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Minimally Invasive Long Saphenous Vein Harvesting Using a Laryngoscope

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ABSTRACT

Background: Traditional open incisions for long saphenous vein (LSV) harvesting are common sources of postoperative complications after coronary artery bypass grafting (CABG). To reduce pain and wound healing complications, minimally invasive harvesting techniques are being developed. We have investigated the use of a conventional laryngoscope for cost effective saphenous removal using short incisions and long subcutaneous tunnels.

Methods: The LSV was exposed through small incisions connected by long subcutaneous tunnels. Soft tissue retraction, visualization and illumination were provided by a sterilized laryngoscope with a #3 or #4 Macintosh blade. Dissection was performed with standard instruments while branch ligation was performed with vascular clips. Thirty-two patients undergoing CABG between October 1997 and January 1998 underwent minimally invasive vein harvesting assisted by a laryngoscope. Clinical outcomes were evaluated.

Results: There were 27 males and 5 females with a mean age of 62.6 ± 9.3 years in this study. Adequate saphenous vein was removed in 29 of 32 cases. (In three patients, the vein was so superficial that an open incision proved easier). The length of harvested conduit averaged 38.2 ±11.01 centimeters (21–55 centimeters). Harvesting time average 37.1 minutes (±10.8 minutes; range from 20 to 62 minutes). Postoperatively, there were no wound dehiscences, infections, cellulitis, or major hematomas. Pain and leg edema were considerably less than with traditional open harvest.

Conclusions: Minimally invasive vein harvesting is less traumatic to the extremity with fewer complications and superior patient satisfaction. Although commercial disposable systems are now available to permit minimally invasive harvesting of the saphenous vein, a conventional laryngoscope can be used with much reduced costs.

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INTRODUCTION

The long saphenous vein (LSV) still retains its place among the conduits of choice by the majority of cardiac surgeons performing coronary artery bypass grafting (CABG) procedures. Most surgeons employ extensive lower extremity incisions for vein exposure and retrieval. These incisions are frequently the source of inadequate healing and wound complications leading to patient discomfort and dissatisfaction. Minor wound complications include hematomas, ecchymosis, erythema and edema. Major complications include suppurative bacterial infection, cellulitis and/or dehiscence [DeLaria 1981]. Even in the absence of a demonstrable complication, patients frequently complain of postoperative discomfort, pain, or dysesthesias especially around the knee and ankle areas [Lavee 1989]. Needless to say, the cosmetic result from saphenous vein harvesting remains variable with poorer appearance in obese patients or in individuals with deficient healing abilities, such as diabetics [Lee 1996].

To address these issues minimally invasive harvesting techniques are being developed. A variety of equipment is now commercially available for harvesting the LSV through small incisions or endoscopically with the focus mainly on the cosmetic result and patient satisfaction [Utley 1989]. Most of this new equipment is disposable and thus adds significant cost to the procedure. We describe a simple method of less invasive saphenous vein exposure and harvesting which improves the cosmetic and healing results while keeping costs to a minimum. Our technique employs a common anesthetic laryngoscope equipped with a Macintosh blade and ordinary surgical dissecting instruments. This report includes a description of the technique as well as our results in the first 32 patients in whom laryngoscopic minimally invasive vein harvesting was employed.

MATERIALS AND METHODS

Surgical Technique

Minimally invasive saphenous vein harvesting was performed through small incisions and subcutaneous tunnels assisted with a conventional anesthetic laryngoscope. The device is the same instrument used to intubate patients and is fitted with a standard #3 or #4 Macintosh curved blade (see Figure 1, ◎). The device is sterilized in ethylene oxide gas. After sterilization, the battery compartment is opened and batteries are inserted by the circulating nurse. Replacement bulbs can be gas sterilized and packaged separately.

The patient is positioned on the operating table with the hips abducted and externally rotated. A 4 to 5 centimeter incision is created lateral to the long adductor muscle of the thigh and about 15 centimeters distal to the inguinal crease. The long saphenous vein is identified in the subcutaneous space and dissected free from the surrounding tissues in the usual manner (see Figure 2, ◎).

Side branches are ligated using ordinary vascular clips (just as those used for internal mammary artery harvesting). Next, a subcutaneous tunnel is created in both directions superficial to the anterior wall of the vein using blunt disection with the surgeons finger. The laryngoscope with a #4 Macintosh blade is inserted into the tunnel. Illumination from the laryngoscope light bulb provides visualization of the saphenous vein and its side branches (see Figure 3, ◎).

The blade slides carefully and progressively inside either tunnel illuminating the cavity and facilitating proximal and distal LSV dissection and branch ligation. It is sometimes helpful to have the laryngoscope handle stabilized by an assistant to allow the harvesting surgeon to utilize both hands (see Figure 4, ◎).

