Recent trends in management of lower limb varicose veins

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In General Surgery

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الأتجاهات الحديثة في تشخيص وعلاج دوالي الساقين

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للحصول على درجة الماجستير فى الجراحة العامة

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List of Abbreviations

ABPI	Ankle brachial pressure index
ASVAL	Ambulatory selective varices ablation under local anaesthesia
AV	Accessory veins
AVVQ	Aberdeen varicose vein questionnaire
CE	Cranial extension
CHIVA	Cure conservatrice et hémodynamique de l’insuffisance veineuse en ambulatoire
CIVIQ	Chronic Venous Insufficiency Questionnaire
CT	Computed tomography
CTV	Computerized tomographic venography
CV	Communicating veins
CVA	cerebrovascular accident
CVD	Chronic venous disease
DC	Deep compartment
DVT	Deep vein thrombosis
EVLA	Endovenous laser ablation
EVSA	Endovenous steam ablation
FDA	Food and Drug Administration
FS	Foam sclerotherapy
GSV	Great saphenous vein
HHD	Hand-held Doppler
IVC	Inferior vena cava
LEED	Linear endovenous energy density
LS	Liquid sclerotherapy
MARADONA	Mechanochemical endovenous Ablation versus RADiOfrequeNcy Ablation

MF	Muscular fascia
MMPs	Matrix metalloproteinases
MOCA	Mechanochemical ablation
MRI	Magnetic resonance
MRV	Magnetic resonance venography
NICE	National Institute for Health and Clinical Excellence
NP	Nurse practitioner
NTNT	Non-thermal, non-tumescent
POL	Polidocanol
PTV	Preterminal valve
PV	Popliteal vein
QoL	Quality-of-life
RCT	Randomized controlled trial
RFA	Radiofrequency ablation
SC	Superficial compartment
SFJ	Sapheno-femoral junction
SPJ	Sapheno-popliteal junction
SSV	Small saphenous vein
STS	Sodium tetradecyl sulphate
TIA	transient ischeamic attack
TV	Tributary veins
TV	Terminal valve
UGFS	Ultrasound-guided Foam sclerotherapy
US	Ultrasound
VCSS	Venous clinical severity score
VEINES	Venous Insufficiency Epidemiological and Economic Study

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Introduction

Varicose veins are enlarged, tortuous, subcutaneous veins that commonly occur in the legs ***(El-Sheikha et al., 2015)***. The principal superficial leg veins are the great saphenous vein (GSV), which ascends the inner side of the leg from the inner arch of the foot up to the femoral vein, and the small saphenous vein (SSV), which runs from the outer arch of the foot up to the popliteal vein via the back of the leg ***(Gloviczki et al., 2011)***. Veins carry deoxygenated blood from the body back to the heart to be oxygenated and recirculated around the body. Blood from the legs must travel against gravity to reach the heart. This movement is helped by contractions of the lower leg muscles and the elasticity of the vein walls, which act together to pump the blood upwards. Valves positioned along the length of the vein close as the blood is pumped through them to prevent blood flowing backwards during muscle relaxation ***(Brake et al., 2013).***

Varicose veins are caused by faulty valves and decreased elasticity in the vein walls, which allow blood to backflow and pool. This is known as venous reflux. The affected veins enlarge and appear as green, dark blue or purple protrusions just below the skin's surface ***(Tisi, 2011)***. The severity of symptoms associated with varicose veins varies and may include pain, heaviness, pruritis, ulceration, skin discoloration and edema. Severe symptoms include thrombophlebitis, bleeding and venous dermatitis, which often require intervention. The exact cause of venous reflux is unknown; however, several risk factors for the condition have been identified, including increasing age, female sex, obesity, inactivity and pregnancy ***(Beale and Gough, 2005)***.

Risk factors associated with venous disease include previous deep venous thrombosis (DVT), obesity, pregnancy, family history and posture (e.g. standing for long periods of time) ***(Gujja et al., 2014)***.

Varicosities are manifestations of chronic venous disease (CVD), which includes various other venous abnormalities, such as dilated intradermal veins, spider veins, reticular veins, and telangiectasia. Although varicose veins have long been thought to be a simple cosmetic nuisance, they can actually be the source of more serious complications, including pain and discomfort that can lead to missed work days, a lower quality of life ***(Feliciano and Dalsing, 2011)***.

