CHIVA strategy in chronic venous disease treatment: instructions for users

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Key words: CHIVA, chronic venous disease, Doppler ultrasound, great saphenous vein, vascular surgery.

ABSTRACT

Along the years scientific clinical data have been collected concerning the possible saphenous flow restoration without any ablation and according with the CHIVA strategy. Moreover, in 2013 a Cochrane review highlighted the smaller recurrence risk following a CHIVA strategy rather than a saphenous stripping.

Nevertheless, the saphenous sparing strategy surely remains a not so worldwide spread and accepted therapeutic option, also because considered not so immediate and easy to perform.

Aim of this paper is to provide an easily accessible guide to a everyday use of a saphenous sparing strategy for chronic venous disease, highlighting how even apparently too complicated reflux patterns classifications can be fastly and successfully managed and exploited for a haemodynamic correction.

INTRODUCTION

CHIVA is an acronym standing for Haemodynamic Correction of Venous Insufficiency in an office-based setting.

This strategy was first proposed by Franceschi in the late eighties,[1,2] presenting a charming, though debated, saphenous sparing therapeutic approach to chronic venous disease (CVD).

The rationale is to avoid a saphenous ablation because of the literature evidence, demonstrating that most of the time the reflux in this vessel is actually originated by an energy gradient that is not caused by a pathological alteration of the saphenous vein itself.[1-7]

Along the years scientific clinical data have been collected concerning the possible saphenous flow restoration without any ablation and according with the CHIVA strategy.[1-20] Moreover, in 2013 a Cochrane review highlighted the smaller recurrence risk following a CHIVA strategy rather than a saphenous stripping.[21]

Nevertheless, the saphenous sparing strategy surely remains a not so worldwide spread and accepted therapeutic option, mainly for three different reasons: diagnostic, evidence base and health economic issues.

As demonstrated by Pares, an accurate sonographic assessment prior to whatever venous procedure is mandatory just in case of a vessel function restoration. If the therapeutic strategy is aimed to the vein abolition, it is more than enough to know if there is a refluxing flow or not.[15] An old pocket Doppler could be all the needed diagnostic instrumentation in the latter case.

To the contrary, in order to perform a haemodynamic restoration of a refluxing venous network, an advanced sonographic skill is required, together with a not immediate learning curve, that must be addressed to develop an adequate experience in the several possible reflux patterns identification.

The “evidence based” issue constitutes the real Achille’s tendon of the strategy, together with a nomenclature of the different reflux patterns that was found not immediately worldwide understandable because of linguistic misunderstandings.

Several randomized comparative trials have scientifically demonstrated how CHIVA is the only therapeutic option offering a 10 years follow up outcome superiority versus the ablative solution,[14] showing also a significant impact in the venous ulcer management.[11]

Neverhteless, objective measures, like the one provided by plethysmography for example, have been very rarely published in CHIVA support.[18]

At last, the health economic issue rises from a not worldwide reimbursement interest in covering minimally invasive procedures that do not imply a saphenous trunk abolition. In the Authors opinion, this aspect should be corrected, considering that a disease treatment is not the mere manual act, but rather a complex process that include a diagnostic effort, that, in case of a venous preservation, is considerably more time-consuming and higher in required skills whenever compared with a simple vessel elimination.

Aim of this paper is to provide an easily accessible guide to a everyday use of a saphenous sparing strategy for chronic venous disease, highlighting how even apparently too complicated reflux patterns classifications can be fastly and successfully managed and exploited for a haemodynamic correction.

According to the literature, this diagnostic and therapeutic approach is expected to provide better clinical outcomes.

Applying the herein proposed diagnostic and therapeutic protocol means to significantly reduce the risk of clinical failure that could be potentially caused by a not enough CHIVA expert phlebologist.[16]

Moreover, it could encourage more physicians around the world to give CHIVA a try, collecting those objective measures that could finally clarify the exact pathophysiological model of the lower limb venous haemodynamics, together with a health economic evaluation of the most convenient form of reimbursement.

DIAGNOSTIC ASSESSMENT

The shunt concept

Since several refluxing paths can be created along the superficial venous system, a specific classification of these anomalous patterns has been proposed and based on the so-called "shunt concept". [1,2]

A "shunt" is defined as a venous pathway carrying not only the physiologically drainage, but also the pathologically deviated blood. Anatomically and hemodynamically, it starts in a refluxing (or escaping) point (EP) and terminates in the so-called re-entry point (RP).

For example, an incompetent sapheno-femoral junction can be the EP of a reflux involving the saphenous trunk, so dilating it and making it incompetent. At the same time, a leg perforating vein that is focused on the saphenous trunk could eventually drain the same refluxing blood into the deep venous system, so re-establishing the physiological hierarchical order of emptying from the most superficial to the deepest compartments, so constituting the shunt RP (fig. 1).

Three main shunt networks are described: closed (CS), open by-passing shunts (OBS)(also known as open vicarious shunts), open deviated (ODS) shunts.

