Conservative surgery using the CHIVA method

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Introduction

The CHIVA method was proposed in 1988 as a treatment for chronic venous insufficiency.[1–3] The word is a French acronym translated as ambulatory conservative and haemodynamic (treatment) of venous insufficiency (Conservatrice et Hémodynamique de l'insuffisance Veineuse en Ambulatoire). This chapter examines the concepts behind this haemodynamic CHIVA approach.

Description

Haemodynamic disorder and recirculation

The high recurrence rates[4–6] observed with most ablative treatments for varicose veins range from 20–80%. This has resulted in practitioners seeking better ways to manage the disease. The principle of CHIVA is first based on the duplex ultrasound recognition of recirculation as the haemodynamic disorder. It is then corrected by a focused treatment on tributaries, junctions and perforating veins, whilst preserving the saphenous trunks.[7] This will reduce recurrence of the signs and symptoms of venous insufficiency, namely pain, varicose veins and ulcers, whilst preserving the great saphenous vein for future bypass.

The Brodie-Trendelenburg tourniquet tests of 1846 have been used for generations in teaching medical students as a way of controlling reflux and demonstrating drainage by occluding the superficial veins.[8] A positive test means the varicose veins can be prevented from filling from above with a mid-thigh tourniquet whilst the patient moves from a lying to a standing position. This "private circulation" suspected by Trendelenburg was supported by the Perthes test.[9] Subsequently, recirculation was observed and confirmed.[10,11] Retrograde flow requires a distal escape point for reflux to flow though and this re-entry into deep veins completes the recirculation circuit. The findings of Trendelenburg form the basis of defining the types of recirculation circuits today.

Venous insufficiency

This is an exclusive haemodynamic term, which means impaired venous drainage due to obstruction and/or valve incompetence. Valve incompetence is responsible in two disorders activated specifically by the muscular pump when walking.

Figure 1: New varicose veins are seen, which have developed along the path of a stripped great saphenous vein. These may not have appeared if their drainage was not interrupted. [Printed with permission from Massimo Cappelli].

The first is the impaired reduction of the venous pressure.[11,12] The second is the overload of incompetent superficial veins by the flow diverted from other veins through escape points. When the overloading flow is fed by deep veins, recirculation occurs. When it is fed only by other superficial veins, the overloading flow is smaller and occurs without recirculation.[12]

The CHIVA strategy consists of reducing the venous column height, disconnecting the recirculation circuits at the escape points (saphenous and extra-saphenous) and preserving the draining veins, even if they are varicose, as well as the great saphenous vein. The aim of CHIVA is primarily the correction of venous insufficiency locally and regionally. If this is achieved, then aesthetic and quality-of-life improvements should follow. It considers that varicose veins are a sign of chronic venous disorder[13] which develop like collaterals in response to pathological circuits that become volume overloaded. They frequently reduce in size with haemodynamic correction. The CHIVA method does not advocate a standard ablation technique for all patients with varicose veins. Firstly, because varicose veins often reoccur at the sites of original surgery by neovascularisation.[14,15] Secondly, they may reoccur if their natural drainage is obstructed (Figure 1, 2).

Duplex ultrasound

This identifies the presence and significance of escape points, refluxing veins and recirculation circuits. Duplex evaluation in CHIVA is a pathophysiological study of venous haemodynamics which goes beyond the conventional anatomical assessment of marking the sites of reflux.[16] As a consequence, an enriched vocabulary of terms has been developed to describe the circuits and flow patterns for planning treatment and for use in reporting.[2]

A minimum requirement is to identify the reflux source(s), the refluxing conduit(s) and its re-entry point(s) into the deep system. Next, the relationship of the varicose tributaries to this network is mapped. Then the type of circuit can be classified from which the treatment can be planned. Finally, various manoeuvres

