ENDOSCOPIC VEIN HARVESTING – HOW DO WE DO IT?

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INTRODUCTION

The saphenous vein graft (SVG) remains the most used conduit as a second graft in Coronary Artery Bypass Grafting (CABG).[1] Traditionally, surgeons harvest SVG with an open approach, making a long incision along the medial part of the leg or thigh. This procedure can potentially result in important complications, such as delayed wound healing, postoperative pain and infection.[2] Thus, less invasive techniques for vessel harvesting have grown in popularity. Endoscopic vein harvesting (EVH) is a minimally invasive harvesting procedure, which only requires a short incision, leading to less wound complications and a faster return to normal daily activities.[3,4]

This article intends to describe how we do EVH technique in our centre, from the preparation of the patient to the postoperative period and share some tips and tricks from our experience.

INDICATIONS AND CONTRAINDICATIONS

Although EVH can be done in almost all patients, it is our belief that the patients who benefit the most are the ones with a higher propensity for wound complications, such as those ones with Diabetes Mellitus, peripheral vascular disease, chronic renal failure and increased body mass index (BMI).

There are no absolute contraindications for EVH specifically. However, this technique shares the same concerns regarding the harvest of the saphenous vein in general: we try to exclude patients with extensive varicosities, deep venous thrombosis or poor-quality vein.[5]

EQUIPMENT

For EVH, we use:

- A zero-degree endoscopic lens connected through a cable to a monitor video display.
- A conical dissection tip that is attached to the lens.
- A light source unit wired to the lens to provide illumination.
- A source of carbon dioxide to insufflate and keep the vein accessible during the procedure.
- A ready-made single-use kit (harvesting tool) to provide housing for the endoscope and electrocautery probe.
- Two trocar seals – one for the endoscope, other for the complete harvesting tool.

Different manufacturing companies provide similar equipment with minor design differences. The harvesting tool used in our centre is formed by a cannula with 4 lumens: one for the endoscope, a C-ring, a distal lens washer tube and an electrocautery for cutting and sealing the vessel branches. The C-ring is independently controlled by a C-ring slider on the handle of the harvesting cannula. The harvesting tool can be manipulated from the main harvesting cannula through the tool adapter port. It cuts and seals through a process of heat and pressure, powered by direct current only.[6]

PREPARATION AND POSITIONING

One of the most important steps for a successful EVH is preoperative bedside venous doppler mapping (Figure 1.A, B). This exam provides crucial information regarding the vein course, size, and quality, allowing to decide which

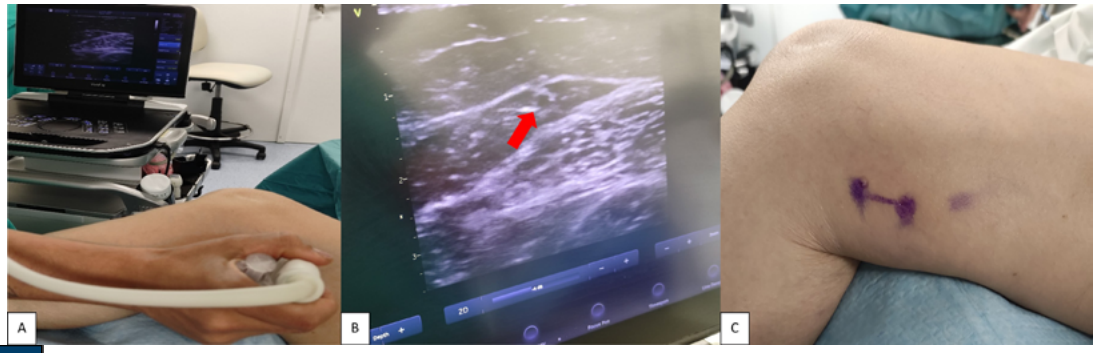

Figure 1 *A- Bedside venous doppler mapping; B- Identification of the vein (red arrow); C- Local of the incision is marked.*

