Thermal Ablation of Varicose Veins

BY

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- Venous insufficiency resulting from superficial reflux because of varicose veins is a serious problem that usually progresses if left untreated.

- When the refluxing circuit involves failure of the primary valves at the saphenofemoral junction, treatment options for the patient are limited, and early recurrences are the role rather than the exception.

- In the historical surgical approach, ligation and division of the saphenous trunk and all proximal tributaries are followed either by stripping of the vein or by avulsion phlebectomy.

- Proximal ligation requires a substantial incision at the groin crease.

- Stripping of the vein requires additional incisions at the knee or below and is associated with a high incidence of minor surgical complications.

- Avulsion phlebectomy requires multiple 2- to 3-mm incisions along the course of the vein and can cause damage to adjacent nerves and lymphatic vessels.

Thermal Ablation Techniques

- Endovenous ablation has replaced stripping and ligation as the technique for elimination of saphenous vein reflux.

- Endovenous procedures are far less invasive than surgery and have lower complication rates.

- The procedure is well tolerated by patients, and it produces good cosmetic results.

- Excellent clinical results are seen at 4–5 years, and the long-term efficacy of the procedure is now known with 10 years of experience.

- The original radiofrequency endovenous procedure was cleared by the US Food and Drug Administration (FDA) in March 1999.

- Endovenous techniques :
  - Endovenous laser therapy
  - Radiofrequency ablation
  - Mechanochemical ablation

Clearly are less invasive and are associated with fewer complications compared with more invasive surgical procedures, with comparable or greater efficacy.

Radiofrequency Ablation

- The original radiofrequency endovenous ablation system worked by thermal destruction of venous tissues using electrical energy passing through tissue in the form of high-frequency alternating current.

- This current was converted into heat, which causes irreversible localized tissue damage.

- Ultrasonographically guided percutaneous catheter is placed inside the vein at required places.

- Thermal ablation damages the endothelium and denatures the collagen leading to fibrosis of the vein.

STEP 1:

Disposable catheter is inserted into vein

STEP 2:

Vein warmed and collapses

STEP 3:

Catheter wwithdrawn, closing vein.

Endovenous Laser Ablation

- **Endovenous** laser ablation also involves closing off the vein from the inside using heat.

- Hemoglobin specific laser wavelengths (810, 940, and 980 nm) and water specific laser wavelengths (1319, 1320, and 1470 nm) are used to destroy the incompetent veins. 1320-nm neodymium-doped yttrium aluminum garnet laser and 1470-nm diode laser gave good results with minimum side effects.

- The procedure is very similar to radiofrequency ablation, but lasers are used to generate heat instead of radio waves.

- Endovenous Laser Ablation (EVLA or EVLT) is minimally invasive and, provided it is performed correctly, should be a permanent ablation of the treated vein.

- Compared to stripping the same vein, the incision is far smaller, being a pinhole rather than a cut in the groin or behind the knee. The bruising should be far less and so the post-operative pain should be markedly reduced and post-operative mobility should be virtually normal from immediately after the procedure.

- The occlusion of the insufficient saphenous vein is obtained in a very high percentage. The major part of the published studies report a success rate of about 100% at a distance of one week after the procedure.

- This success rate decreases over time, but remains over 90% in a large number of case series.

- It has been shown that vein occlusion is connected with the amount of energy delivered by the vein wall.[14]When the energy given is low, there is high probability of reopening or nonocclusion of the vein.

- Vein shrinkage seems to fail with delivery of less than 70 J/cm.There are technical errors that can result in inadequate vein wall heating, such as the rapid withdrawal of the fiber (continuous mode) or the insufficient vein emptying without direct contact of the laser fiber with the vein wall.

- This is important especially for wavelengths other than 1470 nm, where part of the emitted energy is absorbed by haemoglobin. In this case, the amount of energy delivered by the wall of a GSV full of blood can dramatically decrease.

- The Endovenous Laser Ablation (EVLA or EVLT) is not as reliant on contact with the vein wall as radiofrequency ablation and is therefore preferred for larger diameter veins, veins with "blowouts" (dilated segments) or veins with clot, fibrous tissue or calcified areas within the walls.

- However the end firing Endovenous Laser Ablation (EVLA or EVLT) fibres and devices are more likely to cause perforations in the vein wall which can cause increased bruising and pain.

- The new radial firing endovenous laser device however does not seem to have this problem.