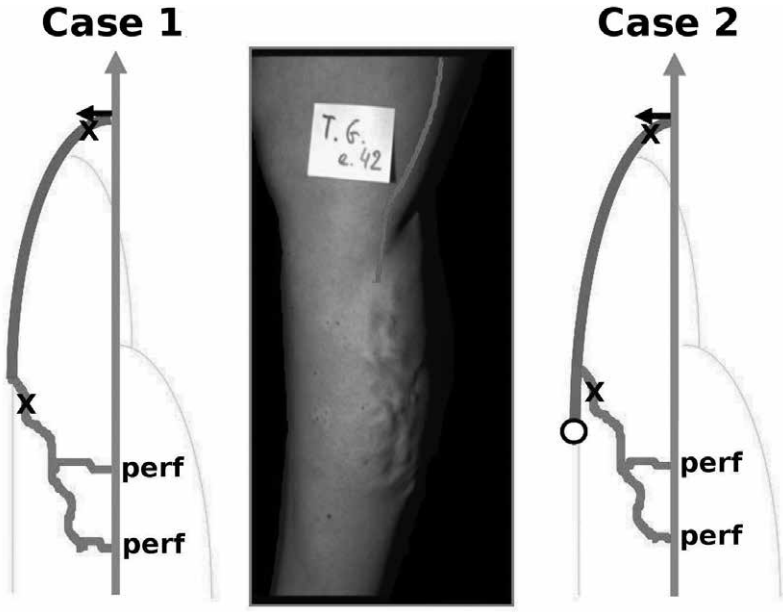

Figure 2: Illustration of how the same interruptions (X) to conserve the great saphenous vein can have different results depending on its drainage. In case 1, the great saphenous vein reflux (red line) has had its main drainage interrupted. Recurrence from veins which drain into the great saphenous vein is inevitable. In case 2, the same procedure is likely to be successful because the saphenous drainage is maintained through a re-entry perforating vein (O). [Printed with permission from Massimo Cappelli].

and compression tests can be performed to test the effect of the planned treatment. The reflux elimination test is commonly used for this purpose.[17]

Ascending and descending theories

In 125 limbs with superficial venous incompetence, the observation that the below-the-knee part of the great saphenous vein was the most common site of reflux (68%), followed by the above-the-knee segment (55%) and then the sapheno-femoral junction (32%) supports the ascending theory of evolution.[18] This is logical because the hydrostatic pressure column is greater towards the foot. However, the frequent occurrence of reflux from a pelvic source (one in six females) supports a descending theory.[19]

Both theories are supported by recirculation and overloaded circuits. However, with recirculation, a circuit is acknowledged rather than an isolated reflux source point. Reflux sources are consistently higher than re-entry points but the conduits carrying the reflux often take a variable course. Segmental saphenous reflux is explained as occurring between a reflux source point and a re-entry point. Circuits may occur below the knee as well as above the knee or involve both segments. There may be several reflux sources and more than one circuit.

Provocation tests

There are many challenge tests which can be used to induce antegrade flow and reflux in leg veins.[20] These include the manual calf compression and release, pneumatic calf compression and release,[21] Paranà,[22] Wunstorfer,[16] elevation-dependency and Valsalva manoeuvres.[23]

Reflux observed by one test may not be apparent in another. For example, a Valsalva manoeuvre is (unlike the others) able to differentiate a normal descending flow of the great saphenous vein arch tributaries from one which is overloaded by pelvic escape points. Therefore, it may pick up reflux sources from the pelvis better than a calf compression and release manoeuvre.[24] However, in the presence of competent femoral valves the test may be negative.[23] Furthermore, active tests using muscle contraction (calf systole) are often more effective than external compression of the calf muscle. Comparative assessments of the velocity profiles in refluxive veins using the pulsed-wave mode of duplex ultrasound may help to evaluate the predominant reflux sources.

Terminal valve incompetence

Duplex assessment of the terminal and pre-terminal valves are required to identify whether the proximal reflux source comes from the saphenofemoral junction directly or from tributaries refluxing into the great saphenous vein.[25] This is important when deciding whether or not the saphenofemoral junction should be disconnected or selected tributaries to be ligated with junction preservation.[26] The precise identification of pelvic sources of reflux is required before contemplating treatment of lower limb venous insufficiency, especially in women.[27] In both circumstances, the Valsalva test is mandatory.

Reflux or drainage

Recognition of the drainage points of varicose tributaries are of paramount importance. Incorrectly planned surgery may inadvertently remove the drainage pathways causing an obstruction to tributary flow. This is often used to explain how the same operation can have great success in some patients and result in recurrence in others.

Not all downward flows greater than one second are pathological refluxes. The flow in the superficial inguinal tributaries, for example, is normally downward draining into the great saphenous vein. This makes the diagnosis of reflux from these veins particularly difficult. The common occurrence of downward flow after CHIVA is often mistaken for reflux and failure. However, if the downward drainage of these veins occurs in the absence of a proximal-reflux source, the vein is no longer volume overloaded. Adequately drained varicose tributaries have been shown to become smaller.

Varicose tributaries

The fate of varicose tributaries after saphenous ablation is variable if they are not removed concurrently. They may regress spontaneously, remain unaffected or even enlarge in the immediate postprocedural period. This has led to randomised controlled trials to assess whether it is cost-effective to perform concurrent phlebectomies on all patients or selective phlebectomies on few and offer treatment at a later stage, if needed.[28] Furthermore, there is controversy as to whether the below-the-knee part of the great saphenous vein should be ablated in all patients since this may prevent recurrence.[29]

From a patient's perspective, it would be advantageous to know the likely outcome of both these approaches in advance to avoid unnecessary procedures which, in some cases, may precipitate recurrence. A duplex ultrasound study of the overloaded and recirculation circuits may be able to predict which interventions are likely to treat volume overload whilst at the same time ensuring there is a re-entry pathway for tributaries to decompress and drain. This explains the

phenomenon why the same procedure can have different results. Preservation of drainage from superficial veins to deep veins is a major strategy in all CHIVA treatments.

Incompetent perforating veins

Pathological perforating veins are commonly defined as large-calibre outward-flowing veins necessitating interruption. In reality, the large-perforating veins, particularly below the knee, are not normally refluxive. They enlarge to accommodate the physiological inwards draining flow during calf diastole when overloaded by the refluxive volume. The advantage of preserving them is that, once the reflux sources have been interrupted, they will continue their physiological role of drainage and usually regress in size. In contrast, they are pathological, whatever their location, when they demonstrate a diastolic reflux (outward flow) during calf muscle pump relaxation or with Valsalva tests.

Follow-up

Follow-up duplex scans are required to assess the effects of treatment because these may not be apparent immediately. It takes some weeks for the varicose tributaries to remodel to a smaller calibre. A decrease in the diameter of the great saphenous vein and the common femoral vein is a good indicator of haemodynamic success.[30] Some patients may require adjunctive procedures.[31]

Future innovations

A current drawback of CHIVA is that many patients require a groin incision to treat the saphenofemoral region when the terminal valve is incompetent. However, laser techniques are now being developed which attempt to comply with the CHIVA strategy.[32,33]

Cochrane review

The haemodynamic principles of CHIVA, frequent conference presentations, and the results obtained by practicing clinicians have led to its growing popularity as a treatment for venous insufficiency. This increase in recognition prompted a Cochrane review in 2012 which summarised the evidence.[34] Four publications were identified as having sufficiently robust data for inclusion in their analysis. These were on open CHIVA surgery alone and are described below. They concluded that the CHIVA method reduces the recurrence of varicose veins and produces fewer side-effects than vein stripping, i.e. nerve injury, hyperpigmentation and matting. However, they acknowledged that their conclusions were based on the limited data available and with a high risk of bias. They also stated that new randomised controlled trials were needed to compare CHIVA with modern endovenous treatments.

