ENDOVASCULAR MANAGEMENT OF VARICOSE VEINS

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Abstract: *Lower extremity varicosities are multifactorial in etiology. Management is essentially aimed at correcting the mechanical reasons for the venous insufficiency. The surgical approach with saphenous vein ligation and stripping has been in vogue for many years. Endovenous techniques now achieve similar results in a minimally invasive fashion. These utilise laser or RF energy to ablate the saphenous vein. Smaller veins can also be treated. Procedures are usually done on daycare or OPD basis under local anaesthesia and intravenous sedation. Many series have shown results equivalent to more invasive surgery.*
Key Words: lower extremity varicosities : Endovenous techniques : Endovenous ablation

INTRODUCTION

Varicose veins are a natural consequence of the vertical posture that mankind adopted in its evolutionary development. The three described variants of teleangiectasias, reticular varicosities and true varicose veins are clinically very different in appearance but identical in physiological and etiological mechanisms.

PATHOPHYSIOLGY AND ETIOLOGY

Normal venous return from the lower limbs requires the following to exist:

(i) A patent pathway from the lower limbs upto the IVC. The pathway that the blood goes through to reach the IVC has two parts: Superficial Veins and Deep Veins. Veins called perforators that pass form the superficial to the deep venous system and prevent reflux from the deep to the superficial venous systems link the two venous networks. (Fig 1)

(ii) A force that pushes the blood up against the force of gravity towards the heart. This is provided by the pressure of the arterial flow to some extent, but is mainly due to the contraction of the calf muscles, also called the “Calf Pump” which pushes blood out of the intramuscular sinusoids and back up to the heart. his is also called the hydrodynamic force.

(iii) A mechanism that prevents the blood from literally “falling back downhill” under the influence of gravity towards the lower limbs. This is provided by a system of valves that allows blood to only pass in the direction of the right atrium, and from superficial to deep veins. (Fig 2)

Thus, venous insufficiency is traceable to the absence of one or more of these factors. Failure of valves can be due to congenital absence, and can occur in both the deep veins, causing deep venous reflux or in the perforators causing perforator incompetence. A common acquired cause is venous thrombosis with valves becoming adherent to the vein wall.

Hereditary factors are involved in the causation of varicose veins. Pregnancy and the attendant hormonal changes are another fertile ground on which the hydrostatic pressure (weight of the blood column form the Right atrium to the Lower limbs)

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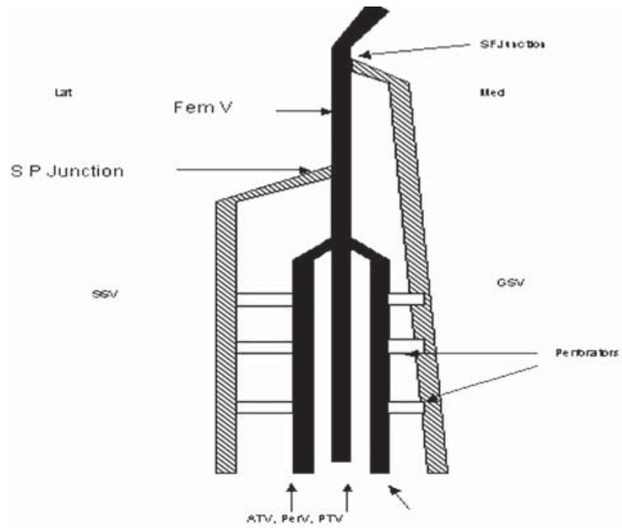


Fig.1 Deep and Superficial Veins. A schematic
FernV= Femoral Vein, SSV= Short Saphenous Vein, GDV= Greater Saphenous Vein, ATV=Anterior Tibial Vein, PerV= Peroneal, PTV= Posterior Tibial Vein, SF Junction= Sapheno-Femoral Junction, S P Function= Sanheno Ponlieal Junction

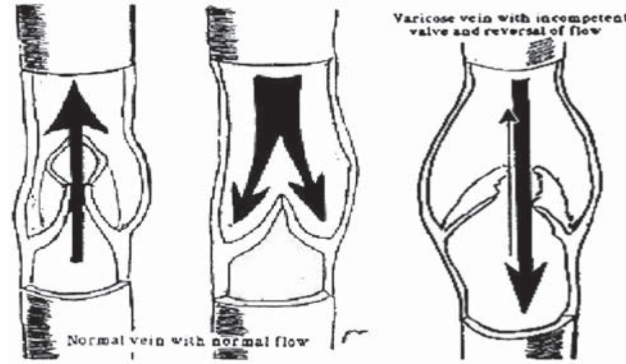


Fig. 2 : Valvular Incompetence

and the hydrodynamic force (contraction of muscles surrounding the veins) act. In event the valves fail under the hydrostatic force, the hydrodynamic force is transmitted directly to the relatively loosely supported venous elements in the subcutaneous tissues. These enlarge, elongate and become tortuous under the influence of this pressure and thereby give rise to varicose veins. Dilatation and tortuousity occurring in different types of veins gives rise to varying clinical appearances (fig 3).

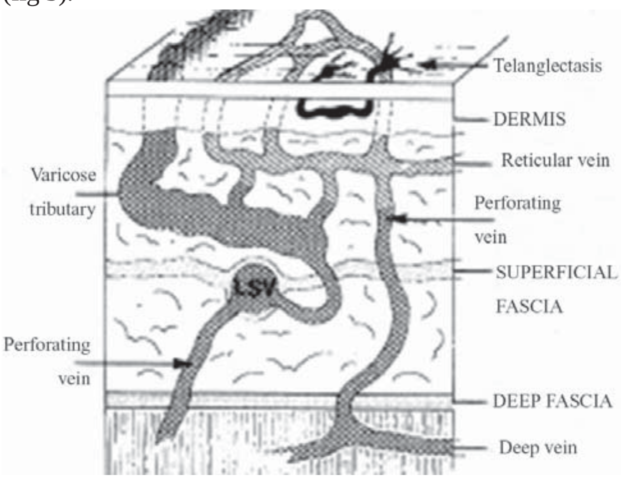


Fig. 3 : Conections from deep to superficial veins showing the various manifestations ofvenous incompetence

Table1: *Indications for Intervention*

	Indications for Intervention
■	Cosmetic indication
■	Aching Pain lower limb
■	Easy Fatiguability
■	Leg Heaviness
■	Superficial Thrombophlebitis
■	External Bleeding
■	Ankle hyperpigmentation
■	Lower Limb Oedema
■	Lipodermatosclerosis

SYMPTOMATOLOGY

Varied symptoms can occur because of venous incompetence, ranging from visible veins, itching and pain, to skin ulceration. Table 1 summarizes indications for intervention in venous incompetence. The varied symptoms and signs may sometimes be difficult to recognise as originating from the venous system. All these symptoms are traceable to dilated veins, increased subcutaneous tissue fluid and stretching of nerves surrounding the veins. Prolonged and severe incompetence causes skin ischemia and breakdown by a variety of factors, leading to ulceration.

MANAGEMENT: BASIC PRINCIPLES

The basic principle of treatment of varicose veins of the lower limb is abolition of the hydrostatic force and isolation of the superficial veins from the transmitted hydrodynamic force. This should be achieved while preserving the venous outflow of the limb. This is conventionally achieved by surgical means. The most commonly implicated area requiring surgical intervention is the sapheno-femoral junction and the further discussions will use this as the illustrative example of the basic principles.

SURGICAL APPROACH

The surgical techniques require an occlusion of the SFJ with removal of the greater saphenous vein (GSV) to achieve reliable long-term results. This is to achieve the objective of removing the hydrostatic force and detaching the tributaries (perforators) of the GSV. This can be achieved by the traditional stripping or by the invagination method; and is now also practiced as an outpatient procedure with groin to knee downward stripping (Fig4). The classical technique recommends removing the below knee portion as well, but this technique is associated with saphenous nerve injury[1].

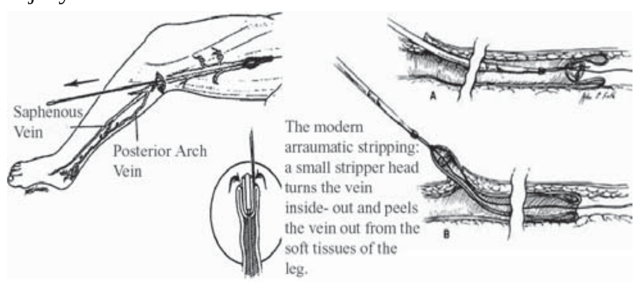


Fig. 4 :Inversion stripping manuver for removing the saphenous vein. The inguinal is about 2cm and the Knee incision is about 3mm

ENDOVASCULAR APPROACH

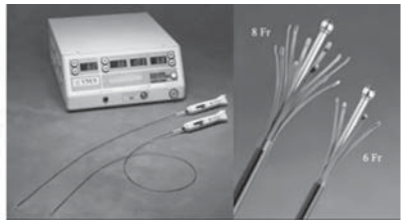
The endovascular procedure achieves the objectives of the surgical technique by using an endovascular application of energy to ablate the saphenous vein. This implies a destruction of the venous wall so that recanalisation is not possible, as opposed to a thrombosis, which can be relatively easily recanalised by natural lytic system[2].

Regarding choices of equipment, saphenous vein ablation is currently carried out with two types of equipment: Laser Ablation Systems and Radiofrequency Ablation Systems

In Laser Ablation systems there is transfer energy to the vein wall by using a 600 or 810 nm wavelength laser through a fibreoptic catheter. The fibre is small enough to pass through a 24-gauge needle and different manufacturers have used both bare and sheathed fibres. The most commonly used system is manufactured by Diomed (Fig 5), though many other manufacturers are now in the market. This laser is absorbed by the surrounding tissue and raises the local temperature sufficiently to destroy the vein wall.

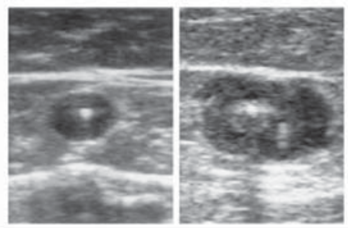
Radiofrequency (RF) ablation systems use radiofrequency energy to create a rise in temperature in the target area and thereby denature the structural proteins. This technology is used in a variety of applications including tumour ablation, nerve ablation, endoscopic gastro esophageal reflux therapy

Diomed Laser system for EVLT Endovenous Laser Thermoablation procedure.



VNUS unipolar system with the Closure catheter

Celon Lab Power Bipolar system with the ProCurve catheter



Tumescent Anesthesia: US Image on the right shows anaesthetic surrounding and collapsing the vein

etc. RF systems are of two types, unipolar and bipolar. These differ in their design. Unipolar systems require a grounding pad to complete the circuit. Bipolar systems do not require any grounding pad (in a fashion similar to bipolar and unipolar surgical electrocauteries). This enables the use of bipolar devices even in patients with pacemakers implanted. There is no fundamental difference in the effects on tissue. These devices have a sensor system that senses the temperature around the probe tip and adjusts the output automatically. The energy output varies as required, and modern devices have microprocessor-controlled systems for this purpose. Unipolar system in common use is the VNUS system using the Closure catheter from VNUS Medical technologies. This has 6F and 8F catheters (fig6). A bipolar system is now available, that is capable of all RF functions including venous ablation. This is manufactured by Celon AG , and has 6 F and 3 F catheters (Fig 7).

TECHNICAL ASPECTS:

Endovenous ablation has the following steps:

1. Access to the target vein (Great Saphenous Vein): This is usually achieved percutaneously, at a level near the ankle. This will require ultrasound guidance in most cases, particularly as the edema and multiple dilated channels make it difficult to accurately localise and puncture the GSV. This is usually better carried out with a micropuncture set (21 G needle, cope dilator, 0.018" wire). The size of the sheath inserted would depend upon the device being used, this may vary from 6 F to 8 F. Bare fibre devices may require just a 21-24 G needle puncture with Teflon cannula placement. A cutdown procedure is also used for this access at times. This may be done at the groin or at the ankle.
2. Cannulation of the Target Vein: Due to the tortuousity of the vein in cases with long standing reflux, this may at times be difficult. If available, an image intensifier or C- arm can be of assistance, though usually US guidance is sufficient. Fibre optic laser systems usually require placement of long sheath upto the SFJ through which the fibre is subsequently passed. The point of ablation is decided upon under US guidance. This is usually 2.5 cm away from the exact SFJ, to avoid causing injury to the deep vein.
3. Removal of blood from the target vein : To achieve consistent and reliable ablation, the vein must be exanguinated. This may be achieved by an esmarch bandage to squeeze out the blood from the vein along with saphenofemoral junction compression. An alternative technique is that of tumescent local anesthesia where a large amount of very dilute local anaesthetic (100–200 mL of 0.2% lidocaine) is injected all along the entire vein, surrounding it and collapsing it over the ablation probe (fig 8). This allows good contact with the vein wall and better transfer of energy. Furthermore, pain relief and prevention of skin burns is achieved.
4. Ablation is generally performed in a manner that achieves adequate heating of the vein wall without skin burns occurring. The exact technique depends on the precise equipment used, but on the whole it consists of pulling back the catheter (probe) at a reasonable velocity while applying energy. The RF ablation systems have a sensor system to control the amount of energy delivered in response to the alteration in tissue resistance. This allows a more precise control with a recorded chart for review purposes (Fig 9).

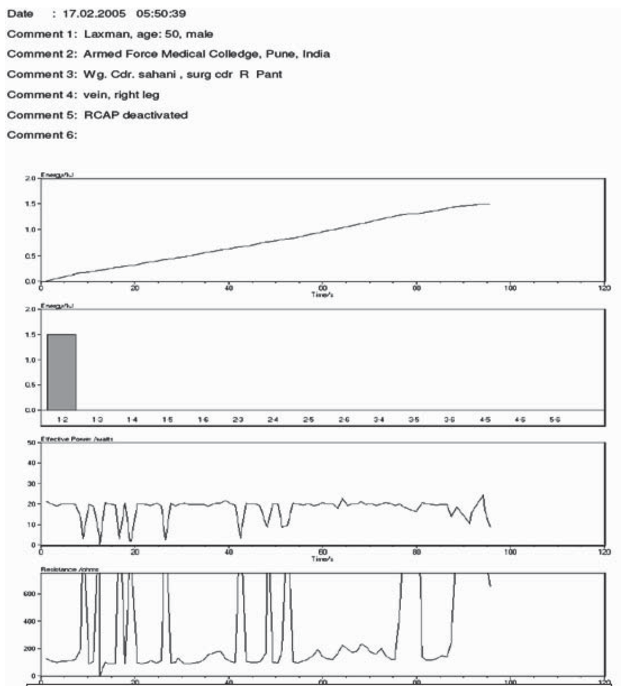


Figure 6: *Chart of Energy Output and Resistance charges during abiation procedure charges during abiation procedure with Bipolar RF system*

5. Post procedurally, haemostasis is generally easily achieved by compression. Most series have reported the use of compression dressing over the treated limb for a week or so. Some practitioners recommend ablation of the subcutaneous track to achieve better haemostasis.

RESULTS FROM REPORTED SERIES

Initial series attempting endovascular RF ablation showed many complications. Burns, nerve injuries, infection etc were reported[3].This has changed with modern technology and precise control of energy output. One of the initial large series (141 saphenous veins) to be reported has shown a high acute closure rate (93%) with clinical cure persisting in 90% cases at 2 years [4]. Series of 499 limbs treated with endovenous ablation showed a recurrence rate of less than 7 % at 2 years. This series also reported extensive use of sclerotherapy for treating tributaries after ablation during follow up[5] .

COMPLICATIONS

Endovenous therapy in saphenofemoral incompetence is not without its share of complications. The obvious ones of haemorrhage and infection are uncommon with current equipment. No definite data exists to show a requirement for prophylactic antibiotics, except in cases of preexisting infection. The use of an intra-procedural antibiotic would depend on individual preference and hospital policy.

Pain is a common problem, more often noted after laser therapy as compared with RF techniques, perhaps because of the less controlled energy application, which may raise the local temperature higher. Ecchymoses have also been more often reported with laser ablation. These are however easily managed with drugs and conservative therapy.

A more serious complication is deep venous thrombosis with pulmonary embolism. This is very uncommon, being reported in 3 out of 522 patients (.57%)in the VNUS registry, with the incidence of pulmonary thromboembolism being even lower at 0.17%. Dysfunction in the territory of the great saphenous nerve can occur, usually manifesting as paraesthesias. This has been reported in upto 3 % of cases at 2 years. %.[6] Later series have reported much lower complication rates, with the series reported above[5] showing a zero incidence of DVT, skin burns or paraesthesias.

FAILURE OF TREATMENT

As noted above, failure is not common with endovascular therapy. There is a theoretical objection to the technique of endovenous therapy. This lies in its failure to address the tributaries joining the femoral vein near the SFJ. These are classically ligated during surgery. However, a study comparing cases done with and without high ligation of saphenous vein has shown that the difference in recurrence rate is not significant, though it is more in cases without high ligation (2% Vs.8%) Both groups showed a 90% freedom from varicosities at 1 year based on actuarial curves[7]. Many cases of recurrence can also be treated with sclerotherapy of the tributaries without undergoing surgery[5].

CONCLUSION

Endovascular saphenous vein ablation is a technique that provides a simple and rapid way of treating cases of saphenous vein incompetence. The procedure can be carried out under local anesthesia with or without intravenous sedation and with proper technique and patient selection has results equivalent to surgical techniques. It has an advantage of being relatively less painful and having a lower complication rate.

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