Endovascular Insitu Saphenous Vein Bypass

By Brenda Koivula, RN, CPN(C)

Vascular surgery has improved the quality of life for many patients with peripheral vascular diseases. Surgical techniques used in the treatment of the disease are developing rapidly. The first bypass graft was implanted in 1948. The 1960's and 70's generated the development of many new surgical procedures utilizing improved instrumentation, synthetic grafts, sutures, angiography and microvascular techniques. The most recent advancements are the endovascular interventions, which occur from within the blood vessel. Most recently the angioscope assisted vein bypass surgery technique allows for the valvulotomy and side branch occlusion to be performed intraluminally, while monitored under direct vision. The purpose of this paper is to provide an overview of the endovascular approach to insitu saphenous vein bypass for lower extremity revascularization.

Anatomy

The abdominal aorta descends to the level of the fourth lumbar vertebrae where it bifurcates to form the common iliac arteries. These arteries supply blood to the pelvic organs, gluteal region and the legs.

Abstract

First endovascular insitu saphenous vein bypass procedure performed in Canada was in November 1998 at North York General Branson Division. This article describes the pathophysiology of lower limb occlusion, the perioperative nursing care and the endovascular approach to insitu saphenous vein bypass graft.

Each common iliac artery descends a short distance then divides into an internal or hypogastric and an external branch. The external iliac artery is the main blood supply to the legs. The external iliac artery becomes the femoral artery after passing beneath the inguinal ligament. The common femoral artery has many branches including the superficial femoral artery. As the femoral artery reaches the popliteal fossa, it becomes the popliteal artery. The popliteal artery divides into the anterior and posterior tibial arteries. The anterior tibial artery continues into the foot as the dorsalis pedis artery which supplies blood to the foot and toes. The posterior tibial artery, the larger of the two tibial branches, divides to form the peroneal artery and the medial and lateral plantar arteries which supply blood to the heel, foot and toes.

The great saphenous vein, which is the longest vein in the body, originates from the medial side of the foot. It ascends up along the medial side of the leg until just below the inguinal ligament where it joins the femoral vein. The saphenous vein has many tributaries from numerous vessels that drain the upper thigh groin and the lower abdominal wall.

Arteries and veins are composed of three layers. The tunica intima is a smooth endothelial inner layer, the tunica media is a muscular middle layer, and the tunica adventitia is the outer layer composed of connective tissue. The tunica media layer of a vein is thin allowing minimal contractibility. The intima layer of the vein contains the semilunar valves, which prevent backflow of blood.

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Pathology

Lower extremity arterial occlusive disease can be acute or chronic. Acute arterial insufficiency is most often the result of an intrinsic obstruction of a major artery by a clot or emboli. An embolus is a clot or other plug brought by the blood from a vessel and forced into a smaller vessel obstructing the circulation. Emboli are most commonly seen in the lower extremities where the vessels taper or branch.

Atheroembolism or blue toe syndrome occurs in patients with disseminated atherosclerosis. This occurs when debris from proximal arterial lesions occlude small vessels.

Inadvertent injection into peripheral arteries of abuse drugs including narcotics, narcotic analgesics, barbiturates, amphetamines can also cause arterial insufficiency by microemboli. Other drugs that may produce arterial ischemia, progressing to gangrene are sclerosing agents, contrast agents, ergotamine and catecholamines.

Extrinsic causes of acute arterial insufficiency include trauma and compression to the vessel by a mass or an abscess.

Chronic arterial occlusive disease is a progressive narrowing of the artery leading to obstruction. The most common cause is atherosclerosis. In the early stage of atherosclerosis, fatty streaks form along the intima. The lesions are widely scattered at first, but as the disease progresses they become more numerous and can eventually cover the intimal surface of the artery entirely. Atheromas or plaques of newly formed cholesterol filled muscle cells build up and protrude into the lumen of the vessel. The deposits cause a roughened inner wall surface, and the muscular wall to become rigid and less elastic. Bloodflow through the vessel is reduced by the narrowing of the lumen and the hardening of the muscle wall, leading to ischemia of the tissues served by the vessel, and may cause the development of clots within the vessel itself.

Risk Factors

Patients requiring lower extremity revascularization suffer from diseases which cause arterial stenosis or occlusion. Symptomatic or chronic lower extremity arterial occlusive disease is more common in cigarette smokers than in nonsmokers and more than twice as great in diabetics as compared with nondiabetic patients. Another major factor is hyperlipidemia, high serum cholesterol. Atherosclerosis is accelerated by hypertension due to the added stress on the linings of the large blood vessels.