Zamboni (2003)

In this study[35] of 45 patients with venous ulceration, 24 legs were randomised to inelastic compression bandages from foot to below knee and 23 to the CHIVA method of treatment. In the CHIVA group, the ulcer was protected with half elastic compression at the ankle. The healing rate was 96% in median (range) 63 (21–180) days with compression and 100% in 31 (17–53) days with CHIVA. At a mean follow-up of three years there were nine (38%) and two (9%) recurrences with compression *versus* CHIVA, respectively ($p<0.05$). At six months the venous volume, venous filling index and residual volume fraction parameters of air plethysmography all improved significantly after CHIVA

($p<0.001$) compared to baseline. In the compression group only the venous volume improved ($p<0.05$). Finally, the generic quality of life scores using the short form 36 questionnaire presented graphically (however, without data) significantly favoured the CHIVA method.

Iborra-Ortega (2006)

In this study[36], 100 patients with primary varicose veins involving the saphenous system, clinical, etiology, anatomic, pathophysiology classification clinical class 2 were randomised to stripping (49 legs) and the CHIVA method (51 legs). After five years, five patients in each treatment group underwent re-intervention. There were no differences in aesthetic improvement between the interventions, as reported by the patient or investigator. Recurrent varicose veins occurred in 18/47 stripped legs and 16/49 CHIVA legs. Regarding complications there were zero *versus* four events of superficial vein thrombosis and 11 *versus* zero events of nerve damage in the stripping *versus* CHIVA groups, respectively.

Carandina (2008)

In this study[37], 75 patients were randomised to stripping and 75 to the CHIVA method and were followed up for a mean of 10 years. All had saphenofemoral junction as well as great saphenous vein incompetence and were in clinical, etiologic, anatomic, pathophysiologic clinical class 2–6. Postoperative scores of clinical recurrence were undertaken by three independent assessors who assigned legs into four categories (A–D). Similarly, patients were asked also to categorise their level of clinical recurrence (A–D). Recurrence occurred in 35% of the stripping group and in 18% of the CHIVA group ($p<0.04$). There were no significant differences in the rate or recurrence at the saphenofemoral junction. The associated risk of recurrence at 10 years was much higher in the stripping group (odds ratio 2.2, 95% confidence interval: 1–5, $p=0.04$). The authors concluded that the deliberate preservation of the saphenous trunk as a route of venous drainage in the CHIVA group may have been a factor reducing the recurrence rate.

Pares (2010)

In this study,[13] 501 patients with primary varicose veins were randomly assigned to the CHIVA method (167), stripping with clinical marking (167) and stripping with duplex marking (167). Clinical recurrence was assessed within five years by trained independent observers. The CHIVA outcome was significantly better (44.3% cure, 24.6% improvement, 31.1% failure). The stripping with clinical marking outcome was 21% cure, 26.3% improvement, 52.7% failure and the stripping with duplex marking outcome was 29.3% cure, 22.8% improvement, 47.9% failure. The odds ratio at five years for recurrence, favouring the CHIVA method *versus* stripping and clinical marking and stripping with duplex was 2.64, 95% confidence interval: 1.76–3.97, $p<0.001$ and 2.01, 95% confidence interval: 1.34–3.00, $p<0.001$, respectively. Regarding complications there were 76/167 *versus* 240/334 bruising events and 0/167 *versus* 15/334 events of nerve damage in the CHIVA *versus* stripping groups, respectively.

Conclusion

The CHIVA method of treating varicose veins with saphenous conservation is the only evidence-based way of correcting the underlying haemodynamic disorder.

There is a significant learning curve in both duplex ultrasound and surgical strategy for the understanding of the different shunts. This is not necessary for the ablative methods. If performed incorrectly, the results of CHIVA can be worse than the conventional destructive techniques.[38]

More randomised trials are mandated in the future so that the CHIVA method can be placed accurately within the treatment armamentarium of chronic venous disorders.

Summary

- CHIVA is an effective method for treating superficial venous insufficiency whilst preserving the great saphenous vein
- Treatment is aimed at reducing the gravitational hydrostatic pressure and disconnecting overloaded and recirculation circuits, not treating reflux *per se*
- More than one provocation test is needed to define the refluxing circuits
- Identification of source and drainage points is mandatory for a good outcome
- The relationship between refluxing circuits and clinical severity requires evaluation
- More studies are required focusing on patient reported outcome measures
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