

How We Perform CHIVA: A Standardized Pathway From Hemodynamic Duplex Mapping to Structured Follow-up

Abstract

CHIVA is a vein-sparing therapeutic strategy based on the analysis of venous hemodynamics. Its purpose is not to treat a named vein according to a fixed anatomical recipe, but to reduce pathological venous pressure by identifying the pressure source, the escape point, the abnormal shunt pathway, and an effective re-entry into the deep venous system. Veins that retain a useful drainage function are preserved whenever feasible. Although venous networks and pressure-drainage relationships vary considerably among patients, individualized treatment does not preclude standardization. This technical note describes an institutional pathway comprising patient selection, weight-bearing dynamic duplex ultrasound, construction of a hemodynamic map, treatment planning, same-day verification, limited intervention, structured follow-up, and remapping before any secondary procedure. The pathway emphasizes that treatment should not be determined by reflux duration or vein diameter alone. Likewise, outcome assessment should not be reduced to vein occlusion or disappearance. The principal endpoints are modification of the pathological pressure gradient, preservation of effective drainage, clinical improvement, and stabilization of the venous network under lower pressure. The proposed pathway is intended to improve reproducibility, training, documentation, and quality assurance while preserving the patient-specific reasoning that defines CHIVA.

Keywords: CHIVA; chronic venous disease; venous hemodynamics; duplex ultrasound; escape point; re-entry; vein-sparing treatment; follow-up

1. Introduction

Chronic venous disease is a network disorder rather than an isolated abnormality of a single named vein. Visible varices, bidirectional or retrograde flow, pressure transmission between the deep and superficial systems, and distal drainage routes interact within a connected venous network. Accordingly, CHIVA asks not only where reflux is detected, but also where pathological pressure enters the superficial system, how it is transmitted, where blood re-enters the deep system, and whether a particular venous segment functions predominantly as a high-pressure shunt or as an effective drainage pathway [1].

CHIVA should therefore be understood as a hemodynamically guided strategy rather than a single operation or a predetermined combination of ligations. The location, extent, and staging of treatment may differ between patients. Nevertheless, data acquisition, hemodynamic interpretation, mapping, decision-making, procedural documentation, and postoperative reassessment should be explicit and reproducible. The central premise of this

article is that CHIVA does not standardize an identical intervention for every patient; it standardizes the pathway by which patient-specific hemodynamic information is converted into treatment and subsequent re-evaluation [1,2].

1	Patient selection and clinical assessment	Define symptoms, signs, goals, and possible non-superficial contributors.
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2	Weight-bearing dynamic duplex	Assess deep and superficial systems, pressure source, shunt pathway, and re-entry.
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3	Hemodynamic map	Record escape point, re-entry, flow direction, preserved pathways, and uncertainty.
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4	Decision node	Are the pressure source and effective drainage sufficiently defined? NO: extend dynamic testing or remap. YES: plan limited or staged correction.
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5	Same-day verification and treatment	Confirm position, target, and flow direction; document any change from the plan.
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6	Structured follow-up	Review within 7 days, at 4-6 weeks, at 3-6 months, and from 12 months.
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7	Re-decision node	Are clinical and hemodynamic results stable? YES: long-term surveillance. NO: remap before observation or secondary treatment.

Figure 1. Proposed institutional pathway for standardized CHIVA assessment, treatment, and re-decision. This figure is not an international consensus algorithm.

2. Patient Selection and Clinical Assessment

The initial consultation begins by defining the patient's principal problem and treatment objective. Relevant concerns include pain, heaviness, edema, recurrent superficial venous thrombosis, skin changes, ulceration, functional limitation, and cosmetic distress. Clinical findings must be interpreted together with duplex ultrasound. The presence of reflux does not establish that every symptom is venous in origin, and the absence of prominent surface varices does not exclude clinically important venous hypertension.

Findings that warrant broader assessment include bilateral or disproportionate edema, advanced gaiter-region skin changes, pulsatile venous Doppler signals, a history of deep venous thrombosis, suspected pelvic-origin varices, reduced calf-pump function, and symptoms suggesting proximal outflow obstruction or systemic venous hypertension. In such circumstances, a superficial-vein intervention should not proceed until the deep

venous system, proximal outflow, and relevant cardiopulmonary or systemic contributors have been considered.