Figure 2 *Positioning of the limb.*

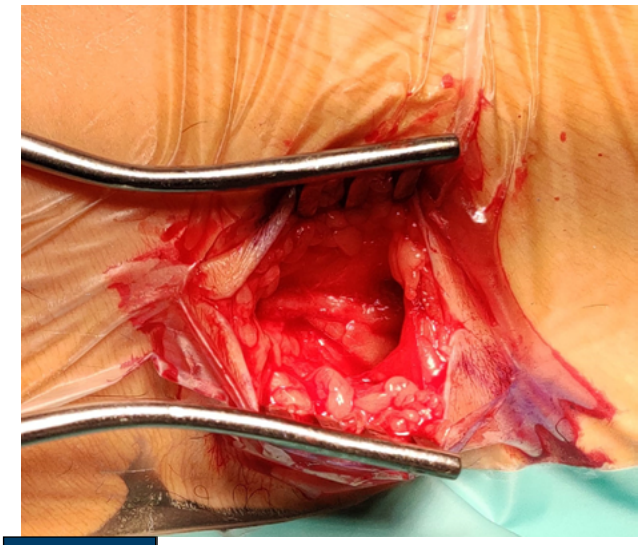

Figure 3 *Incision and initial dissection of the vein.*

side to be harvested or even to cancel the procedure. The course of the vein is then marked with a surgical skin marker to guide the later incision (Figure 1.C). It is noninvasive and is typically performed in less than ten minutes.

The surgeon should flex the patients' knee from 90 to 120 degrees with mild external rotation of the hip joint on the ipsilateral side. Towels should support the leg at the posterior aspect of the knee to avoid any lesion[7] (Figure 2).

TECHNIQUE

A skin incision of around 2 cm is performed on the initial skin marks of the vein mapping, usually on the medial side of the lower limb, 1 cm below the medial tibial tuberosity. Under direct vision, the dissection of the surrounding tissue is completed for 2-3 cm towards the thigh to allow easy introduction of the endoscopic device and the proximal vein branches are ligated and resected (Figure 3).

The endoscope is inserted into the appropriate trocar port balloon and sealed with the smoothly conical tip of the device (Figure 4.A). Then, keeping the silicone sling, the tip is introduced into the subcutaneous tissue tunnel anterior to the vein. Under endoscopic visualization, the instrument is advanced 3-4 cm towards the thigh along the vein to slide the trocar port into the incision. The balloon is inflated until complete sealing (up to 25 cc of air through the balloon inflation port) and carbon dioxide insufflation starts at 3 mmHg until a maximum of 12 mmHg to allow a good exposure of the SVG.

With the conical dissection tip, circumferential blunt dissection of the SVG is completed toward the groin, under videoscopic visualization (Figure 4.B). The optical probe is gripped with one hand while the other follows the advancement of the conical tip from the skin, with care taken to avoid compromising the carbon dioxide tunnel. Firstly, we dissect on the anterior surface of the vein, then posterior and lateral aspects, throughout all its length. This dissection should be gentle to avoid injuries of the wall of the conduit or avulsion of vessel branches.

Once the dissection is completed, the endoscope is pulled out and the dissection tip is removed. The endoscope,

C-ring and electrocautery are inserted into the harvesting tool and connected to the power cable. The trocar seal is replaced and the CO2 tube is connected to the device (Figure 5).

Under endoscopic visualization, the C-ring is extended to the saphenous vein by advancing the C-ring slider. The electrocautery is oriented toward the side branch with the jaws kept open and it should be grasped with the concave side oriented towards the main vessel. The branch is then secured and transected by closing the jaws (Video 1).

If blood or other tissue blocks the lens of the endoscope, we can squeeze the syringe connected to the device with saline and clean it.

When SVG is free of all side branches, the tip of the device is pointed towards the skin at the end of the tunnel. An incision is made at that point and a clamp is inserted to pierce the muscle band and grip the SVG. The distal end of the vein is pulled out through the hole, tied with silk suture, and cut. Then the SVG is hooked by the C-ring, pulled out through the proximal incision, and cut under direct vision (Figure 6.A).