After the maximum scope distance is reached in either direction, another 3 to 4 centimeter incision is performed and the LSV is identified and dissected free under direct vision. Once more a digital tunnel is created in both directions. Subsequently, the blade is inserted again and its bright light contributes to a clear view of the LSV.

For longer vein harvests it is usually necessary to create a third incision about 5cm below the popliteal fossa. For dissection of the vein in the calf, the laryngoscope blade is changed to a smaller #3 Macintosh. The tunneling and dissecting procedure with the blade is repeated in both directions, now having the second and the third incisions communicating via a unified cavity. The last incision is performed about 10 centimeters cephalad to the medial malleolus. After vein identification and nerve preservation, bidirectional tunnels are again created. Finally the LSV is ligated distally at the level of the medial malleolus, using two medium sized clips. The whole vein is withdrawn backwards through the connecting tunnels (see Figure 5, ◎) The proximal vein is ligated and divided over vascular clips just a few centimeters below the saphenofemoral junction with vision assisted by the laryngoscope.

The vein is flushed with normal saline or heparinized blood. Undesired areolar tissue is removed by sharp dissection. Ligation of any unclipped branches can now be done. The tunnels are packed with dry gauze. After reversal of heparin later in the case, the wounds are sutured in one layer. The lower extremity is bandaged with an elastic wrap. We rarely employ a drainage system.

Study Design

Laryngoscopic assisted harvesting of the LSV was employed in 32 patients between October 1997 and January 1998. The total length of harvested vein was measured along with the total length of all skin incisions. Each postoperative day until discharge the lower extremity was inspected for signs of healing, the presence of edema or hematoma and other wound complications. The healing process was coded as good, inflamed or dehisced. The presence of a hematoma was coded as small or diffuse. The perimeter of the legs were measured daily at three levels (ankle, midcalf, midthigh) and the presence of edema was stated, if the sum of the differences (compared to the preoperative measurments) were greater than 1 centimeter.

The harvesting time was calculated from the initial skin incision to the final distension of the conduit, after all its branches were ligated. The leg pain score was estimated by means of a Visual Analogue Scale (VAS).

RESULTS

Laryngoscopic vein harvesting was used for 32 patients over a period of 4 months. There were 27 males and 5 females with a mean age of 62.6 ± 9.3 years. In three patients we had to abandon the method and proceed to the conventional open method due to a very superficial course of the LSV. Eleven patients (34%) fulfilled the definition of obesity (abnormal Quetelet index > 25 kilograms per meter squared).

Long saphenous vein harvesting time average 37.1 minutes (±10.8 minutes; range from 20 to 62 minutes). The length of harvested conduit averaged 38.2 ±11.01 centimeters (21–55 centimeters). The length of all incisions totalled together averaged only 16 ± 4.7 centimeters (9–24 centimeters). Wound healing appeared to be good in all patients. There were no hematomas detected and only 3 patients (9.3%) developed peripheral edema.

The leg pain estimated by the VAS pain scale was a mean value of only 1. 8 ± 0. 6.

DISCUSSION

The method described in this paper was initially introduced by Guy Fradet, MD and Andrew Thompson, MD of Vancouver, B.C., Canada. These surgeons discussed minimally invasive saphenous vein harvesting using a laryngoscope on the OpenHeart-L, an Internet email list for cardiac surgeons. They reported experience with nearly 100 patients in whom thigh segments of the LSV were harvested with the assistance of a Bainton blade [Fradet 1997]. This special blade is quite large and carries a circumferential guard designed to hold back the pharyngeal soft tissues when intubating patients with airway masses. Subsequenlty other surgeons reported similar gratifying results using the straight Phillips, Wisconsin [Levinson 1997] or the Miller laryngoscopic blades [Dullum 1998].

In the past 2 years, several commercial vendors have marketed specialty equipment for less invasive saphenous harvesting, including the Mini-Harvest® (US Surgical Corp, Norwalk, Conneticut), the Endo-Harvest® (Ethicon Endo-Surgery), and GSI Instruments. In contrast to the laryngoscopic technique described here, these commercial systems are primarily disposable which adds significant cost to each procedure. In contrast, the laryngoscopic technique takes advantage of a fully reusable system that is readily available in any hospital. Laryngoscopes can be purchased for as little as $200 and reused many times. The device is simple and requires no training or expertise to begin using. In our judgment, the illumination provided by the Macintosh blade was quite sufficient for saphenous harvesting. The working channel provided by the blade was adequate to use standard Metzenbaum scissors, forceps, cautery and clip appliers. Harvesting may take somewhat longer than with an open incision technique but closure of the small entry wounds was considerably faster. Without question the cosmetic result was far superior to an open harvest technique. The costs of the technique consisted only of replacement bulbs and batteries.