Clinical Manifestations

Physical findings in the acute phase include the six "P"s, pain, pallor, pulselessness, paresthesia, paralysis and poikilothermia. Acute ischemia is manifested by a sudden onset of pain progressing to numbness and finally paralysis of the extremity accompanied by pallor, coolness, and diminished or absent pulses. Atheroembolism or blue toe syndrome has a sudden onset of painful cyanosis of the toes or forefoot in the presence of pedal pulses.

Symptoms of chronic ischemia include intermittent claudication, which is a lower extremity muscular pain induced by exercise and relieved by short periods of rest. The weakness or discomfort is caused by an arterial obstruction preventing inadequate blood flow to the muscle to keep up with the increase in metabolic demands.

Ischemic rest pain is a constant aching discomfort or burning pain usually occurring in the forefoot and toes. This occurs when resting blood flow is insufficient to meet the metabolic demands of non-exercising tissue. Rest pain is usually worse at night and is relieved by placing the foot in a dependent position.

Ischemic ulcerations occur when minor traumatic lesions fail to heal normally due to inadequate blood supply. Gangrene occurs in the least perfused areas when arterial perfusion is so diminished that spontaneous necrosis occurs.

Chronic physical findings may include, hair loss on the affected limb, thickened nails, cyanosis, rubor, coolness, pallor, delayed capillary filling, muscular wasting and positive elevation dependency test.

Treatment

Peripheral vascular disease can be treated medically by way of thrombolytic therapy or surgically by repair, reconstruction, or replacement of the affected arteries.

Reversed Vein Graft - Historically the most successful approach to revascularization of severely ischemic lower limbs has been the reversed autogenous saphenous vein. An autogenous graft is taken from the patient's saphenous vein. The vein is reversed from normal anatomic position so that the valves will not obstruct blood flow. However, the graft may be damaged during the course of vein

harvesting after it has been deprived of its blood supply for more than 30 minutes. The damaged endothelium becomes conducive to thrombus formation.

Insitu Saphenous Vein Arterial Bypass - Insitu Bypass has been the operation of choice in the treatment of lower extremity arterial occlusive disease for the past 30 years. During insitu bypass the saphenous vein is left undisturbed maintaining the blood supply to the vein/artery, keeping the endothelium intact. The preparation of the saphenous vein for arterial bypass has two components. First the valves are rendered incompetent and secondly the side branches are occluded. The saphenous vein is then anastomosed at both the proximal and distal ends to the obstructed artery. When left in its anatomical position, the arterialized saphenous vein has proven to be an excellent channel to restore circulation.

Endovascular Insitu Saphenous Vein Bypass-

Unlike the previous surgical procedures that require full length leg incision, use of the angioscope avoids the need of a full length incision. Two small incisions are made, the saphenous vein is divided at the level of the proximal and distal anastomosis. The angioscope is connected to the camera and light cable and inserted intraluminally into the proximal vein from above at the proximal incision. The valvulotome is connected to the irrigation and inserted into the distal saphenous vein via the distal incision. The valvulotome is advanced until it is visualized by the angioscope. A coil delivery catheter is inserted into the working channel of the angioscope to prevent backflow of blood and or irrigation.

During angioscopically directed valvulotomy, passage of the valvulotome down the vein is monitored under direct vision. This enables the valves to be cut with precision and avoids residual competent valves. Valvulotomy and side branch occlusion are performed as necessary. When a side branch oriface is visualized, the coil delivery catheter is guided into the oriface and a coil is ejected - occluding the side branch. As the angioscope is advanced distally down the vein the valvulotome is simultaneously withdrawn from the vein. Once the valvulotome is removed from the vein, an on table angiogram is performed to verify results. Postoperative assessment will evaluate the affected limb on color, temperature, and circulation including pedal pulse monitoring with a Doppler.

The selection criteria for endovascular insitu bypass will be established through vein mapping. The saphenous vein will be present, undamaged, disease free and not varicosed. The diameter of the vessel must be greater than 3mm to accommodate the angioscope, and less than 6mm to ensure proper functioning of the coil delivery mechanism.

