Case Study 2; Intermittent Claudication

Intermittent Claudication: Pain caused by stenosis (narrowing of a vessel; it results from a continued lack of arterial flow) analogous to anginal pain. It occurs when a muscle is forced to work without an adequate blood supply to meet its metabolic demands. Remember muscles are metabolically active and use aerobic metabolism; therefore without blood they resort to anaerobic metabolism.

Atherosclerosis starves tissues from oxygenated blood. Collateral arterioles develop to attempt to compensate for the occluded arterial supply. Vasodilation is the first compensation that the body makes. Then cellular anaerobic metabolism tries to meet the basic requirements, but it produces lactic acid and pyruvic acid waste (which is toxic and excreted slowly).

The pain is a tightening pressure in the calves or buttocks or a sharp cramp or burning sensation that occurs during walking and disappears with rest. Can also present as the hip or leg “giving out” after period of exertion. Normally does not occur with sitting or standing. Claudication generally occurs in men (women after menopause). It is worsened by the speed or incline of walk (conditions that increase demand for oxygen). Response is constant, reproducible and not positional. Aortoiliac stenosis and occlusion result in hip, thigh, and buttock claudication with absent or diminished femoral and distal pulses. Can lead to rest pain (pain is not alleviated by rest).

Sometimes the body will attempt to change the flow of blood when a portion of an artery is narrowed by plaque. Smaller arteries around the blockage begin to take over some of the blood flow. This adaptation of the body (collateral circulation) is one reason for the absence of symptoms in some people who have PAD. Another reason is that plaque develops gradually as people age. Symptoms usually don’t occur until a blockage is over 50%, or when a piece of plaque breaks off and blocks an artery completely. Blockage in the legs reduces or cuts off circulation, causing painful cramping during walking, which is relieved on rest (intermittent claudication). The feet may ache even when lying down at night.

When narrowing of an artery occurs gradually, symptoms are not as severe as they are when sudden, complete blockage occurs. Sudden blockage does not allow time for collateral vessels to develop, and symptoms can be severe. Gradual blockage creates muscle aches and pain, cramping, and sensations of fatigue or numbness in the limbs; sudden blockage may cause severe pain, coldness, and numbness. At times, no pulse can be felt, a leg may become blue (cyanotic) from lack of oxygen, or paralysis may occur.

When the lower aorta, femoral artery, and common iliac arteries (all in the lower abdominal and groin areas) are blocked, gradual narrowing may produce cramping pain and numbness in the buttocks and thighs, and men may become impotent. Sudden blockage will cause both legs to become painful, pale, cold, and numb, with no pulse. The feet may become painful, infected, or even gangrenous when gradual or complete blockage limits or cuts off circulation. Feet may become purple or red, a condition called rubor that indicates severe narrowing. Pain in the feet or legs during rest is viewed as an indication for bypass surgery because circulation is reduced to a degree that threatens survival of the limb.
Early treatment for PAD usually includes medical intervention to reduce the causes of atherosclerosis, such as lowering cholesterol and blood pressure, **smoking cessation**, and reducing the likelihood of clot formation. When these measures are not effective, or an artery becomes completely blocked, lower extremity bypass surgery may be performed to restore circulation, reduce foot and leg symptoms, and prevent limb amputation.

**Nursing Diagnosis**
1) Ineffective peripheral tissue perfusion as evidenced by Peripheral Arterial Occlusive Disease  
**Actions/Interventions:**  
**Assessments**  
- assess extremities for color, temperature, and texture;  
- Assess quality of peripheral pulses, noting capillary refill  
- dependent changes  
- pain, numbness, and tingling  
- segmental limb pressure measurements such as ankle-brachial index (ABI): normally the BP readings are higher than in the upper extremities. Normal ratio of ankle systolic pressure divided by brachial systolic pressure is 0.9 or greater. An ABI ratio of less than 0.9 in either leg is diagnostic of PAD. A ration of 0.4 or greater signifies severe disease.  
- Ulcerated areas on the skin (on toes and feet—can lead to gangrene—caused by chronic ischemia)  
- Monitor results of diagnostic tests: pulse volume recordings, vascular stress testing, magnetic resonance angiography, convententional arteriography ( used for patients requiring surgical intervention), and digital subtraction angiography. Exercise stress testing helps in reproducing claudication and provides data for evaluating effectiveness of any treatment.  
- Maintain affected extremity in a dependent position. Gravity can increase peripheral blood flow. However, if edema is present in the lower legs, the feet should be elevated.  
- Keep extremity warm (socks or blankets). Warmth promotes vasodilation and comfort.  
- Encourage need for progressing activity program, noting claudication. During exercise, tissues do not receive adequate oxygenation from obstructed arteries and convert to anaerobic metabolism, of which lactic acid is byproduct (causing muscle spasm and discomfort). However, gradual progressive exercise helps promote collateral circulation. Pt should be encouraged to walk to the point of claudication, stop and rest, and continue walking.  
- Provide meticulous foot care. Cleanliness is important to prevent infection. Minor trauma can result in skin breakdown. Toenails trimmed straight across. Administer analgesics  
- Provide drug therapy: antiplatelets, cilostazol, Pentoxifylline  