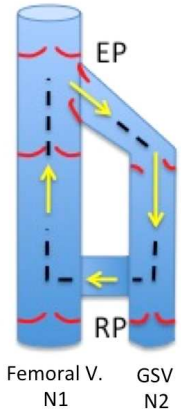

Fig. 1 Closed shunt*: it is a refluxing pattern constituting a vicious re-circulation. In this example an incompetent sapheno-femoral junction represents the EP, pathologically shunting the blood from the deep venous system (N1) to the*

saphenous system (N2). A leg perforating vein constitutes the RP, draining the reflux back into the deep venous system.

In ***closed shunts*** (CS) (Fig. 1) a vicious circle is created between the EP and the RP. The deviated flow re-circulates at each energy gradient inversion like in a close circuit. The energy gradient inversion is created every time a calf muscle systole is followed by the muscular relaxation (diastole), which means at every footstep.

A classical example is an incompetent sapheno-femoral junction (EP) shunting the deep venous system blood (so called N1 compartment) down along the saphenous trunk (N2 compartment).

A leg perforating vein that is focused on the saphenous trunk can represent the shunt RP, draining the refluxing blood back into the deep venous system. During the diastolic phase the same vicious circle will start again, so progressively overloading and enlarging the involved saphenous trunk.

In this way a close shunt will be established and a certain amount of blood will be excluded by the systemic venous network, because entrapped into the above described "private circulation". It becomes evident how a simple ligation of the EP will break the vicious recirculation, allowing the saphenous blood to drain into the RP, without be overloaded anymore by the diastolic femoral reflux.

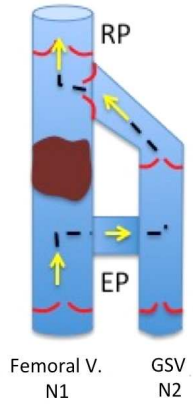

Fig. 2 Open by-passing shunt*: In case of a drainage obstacle, like a thrombosis of the femoral vein as herein depicted, the venous blood shunts in a "para-physiological" pattern, aimed to preserve the same limb drainage. In this example a perforating vein allows an inverted flow (from the deepest toward the more superficial compartment, from N1 toward N2), so overloading the saphenous trunk while by-passing the obstacle. The anomalous pathway re-enter into N1 by means of the sapheno-femoral junction, that, in this example, becomes the RP.*

An ***open by-passing shunt*** (OBS) (Fig. 2) is a natural bypass, exploited by the venous network to go over an obstacle.

In this type of shunt there is no re-circulation and it may be either antegrade or retrograde.

The use of a collateral route to by-pass what is usually a thrombotic occlusion is desirable, as it reduces the drainage resistance. For this reason, CHIVA strategy do not surgically treat this type of shunts, suggesting just a short follow-up sonographic monitoring, in order to detect eventual changes in the reflux pattern. A typical OBS example can be found in the so-called "spontaneous Palma", where a deep venous system occlusion at the inguinal region opens a collateral hypogastric network that is aimed to by-pass the obstacle draining into the contralateral limb.

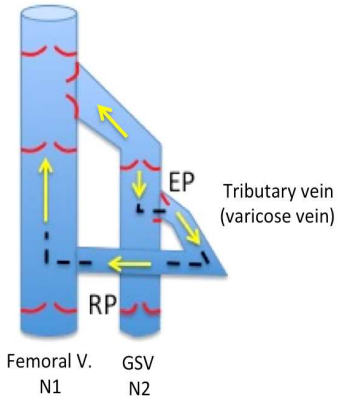

Fig. 3 Open deviated shunt (ODS): *this shunt type is generated whenever the refluxing blood shunts into the more superficial compartment (from N2 toward N3, the saphenous tributary compartment). The same saphenous tributary presents its own RP, in the form of a perforating vein directly connecting N3 to N1. In this way no re-circulation occurs.*

An ***open deviated shunt*** (ODS) (Fig. 3) is a flow diversion into an incompetent vein caused by a reversed energy gradient, that is usually generated during a muscular pump diastole.

The blood overload is directed to a re-entry perforator which drains directly into a network not linked to the escape point one: no recirculation occurs.

A typical example is an incompetent saphenous tributary endowed with a re-entry perforator draining into the deep venous system: the blood overload will "jump" from N2 to the saphenous tributary (N3 compartment) and then will flow down directly into N1.

In the end, a combination of CS and OBS is a possibility that is defined as "***mixed shunt***".

In this pattern the two shunt types share the same EP and part of their refluxing pattern toward the corresponding different RP. [2]

The shunt classification

Inside CS, ODS and OBS, CHIVA strategy identifies different type patterns, according both to the compartment jumps and to the location of the RP.

To the best of our knowledge, there is a lack in the literature concerning the epidemiology of the different shunt types. Only in Franceschi's CHIVA textbook it is reported how more than 90% of the superficial venous system refluxes belong to the so-called type 1 or 3 shunt.[1,2]

In ***type 1 shunt*** (Fig 4a) the EP allows a reflux from N1 to N2 compartment, eventually interesting also N3. The main characteristic of this shunt type is the presence of a RP focused on the saphenous trunk (N2), so aspirating the shunted blood back into the deep venous compartment.