After the SVG is out of the body, the tunnel gets checked one last time for proper haemostasis. Only after the haemostasis is secured, we order to heparinize the patient.

We do not insert a surgical drain by routine, only when some bleeding can be expected. All incisions get sutured appropriately and the limb should be tightly bandaged (Figure 7.A, B).

Finally, the SVG is inspected for any tears, thrombus, or avulsed branches. All branches should be tied with silk suture or clipped and tears can be fixed with (7-0) nonabsorbable sutures (Figure 6.B). The graft should be kept in a solution, typically heparinized saline, until it is time to be used.[7-9]

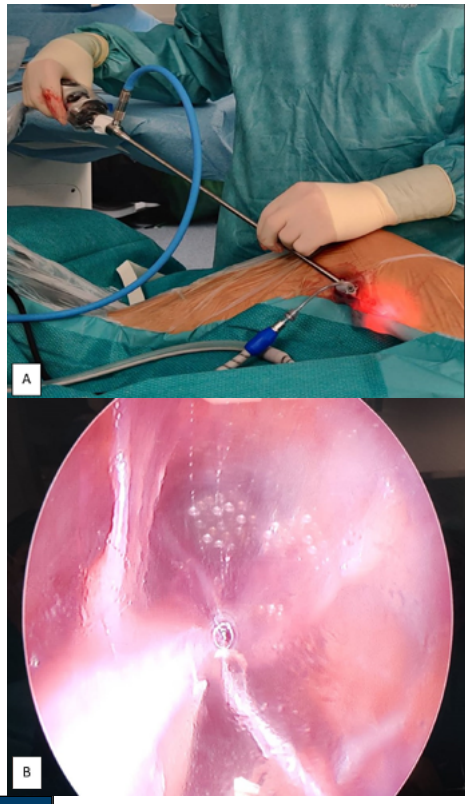

Figure 4 *A- Insertion of the endoscope; B- Endoscopic dissection of the surrounding tissue of the vein.*

SPECIAL CASES, TIPS AND TRICKS

High or low Body Mass Index (BMI)

In patients with high BMI, the vein is often embedded deep within in the fat. It can be difficult to find the conduit with a small incision and the fat can bleed easily and obscure the surgeon's vision. In this case, mapping the SVG with ultrasound is essential to choose the incision site and identify potentially complicating side branches. We advise to ultrasound both legs, so it is easy to quick cross-over to the contralateral leg if there are difficulties to find the SVG. It is also possible to use the "fishing maneuver": The surgeon moves a hooked clamp from the fascia towards the skin in both directions, the vein is then gently hooked with a sling and dissected from the surrounding connective tissue.

In patients with low BMI, the vein can be very superficial. A careful approach to the initial dissection is crucial. Usually there are difficulties to dissect the anterior surface of the vein, so we try to dissect the posterior and lateral sides of the vein firstly and then the anterior surface.

Short stature or long vein needed

When a long vein is required or patients are short, there is a possibility that the length of SVG is insufficient from knee to groin. The options are to repeat the procedure through the same incision in the opposite direction; to begin the harvesting procedure 2-3 cm below the knee; or use the contralateral limb.

Dilated branches

Dilated side branches are at risk for bleeding easily if they are not carefully divided during the harvesting procedure. Sometimes a conversion into an open harvest for haemostasis is required. Dilated branches also increase the risk of carbon dioxide embolism. It is recommended to do a complete dissection of these branches from fat to ensure enough length, minimize tension and get a perfect control of the branch. We must be careful to avoid pulling or rotating at the branch junction. Rather than a single large buzz, we recommend doing several short buzzes in order to get a good coagulation.[5]

COMPLICATIONS

One of the main complications is the formation of a hematoma. Usually, it is small and not associated with