CHIVA is most appropriate when the operator can construct a coherent hemodynamic explanation that links the patient's clinical presentation to a modifiable pressure pathway while preserving adequate drainage. If the pressure source or drainage route remains uncertain, uncertainty should be documented and the examination extended rather than replaced by an empirical intervention.

3. Weight-bearing Dynamic Duplex Mapping

The principal hemodynamic examination should be performed with the patient standing or otherwise appropriately weight bearing whenever clinically safe. Supine imaging remains important for excluding deep venous thrombosis and assessing selected anatomical structures, but it usually cannot substitute for weight-bearing evaluation of superficial venous function [2-4]. The examination proceeds from deep venous patency and basic function to the saphenofemoral and saphenopopliteal regions, great and small saphenous trunks, major varicose tributaries, perforating veins, potential re-entry points, and non-saphenous or pelvic-origin pathways when indicated.

Provocative maneuvers are selected to answer specific questions. Distal compression and release, the Valsalva maneuver, active ankle movement, and calf-muscle contraction may be used to observe changes in flow direction, velocity, duration, and pathway dependence. Temporary compression of a connection may help determine whether the original flow pattern changes, whether a distal segment continues to empty, and whether flow is redirected through an alternative route. These observations provide a short-term model of redistribution after intervention; they should not be presented as a complete prediction of long-term remodeling.

Three dimensions must be distinguished. Reflux describes retrograde flow under defined test conditions. The pressure source identifies the gradient that drives the pathway. Drainage capacity describes whether the network can empty toward a lower-pressure route during posture change and calf-pump activity. Reflux duration is therefore a descriptive measurement, not an autonomous indication for treatment. A segment with retrograde flow may still provide useful drainage, whereas an inconspicuous pathway may sustain a clinically important high-pressure shunt.

The ultrasound report should contain sufficient information to reconstruct the decision. At minimum, it should document examination position, relevant maneuvers, deep venous patency, the proposed escape point, the course of the shunt, major tributaries, re-entry sites, flow-direction changes, and segments intended for preservation or intervention. Representative images or cine loops should be saved at locations that determine the treatment plan.

4. From Hemodynamic Map to Treatment Strategy

Duplex findings are converted into a concise and reviewable hemodynamic map. The map should identify the deep system, superficial trunks, major tributaries, the probable escape point, principal re-entry routes, dynamic flow directions, planned drainage preservation, and proposed intervention sites. Areas of uncertainty are marked explicitly. Every treatment point must be traceable to a hemodynamic rationale on the map.

Treatment planning follows four questions. First, where does pathological pressure enter the network? Similar reflux patterns may be driven by a superficial junctional source, deep-to-superficial pressure transmission, pelvic-origin flow, compensation for deep obstruction, or systemic pressure transmission. Second, where does blood leave the affected network? Re-entry location and actual drainage capacity must be defined, together with the possible consequences of interrupting a connection. Third, which veins should be preserved? Preservation is justified when a segment supports effective drainage, connects to an important re-entry, or has a reasonable prospect of decompression and remodeling. Preservation is not an end in itself. Fourth, should treatment be staged?

The initial intervention targets the connection or connections that maintain the pathological pressure gradient and hemodynamically relevant shunt. The objective is not to abolish every visible refluxing segment. A staged strategy may be preferable when a large-caliber vein, multiple interacting connections, a potentially recruitable drainage route, or the expected regression of distal varices makes the effect of extensive one-stage treatment difficult to predict. Staging is not incomplete treatment; it is a deliberate strategy in which subsequent treatment depends on the observed clinical and hemodynamic response [1,5].

Vein preservation is not absolute. A segment that persistently sustains a clinically significant high-pressure shunt, lacks effective drainage, and cannot be decompressed by a more limited correction requires reconsideration. The relevant question is neither whether a vein must always be preserved nor whether reflux must always be eliminated, but whether each decision is consistent with the pressure source, network connections, and predicted drainage consequences.