Varicose veins are common in many populations, with prevalence rates generally ranging 10.4-23.0% in men and 29.5-39.0% in women. One large U.S. cohort study found the biannual incidence of varicose veins to be 2% in men and 3% in women. The same study suggested that 2.0% of men and 2.6% of women would develop varicose veins over a 2-year period ***(Walker and Committee, 2003)***.

A patient's suitability for varicose vein treatment is ascertained through clinical examination to determine the source of venous incompetence and the type and extent of the veins to be treated. Ideally, this examination is followed by a duplex Doppler ultrasonography scan to confirm the presence of reflux as the venous disease is defined using a number of classification systems, none of which is universally accepted ***(Leopardi et al., 2009).***

A variety of therapies are available for treating varicose veins, including conservative therapies and surgical interventions. Conservative therapies are commonly recommended in asymptomatic patients or those with mild to moderate symptoms. Surgical interventions generally become necessary when symptoms of varicose veins significantly impinge on the patient's quality of life. Provided the deep venous system of the legs is competent and free from obstruction, a patient can safely tolerate the surgical removal or occlusion of varicose veins. The small saphenous vein (SSV) and great saphenous vein (GSV) are part of the superficial venous system. Most of the blood from the legs is returned to the heart via the deep leg veins; therefore, blood that previously travelled through the saphenous vein can be redirected through deep leg veins if the GSV becomes distending or varicotic. High recurrence rates are common in patients with larger veins or venous reflux, primarily because of recanalization or neovascularization. *Recanalization* is the spontaneous restoration of the lumen of the saphenous vein after occlusion, while *neovascularization* is the proliferation of blood vessels in tissue where the saphenous vein has previously been removed ***(Willenberg et al., 2013).***

Conservative therapy attempts to limit disease progression. A clinician may advise lifestyle changes, including physical exercise and weight loss, to promote circulation. Patients are also discouraged from prolonged sitting or standing and advised to elevate the affected limbs whenever possible to reduce pressure on impaired vein valves. Compression stockings provide relief for varicose vein symptoms, such as pain and swelling, while improving venous hemodynamics ***(Leopardi et al., 2009)***.

Sclerotherapy usually occurs as an outpatient procedure under local anesthetic. The procedure involves the injection of a liquid chemical (sclerosant) into the abnormal vein to initiate inflammation, occlusion, and scarring ***(El-Sheikha et al., 2015)***. The damaged vein collapses and eventually fades. Ultrasound-guided sclerotherapy allows the sclerosant to be injected directly into the GSV to treat larger and deeper varicosities. Foam sclerotherapy mixes air or gas with the sclerosant to produce foam, allowing a small amount of sclerosant to cover a larger surface area by displacing blood within the vein. Sclerosant can be delivered into the vein by a catheter, allowing targeted and selective treatment ***(Feliciano and Dalsing, 2011)***.

Ambulatory phlebectomy involves removing abnormal veins below the saphenofemoral junction (SFJ) and saphenopopliteal junction (SPJ), not including the GSV or SSV. This outpatient procedure is best used on larger veins without venous reflux. Under local anesthetic, small incisions are made in the skin and large surface varicosities are extracted using a phlebectomy hook ***(El-Sheikha et al., 2014)***.

Junction ligation with or without vein stripping is generally appropriate when the GSV and SSV have reflux or incompetence is demonstrated on duplex scanning. This intervention is generally performed as an inpatient procedure under general anesthetic. Junction ligation involves tying off the vessel at the SFJ or SPJ. Ligation alone usually leads to high rates of varicose vein recurrence; therefore, patients often require after-care treatment, such as sclerotherapy. In most cases, ligation is accompanied by GSV stripping and is generally regarded as the treatment of choice for varicose veins ***(Leopardi et al., 2009***. Following ligation of the GSV and tributary veins, an incision is made in the patient's groin and knee or ankle. Next, a stripper is inserted into the vein and passed either down from the groin to the knee or up from the ankle to the groin. The end of the GSV is tied onto the stripper, which is gently withdrawn, removing the vein with it ***(Flessenkamper et al., 2016)***.