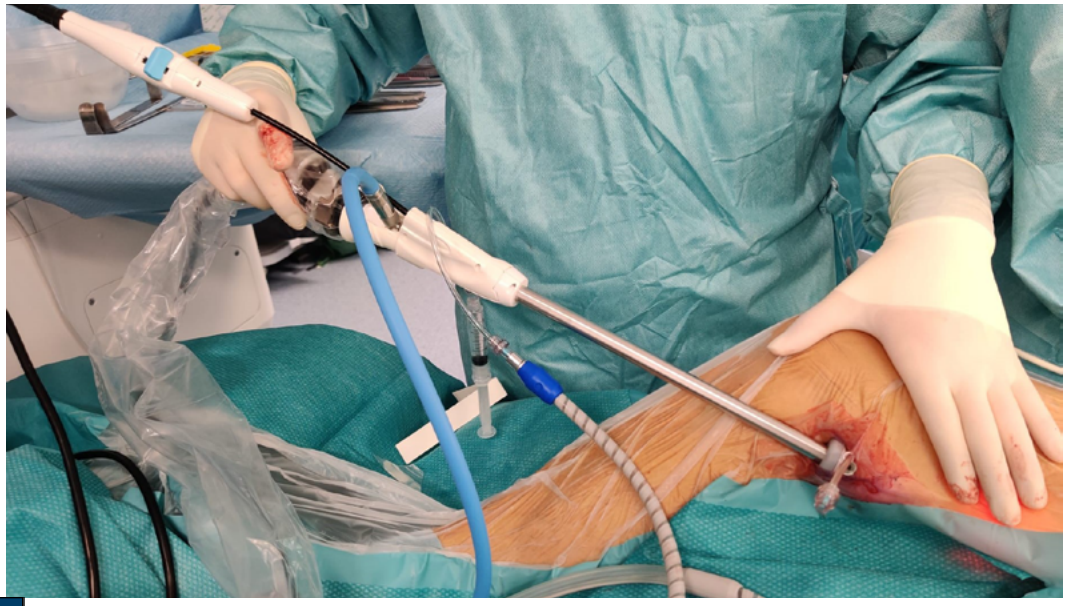

Figure 5 *Inserting the harvesting tool.*

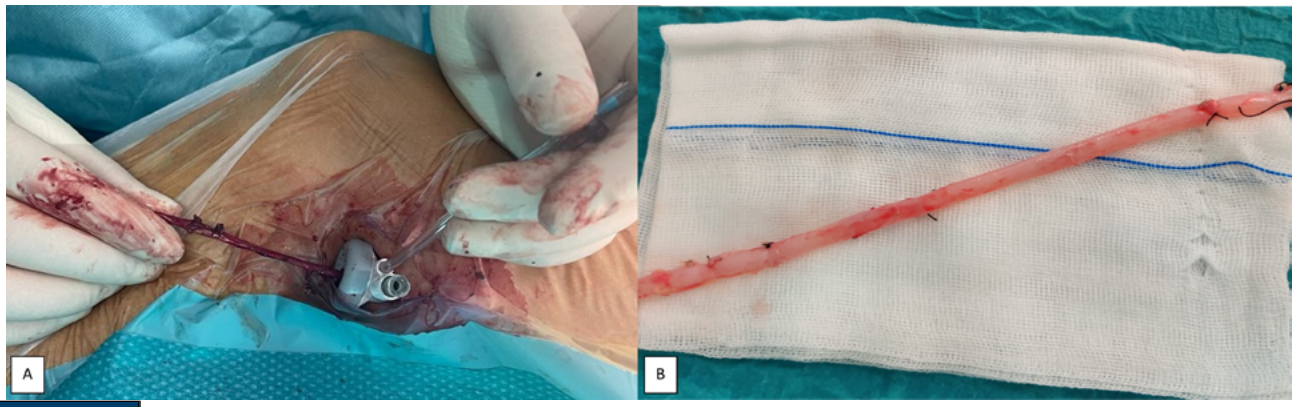

Figure 6 *A- The vein is pulled out through the proximal incision; B- The vein after all side branchs were tied.*

haemoglobin level drop. We treat it conservatively with a bandage around the limb.

Dehiscence and infection can also occur but often managed conservatively. Additional surgery may be necessary for definitive correction.