Patient preparation

History should include information on the following- coronary artery disease, diabetes mellitus, hypertension, chronic obstructive pulmonary disease, hypercoagulable states renal disease, unusual bleeding, hyperlipidemia and family history of atherosclerosis.

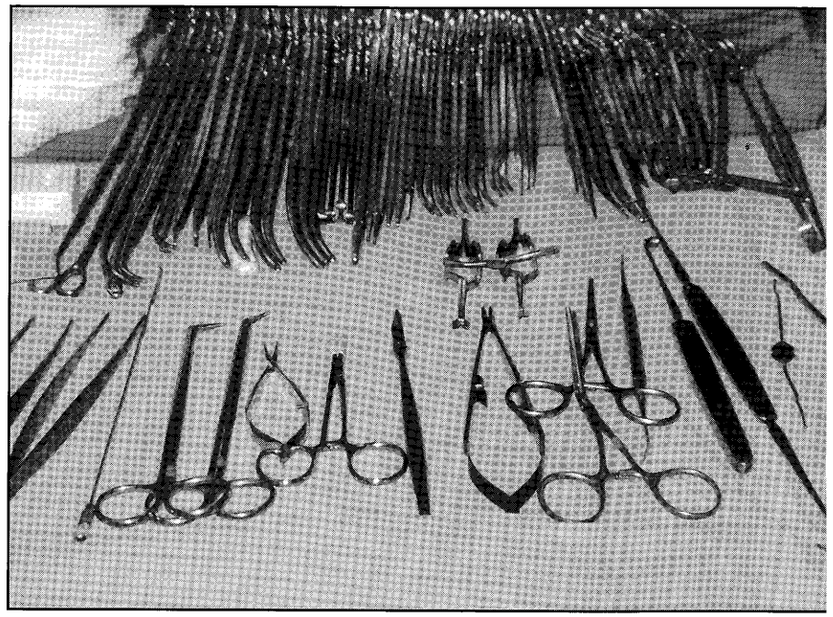
Physical examination should include bilateral arm pressures, peripheral pulses, aneurysm (identify aorta or peripheral aneurysm) bruits in the neck, abdomen or groin.

Preoperative testing includes:

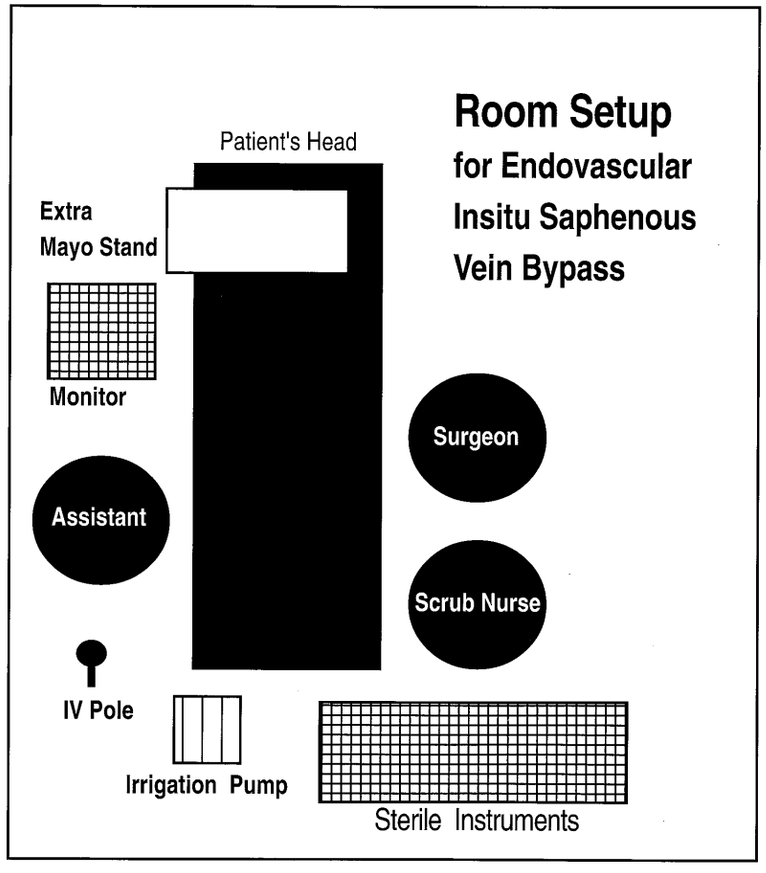
- CBC, platelet count, PT, PTT, BUN, serum creatinine, serum cholesterol and triglyceride levels and fasting blood sugar.
- Younger patients should also be tested for homeocystinuria.
- X-ray exams will include angiography of the aorta, iliac, femoral, popliteal, and tibial arteries of one or both legs.
- Ultrasound vein mapping is extremely useful to determine the diameter of the vessel and the number of sidebranches involved.
- Other testing may be an exercise stress electrocardiogram, exercise thallium cardiac scan
- IV dipyridamole or adenosine thallium scan, multigated cardiac blood pool scan
- Long term Holter monitor and duplex and ankle pressures.