5. Same-day Verification, Intervention, and Documentation

Immediately before intervention, the operator repeats focused duplex assessment in the appropriate position and verifies the target connection, flow direction, skin marking, and pathway intended for preservation. Venous hemodynamics vary with posture, muscular activity, venous filling, and physiological state. The preoperative map is the foundation of the strategy, but it does not replace same-day confirmation. A material discrepancy should trigger re-evaluation rather than mechanical completion of the original plan.

The intervention is limited to the confirmed hemodynamic target and should avoid unnecessary disruption of non-target structures and useful drainage pathways. For each treatment point, the record should state its role in the abnormal circuit, the pressure relationship expected to change, and the route through which blood is expected to continue draining. In this context, minimally invasive treatment refers not only to incision size but also to minimizing unnecessary destruction of the venous network.

Any deviation from the planned procedure must be documented, including additional, omitted, or relocated treatment points and the duplex finding that prompted the change. The preoperative map, decisive ultrasound images, actual intervention sites, and postoperative map should correspond. This traceability supports peer review, case discussion, training, quality assurance, and interpretation of later recurrence.

6. Structured Follow-up and Re-decision

Follow-up is both a safety process and a hemodynamic observation period. Assessment combines symptoms, physical findings, vein morphology, duplex flow, the residual or new pressure source, and drainage capacity. A

preserved vein that remains visible or patent is not, by itself, a treatment failure. Conversely, occlusion of a treated segment does not prove that the hemodynamic objective has been achieved.

The 3- to 6-month visit is particularly useful for assessing a more stable phase of remodeling. At this stage, the examiner should distinguish persistent pathological reflux from lower-pressure drainage flow and from a newly detected reflux point without clinical or network-level significance. A new reflux point is more likely to represent a treatable shunt when it sustains abnormal pressure transmission, compromises drainage, and is associated with persistent symptoms or disease progression.

When visible veins reappear or remain, the operator should distinguish residual morphology, compensatory drainage, collateral recruitment, and true hemodynamic recurrence. Continued observation is reasonable when symptoms and skin findings improve and no clinically important high-pressure pathway is demonstrated. Persistent abnormal pressure, absent clinical improvement, or progression should lead to complete weight-bearing remapping before any secondary intervention.

Interval	Primary objective	Minimum assessment
Within 7 days	Safety and early drainage	Deep venous patency; location and extent of thrombus; wound status; unexpected congestion; early flow in preserved pathways
4-6 weeks	Early remodeling	Symptoms; softening or regression of varices; attenuation of the original high-pressure pathway; persistence of effective re-entry
3-6 months	Core stability assessment	Diameter and volume-load trend; pathological reflux versus drainage flow; clinically relevant new shunt; need for staged treatment
12 months and beyond	Long-term stability and recurrence	New pressure source; collateral recruitment; distinction among residual veins, compensatory drainage, and true hemodynamic recurrence

7. Training, Quality Assurance, and Limitations

Training should extend beyond the performance of a technical maneuver. Trainees must learn to acquire, interpret, map, communicate, and document hemodynamic information. Quality assurance therefore examines the entire reasoning chain: appropriate patient position; assessment of the deep system and drainage capacity; use of relevant dynamic maneuvers; identification of the escape point and re-entry; explicit justification of each intervention; documentation of preserved pathways; reconciliation of planned and actual treatment; and remapping before re-intervention.

This article describes a proposed institutional workflow and should not be interpreted as an international consensus statement. Published randomized trials and systematic review suggest that CHIVA is a clinically relevant option, but certainty is limited by study heterogeneity, operator dependence, and the quality of the available evidence [6-9]. Dynamic duplex interpretation is operator dependent, and temporary compression demonstrates an immediate response rather than long-term remodeling. Venous compliance, collateral recruitment, calf-pump function, deep venous disease, and systemic hemodynamics may all modify outcome.

The proposed decision nodes and quality indicators require prospective evaluation. Relevant research priorities include interobserver agreement in hemodynamic mapping, reproducibility of escape-point and re-entry classification, concordance between predicted and observed redistribution, patient-reported outcomes,

standardized definitions of hemodynamic recurrence, and external validation across centers with different levels of CHIVA experience.