2) Impaired Skin Integrity as evidenced by ulceration over bony prominences, primarily toes and feet, presence of gangrene, atrophic skin  
- Assess lower extremity circulation  
- Assess skin for signs of redness, open wounds, and vascular ulcers  
- Protect skin from trauma and pressure  
- Cover noninfected wounds with appropriate dressings  
- Use sterile technique when caring for wound; measure wound (delayed wound healing common)
3) Pain as evidenced by intermittent claudication
   - The head of bed can be elevated to promote blood flow to the legs. Remind the client with arterial insufficiency to avoid standing in one position for more than a few minutes, avoid crossing legs at the knee, watch for and report edema, seek most comfortable position.
   - Promote arterial flow: reverse Trandelenberg so blood flows more easily to extremities; float heels

4) Deficient Knowledge
   - How to prevent progression of disease
   - Smoking
   - Diet modification (low-density lipoprotein cholesterol goal is less than 100 mg/dL); weight management; hypertension management
   - Daily exercise: walk on flat surface to aggravate calf pain
   - Walk about half a block after intermittent claudication is experienced, unless otherwise ordered by the physician.
     *Ischemia is the stimulus for collateral circulation. Small (normally closed arteries) open and connect to larger arteries; can serve as alternate routes (explains why people don’t experience symptoms of PAD)*

**Doppler ultrasound:** detect irregularities in the structure of the arteries; detect plaque or stenosis of lower extremity artery, as evidenced by turbulent blood flow or changes in the Doppler signals indicating occlusion.
- Abnormal results: reduction in vessel diameter of more than 16%, indicating stenosis; aneurysm.
  - Interfering factor: cigarette smoking, because nicotine can cause constriction of the peripheral arteries and alter results
  - Before: explain to pt; inform that it is painless; remove all clothing from extremity; instruct to abstain from smoking for at least 30 minutes before the test
  - During: Arterial studies
    - Performed with use of BP cuffs; a conductive paste is applied to skin overlying artery distal to cuffs. If the AB index (the ankle pressure divided by the brachial pressure) is less than 0.85, it indicates arterial occlusive disease within the extremity.
    - Takes about 30 minutes
  - After: Encourage pt to verbalize fears; Remove gel; inform pt that physician must interpret studies; results will be available in a few hours

**Peripheral bypass surgery**
A peripheral vascular bypass, also called a lower extremity bypass, is the surgical rerouting of blood flow around an obstructed artery that supplies blood to the legs and feet. This surgery is performed when the buildup of fatty deposits (plaque) in an artery has blocked the normal flow of blood that carries oxygen and nutrients to the lower extremities. Bypass surgery reroutes blood from above the obstructed portion of an artery to another vessel below the obstruction.
A bypass surgery is named for the artery that will be bypassed and the arteries that will receive the rerouted blood. Our pt is having an aortobifemoral bypass, which reroutes blood from the abdominal aorta to the two femoral arteries in the groin.

A substitute vessel or graft must be used in bypass surgeries to reroute the blood. The graft may be a healthy segment of the patient's own saphenous vein (autogenous graft), a vein that runs the entire length of the thigh. A synthetic graft may be used if the patient's saphenous vein is not healthy or long enough, or if the vessel to be bypassed is a larger artery that cannot be replaced by a smaller vein.