Room set-up

The patient is positioned supine on the OR table. Following induction of anesthesia, a betadine prep solution is the applied from umbilicus down to the forefoot affected leg. The patient is draped in a sterile fashion with the affected leg exposed from the groin to the forefoot. The affected foot is placed in a transparent drape for assessment. The cautery and suction machines are placed at the head of the OR table to the patients right . A mayo stand is draped and placed over the patient's head, allowing for placement of the angioscope. The video monitor is placed on the unaffected limb side. The irrigation pump is placed at the bottom of the OR table along with the IV pole. The surgeon stands on the affected limb side, foot pedal for the irrigation machine is placed nearby, while the assistant will stand opposite the surgeon. The scrub nurse and sterile setup are situated on the same side as the surgeon at the foot of the bed. The irrigation solution contains heparin and papaverine and is prepared according to surgeon preference. An accurate infusion volume must be kept by the circulating nurse to avoid fluid overload.



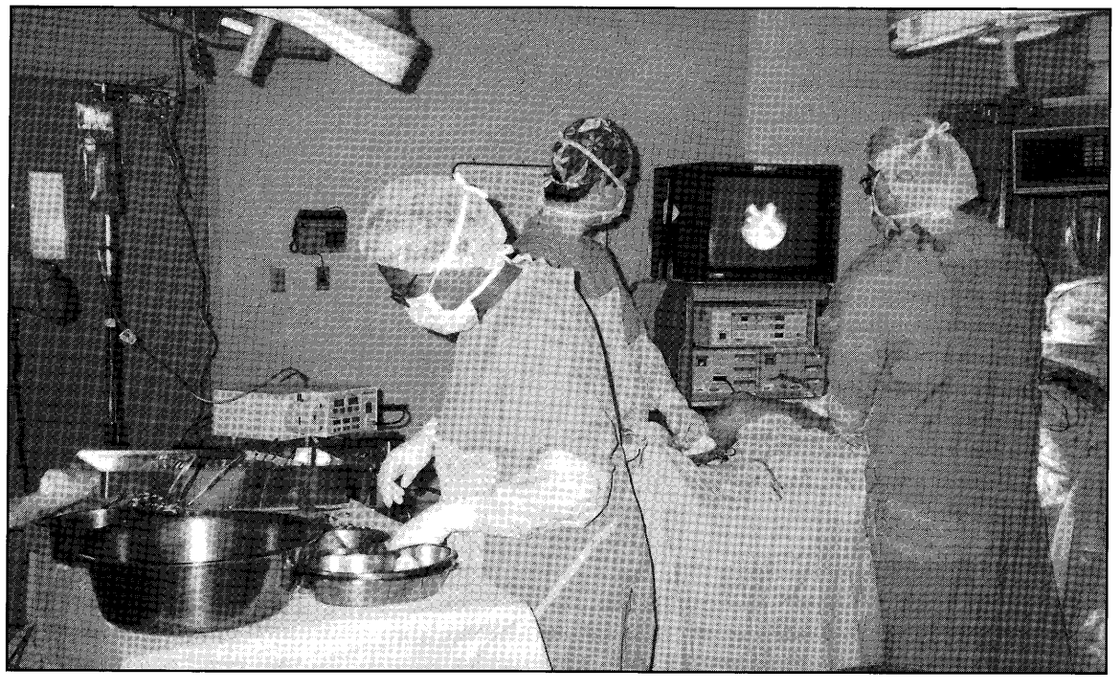
Instruments (photo above) and Room set-up for left leg Endoscopic Insitu Bypass (diagram below).



