Assessment of the CHIVA and the ASVAL Method

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Int J Angiol 2022;31:83–87.

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Abstract

In this article, the CHIVA and ASVAL methods are assessed from the hemodynamic point of view. The CHIVA method comprises complicated, unusual terminology and new perceptions, such as closed and open shunts, fractionation of the hydrostatic pressure, subdivision of the venous network. The principal part of the CHIVA theory is the drainage of venous blood from the thigh saphenous system into the deep lower leg veins through the preserved saphenous trunk after high ligation at the saphenofemoral junction, which is considered as a beneficial, physiological phenomenon. In reality, this is recurrent reflux producing ambulatory venous hypertension. The main impact of the CHIVA procedure is the elimination of the saphenous reflux by high ligation at the saphenofemoral junction; thus it can be presumed that the CHIVA procedure yields similar results like the crossectomy.

The ASVAL procedure is de facto the modification of the old Madelung method that was the prevalent surgical procedure before the Trendelenburg era in the 19th century. The results after ASVAL were not checked by plethysmography; there is a good case to suppose that the results after the ASVAL method would comply with those after sclerotherapy.

Keywords

- reflux
- varicose veins
- CHIVA
- ASVAL
- hemodynamics
- venous hemodynamics

Several different methods are used in the treatment of primary varicose veins: in addition to the standard crossectomy and stripping, ablative methods using radiofrequency and laser, prevalently performed without high ligation, and sclerotherapy are the most frequently applied procedures. In addition, the CHIVA method (*C*ure *H*émodynamique de l'*I*suffisance *V*eneuse en *A*mbulatoire) the and the ASVAL method (*A*blation *S*élective des *V*arices sous *A*nesthésie *L*ocale) method were also recommended as an alternative to the ablative methods, both with the preservation of the incompetent great saphenous vein.

The CHIVA conception comprises some new viewpoints. It uses unconventional terms, such as closed and open shunts, fractionation of hydrostatic pressure, subdivision of the venous network in R1–R4 (N1–N4), vicarious circulation. From the hemodynamic point of view, several standpoints proclaimed by the CHIVA proponents do not conform to the matter of fact, as confirmed by the results of venous pressure measurements and plethysmographic findings accrued from the literature.

The ASVAL method targets the elimination of varicose veins, while purposefully sparing the incompetent saphenofemoral junction as well as the incompetent great saphenous vein.

In this article, the contentious ideas presented by the CHIVA and ASVAL conception are discussed and confronted with the results of precise venous pressure and plethysmographic measurements.

The CHIVA Theory

The CHIVA conception[1] comprises, on the one hand, evidenced hemodynamic elements. It termed calf perforators *"re-entry points"* of venous reflux; it stressed the effectiveness of saphenous reflux interruption at the saphenofemoral junction; it aims to preserve the great saphenous vein trunk in the thigh for possible bypass grafts. In this regard, it represents a positive contribution. But on the other hand, it contains subjectively contrived ideas and perceptions that are misleading and at odds with the reality. First of all, the so called "physiological drainage" of venous blood from superficial thigh veins into the deep lower leg veins through the preserved incompetent saphenous trunk in the thigh after

published online
February 12, 2022

DOI https://doi.org/10.1055/s-0041-1741469.
ISSN 1061-1711.

high ligation. This drainage produces harmful effects: it causes ambulatory venous hypertension, and it promotes the displacement of the dividing line of the ambulatory pressure gradient from below the knee into the thigh, which triggers the process leading to recurrent reflux, as described in detail in another article.[2] The essentials in brief: after elimination of saphenous reflux, e.g., by high ligation, the decreased ambulatory pressure, which is produced during calf pump activity in the veins below the knee, is displaced upward into the incompetent thigh segment of the great saphenous vein. Because the ambulatory pressure in the femoral vein does not decrease during calf pump activity, a pressure gradient arises between the femoral vein and the incompetent thigh segment of the great saphenous vein; it triggers the chain of events that induce recurrent reflux. Furthermore, CHIVA uses superfluous terminology describing fictive situations: closed and open shunts, subdivided moreover into subtypes; fractioning of hydrostatic pressure; vicarious circulation; subdivision of the venous network in R1–R4 (N1–N4). This all adds to unnecessary complexity and to additional confusion, and furthermore does not conform to the reality. Ultimately, CHIVA does not take into account some proven evidences, such as ambulatory venous hypertension, ambulatory pressure gradient, the different pathophysiological function of thigh and lower leg veins, and the tenacious tendency of varicose veins to recurrence.

