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Sarah Onida and Alun H Davies

Abstract

Chronic venous disease (CVD) is a highly prevalent condition with significant effects on patients' quality of life. Despite this, the underlying pathophysiology of venous disease still remains unclear. Two schools of thought exist, explaining the development and propagation of venous disease as an "ascending" and "descending" process, respectively. The descending theory, stating that CVD is secondary to proximal disease (e.g. saphenofemoral/saphenous incompetence), is the most widely accepted when planning treatment aiming to remove or destroy the junction or truncal veins. The ascending theory, describing the disease process as developing in the lower most part of the leg and propagating cranially, aims to re-route the venous circulation via minimally invasive interventions. Classically, superficial venous insufficiency has been treated with the removal of the incompetent trunk, via open surgery or, increasingly, with endovenous interventions. Minimally invasive treatment modalities aiming to preserve the saphenous trunk, such as CHIVA and ASVAL, may also play an important role in the treatment of the patient with varicose veins.

Keywords

ASVAL, chronic venous disease, chronic venous insufficiency, duplex ultrasound, haemodynamic surgery

Introduction

Chronic venous disease (CVD) is a highly prevalent condition in the western world, with approximately 30% of the population displaying varicose veins[1] and up to 80% demonstrating evidence of venous insufficiency.

The spectrum of venous disease is extremely variable, as graded by the CEAP (Clinical, Etiological, Anatomical, Pathophysiological) classification.[2] Affected individuals can present with a variety of symptoms across the spectrum, from asymptomatic disease, to varicose veins, to venous ulceration and bleeding.

Treatment, historically, was in the form of open saphenofemoral or saphenopopliteal junction ligation with or without stripping of the saphenous trunk. This was the gold standard treatment up to the advent of new technology and minimally invasive techniques. The last 15 years have seen the development and affirmation of endovenous thermal ablation, which is now a first-line intervention according to the UK National Institute of Care Excellence (NICE) Guidelines.[3] Radiofrequency ablation, endovenous laser therapy, and ultrasound guided foam sclerotherapy are alternatives to open surgery. These techniques all aim to either remove or destroy the great saphenous (GSV) or short saphenous (SSV) vein, with the purpose of abolishing reflux in the superficial venous system.

Alternative techniques exist, relying on different principles. CHIVA (Ambulatory Conservative Haemodynamic Treatment of Venous Insufficiency) and ASVAL (Ambulatory Selective Varices Ablation under Local Anaesthesia) are two techniques characterised by targeted therapy of the venous system without saphenous trunk destruction or removal.

In this chapter, we will review the two main schools of thought on the haemodynamics of superficial venous insufficiency, as well as describing CHIVA and ASVAL and how they relate to haemodynamic principles.

Superficial venous insufficiency

Despite the prevalence of venous disease, the aetiology and pathogenesis of varicose veins is still poorly understood. However, improvements in technology, particularly duplex ultrasonography, have enabled physicians to carefully map the venous system, gaining anatomical

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and functional information that can accurately describe patterns of reflux.

The features of CVD are secondary to high venous pressures in the lower limb, resulting in the development of varicosities, skin changes and, in the extreme, ulceration. However, the steps leading to the development of venous hypertension are still poorly understood. A comprehensive understanding of the theories regarding the development of the disease process is necessary to enable specialists to assess and manage their patients approriately.

Ascending/multifocal theory

When an individual is standing, a column of venous blood extends from the right atrium to the lower limb, its full weight transmitted to the venous system, secondary to the effect of gravity.[4] The resulting pressure, in addition to an intrinsic weakness in the venous and venular wall, leads to venous dilatation, creating a varicose reservoir. According to the ascending theory of varicose vein development, due to the filling effect of said reservoir, venous reflux will initially develop distally, propagating proximally along the saphenous trunk.

Evidence

This theory is supported by studies demonstrating that, on duplex assessment, reflux can follow a multifocal pattern of insufficiency[5] that does not always include sapheno-femoral junctional incompetence. A large study on 1882 limbs revealed different patterns of reflux, including: varices with no saphenous vein (SV) incompetence (33%), saphenous reflux without varices (8.4%), varices and SV reflux with (37%) and without (15.4%) saphenofemoral junction incompetence, and varices with junctional incompetence but no truncal reflux (6.1%).[6]

According to this theory, with time, reflux ascends cranially to previously uninvolved venous segments.[7] Two separate studies identified cranial disease progression in 76% of patients at 5-year[7] and 94% at 9-year[8] follow-up.

The ascending theory has important therapeutic implications, suggesting that simple high tie and ligation, with the aim of treating saphenofemoral incompetence, are not relevant in the treatment of venous disease. Treatment should start with removal of the venous reservoir, sparing the saphenous trunk.

Descending/saphenocentric theory

The descending theory proposes that varicose veins and chronic venous insufficiency are due to a failure of the proximal components of the superficial venous system: the valves at the sapheno-femoral (SFJ) or saphenopopliteal junction (SPJ).

Valvular incompetence at a proximal level results in blood refluxing through the truncal veins, leading to increased venous pressure and stress on the distal valve. This results in progressive valvular incompetence and stress onto the vein wall, with venous dilatation and varicosity formation.

The descending theory proposes that treatment of the primary area of incompetence, i.e. removal of the SFJ or SPJ, abolishes venous reflux.

Evidence

Historically, the aetiology of varicose veins was thought to be secondary to pathophysiological processes stemming from the descending theory. Cadaveric studies have supported this, describing a reduction in external iliac and femoral venous valves in patients with venous insufficiency.[9] An increase in venous pressure in the deep veins unsupported by valves could lead to further pressure and valvular failure at the proximal junctions between the superficial and deep venous systems, resulting in varicose vein development.[10] In addition to cadaveric studies, both venographic and histological studies have supported the theory of primary valve failure leading to the development of varicose veins.[9]

Varicose vein disease has classically been treated with saphenous-destroying interventions, via open surgery or endovenous mechanisms. Two important alternative, minimally invasive treatment modalities aiming to preserve the saphenous trunk are now reviewed.

CHIVA – ambulatory conservative haemodynamic correction of venous insufficiency

CHIVA is a surgical approach with the aim of correcting abnormal haemodynamic pathways in the venous system, resulting in targeted intervention. This approach relies on careful venous duplex assessment to gain a detailed knowledge of the anatomical and haemodynamic characteristics of individual patients. In CHIVA, the aim is to maintain the superficial venous system, altering the venous haemodynamics to promote more efficient drainage into the deep venous system.

Background

CHIVA is described as a minimally invasive, non-ablative, saphenous-sparing technique. Its development has been made possible by advances in Doppler ultrasonography, enabling detailed anatomical and functional mapping of the superficial venous system. The aim of the procedure is fragmentation of the haemostatic

column of blood, which is achieved by selective ligation of the truncal vein, preservation of communicating branches draining into the deep venous system and ligation of refluxing sapheno-femoral connections.[11]

The underlying theory is that varicose veins arise as a consequence of pathological veno-venous shunts, allowing recirculation of blood between the deep and superficial venous systems. CHIVA re-routes venous blood flow into the superficial venous system through to the competent deep venous system, promoting venous drainage and reducing venous hypertension. This is achieved by the formation of new haemodynamic pathways correcting the pathological reflux.

Technique

CHIVA can be performed under local anaesthesia as a day case procedure. A detailed pre operative duplex assessment is required, analysing the superficial and deep venous systems, as well as tributaries and perforators.

Once the clinician has a sound understanding of the venous haemodynamics specific to the individual patient, a plan for intervention can be made with the following aims:[11]

1. Fragmentation of the venous column of blood

This is achieved by ligation of the saphenous trunk at predetermined points, e.g. below competent perforating veins or, if incompetent, at the junction, allowing drainage of smaller portions of truncal vein into the deep system via competent channels. This fragments the venous column of blood, interrupting high pressure in the system.

2. Interruption of veno-venous shunts

Communicating channels between the superficial and deep venous systems via incompetent tributaries are also disconnected, suppressing the haemodynamic load.

3. Preservation of competent re-entry perforating veins

As described in point 1, this allows drainage of the superficial venous system into the deep.

4. Removal of non draining venous networks from the haemodynamic circuit

This is achieved via ligation.

Importantly, CHIVA cannot be performed on patients with deep venous incompetence, as there is no competent channel through which the venous flow can be re-routed.

Evidence

A Cochrane review published in 2013 identified three randomized controlled trials comparing CHIVA vs saphenous stripping and one comparing CHIVA vs compression. The review found that CHIVA had reduced recurrence rates, improved quality of life results and a reduced side effect profile compared to both open surgery and compression. The authors noted that their assessment was based on a small number of trials and called for further RCTs to compare CHIVA with modalities other than stripping.[12]

A comparison between CHIVA, stripping and endovenous laser ablation (EVLA) found that CHIVA and EVLA patients had improved cosmetic results and reduced pain scores compared to those undergoing open surgery.[13] A retrospective comparison between CHIVA and EVLA found that patients undergoing CHIVA had less pain postoperatively and were less likely to require further sclerotherapy for residual varicosities.[14]

Reported recurrence rates (defined as reflux in the GSV) are variable, ranging from as high as 91% at 3 years[15] to 18% at 10 years.[16]

The nature of CHIVA is such that careful planning is paramount. A retrospective review found that CHIVA had good results when performed appropriately; however, if performed incorrectly, results were far worse than stripping. The authors remarked that CHIVA is less reproducible than stripping and good results are more difficult to achieve.[17]

ASVAL

Background

ASVAL is a minimally invasive technique based on the ascending theory of varicosity development. ASVAL aims to remove varicose tributaries, considered to be at the origin of incompetence, without treating the saphenous trunk. Removal of varicosities reduces the haemodynamic load onto the saphenous vein.

Technique

The procedure is performed as a day surgery case; the varicosities are marked pre-operatively with the patient standing. The leg is cleaned and draped and local anaesthesia is administered. Phlebectomies are performed with micro-incisions (blade or needle) and the varicosities removed with a phlebectomy hook, whilst preserving the saphenous trunk.

Evidence

A retrospective analysis on patients (majority C2 disease) treated with ASVAL and saphenous vein sparing, revealed

encouraging midterm results. Saphenous reflux reduced in more than two-thirds of cases over a four-year follow-up period, whilst symptoms improved or disappeared in the majority of cases. There was no recurrence in 95% of patients at one year and 88.5% at four years.[18] Recurrence was more likely to occur if the varicosities were extensive.

The effect of ASVAL on venous haemodynamics was assessed in patients with C2–C4 disease. This study revealed that ASVAL had significant effects on venous haemodynamics, with a reduction in reflux duration, peak velocity and mean diameter of the great saphenous vein (GSV).[19] This was corroborated by a multicenter study in patients with C2–C4 disease with symptomatic GSV and tributary incompetence. One year after ASVAL, 50% of patients had no residual truncal reflux; the GSV diameter reduced significantly and clinical scores improved.[20] However, the authors clarified that patients with limited disease progression and mild haemodynamic alterations are most likely to benefit from this approach.

Conclusion

CHIVA and ASVAL are two techniques that aim to treat CVD by altering venous haemodynamics and sparing the saphenous trunk. Detailed patient assessment and selection are important to maximize the chances of treatment success. Further randomized controlled trials are necessary to evaluate their effect compared to techniques such as endovenous ablation.

Conflict of interest

None declared.

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