Two endovenous treatments include radiofrequency ablation (RFA) and endovenous laser therapy (ELT). Both treatments involve inserting a heat-generating laser fiber or catheter into the incompetent saphenous vein, positioned just below the SFJ or SPJ. Heat is generated through laser (ELT) or radiofrequency (RFA) energy, and as the fiber or catheter is slowly removed down the length of the vein, endothelial and venous wall damage occurs, causing contraction of the vein wall and ultimately destruction of the vessel ***(Ladwig et al., 2012).***

Anatomy and Physiology of Veins of the Lower Limb

A thorough understanding of venous anatomy and physiology is foundational to the diagnosis and management of venous disease. Compared with the arterial system, there is significantly greater developmental variation in the venous system. Classic venous anatomy has been reported to be present in as few as 16% of limbs***(Gillespie et al., 1997)***. The veins of the lower extremity include the superficial and deep veins, which are defined by their respective relationships to the muscular fascia. Perforating veins traverse the muscular fascia to connect superficial and deep veins. Communicating veins connect veins within the same venous compartment, either deep to deep or superficial to superficial. The deep veins of the lower extremities accompany arteries, primarily drain muscles, and are encompassed by muscular fascia. The veins located between the skin and the muscular fascia are considered superficial veins. Superficial veins drain the cutaneous microcirculation and include the great saphenous vein (GSV), small saphenous vein (SSV), and numerous venous tributaries. The GSV and SSV with accompanying nerves are contained within a saphenous compartment that is bound superficially by saphenous fascia and deeply muscular fascia. Figure (**1**) illustrates the deep and superficial venous compartments ***(Black, 2014)***.

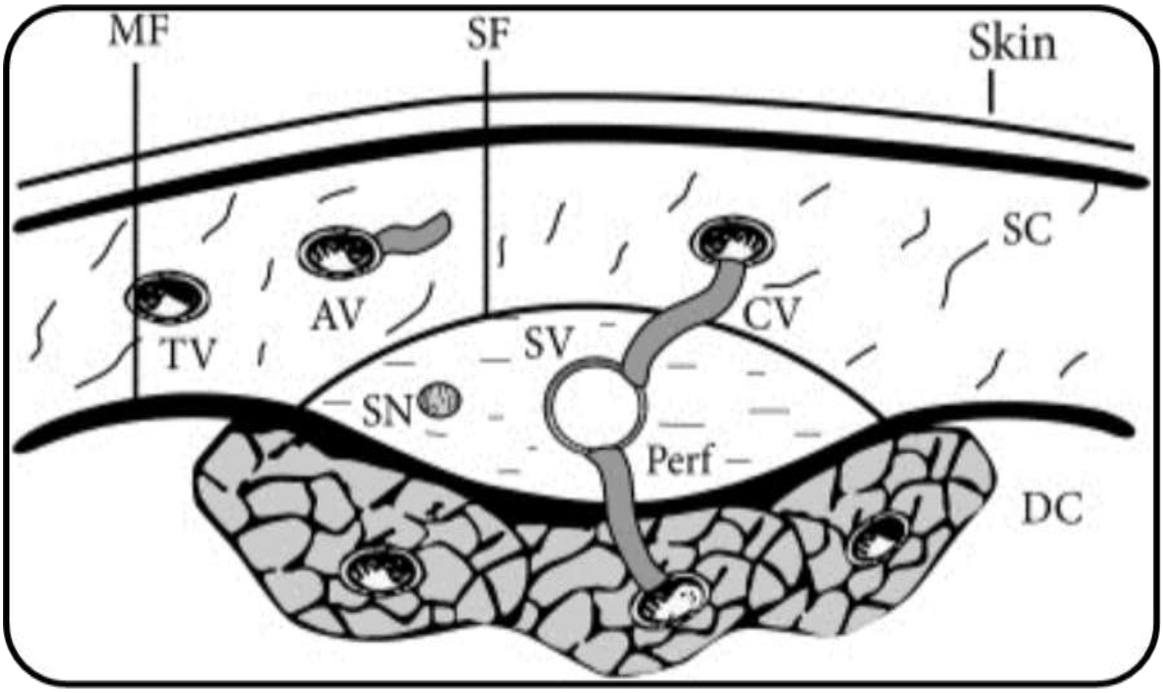

Figure (1): Deep and superficial venous compartments. Muscular fascia (MF) separates the superficial compartment (SC) from the deep compartment (DC). The superficial compartment contains saphenous veins (SV), tributary veins (TV), and accessory veins (AV). Saphenous veins and accompanying nerves are contained within a saphenous compartment that is bound superficially by saphenous fascia (SF) and deeply by muscular fascia. The deep compartment is bound by muscular fascia and contains the deep veins. Perforator veins (Perf) traverse the superficial and the deep compartments. Communicating veins (CV) connect veins within the same venous compartment, either deep to deep or superficial to superficial***(Black, 2014)***.