Closed Shunts

"Closed shunts" do not exist in reality. There is no closed circulation in a circle: deep lower leg veins –> popliteal vein –> femoral vein –> sapheno-femoral junction –> incompetent great saphenous vein –> calf perforators –> deep lower veins. Instead, there is *up and down* flow in the incompetent great saphenous vein: antegrade/centripetal flow (toward the heart) during calf muscle contraction (systole), and retrograde/centrifugal flow (away from the heart) during calf muscle relaxation (diastole). The reflux in the incompetent great saphenous vein is fed from the iliac veins, which are valveless and represent a large venous reservoir feeding the reflux. There is a systolic antegrade flow in the popliteal-femoral venous axis, which is followed by a short physiological diastolic retrograde flow lasting 200 to 300 ms until the competent valves close.[3] Thereafter the flow in the superficial femoral vein stops until the ambulatory pressure gradient is equalized. Thus, in the early diastole there is a retrograde flow in both the incompetent great saphenous vein and the superficial femoral vein. Thereafter the flow in the superficial femoral vein stops, whereas in the incompetent great saphenous vein the retrograde streaming continues during the diastole, being fed from the iliac vein, until the ambulatory pressure gradient is equalized. So, no "closed shunts," i.e., streaming in a closed circle without any other influx or tributary exists.

Fractioning of the Hydrostatic Pressure

The term "*fractioning of hydrostatic pressure"* is another false invention. Hydro*static* pressure exerts its effect in the *quiet standing position* and has just the same value before CHIVA treatment as after the procedure, i.e., after the so called "fractioning of the hydrostatic pressure." The hydrostatic pressure in deep lower leg veins is manifold "fractionated" by competent valves, but at the same hydrostatic level its value equals that one in the incompetent great saphenous vein.[4] High ligation of the incompetent great saphenous vein or any other ligation at very different hydrostatic levels induces the same hemodynamic effect. It does not "fractionate" the hydrostatic pressure; it just interrupts the saphenous reflux and counteracts in this way the development of ambulatory venous hypertension. Thus, elimination of saphenous reflux, not fractionation of hydrostatic pressure is in play.

Venous Flow Characteristics

When we are speaking about reflux, we must define where the point with higher pressure (source) is and where the point with lower pressure (outlet) is, both related to the same hydrostatic level. The position of these two pressure points determines the flow direction.

The *physiological flow direction* in the venous system is *antegrade, centripetal:* from the periphery to the heart. In the motionless position and during calf muscle contractions, the point with higher pressure is situated more distally, the point with lower pressure more proximally, which propels the venous blood in the centripetal direction toward the heart. Ambulatory pressure gradient arising during calf muscle relaxation or during calf pump activity *inverts* the position of these two points: the point with higher pressure is now situated more proximally (in the thigh), the point with lower pressure more distally (in the lower leg).[5] If the saphenous system is incompetent, the resulting flow direction in the incompetent vein connecting both pressure points is *retrograde* or *centrifugal*; it is a *pathological flow*; it is a *reflux.*

CHIVA does not take into account that the venous flow direction is determined by the physiologically changing orientation of the pressure gradients. It defines the physiological direction of venous flow as a *flow respecting the hierarchy of the physiologic drainage N3 > N2 > N1, i.e., from superficial into deep veins.* Thus, after high ligation, according to the CHIVA theory the venous flow through the preserved incompetent great saphenous vein trunk, which streams from the thigh into the lower leg and further through calf perforators inward into deep lower leg veins, is regarded as a physiological situation, a favorable phenomenon because it abides by the "*hierarchy of the physiological drainage.*" Actually, it is a harmful phenomenon, a pathological recurrent reflux producing ambulatory venous hypertension. Drainage of venous blood from the thigh veins into the lower leg veins does not exist under physiological conditions; competent valves preclude it.

CHIVA regards the outward flow within calf perforators as a reflux because the flow direction is oriented from deep into superficial veins, i.e., against the *"physiological drainage N3 > N2 > N1."* Thus, the same calf perforator is simultaneously the re-entry point of reflux, the source of reflux, and after high ligation part of the physiological drainage

route. A real confusion of thought! In reality, the outward flow within calf perforators arising during calf muscle contraction is an antegrade (centripetal) flow streaming in the physiological direction via the great saphenous vein toward the heart; it does not cause any hemodynamic disorder. Reflux within calf perforators is an *inward, not outward* flow,[6] be it in the case of reflux before treatment or in the case of recurrent reflux after the therapeutic procedure, CHIVA inclusive. Thus, according to the CHIVA theory, the *harmful retrograde, refluxing* streaming in the incompetent great saphenous vein remnant after the CHIVA procedure, which continues within calf perforators inward into deep lower leg veins is referred to as a physiological phenomenon, whereas the outward *harmless* streaming within the calf perforators, which continues in the antegrade/centripetal physiological direction toward the heart, is referred to as reflux. A confusion of terms!