There are several theoretical disadvantages to using a laryngoscope for saphenous vein harvesting. First, there is the potential for damage to the LSV from forceful manipulations. It is likely that with further clinical experience, we can harvest the vein with more refined techniques and less retraction. Another concern is the need to pass batteries into the device after sterilization. Batteries will not tolerate immersion sterilants or heat. In our experience, it is simple to open the battery casing and permit the circulating nurse to insert unsterile batteries into the laryngoscope handle. We do not yet know if there is any risk of a break in sterility, but we have not seen any infections in our initial patient series. If the batteries are removed at the end of the procedure, they can be used in a future surgery as well.

Laryngoscopic light bulbs are sensitive to gas sterilization and will fail at a more rapid rate than in normal use situations. However, spare bulbs can be gas sterilized and placed on the surgical field for use as needed. At one point we investigated the use of a fiberoptic laryngoscope but illumination proved to be suboptimal.

Occasionally the LSV is quite superficial and actually runs in the deep fibrous dermis layer of the skin. We encountered this in three patients. The laryngoscopic technique does not work when the vein is this superficial. Open harvesting is best in this situation.

Our preliminary results with laryngoscopic saphenous vein harvesting for CABG appears to be quite encouraging. As of this writing, we have performed 32 cases with excellent clinical and cosmetic results. These results have encouraged us to embark on a prospective, randomized trial comparing the laryngoscopic to the conventional long incision technique. We plan to study the complication rates, the harvesting times, the macroscopic quality of the conduit, the frequency of conduit injury and need for suture repair and most importantly, the pain experienced by the patient (measured by pain scales), and their overall satisfaction with the cosmetic result.

REFERENCES

1. DeLaria GA, Hunter JA, Goldin MD, Serry C, David H, Najafi H. Leg wound complications associated with coronary revascularisation. J Thorac Cardiovasc Surg 81:403–7, 1981.
2. Dullum M. Personal Communication 1998.
3. Fradet G and Thompson A. Personal Communication 1997 on the OpenHeart-L listServ of The Heart Surgery Forum[tm] (www.hsforum.com).
4. Lavee J, Schneiderman J, Yorav S, Shewach-Millet M, Adar R. Complications of saphenous vein harvesting following coronary artery bypass surgery. J Cardiovasc Surg 30: 989–91, 1989.
5. Levinson MM. Personal Communication 1997.
6. Lee J. Minimally invasive vein harvesting. Surgical Physician Assistant Nov/Dec 25–32, 1996.
7. Utley JR, Thompson ME, Wallace DJ, et al. Preoperative correlates of impaired wound healing after saphenous vein excision. J Thorac Cardiovasc Surg 98:147–9, 1989.

REVIEWS AND COMMENTARY

Invited Commentary by Mark M. Levinson, MD of Hutchinson, Kansas, USA

This elegant paper by George Stavridis and colleagues from the Onassis Cardiac Surgery Center in Athens, Greece is remarkable for several features, not the least of which is the ingenuity of the authors to utilize available tools to extend the range of cardiac surgery. Every surgeon (and every CABG patient) knows the frustrations of leg wounds after saphenous harvesting. When asked about discomfort after CABG, two-thirds of patients indicate the leg wounds were more painful than the sternotomy. Paresthesis and dysesthesias often last for 6 to 12 months and are a constant source of patient disatisfaction. Ipsilateral leg edema and drainage are the virtual pariahs of coronary surgery.

I was personally enlightened to the importance of leg wounds by observing the way patients without saphenous incisions ambulate after surgery. Patients with arterial grafts but no venous grafts move quicker and less stiffly down the hallway with no limp. They are not dragging soaked gauze dressings and do not need home health nurses to change dressings.

Minimally invasive vein harvesting is a “breakthrough” in many ways. Even with the first generation of instrumentation, it is possible to remove the entire saphenous vein through small incisions. The results are obviously different, with no pain, ambulatory difficulty, and trivial wound complications. For skeptical surgeons, the results must be seen and experienced.

In the past, there was always a rush to retrieve the vein before the surgeon initiated cardiopulmonary bypass. In the modern era, there is additional time since the mammary artery is usually being harvested at the same time. As pointed out by the authors of this paper, it does take some additional time to perform minimally invasive vein harvesting, but the rewards are worth it.

I am very honored to comment on the superb technique reported here by Dr. Stavridis and colleagues. I have also used a laryngoscope to harvest saphenous veins and would like to make some comments on surgical technique above and beyond the excellent points already made in this paper.