The pelvic venous system is a complex transitional outflow pathway between the lower extremities, the pelvic structures, and the inferior vena cava (IVC). The anatomy related to the lower extremities, abdomen, and pelvis described in this article conforms to uniform international standards for venous terminology***(Perrin, 2003; Caggiati et al., 2005; Kachlik et al., 2010)***.

General Anatomical and Physiological Considerations:

The vein wall is relatively thin compared with that of arteries but is also composed of intima, media, and adventitia. The intima is actively antithrombogenic owing to its in situ production of prostaglandin I_2, glycosaminoglycan cofactors of antithrombin, thrombomodulin, and tissue-type plasminogen activator. The media is adrenergically innervated and consists of 3 smooth muscle layers combined with collagen and elastin. The adventitia is the outermost and thickest layer***(Meissner, 2005; Kotovskaya et al., 2015)***.

Principal anatomical and physiological forces affecting venous return include hydrostatic pressure, competence of unidirectional valves, respiration, and the compressive force generated by the thigh, calf, and foot muscle pumps. Bicuspid unidirectional valves are found in superficial, deep, and most perforating veins. They are derived from endothelial folds and are supported by a thin layer of connective tissue. Valves are found in higher frequency caudally in the leg and decrease in number centrally toward the groin***(Oguzkurt, 2012; Seyahi et al., 2015)***. In the lower extremities, valves function to minimize hydrostatic pressure, generated by the column of blood, into lower-pressure segments and to facilitate unidirectional flow from superficial to deep and from caudal to cephalad. Valve closure is a passive process that depends on the local transvalvular pressure gradient. As the pressure gradient across a valve reverses, there is a transient retrograde flow (<0.5 seconds in erect position) before valve closure. Transient reflux of less than 0.5 seconds is considered normal***(Oguzkurt, 2012; Seyahi et al., 2015)***.

Movement of the diaphragm changes thoracic and abdominal cavitary pressures, which directly affects venous outflow. During inspiration, there is decreased thoracic cavity pressure with an associated increase in blood flow from the upper extremities. By contrast, abdominal cavity pressure increases during inspiration, resulting in decreased outflow from the lower extremities. With expiration there is increased thoracic cavity pressure, which decreases blood flow from the upper extremities. Abdominal cavity pressure decreases with expiration, resulting in increased blood return from the lower extremities. During the Valsalva maneuver, there is simultaneously increased thoracic and abdominal cavity pressure that diminishes overall venous return***(Oguzkurt, 2012)***.

The dynamic capacitance of the venous system is critical to the function of the thigh, calf, and foot muscle pumps and is largely attributable to the elliptical cross-sectional geometry of the calf and thigh veins. The elliptical shape accommodates significant fluctuations in blood volume with minimal effect on venous circumference or endoluminal venous pressure***(Black, 2014)***. Under conditions of increased flow requirements, veins assume a lower-resistance, more circular geometry. Cross-sectional vein geometry is determined largely by the local transmural pressure gradient, which is defined as the difference between endoluminal venous pressure and the pressure in the adjacent tissue***(Black, 2014)***.

Approximately 90% of deep venous return from the lower extremities is related the active force generated by the pedal, calf, and thigh compartmental muscle pumps. With muscle contraction, intracompartmental pressure increases, extrinsically compressing compartmental veins and augmenting flow across the unidirectional valves. Among the 3 peripheral pumps, the calf muscle pump has the largest capacitance, generates the highest pressures, and is of the greatest physiological importance. The normal ejection fraction of the calf muscle pump is approximately 65% compared with only 15% for the thigh pump***(Ludbrook, 1966; Firsov et al., 1998)***. During the postcontraction relaxation phase, there is a reduction in deep venous pressure that favors flow from the superficial to the deep system through the perforating veins. The plantar venous foot pump functions through a combination of weight bearing and intrapedal muscular contraction***(Corley et al., 2010; Uhl and Gillot, 2012)***.

Deep Venous System:

1- Pedal Veins: