Minimally Invasive Techniques for Limb Salvage Procedures

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Procedures for limb salvage have evolved from surgical bypass exclusively to the increasing use of endovascular procedures. There remain, however, a group of patients who require distal bypass to small vessels, due to the extent of their disease or the need for more flow to the ischemic limb than can be provided by an endovascular procedure. In this situation, limb salvage is associated with excellent primary and secondary graft patency; however, one of the major sources of failure is wound complications at the site of autogenous graft harvest or inflow or outflow vessel exposure. Recently, techniques have been developed to minimize the risk of wound complications following autogenous conduit harvest and increase the speed of recovery and return to ambulation. Autogenous arteries and veins, matching the size of the donor and recipient artery, of variable lengths, can be harvested with minimally invasive techniques. The vascular surgeon can now select the best autogenous conduit with respect to wall thickness, diameter, and length, for the purpose needed. These techniques should all be in the armamentarium of the vascular surgeon who specializes in limb salvage; selection of conduit should be based on the needs of the patient rather than the experience of the surgeon. As has been learned by microvascular surgeons, the best conduits match the graft diameter with the recipient artery diameter. Customized autogenous conduits should be available for every patient-the days of moving to a prosthetic graft once the long saphenous vein(s) have been harvested should be over!

Principles of Incision Management

The length, location, and direction of an incision are critical for a successful outcome from a surgical limb salvage procedure. Although each surgeon has particular preferences when making incisions, the more ischemic the limb, the more important these basic principles are. When large incisions are created or the limb becomes edematous following revascularization, plastic surgical techniques of closure may be required, including relaxing incisions, skin grafts, and secondary closure to avoid wound failure, graft exposure, and graft loss owing to compression. Recently, minimally invasive techniques have been developed or refined to reduce the invasiveness of harvesting the autogenous conduit and exposing the vessels.

Endoscopic Vein Harvest

The technique of endoscopic vein harvest has been routinely used in both vascular surgical procedures and cardiac surgery procedures over the past 10 years. However, new equipment for this procedure and increased experience, with refinement of the technique, has resulted in a more rapid and reliable procedure. Reports of minimally invasive harvest of the long saphenous, short saphenous, and arm veins with no conduit injury and little or no donor site injury have become routine. Conduit harvest of the entire saphenous vein through a single 2 cm incision can routinely be performed in < 1 hour and frequently in < 30 minutes. There is reduced wound closure time, so that the total harvest time is frequently less than it would be for open exposure. Long-term advantages of an endoscopic vein harvest are reduced pain at the limb harvest site, reduced wound infections and skin necrosis, and reduced sensory nerve injury.

Once the vein is harvested, it can be left non-reversed, reversed, or transposed. Since all branches are divided during the endoscopic harvest technique, there is no risk of retained vein branches, which can reduce graft patency. The proximal anastomosis can be constructed with the vein removed from the harvest tunnel, after which it can be replaced in the tunnel, with visualization of the arterialized conduit in the tunnel to inspect for extrinsic webs and twists.

Endoscopic Artery Harvest

As radial arteries have been increasingly used for coronary bypass, techniques have been developed to harvest these arteries through smaller incisions and with less damage to the arterial conduit. Preoperative testing is useful to identify collateral ulnar artery circulation and to assess the arterial wall for stenosis and calcification, which particularly occurs in diabetics. Endoscopic Radial Artery Harvest is a relatively new approach to obtaining conduit for limb salvage procedures. The radial artery in one or both arms can be harvested through a 2 cm incision. Each radial artery can provide up to 20 to 25 cm of conduit. Spliced radial arteries, which are similar in size to the posterior or anterior tibial arteries at the malleolar level, can originate from as far proximal as the superficial femoral artery, if that much length is needed. Additional length can also be obtained by splicing a radial artery to another smaller artery, such as the subscapular artery, which branches and can provide a conduit to more than one outflow artery.

Minimally Invasive In Situ Vein Harvest

Although in situ bypasses can be done with open or closed techniques, newer instrumentation has enabled vascular surgeons to do the in situ technique with a semiclosed technique. Several valvulotomes, including the LeMaitre, are designed to be passed from the distal anastomotic site to the proximal anastomotic site with the skin closed. The valvulotome can enter a 2 mm vein without causing damage to the vein wall, and reliably cut the valves. Once the valves are cut, the branches can be identified with a Doppler or angiogram, marked, and then divided with small stab incisions over the identified branches. As stated previously, the option of using endoscopic vein harvest equipment in conjunction with the valvulotome reduces the complexity of the procedure and reduces the need for even the small stab incisions to ligate the vein branches.

Conclusions

Minimally invasive techniques should be used to harvest autogenous arterial and venous conduits and reduce the risk of early conduit and skin complications, such as skin necrosis, infection, graft exposure, and graft infection. Conduit harvest can often be performed in less time than with conventional open techniques. Late outcomes, including patient activity and incisional pain, are also improved with minimally invasive harvest techniques.

References

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