First and foremost, atraumatic harvest of the conduit is of maximum importance. I find it concerning that the authors delivered the saphenous vein into the wound using traction. If enough force is applied by traction, disruption of the endothelial integrity can occur. This is not a small matter in saphenous conduits since accelerated atherosclerosis occurs whenever the endothelium of the vein is breached. In my hands, this kind of traction is not necessary. There are other means to dissect the vein without applying any force to the conduit. In fact, the principle I apply is "no-touch". The vein is permitted to lay undisturbed. Dissection is done by sweeping all areolar tissue away from the conduit. The vein lays in its bed undisturbed until the very last moment. Standard Metzenbaum scissors can be used to push the areolar tissue sideways until a branch is identified. After division of the branch, the lateral sweeping maneuvers are repeated in a forward momentum until the conduit is freed. Then the vein can be gently lifted and the filmy adhesions remaining are sharply divided. Exposure of the vein is facilitated by passing a blunt tip suction forward into the saphenous tunnel in front of the laryngoscope blade. This maneuver atraumatically develops the tunnel and identifies the course of the vein without finger dissection. For this maneuver I use the central core of an abdominal "pool" suction.

Second, the success of the whole procedure depends on complete identification and control of all side branches. The point I wish to make relates to attention to detail. Minimally invasive vein harvesting fails completely if there is any bleeding into the harvesting tunnel. The subcutaneous tunnel runs vertically through the entire leg. Any bleeding into the tunnel communicates through the whole wound. Accumulation of hematoma not only causes pain, but extremity edema and drainage. All of the advantages of minimally invasive saphenous harvesting are lost if bleeding occurs. It is imperative that each side branch of the saphenous vein be identified and controlled before division. Even small branches that are cut or torn will retract into the areolar fat causing impressive hematomas and ecchymosis during the period of heparinization. If all side branches are controlled, these wounds are so inocuous that the patients often don't know they are there. Meticulous surgical technique and hemostasis are richly rewarded in minimally invasive vein harvesting.

One of the future advances will be devices to quickly identify and divide each branch. Instrument exchanges (scissors, clip appliers, cautery, suction) slow the procedure down. It is very likely that new instrumentation will permit the surgeon to identify, control, and divide branches with a single device. The Everest Medical Bisector (Everest Medical, Minneapolis, Minnesota) is one such device. There are also bipolar cauterizing scissors and harmonic scalpels now being investigated for the same purpose. When secure branch ligation and division can be done quickly through a scope, harvesting times may actually be less than with an open procedure.

Dr. Stavridis made many excellent points in favor of minimally invasive vein harvesting in his paper, but I would like to add to his discussion. Whether a laryngoscope or other visualization system is used or not, one of the prime advantages of this procedure is the absence of deep lateral flaps in the leg. Flaps are a consequence of making a large incision only to find the vein is quite a distance away. A large subcutaneous flap is the result of chasing the vein far from the inital skin incision. These flaps are notorious for poor healing, infection, and dermatolysis. With minimally invasive techniques, these flaps never occur. The reason is simple. Empiric incisions are not used. The vein is tracked visually allowing the surgeon to remain directly on top of the conduit at all times. This is a distinct advantage that only becomes obvious after trying the technique a few times. The reduced flaps and subcutaneous tissue division also means considerably less blood loss and higher postoperative hematocrits.

I have become more succesful with this procedure by identifying the location and course of the vein using preoperative duplex examination. The saphenous vein can easily be mapped with a 5 megahertz duplex probe. The skin is marked with an indelible, waterproof pen as the technician follows the vein from the groin to the ankle. The diameter of the vein is noted at various levels. This simple noninvasive procedure not only identifies the best quality and uniformity of conduit for coronary grafting, but visually directs the assistant to create the initial incision directly over the course of the main vein. Flaps and inappropriate dissection into the deep recesses of the leg are completely avoided. Once the vein is identified, the harvesting scope follows the vein like a road map, preventing flaps and devitalized tissue.

Although Dr. Stavridis used a quantitative pain scale to assess his patients, it is hardly necessary to do so. After a few patients, the differences are very obvious. Most patients with minimally invasive harvesting are unaware of the incisions. The advent of minimally invasive saphenous harvest is going to markedly reduce the lost time from employment for many postoperative patients who would have otherwise complained of leg pain, edema, drainage, and paresthesias. Earlier participation in cardiac rehabilitation is another benefit. When I was trained in cardiac surgery between 1983 and 1985, every painful leg incision was diagnosed as "saphenous neuritis". Based on my first experience with minimally invasive saphenous harvest results, I no longer think there is such an entity. The pain and paresthesias typical of open harvesting are due to extensive subcutaneous and cutaneous trauma and division of the many fine sensory branches which run under the fibrous dermis.

Minimally invasive saphenous harvest will favorably change the perception of our patients and their cardiologists. This procedure is a goal that every surgeon should establish for his/her practice in the coming years. I am looking forward to further data from Dr. Stavridis and colleagues as well as further refinements in surgical technique and instrumentation for minimally invasive saphenous vein harvest in the near future.