**Purpose**
Peripheral vascular bypass surgery is performed to restore blood flow (revascularization) in the veins and arteries of people who have peripheral arterial disease (PAD), a form of peripheral vascular disease (PVD). People with PAD develop widespread hardening and narrowing of the arteries (atherosclerosis) from the gradual build-up of plaque. In advanced PAD, plaque accumulations (atheromas) obstruct arteries in the lower abdomen, groin, and legs, blocking the flow of blood, oxygen, and nutrients to the lower extremities (legs and feet). Rerouting blood flow around the blockage is one way to restore circulation. It relieves symptoms in the legs and feet, and helps avoid serious consequences such as heart attack, stroke, **limb amputation**, or death.

The risk factors for atherosclerosis include:
- high levels of blood cholesterol and triglycerides.
- high blood pressure (hypertension)
- cigarette smoking or exposure to tobacco smoke
- diabetes, types 1 and 2
- obesity
- inactivity, lack of exercise
- family history of early cardiovascular disease

**Procedure**
Bypass surgery is an open procedure that requires general anesthesia. Aortobifemoral bypass surgery requires an abdominal incision to access the lower portion of the abdominal aorta and both femoral arteries in the groin. This is generally a longer and more difficult procedure than the other types of bypass surgeries. The arteries are blocked off with vascular clamps. The surgeon sutures the graft into an opening in the side of one artery and then into the side of the other. The clamps are then removed and the flow of blood is observed to make sure it bypasses the blocked portion of the affected artery. Synthetic grafts (PTFE) are used in a aortobifemoral bypass because the lower abdominal aorta is a large conduit, and its blood flow cannot be handled by the smaller saphenous vein. Vascular surgeons prefer the saphenous vein graft for femoropopliteal or femorotibial bypass surgery because it has proven to stay open and provide better performance for a longer period of time than synthetic grafts. Bypass surgery patients will be given heparin.
immediately after the surgery to prevent clotting in the new bypass graft.

**Diagnosis**
After obtaining a detailed history and reviewing symptoms, the physician examines the legs and feet, and orders appropriate tests or procedures to evaluate the vascular system. Diagnostic tests and procedures may include:

- Blood pressure and pulses—pressure measurements are taken in the arms and legs. Pulses are measured in the arms, armpits, wrists, groin, ankles, and behind the knees to determine where blockages may exist, since no pulse is usually felt below a blockage.
- Doppler ultrasonography—direct measurement of blood flow and rates of flow, sometimes performed in conjunction with stress testing (tests that incorporate an exercise component). – see above
- Angiography—an x ray procedure that provides clear images of the affected arteries before surgery is performed.
- Blood tests—routine tests such as cholesterol and glucose, as well as tests to help identify other causes of narrowed arteries, such as inflammation, thoracic outlet syndrome, high homocysteine levels, or arteritis.
- Spiral computed tomography (CT angiography) or magnetic resonance angiography (MRA)—less invasive forms of angiography.

**Preparation**
If not done earlier in the diagnostic process, ultrasonography or angiography procedures may be performed when the patient is admitted to the hospital. These tests help the physician evaluate the amount of plaque and exact location of the narrowing or obstruction. Any underlying medical condition, such as high blood pressure, heart disease, or diabetes is treated prior to bypass surgery to help obtain the best surgical result. Regular medications, such as blood pressure drugs or diuretics, may be discontinued in some patients. Routine pre-operative blood and urine tests are performed when the patient is admitted to the hospital.

Pt will receive full workup prior to surgery, including a CXR and EKG to determine heart disease. CXR may also tell us if there are any emboli in the lungs, but I’m just guessing here. All infections must be resolved prior to surgery!

Because infection is very bad for these patients, they are going to be assessed for any infection prior to surgery and will likely receive prophylactic antibiotics (2 hour window before surgery).

**Pre-op labs**
- CBC will determine WBC counts, Hbg, Hct and PLT.
  - WBC is important b/c of the risk for infection
  - Hbg and Hct determine clotting factors and if pt will likely need to be transfused during surgery
  - PLTs will want to be within normal range. High levels of platelets indicate risk for embolism in patients with PVD.
- UA will provide information about renal fxn and the possibility of dehydration and UTI.
- Chem 7 is a grouping of basic labs (Na, K, Cl, CO2, BUN, creatinine, glucose).

**Post-op care**
After bypass surgery, the patient is moved to a recovery area where blood pressure, temperature, and heart rate are monitored for an hour or more. The surgical site is checked regularly. The patient is then transferred to a concentrated care unit to be observed for any signs of complications. The total hospital stay for aortobifemoral bypass surgery, which involves abdominal incisions, may extend up to a week.