(EVLA) Vs (MOCA)

- When compared to some of the new devices such as the mechanical sclerotherapy catheter, steam vein sclerosis and glue sclerotherapy, it would be unfair to provide much in the way of comparison as these devices are very new in the market and need to prove that they are as effective as Endovenous Laser Ablation (EVLA or EVLT) before such comparisons are made.

- However, there are a couple of comparisons that can be made between Endovenous Laser Ablation (EVLA or EVLT) and the mechanochemical enndovenous ablation (MOCA) with the data available.

- On the positive side for Endovenous Laser Ablation (EVLA or EVLT); it can be used for multiple veins at one treatment session whereas the mechanochemical enndovenous ablation is limited by the maximum dose of sclerosant and can only be used for one main truncal vein at a time.

- However on the negative side for Endovenous Laser Ablation (EVLA or EVLT), the mechanochemical endovenous ablation does not need tumescent anaesthesia and therefore is both quicker and save the patient from having multiple injections of local anaesthetic down the leg.

Histologic Findings Post-thermal Ablation

- Immediately after treatment, biopsy specimens show a significant reduction in the size of the vein lumen, with denudation of endothelium, thrombus formation, thickened vessel walls, loss of collagen birefringence, and inflammatory changes.

- The zone of thermal damage is limited to 2 mm beyond the point of contact with the electrodes.

- In more than 90% of patients, biopsy specimens demonstrate complete occlusion of the vein lumen 6 weeks after treatment.

- The lumen is completely ablated in most areas, with some portions of the vessel demonstrating a small residual lumen containing organized fibrous thrombi.

Complications of thermal ablation:

- In the literature the complications after EVLA are very limited. The most feared complication is DVT. This is the reason for which some authors recommend the administration of low molecular weight heparin (LMWH) for a week. The incidence of DVT is variable, nevertheless it remains extremely low (0–5,7%).

- The correct positioning of the fiber tip at a distance of 2 cm from the SFJ prevents the possible thermal injury at the common femoral vein, which could result in a thrombotic response.

- In our practice, by administrating much more tumescent solution in proximity to the junction, we obtain a good sealing by the external compression that, in association with the vein spasm provoked by the cold tumescent, prevents the damage of the common femoral vein or the extension of a thrombosis of the saphenous vein to the common femoral vein.

- The US examination is recommended to be performed within the first week from the procedure and in case of DVT, anticoagulation therapy must be started.

- Skin burns are another possible complication of this procedure. The incidence in the overwhelming majority of the studies is extremely low (<1%).

- This complication can be easily prevented by the administration of the tumescent solution, which keeps the vein away from the skin and cools the perivenous tissues.

- To have a further protection against that complication some authors consider in the exclusion criteria for the EVLA a minimum distance of 4 mm between the skin and the vein. In case of a very superficial saphenous vein, EVLA should be avoided.

- Ecchymosis is the result of microperforations of the vein. These complications were more frequent when the bare fiber with a forward emission of energy was used.

- At the advent of the radial fiber with a 360° emission, the energy is distributed homogenously at the vein wall so microperforations are not so frequent.

- Generally, ecchymoses disappear within 1–2 weeks from the procedure. It is observed that higher wavelengths and continuous mode are associated with less ecchymosis.

- Superficial thrombophlebitis may be another complication with an incidence rate that varies from 0 to 25%, especially in patients with large side branches of the varicose vein treated.

- Superficial thrombophlebitis peaks at 4–7 days and resolves in about a week. This complication can be prevented by simultaneously performing the phlebectomies of the branches. The postoperative treatment with NSAIDs for one week and the use of elastic stockings are very useful.

- Progression of thrombus from local superficial phlebitis has occasionally been observed when compression was not used.

- The greatest current area of concern is deep vein thrombosis, with one 2017 study documenting deep vein thrombus requiring anticoagulation in 16% of 73 limbs treated with a radiofrequency ablation procedure.

- Nerve injury with paraesthesia and dysaesthesia is another possible adverse event with an incidence between 0 and 22%[7]. Because of the close proximity of the saphenous nerve to the segment of the vein from the knee to the ankle, the EVLA of the GSV is effectuated from just below the knee to the SFJ (at 2 cm from the junction).

- Additionally, the tumescent solution along the entire course of the treated segment of the vein separates the vein from the perivenous tissues, nerve included. Nerve injury seems to be more frequent in the case of the SSV treatment, due to anatomical factors

- Bruising after the procedure occurs at the points of the instillation of tumescent anaesthesia. Generally, it resolves within the first 10 days after the operation

To Sum This UP:

- Published results show a high early success rate with a very low subsequent recurrence rate up to 10 years after treatment.