Instrument Set-up

A femoral popliteal bypass tray is used for this procedure. The instruments in this tray include noncrushing forceps such as debakeys and cushings, to prevent undue trauma to the vessels, specialty scissors such as potts that are specifically designed for vascular surgery and vascular needle drivers. Vessel loops and umbilical tapes are used to control bleeding and aid in retraction. The insitu instruments include retrograde valvulotom, antegrade scissors, bulldogs, an irrigating cannula, and a variety of small vascular clamps.

Angioscope/ introducer catheter is a disposable catheter consisting of two lumens, one for a moving angioscope and the other a working channel for the coil delivery catheter. The valvulotome is a retrograde valvulotome with an irrigating channel. The Coil delivery catheter is a flexible catheter loaded with a Gianturco occlusion coil for placement into the saphenous vein side branches. The coil delivery catheters are available in 2 mm, 3 mm and 4 mm diameters.



The first endovascular insitu saphenous vein bypass procedure performed in Canada was in November, 1998 at North York General Branson Division. Sunnybrook Health Science Centre performed the procedure a month or so later

Benefits

1) Endovascular bypass technology facilitates a decrease in the length of healing time as the two small incisions heal faster than a long continuous incision. The risk of wound complications is reduced due to decreased trauma to the tissue.

2) Patients are able to ambulate earlier postoperatively. Early ambulation postoperatively increases circulation, eliminating stasis of blood that may result in thrombus/embolus formation.

3) Pain is decreased in the postoperative phase reducing the amount of analgesic requirement.

4) Patient's length of hospitalization is reduced, as patients are able to care for themselves early on in the postoperative phase enhancing their mental outlook through physical recovery.

5) The risk of vein graft occlusion due to incomplete valvulotomy is reduced, as the valvulotomy is performed under direct visualization.

Conclusion

To date there have been six (6) endovascular insitu bypass procedures performed at the Branson site. The patients have all been afflicted with major vascular disease and range in age from 77 to 88 years. According to research out of the United States patients may be discharged as early as 48hrs postoperatively. As yet our limited exposure has not supported early discharge.

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Sterile O.R. Repack: Collaboration in Action

By Patricia Pocock, RN, Dipl. N.Ed.

Health Care Facilities across the Country are experiencing major changes related to social, technological and economic factors.

St. Joseph's Health Centre, London, Ontario (SJHC) has required unprecedented changes in the way our service is provided. Likewise provider corporations serving hospitals find their market place changing.

London Hospital Linen Service Incorporated (LHLSI), in collaboration with St. Joseph's Health Centre, is providing sterile, reusable linen packs and products to our operating rooms, family birthing centre and radiology suite. The Canadian Sterile Repack® program (C.S.R.) incorporates the following components:

- A high tech surgical barrier fabric from W.L. Gore and Associates, the manufacturer.
- Manufactured product: gowns, drapes and wraps from Lac Mac Ltd.
- Processing, production, sterilization and delivery of packs by LHLSI
- Receiving and case cart distribution by SJHC Central Processing staff to the end users; the staff in the operating rooms.

Major outcomes achieved in this collaboration are an exceptional, reusable sterile product offering superior protection for our patients and health care providers, process improvements, the reduction of numerous steps in rework and a 15% cost savings to the hospital of approximately $150,000.00 per year.

LHLSI is a not-for-profit operation which began providing centralized linen service in 1972. In 1973, upon request of hospitals, an O.R. Pack Service was initiated. Presently the Company services from Windsor to Kitchener - 28 hospitals (15 of them having O.R. suites), 8 Nursing Homes and many affiliated health care services.

One of the Corporate objectives is to maintain a leadership position in the laundry and linen industry consistent with components of its Mission Statement, being to serve customer hospitals in the best way possible at a contained cost, while improving the quality and scope of its services.

Competitive conditions and the need to be responsible for the entire processing cycle of surgical product was the spark that moved LHLSI into the complete production of surgical packs, including sterilization.

Credibility for providing this service was determined to be the immediate hurdle; the Laundry Corporation required one of its major customers to demonstrate an interest, before it could commit major capital dollars for the sterilizing service.

At the same time, St. Joseph's Health Centre, London, was restructuring its Central Supply, installing a Carousel for distribution purposes and moving to a Case Cart System.

By working together, a Process Protocol was developed that provided the credibility for London Hospital Linen Service Incorporated to provide this new Value-Added service of sterilization and delivery of sterile packs to the O.R.

After consultation, the following criteria and standards established were met:

- The surgical linen is processed in a separate part of the Plant having its own air flow (air pressure),

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