Evaluation of the CHIVA theory

CHIVA is a conception comprising, on the one hand, evidenced hemodynamic elements; it opposed the generally acknowledged theory of incompetent calf perforators; it termed calf perforators ***"re-entry points"*** of venous reflux irrespective of their size, in contrast to ***escapes points*** according to the theory of incompetent calf perforators; it stressed the effectiveness of saphenous reflux interruption at the sapheno-femoral junction.

In this regard, it represented a progressive contribution as it opposed the generally accepted false opinions prevailing at that time. But on the other hand, it encompasses subjectively contrived ideas and perceptions that do not reflect or are 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 remnant in the thigh after high ligation.

Furthermore, it 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; this all adds to unnecessary complexity and to additional confusion.

Ultimately, CHIVA does not take into account some proven evidences, such as ambulatory venous hypertension, ambulatory pressure gradient.

The term ***fractioning of hydrostatic pressure*** is a pure invention. Hydrostatic pressure exerts its effect in the ***quiet standing position*** and has the same value before CHIVA treatment as after the procedure. ***High ligation or any other ligation along the incompetent GSV does not fractionate the hydrostatic pressure***; *it just precludes reflux in incompetent GSV or its tributaries and counteracts in this way the development of ambulatory venous hypertension during calf pump activity.*

When we are speaking about reflux, we must define: where is the source (point with higher pressure); where is the issue (point with lower pressure); where is the reflux carrying conduit connecting both points. The position of the two pressure points determines the flow direction.

The ***physiological flow direction*** in the venous system is ***centripetal:*** from the periphery to the heart. That does not mean that it must take always a straight way; the path can be winding. In the lower extremity, the point with higher pressure is situated more distally, the point with lower pressure more proximally (at rest, during calf muscle contraction).

Ambulatory pressure gradient arising during calf pump activity ***inverts*** the position of the two points: the point with higher pressure is now alternately situated more proximally (in the thigh), the point with lower pressure more distally (in the lower leg); the resulting flow direction in an incompetent vein connecting both pressure points is ***centrifugal;*** it is a ***pathological flow***; it is a ***reflux***. We must realize that this

pathological centrifugal flow produces ambulatory venous hypertension, the degree of which depends on reflux intensity. Drainage of venous blood from the thigh veins into the lower leg veins does not exist under physiological conditions; competent valves preclude it.

CHIVA does not proceed on the assumption that the venous flow direction is determined by physiologically changing pressure gradients. It defines the physiological direction of venous flow as a ***flow respecting the hierachy of the physiologic drainage N3>N2>N1, i.e. from superficial into deep veins.***

Thus, according to the CHIVA theory, the drainage through the preserved incompetent great saphenous remnant after high ligation is considered to be a physiological situation, a favourable phenomenon because it respects the hierarchy of venous drainage from superficial into deep veins; in reality, this is a pathological reflux.

The CHIVA theory does not take into account that the pathophysiological function of the deep lower leg veins is quite different from that one of the deep thigh veins. High ligation, which is the most effective therapeutic component of the CHIVA procedure, abolishes saphenous reflux, removes the hemodynamic disturbance, and restores physiological decrease in pressure in the lower leg veins during calf pump activity; in contrast to that, the ambulatory pressure in the thigh veins remains unaffected.

Unfortunately, the excellent immediate result deteriorates progressively during the follow-up due to recurrent reflux. The CHIVA theory disregards the fact that, once the saphenous reflux has been abolished, new connections develop in the course of time between deep thigh or iliac veins and superficial veins in the thigh and provide new escape points for recurrent reflux.

Thus, the centrifugal flow in the saphenous remnant is the consequence, let's use the CHIVA terminology, of newly developed (closed) shunts; the incompetent GSV remnant in the thigh constitutes the main route for recurrent reflux.

The hemodynamic situation a few years after CHIVA differs from that one before CHIVA just in a lower level of reflux intensity causing recurrent hemodynamic disorder. Air plethysmographic evaluation performed by Zamboni, himself a CHIVA proponent, showed that the original value of reflux intensity before CHIVA treatment was 5.4 ml/s; 6 months after CHIVA it improved to 2.9 ml/s, but 3 years after CHIVA the intensity of recurrent reflux was 5.0 ml/s, i.e. nearly the same as before treatment, documenting in this manner the hemodynamic failure of the CHIVA method.

Varicose vein disease embodies a surprising and astonishing run of events: abolition of saphenous reflux removes the hemodynamic disorder, but simultaneously it creates hemodynamic preconditions for development of recurrent reflux. This phenomenon starting the same trouble while fixing the problem has been called ***hemodynamic paradox***.

CHIVA takes the centrifugal into the deep lower leg veins oriented, although reflux-carrying flow for a beneficial draining phenomenon because it abides by the

"hierarchy of the physiological drainage"; actually, as mentioned above, it is reflux, a harmful phenomenon producing ambulatory venous hypertension.

On the other hand, the systolic centripetal flow evoked by higher pressure in deep lower leg veins and lower pressure in superficial lower leg veins, streaming within calf perforators into the GSV and further via femoral vein toward the heart is regarded a reflux because the flow direction at the beginning is oriented from deep into superficial veins, i.e. it runs afoul of the "physiological drainage" *N3>N2>N1*.

In reality, this systolic flow is a physiological centripetal double-barrelled streaming toward the heart through both the popliteal/femoral vein and the GSV. Thus, according to CHIVA theory of the "physiological drainage" *N3>N2>N,* the ***harmful centrifugal*** streaming is referred to be a physiological phenomenon, whereas the ***physiological centripetal*** streaming is referred as reflux.

Articles claiming lesser recurrence rate after CHIVA than after ablative methods are misleading and at odds with the reality because they do not include the "drainage" in the preserved incompetent saphenous remnant, in reality recurrent reflux, into the recurrence rate; if this "drainage" had been included, the recurrence rate would have exceeded 80% in a few years of follow-up.

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 remnant; after ablative procedures, new superficial reflux carrying channels must first develop (in CHIVA terminology "vicarious circulation").

Principally, the results after CHIVA were not assessed by air- or strain gauge plethysmography, which are quite suitable methods enabling evaluation of the degree of the hemodynamic disorders caused by reflux or recurrent reflux; the exception was the article by Zamboni et al.

Consequently, the presented results after CHIVA do not objectively reflect the real situation. Therapeutic results after CHIVA comply with those after sheer crossectomy; the main therapeutic effect is namely achieved by abolition of saphenous reflux at the sapheno-femoral junction. Other therapeutic measures do not ameliorate this effect. For example: additional stripping does not improve the **immediate** hemodynamic benefit achieved by interruption of saphenous reflux at the SFJ.

Thus, the CHIVA theory diverges in several points from the reality.

This evaluation does not aim to discredit the CHIVA procedure; it intends, based on proven evidences, to present objective assessment of the CHIVA theory and to prevent overestimating the effectivity of this method.

Curiously, according to the survey among 675 surgeons of the French speaking Vascular Surgery Society performed 2003 by Perrin, only 0.3% of surgeons performed CHIVA.