- Early and mid range results are comparable to those obtained with other endovenous ablation techniques. The authors' overall experience has been a 90% success rate, with rare patients requiring a repeat procedure in 6-12 months.

- The vein occlusion rate was 91.9% at last follow-up, with the Venous Clinical Severity Score changing from 3.9 at baseline to 0.6 at 1 year, 0.9 at 3 years, and 1.3 at 5 years.

- Overall efficacy and lower morbidity have resulted in endovenous ablation techniques replacing surgical stripping.

- Patient satisfaction is high and downtime is minimal, with 95% of patients reporting they would recommend the procedure to a friend.

- A study by Proebstle et al found that at 5-year follow-up, radiofrequency segmental thermal ablation remained a successful treatment for over 90% of patients who underwent the therapy for incompetent great saphenous veins.

The most common factors behind varicose vein recurrence were as follows:

- Recanalized great saphenous vein (29% of patients)
- New anterior accessory great saphenous vein reflux (24% of patients)
- New small saphenous vein reflux (15% of patients)
- It was also found that a higher rate of recanalization occurred with radiofrequency ablation than with the laser procedure.

- A study by Bozoglan et al also suggested that endovenous laser ablation may have some advantages over radiofrequency ablation of varicose veins.

- The study included 60 patients with bilateral saphenous vein insufficiency, each of whom had one leg treated with the radiofrequency procedure and the other treated with laser therapy.

- The investigators found that the recanalization rate was 6.8% in the legs treated with radiofrequency ablation, compared with 0% in the laser-treated legs.

- Moreover, 51.7% of patients were satisfied with endovenous laser ablation, versus 31.0% who were satisfied with radiofrequency ablation (and 17.2% who were satisfied with both procedures).

- The major advantages over stripping are firstly that Endovenous Laser Ablation (EVLA or EVLT) should be performed under a local anaesthetic as a walk-in walk-out procedure whereas with stripping, it is more common to have general anaesthetic, regional anaesthetic or sedation.

- Secondly if performed correctly, the vein should never re-open or grow back again, whereas after stripping, a very large number (if not the majority) of veins grow back again without valves, causing the same problem to re-occur in the medium to long-term making the stripping surgery useless.

- When Endovenous Laser Ablation (EVLA or EVLT) is compared with radiofrequency ablation they are both quite similar and so there are much smaller advantages and disadvantages when compared with the huge advantages over tying and stripping.

- The disadvantage of radiofrequency ablation (RFA) compared to endovenous laser ablation (EVLA) is that radiofrequency ablation (RFA) is a contact thermal technique requiring good contact between the radiofrequency catheter tip and the vein wall.

- Therefore it is less effective than endovenous laser ablation (EVLA) in some cases of very large diameter veins, and veins where the wall might not be in good contact with the catheter tip i.e.; clots within the veins, vein webs or other irregularities of the vein wall.

Limitations and Exclusion Criteria

- Patients with peripheral arterial disease, without peripheral arterial pulse on clinical examination, where compression bandaging may be improper, must be excluded.

- Pregnant and breast feeding women must also be excluded, because the procedure has not been studied in this cohort of patients. Besides this, the risk for DVT is generally higher during pregnancy.

- The presence of thrombophlebitis can cause technical difficulties because inflammation makes the laser fiber difficult to advance at the desired position.

- Obviously, patients with active or recent DVT or with a history of pulmonary embolism must be excluded, such as those with bad general conditions (bedridden).

- Anatomical factors could play a role in patient selection. As mentioned above, treatment of a very superficial GSV or SSV, at 4 or less mm from the skin, even with appropriate tumescent administration, could result in skin burns.

- On the other hand, vein diameter does not influence the outcome, if proper tumescent is injected, because tumescent reduces vein diameter by external compression.

- Vein tortuosity may be a limiting factor because of technical difficulties in advancing the guidewire, placing the sheath and navigating with the laser fiber within the tortuous saphenous vein.

Take Home Message

Pros of Minimally Invasive Options

- These treatments are effective where Endoscopic venous ablation is effective 91-100% of the time
- These are outpatient procedures that can be performed outside of a hospital
- You will not need stitches
- Usually, the only anesthesia needed is an injection of a local anesthetic
- Most patients report symptom relief and are able to return to normal daily activities immediately, with little or no pain.

Cons of Minimally Invasive Options

- The varicose veins may not be treatable with minimally invasive procedures. Additional treatments may be needed.
- Some common side effects can include bleeding, infection and inflammation of the vein
- Blood clots are a rare complication of endovenous treatment

Non Thermal Ablation

Thank You