Postoperative pain, characterized by parasthesias and hyperalgesia, can occur along the medial aspect of the lower limb, which is typically temporary. We must try to avoid damage to the adjacent saphenous nerve by mechanical force or heat, particularly in the lower part of the leg where the nerve is close to the great saphenous vein.

Air embolism, pneumoperitoneum or subcutaneous extravasation of carbon dioxide may appear during the procedure. It can be necessary to stop insufflation and control the hemodynamic status until the carbon dioxide is absorbed.[3,8,9]

OUTCOMES

Traditional open harvesting is known for long and painful incisions and a risk of wound complications around 2-25%.[9] Endoscopic vein harvesting emerges as a minimally invasive alternative as a means to reduce the incidence of wound complications and patient's dissatisfaction. The in-hospital advantages on pain, wound infection and hospital length of stay of EVH have been well established through multiple randomized and observational studies. According with the meta-analysis of Athanasiou T et al, EVH shows a nearly five times reduction in the incidence of infections.[3] Also, the return to normal activities of daily living is much quicker and the quality of life scores for physical health at two years follow-up are higher for EVH.[4]

Figure 7 *A- proximal incision closed; B- distal incision closed.*

Video 1 *Cutting the side branches.*

However, as mentioned before, this procedure includes a number of complications, especially during the initial learning curve, which is longer than the open harvesting. Initially, concerns regarding SVG patency rates with EVH were raised, but recent data have demonstrated there was no increase in death, myocardial infarction or repeat revascularisation with endoscopic procedure.[8]

CONCLUSIONS

Endoscopic vein harvest is being used due to decreased rates of wound complications. We recommend appropriate planning with ultrasound and awareness of the patient characteristics and potential venous anatomy factors. Attention to the initial learning curve, so we suggest the first cases to be done with proctor.

REFERENCES

1. Alexander JH, Smith PK. Coronary-artery bypass grafting. N Engl J Med 2016;374:1954–64.
2. Ferdinand FD, MacDonald JK, Balkhy HH, Bisleri G, Hwang HY, Northrup P et al. Endoscopic conduit harvest in coronary artery bypass grafting surgery: an ISMICS systematic review and consensus conference statements. Innovations (Phila) 2017;12:301–19.
3. Athanasiou T, Aziz O, Skapinakis P, Perunovic B, Hart J, et al. Leg wound infection after coronary artery bypass grafting: a meta-analysis comparing minimally invasive versus conventional vein harvesting. Ann Thorac Surg. 2003 Dec;76(6):2141-6. doi: 10.1016/s0003-4975(03)01435-8.
4. Krishnamoorthy B, Critchley WR, Venkateswaran RV, et al.

A comprehensive review on learning curve associated problems in endoscopic vein harvesting and the requirement for a standardised training programme. J Cardiothorac Surg 2016;11:45.

5. Siddiqui S, Whooley J, Miceli A, Bartolozzi F, Soo A. Endoscopic vein harvesting: a guide for approaching difficult cases and assessing patients preoperatively. Interact CardioVasc Thorac Surg 2022; doi:10.1093/icvts/ivac142
6. Diepen SV, Brennan JM, Hafley GE, Reyes EM, Allen KB, et al. Endoscopic harvesting device type and outcomes in patients undergoing coronary artery bypass surgery. Ann Surg. 2014 Aug;260(2):402-8.
7. Mahmood D, Rosati F, Petsikas D, Payne D, Torkan L, Bisleri G. Endoscopic saphenous vein harvesting with a non-sealed approach. Multimed Man Cardiothorac Surg. 2019 Apr 09;2019.
8. Akowuah E, Burns D, Zacharias J, Kirmani BH. Endoscopic vein harvesting. J Thorac Dis 2021;13(3):1899-1908. doi: 10.21037/jtd-20-1819
9. Raja SG, Sarang Z. Endoscopic vein harvesting: technique, outcomes, concerns & controversies. J Thorac Dis. 2013 Nov;5 Suppl 6(Suppl 6):S630-7. doi: 10.3978/j.issn.2072-1439.2013.10.01.