

## Peripheral Arterial Disease/ Cardiac Surgery

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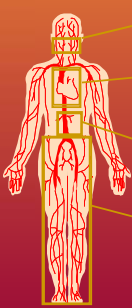
## Test Plan

- 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

## PAD 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

## Carotid Disease

### Causes

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

## Carotid Disease

### 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

## Carotid Disease

### First event may be TIA or Stroke

#### Low Flow

- Brief
- Repetitive
- Stereotypical

#### Embolic

- Single
- More prolonged
- Atypical
- Symptoms related to area receiving emboli

## Carotid Disease

### ○ Signs and Symptoms

- Unilateral symptoms
- Visual Disturbances
- Speech Deficit
- Bruit
- 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

Symptoms	Arterial	Venous
Pain	Upon Walking	While Standing
Pain Relief	On resting, standing or dependent position of lower limb	Elevation of extremities
Edema	None	Present
Pulses	Decreased or absent	May be difficult to palpate
Skin Changes	Hair loss Shiny skin Nail thickening Red when dependent	Brownish pigment May be cyanotic when extremities are dependent
Ulcers	Ulcers located on toes Lateral areas or sites of trauma Gangrene possible	Ulcers located on ankles, medial or pre-tibial areas
Skin Temperatures	Cool	Normal

## 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
    - Thromboendarterectomy
    - 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
  - The 6 P's
  - Early: Pain, Pallor, Polar
  - Late: Pulselessness, Parasthesia, Paresis

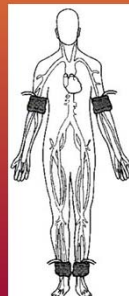
## Acute Arterial Occlusion

- Management
  - Urgent Interventions
    - Oxygen
    - Limb positioning
    - Notification of team
    - IV access
    - Pain Relief
  - Restoration Artery Patency
    - Fibrinolytics
    - Anticoagulants
    - Surgical Endarterectomy
    - Thromboendarterectomy
    - 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



ABI	Interpretation
0.90–1.30	Normal
0.70–0.89	Mild
0.40–0.69	Moderate
≤0.40	Severe
>1.30	Noncompressible

## 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
- Thrombolytics
- 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
- Infringuinal 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 1<sup>st</sup> and 2<sup>nd</sup> toes
- Tenseness/fullness of the compartment
- Decreased muscle strength within the compartment
  - Weakened dorsiflexion of the foot
- Pulses: normal or diminished, **LATE SIGN**



## Test Plan Continued

### Aneurysms

- Thoracic (C)
- Abdominal (C)
- Thoraco-abdominal (C)
- Dissecting (P/C)
- Ruptured (P/C)
- Repair (C)

## 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)
- 13<sup>th</sup> leading cause of death overall
- 3-5% of population over 65 have Aneurysmal disease.
- Four times greater in males

## Aneurysmal Disease

- 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
  - sacular
- Thoracic
  - Ascending
  - Descending
- Thoraco-Abdominal (12% incidence)
- Abdominal
  - Supra-renal
  - Infra-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

- <5.5cm < 1% chance of rupture
- 5.5-5.9cm 9.4% chance of rupture
- 6.0-6.9cm 10.2% chance of rupture
- >7cm 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 > 5.5cm
- 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
- Sx 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

- Valvuloplasty/Annuloplasty (regurgitation)
- Commissurotomy (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

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, & the risk of infection correlated with the degree of glucose elevation."

## CardioPulmonary Bypass

### Systemic effects continued

- Electrolyte imbalance
  - ↑ or ↓ Potassium, ↑ or ↓ 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 CPB, 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 fx's: ischemia, lites (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)
  - Diminishing pulse pressure/hypotension
  - Signs of J.C.O.
- Tachycardia
- SOB
- Hemodynamic? BP?
- Muffled heart sounds
- JVD
- Sudden change in C.T. output
- Late tamponade – anticoagulants, post-pericardiectomy 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 aneuric, with a CVP of 17 mmHg. The nurse should expect the *immediate* treatment to include.

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