The CHIVA theory does not take into account that the pathophysiological function of lower leg veins is quite different from thigh veins. Whereas in healthy people the pressure in the veins of the lower leg decreases during calf pump activity, it remains unaffected in the thigh veins; the consequence is the development of the ambulatory pressure gradient; CHIVA does not know this term and does not respect this reality.

Intrinsic Tendency of Varicose Veins and Venous Reflux to Recur

The CHIVA theory disregards the fact that, once the saphenous reflux has been abolished, the intrinsic tendency of varicose vein disease to recur creates new connections (escape points) between the femoral or iliac veins and the superficial veins in the thigh, which entail recurrent reflux, whose intensity increases progressively. The incompetent remaining great saphenous vein in the thigh that has been deliberately left behind constitutes the main route for recurrent reflux. Zamboni, himself a CHIVA proponent, examined the hemodynamic situation after CHIVA procedures using air plethysmography.[7] The value of venous filling index indicating the reflux intensity was 5.4 mL/s before CHIVA treatment; it improved to 2.9 mL/s 6 months after CHIVA: a significant improvement, although rather higher than the physiological value of <1.7 mL/s, which indicates that the intensity of recurrent reflux amounted to 1.2 mL/s 6 months after the CHIVA procedure. Three years after CHIVA the intensity of recurrent reflux was 5.0 mL/s. Thus, after a transitory significant improvement 6 months after CHIVA the hemodynamic situation deteriorated further on in the course of follow-up due to the progressively increasing intensity of recurrent reflux, and the value indicating recurrent reflux intensity 3 years after the procedure was nearly the same as the value of the original reflux before the treatment; this documents the hemodynamic failure of the CHIVA method.

CHIVA proponents claim that the recurrence rate after CHIVA is smaller than after the stripping procedures.[8–13] Very low recurrence rates after CHIVA were reported: 1.1% 3 years after CHIVA,[8] 11% 4 years after CHIVA,[9] and 18% 10 years after CHIVA.[10] However, the presented results are misleading. The authors evaluated clinical results, patients' satisfaction, and duplex findings. Regrettably, they did not use plethysmography for assessing the postoperative hemodynamic disturbance (one exception: Zamboni), nor did they include the "drainage" in the preserved incompetent saphenous trunk, in fact recurrent reflux, into the recurrence rate. If this "drainage" had been included, the recurrence rate after CHIVA would have exceeded 80% in a few years of follow-up. Zamboni[9] detected patent and draining great saphenous vein trunk in the thigh (that means recurrent reflux) in 94% 4 years after CHIVA. His duplex ultrasonography finding is in accord with his air plethysmographic finding[7]; both document hemodynamic failure of the CHIVA method.

Recurrent reflux is an indispensable part of varicose veins recurrence. In cases after CHIVA procedures, the recurrent reflux takes place mainly through the persistent incompetent saphenous trunk; after ablative procedures, new reflux carrying channels must first develop. Therefore, more "visible" recurrent varicose veins might be apparent after ablative methods than after CHIVA. Carandina,[10] a CHIVA proponent, boiled it down with his statement: "*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.*"

Plethysmographic methods enable quantification of the degree of hemodynamic disorders caused by reflux or recurrent reflux. Principally, CHIVA proponents shrink back from using plethysmography. Plethysmography refutes namely the principal part of the CHIVA theory, as the study by Zamboni[7] did. Plethysmography documented that the drainage of venous blood from the thigh into deep lower leg veins via incompetent thigh saphenous segment after the CHIVA procedure was no physiological phenomenon healing "hemodynamically" varicose vein disease, as claimed by CHIVA proponents, but a harmful recurrent reflux inducing ambulatory venous hypertension and hemodynamic disorders. Consequently, the results after CHIVA presented by CHIVA proponents do not objectively reflect the real situation. Therapeutic results after CHIVA comply presumably with those after a pure crossectomy; the main therapeutic effect is namely achieved by the abolition of saphenous reflux at the saphenofemoral junction.

