Spinal Compartment Syndrome
    - Lumbar Pressure Monitoring
**Question?**
Which of the following aneurysms would likely require immediate surgical repair?

1. Dissecting 6 cm aneurysm of the ascending aorta
2. 3.5 cm saccular abdominal aneurysm
3. 4 cm bulging thoracic aneurysm in the ascending aorta in a patient with Marfan’s syndrome
4. 5 cm fusiform abdominal aneurysm

**Discharge Teaching**
- Monitor tissue perfusion/ circulation
- Wound management
- Pain management
- Health promotion

**Test Plan Continued**
- Cardiac Surgery (C)
  - CABg (C)
  - Valve Replacement (C)
  - More than 48 hours postoperative (P)
- Minimally Invasive Cardiac Surgery (P)
- Non-sternal approach (P)
- Cardiac Trauma (C)
- Cardiac Tamponade (P)
- Monitor patients/follow protocols for cardiac surgery (C)

**CABg (Coronary Artery Bypass Grafting)**
**Goal**
- To provide arterial or venous conduit to redirect blood flow to bypass occluded coronary arteries.

**Indications**
- Left Main Stenosis >50%
- 3 vessel disease with EF <50%
- 3 vessel disease with EF > 50% & significant inducible ischemia
- 2 vessel disease with involvement of proximal LAD
- Intractable angina
- CAD with EF<35%
- Emergent Conditions

**CABg**
**Techniques**
- Median Sternotomy with cardiopulmonary bypass
- Off pump via sternotomy or thoracotomy
- Minimally invasive direct via thoracotomy (MIDCAB)

**CABg**
**Nursing Management**
- Treat pain
- Titrate medications to optimize output and protect grafts
- Monitor chest tubes for excessive bleeding, maintain patency
- Monitor for signs of hypoperfusion
- Monitor ECG for dysrhythmia or blocks
- Replace electrolytes as needed
- Monitor for complications
CABg - Complications

- Cerebral or Myocardial Infarct
- Hemorrhage
- Inability to wean from CPB
- Hypotension, low CO
- Renal Failure
- Graft Closure
- Surgical Site Infections

Valve Surgeries

- Valveoplasty/Annuloplasty (regurgitation)
- Commisurotomy (stenosis)
- Valve Repair (regurgitation)
- Valve Replacement
  - Bioprosthetic valves - homografts and heterografts
  - Mechanical valves - stainless steel, carbon
- Post-op management similar to CABg with close monitoring for AV nodal blocks
- Endovascular Aortic Replacement (TAVR)

Mechanical vs Tissue

**Mechanical**
- Children
- Young Adults (except childbearing women)
- Renal Failure
- Small Valvular Annulus
- High Operative Risk
- Patient needing anticoagulation (Chronic AF)
- Patients requiring aortic root replacement

**Tissue**
- Elderly
- Chronic Anticoagulation contraindicated
- Patients at risk for thromboembolism

Question

- Which of the following cardiac surgery patients should the nurse anticipate to develop a postoperative heart block? A patient who underwent
  - Mitral valve repair
  - CABg with perioperative ischemia
  - Cardiac transplantation
  - Robotically assisted atrial septal defect repair

CardioPulmonary Bypass

**CardioPulmonary Bypass**

Functions as heart and lungs during CABg

**Systemic Effects**

- Catecholamine Release:
  - Tachycardia, Increased myocardial workload, Hypertension, Risk of Infarction
- Activation of RAAS:
  - Edema, Hypertension
- Decreased secretion of ACTH and Cortisol:
  - Altered sleep pattern, Decreased ability to respond to stressors
  - Impaired insulin and lipid metabolism
  - Increased risk for developing ketoacidosis

- Latham, R. et al - Infection Control & Hospital epidemiology; 2001 - “Hyperglycemia during the immediate postoperative period was an independent risk factor for developing infection among those patients with & without a hx of diabetes, is the risk of infection correlated with the degree of glucose elevation.”

CardioPulmonary Bypass Systemic effects continued

- Electrolyte Imbalance:
  - ↑ Potassium, ↓ Sodium, ↓ Calcium, ↓ Magnesium
- Immune System:
  - Complement, Immunoglobulin, Leukocytes
- Coagulation:
  - Platelet destruction, Loss of natural coagulation factors, administration of anticoagulants
- Myocardium:
  - Myocardial ischemia, dysrhythmias, inability to wean from CPR, Graft Closure
- Pulmonary:
  - Interstitial Edema, Atelectasis, Respiratory Failure, Decreased surfactant production
- Neurologic:
  - Stroke, Cerebral Hemorrhage
- Renal:
  - Renal Failure
Arrhythmias Post-OHS

- Incidence:
  - Ventricular – 2-13%
  - Supraventricular – 11-54%
- Valve surgery; expect supraventriculars & heart block
- CABG; expect anything!
- Predisposing factors: ischemia, lytes (K, Mg), hypoxia, caffeine, acidosis, dig tox, etc.
- AF prophylaxis...

Cardiac Tamponade

Accumulation of fluid within the pericardial sac which compresses the heart. Fluid accumulation causes changes in pressures inside & outside the heart. Filling of the heart (diastole) becomes limited due to this fluid.

- High index of suspicion ("this dx should be suspected any time there is a sudden deterioration in the condition of a postoperative cardiac surgical patient…" – Finkelmeier, 2000)
- Tachycardia
  - Diminishing pulse pressure/hypotension
- SOB
  - Signs of CHF
- Hemodynamic? BP?
  - Muffled heart sounds
- JVD
  - Sudden change in C.T. output
- Late tamponade – anticoagulants, post-periocardiotomy syndrome, epicardial pacing wires d/c’d.
- CXR – widened mediastinum

Treatment:

Cardiac Trauma/Myocardial Contusion

Transient or permanent dysfunction of heart due to blunt trauma

- Causes
  - Acceleration/deceleration injury
  - Kick to chest from large animal
  - Assault with blunt instrument
  - Crush Injury
  - Explosion
  - Vigorous CPR

Question:

A patient who was admitted for an acute episode of ischemia of the right leg is taken to surgery for an embolectomy. During the procedure, extra dye is used for arteriography. Over the first two postoperative hours, the patient is anuric, with a CVP of 17 mmHg. The nurse should expect the immediate treatment to include.

1. Diuretics
2. Vasodilators
3. Vasopressors
4. Fluid Challenge