The leg will be flat in bed for the evening after surgery. It will be wrapped with light dressings or a fleece vascular boot. See care plan in Big Red!

Walking will begin immediately for patients who have had femoropopliteal or femorotibial bypasses, but patients who have had aortobifemoral bypass may be kept in bed for 48 hours. When bypass patients go home, walking more each day, as tolerated, is encouraged to help maintain blood flow and muscle strength. Feet and legs can be elevated on a footstool or pillow when the patient rests. Some swelling of the leg should be expected; it does not indicate a problem and will resolve within a month or two.

During recuperation, the patient may be given pain medication if needed, and clot prevention (anticoagulant) medication. Any redness of the surgical site or other signs of infection will be treated with antibiotics. Patients are advised to reduce the risk factors for atherosclerosis in order to avoid repeat narrowing or blockage of the arteries (smoking, diet, inactivity). Repeat stenosis (restenosis) has been shown to occur frequently in people who do not make the necessary lifestyle modifications, such as changes in diet, exercise, and smoking cessation. The benefits of the bypass surgery may only be temporary if underlying disease, such as atherosclerosis, high blood pressure, or diabetes, is not also treated.

Pts are encouraged to begin walking as soon as possible as well as climbing stairs. Pt can use elastic wraps when ambulating, but they should not be worn continuously.

**Risks & Complications**
The risks associated with peripheral vascular bypass surgery are related to the progressive atherosclerosis that led to arterial occlusion, including a return of pre-operative symptoms. In patients with advanced PAD, heart attack or heart failure may occur. Build up of plaque has also taken place in the patient's arteries of the heart. Restenosis, the continuing build up of plaque, can occur within months to years after surgery if risk factors are not controlled. Other complications may include:

- clot formation in a saphenous vein graft (major complication)
- failed grafts or blockages in grafts
- reperfusion syndrome (see below)
- infection more common when graft is synthetic (will have to be removed, and limb will be amputated)

**Signs of a Clot!**
Limb becomes cool, pale, painful and pulseless.
- reactions to anesthesia
- breathing difficulties
- embolism (clot from the surgical site traveling to vessels in the heart, lungs, or brain)
- changes in blood pressure
- infection of the surgical wound
- nerve injury (including sexual function impairment after aortobifemoral bypass)
- post-operative bleeding
- failure to heal properly

Reperfusion Syndrome
When an ischemic leg is revascularized and the ischemic muscle is reperfused, a variety of ions, proteins and enzymes that accumulated in the ischemic tissue return to circulation. Can lead to renal failure when the myoglobin is trapped in the renal tubules. Lactic acid can lead to myocardial depression, and debris can impair blood flow in the limb as it enters smaller blood vessels. Edema can develop and create compartment syndrome.

Normal results
Aortobifemoral bypass grafts have been shown to stay open and reduce symptoms in 80% of patients for up to 10 years. Pain and walking difficulties should be relieved after bypass surgery. Success rates improve when the underlying causes of atherosclerosis are monitored and managed effectively. Swelling can continue for 2-3 months (this is normal).

Morbidity and mortality rates
The risk of death or heart attack is about 3–5% in all patients undergoing peripheral vascular bypass surgery. Following bypass surgery, amputation is still an outcome in about 40% of all surgeries performed, usually due to progressive atherosclerosis or complications caused by the patient's underlying disease condition.

Alternatives
Peripheral vascular bypass surgery is a mechanical way to reroute blood, and there is no alternative method. Alternative ways to prevent plaque build-up and reduce the risk of narrowing or blocking the peripheral arteries include nutritional supplements and alternative therapies, such as:

- Folic acid can help lower homocysteine levels and increase the oxygen-carrying capacity of red blood cells.
- Vitamins B6 and B12 can help lower homocysteine levels.
- Antioxidant vitamins C and E work together to promote healthy blood vessels and improve circulation.
- Angelica, an herb that contains coumadin, a recognized anticoagulant, which may help prevent clot formation in the blood.
- Essential fatty acids, as found in flax seed and other oils, to help reduce blood pressure and cholesterol, and maintain blood vessel elasticity.
- Chelation therapy, used to break up plaque and improve circulation.