The author of the CHIVA procedure, Claude Franceschi, is a French surgeon. Curiously enough, according to the survey realized in 2001 by Perrin, only 0.3% of surgeons in France performed CHIVA.[14]

The ASVAL Method

The ASVAL method is geared to remove the varicose veins but to purposefully preserve the incompetent saphenofemoral junction as well as the incompetent great saphenous vein.[15–17] This creates favorable preconditions for the development of recurrent reflux. The method could be acceptable in the early stage of varicose vein disease accompanied with a mild intensity of saphenous reflux and a slight tendency to recurrence; one would prefer rather sclerotherapy in such cases. The author of the ASVAL method, Pittaluga, stated that patients with advanced chronic venous disease should be excluded from the ASVAL treatment.[16]

The ASVAL method is de facto the modification of the old Madelung method that was the prevalent surgical procedure before the Trendelenburg era in the 19th century.[18] Madelung removed the varicose veins while meticulously sparing the main trunk of the great saphenous vein. It was presumed at that time that the interruption of the great saphenous vein would increase the congestion in varicose veins. Trendelenburg was the first who detected the retrograde flow in the great saphenous vein and published his experience with the interruption of the great saphenous vein in 1891.[19]

Because the results after the ASVAL procedures were not checked by plethysmography, it is not clear to which extent and how long the hemodynamic disturbance induced by the saphenous reflux was really improved. Sclerotherapy of varicose veins has the similar aim like the ASVAL method and presumably also the similar effect. Significant improvement of the hemodynamic situation, evaluated by the strain gauge plethysmographic parameters refill time t-90, t-50 and refill volume was registered 1 week after the completed sclerotherapy. Unfortunately, distinct deterioration of the hemodynamic situation was found 2 years after sclerotherapy, as shown in ►**Fig. 1**; the refill times t-90 and t-50 returned to the pretreatment values.[20] The ASVAL method can be characterized as follows: *Killing mosquitoes instead of draining the swampy ground*.

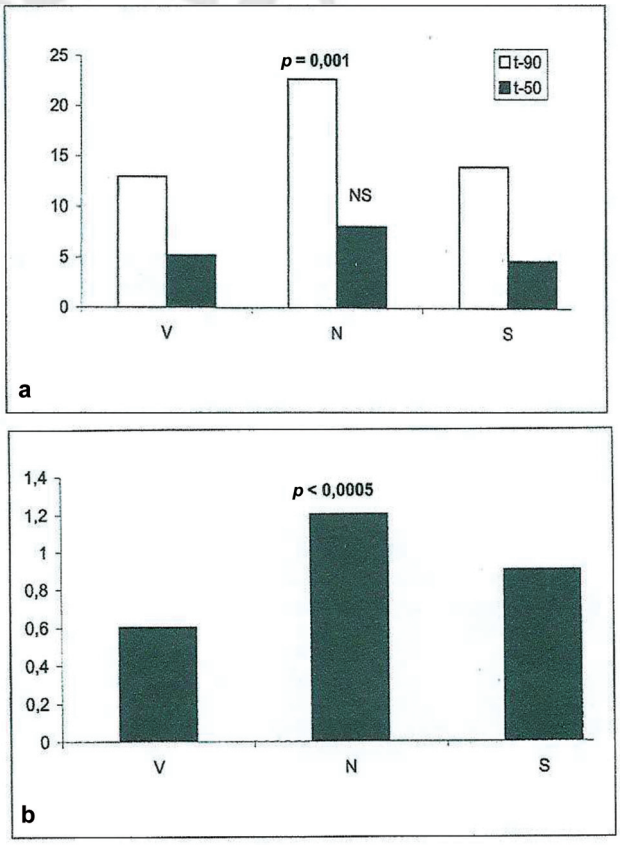

Fig. 1 Impact of sclerotherapy on the hemodynamic disorder in primary varicose veins evaluated by strain gauge plethysmographic parameters refill time t-90, t-50 in seconds (a), and refill volume in ml/100 ml (b). Note the significant improvement of the hemodynamic situation one week after completed sclerotherapy and the following distinct impairment up to two years after sclerotherapy. The parameters refill time t-90 and t-50 returned to the values before treatment. V = before sclerotherapy; N = one week after sclerotherapy; S = two years after sclerotherapy.

Conclusion

Some controversial ideas contained in the CHIVA theory have been disputed. Based on the results of venous pressure and plethysmographic measurements, it was documented that the principal part of the CHIVA conception—the drainage of the venous blood through the preserved thigh segment of the great saphenous vein into the deep lower leg veins is no physiological "hemodynamic healing" of varicose veins, but a harmful recurrent reflux with progressively increasing intensity. In addition, it was evidenced—based on the results of precise measurements—that some other presumptions contained in the CHIVA theory do not conform to the reality, e.g., closed shunts, fractionation of the hydrostatic pressure, reflux in incompetent calf perforators, the flow respecting the hierarchy of the physiologic drainage N3 > N2 > N1.

As concerns the AVSAL method, it is de facto a modification of the old Madelung method, which was used in the 19th century. The results were not verified by plethysmographic methods; it can be presumed that the results after ASVAL would comply with those after sclerotherapy.

Funding
None.

Conflict of Interest
There is no conflict of interest.

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