Domain	Minimum quality requirement
Assessment	Appropriate weight-bearing position; deep venous and drainage assessment; relevant dynamic maneuvers; defined escape point, re-entry, and complete pathway
Decision	Hemodynamic rationale for every treatment point; preserved pathways recorded; staging considered; uncertainty disclosed
Intervention	Same-day verification; limited target-specific treatment; deviations recorded; comparable images retained
Follow-up	Early safety assessment and 3- to 6-month stability assessment completed; full remapping before re-intervention

8. Conclusion

Standardization in CHIVA does not mean performing the same intervention in every patient. It means applying a reproducible process for patient selection, dynamic duplex mapping, hemodynamic interpretation, treatment planning, same-day verification, procedural documentation, and postoperative reassessment. When each individualized decision is supported by an explicit, recorded, and reviewable hemodynamic rationale, individualization and reproducibility are compatible. The ultimate objective is to modify pathological pressure relationships, preserve effective drainage, and allow the venous network to stabilize under lower pressure.

References

1. Franceschi C, Cappelli M, Ermini S, Giancesini S, Mendoza E, Passariello F, et al. CHIVA: hemodynamic concept, strategy and results. *Int Angiol.* 2016;35(1):8-30. PMID: 26044838.
2. De Maeseneer MG, Kakkos SK, Aherne T, Baekgaard N, Black S, Blomgren L, et al. Editor's Choice - European Society for Vascular Surgery (ESVS) 2022 Clinical Practice Guidelines on the Management of Chronic Venous Disease of the Lower Limbs. *Eur J Vasc Endovasc Surg.* 2022;63(2):184-267. doi:10.1016/j.ejvs.2021.12.024. PMID: 35027279.
3. Coleridge-Smith P, Labropoulos N, Partsch H, Myers K, Nicolaides A, Cavezzi A. Duplex ultrasound investigation of the veins in chronic venous disease of the lower limbs - UIP consensus document. Part I. Basic principles. *Eur J Vasc Endovasc Surg.* 2006;31(1):83-92. doi:10.1016/j.ejvs.2005.07.019. PMID: 16226898.
4. Cavezzi A, Labropoulos N, Partsch H, Ricci S, Caggiati A, Myers K, et al. Duplex ultrasound investigation of the veins in chronic venous disease of the lower limbs - UIP consensus document. Part II. Anatomy. *Eur J Vasc Endovasc Surg.* 2006;32(3):288-299. doi:10.1016/j.ejvs.2005.07.020. PMID: 16230038.
5. Cappelli M, Molino Lova R, Ermini S, Turchi A, Bono G, Bahnini A, Franceschi C. Ambulatory conservative hemodynamic management of varicose veins: critical analysis of results at 3 years. *Ann Vasc Surg.* 2000;14(4):376-384. doi:10.1007/s100169910064. PMID: 10943791.
6. Carandina S, Mari C, De Palma M, Marcellino MG, Cisno C, Legnaro A, Liboni A, Zamboni P. Varicose vein stripping vs haemodynamic correction (CHIVA): a long term randomised trial. *Eur J Vasc Endovasc Surg.* 2008;35(2):230-237. doi:10.1016/j.ejvs.2007.09.011. PMID: 17964822.
7. Parés JO, Juan J, Tellez R, Mata A, Moreno C, Quer FX, Suarez D, Codony I, Roca J. Varicose vein surgery: stripping versus the CHIVA method: a randomized controlled trial. *Ann Surg.* 2010;251(4):624-631. doi:10.1097/SLA.0b013e3181d0d0a3. PMID: 20224376.
8. Bellmunt-Montoya S, Escribano JM, Pantoja Bustillos PE, Tello-Díaz C, Martínez-Zapata MJ. CHIVA method for the treatment of chronic venous insufficiency. *Cochrane Database Syst Rev.* 2021;9(9):CD009648. doi:10.1002/14651858.CD009648.pub4. PMID: 34590305.
9. Ricci S. CHIVA for dummies. *Phlebology.* 2024;39(4):238-244. doi:10.1177/02683555231225788. PMID: 38164906.

10. Lurie F, Passman M, Meisner M, Dalsing M, Masuda E, Welch H, et al. The 2020 update of the CEAP classification system and reporting standards. *J Vasc Surg Venous Lymphat Disord*. 2020;8(3):342-352. doi:10.1016/j.jvsv.2019.12.075. PMID: 32113854.