Being a close shunt, after the systolic push, the blood in a type 1 shunt will reflux again through the EP during the diastolic phase.

In case of a co-existing N3 refluxing tributary, the refluxing pattern is named Type 1+N3 shunt. [1,2]

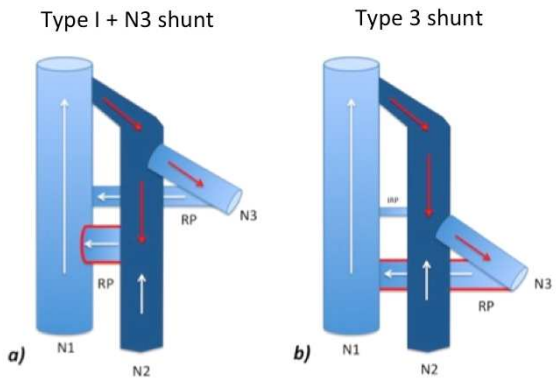

***Fig.4*: a)** *Type 1 + N3 shunt (main RP focused on the saphenous vein). Differently from a Type 1 shunt an incompetent N3 tributary coexists, presenting its own RP that directly connect N3 to N1* **b)** *Type 3 shunt (RP focused on the incompetent N3 tributary).*

Type 3 shunt (Fig.4b) is mainly characterized by the absence of a RP along the N2 compartment.

The pathological flow is directed from N1 to N2 and then to N3. The difference with the Type 1 (or with the Type 1+N3 shunt) is just the absence of an efficient RP along the saphenous vein.

The blood re-enters into the N1 compartment by a RP focused on the N3, then re-establishing the CS by escaping once again from the N1-N2 leaking point.

As below reported, the presence/absence of an efficient RP along the saphenous trunk is a main factor to be taken into consideration whenever choosing the adequate CHIVA strategy. In case of a saphenous trunk RP absence, an interruption of the N1-N2 leaking point would lead to a not draining venous system, because of the energy gradient suppression (see therapeutic strategy chapter).

In ***type 2 shunt*** (Fig.5a) the leaking point is only from N2 to N3, with a re-entry perforator focused on the same incompetent tributary and draining toward N1. In this pattern no recirculation is created, so establishing an ODS. Nevertheless, a more rare type 2 shunt variant is constituted by a N2 pathological jump toward a collateral which drains back into the saphenous system again, so establishing a CS, running from N2 to N3 and then re-entering into N2 (Fig.5b).

In Type 2 shunts a simple interruption of the leaking point is able to remove the haemodynamic overload of the ODS or to avoid the CS recirculation.

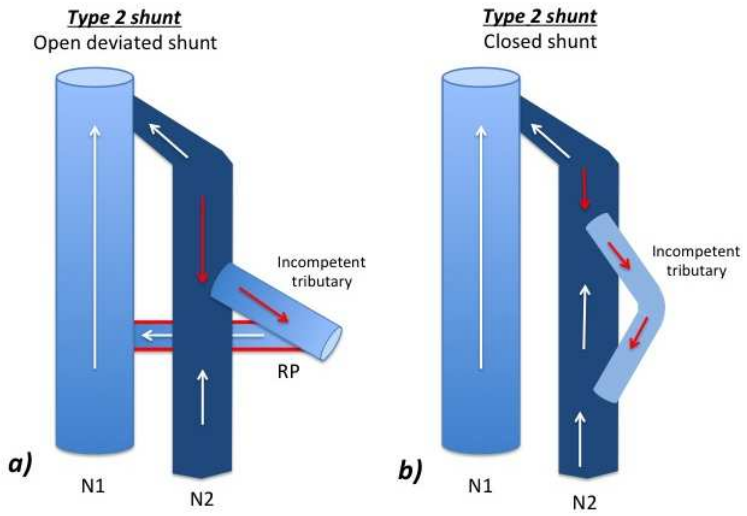

Fig.5: ***a)*** *Type 2 shunt: it is characterized by a N2-N3 pathological compartment jump, with a RP that is focused along the same incompetent tributary, so draining into the N1 network. No recirculation occurs and an ODS is formed.* ***b)*** *Type 2 shunt can also create a CS, whenever exhibiting a N2-N3 jump, draining back into the same saphenous trunk. In this case recirculation occurs.*

The shunt type classification includes also other three kinds of compartment jumps, but being them morerare, both their hemodyanamic and strategic correction descriptions are left to more specifically addressed textbooks.[2]

THERAPEUTIC STRATEGY

CHIVA strategy is performed by means of minimally invasive flush ligations and high ties that are addressed to restore the physiological order of emptying from the most superficial to the deepest venous networks.

The type of procedure is strictly dependent on the shunt type to be previously assessed at the haemodynamic echo-color-Doppler evaluation (ECD), so constituting a tailored on the specific patient reflux pattern. For this reason the Authors recommend to perform the ECD once again on the same procedural day, possibly having the operating surgeon as the assessor.

Two are the main surgical options: the so called CHIVA 1 or CHIVA 2 procedures.

CHIVA 1 is performed in case of a Type 1 or Type 1+N3 shunt. It is addressed to the interruption of the N1-N2 compartment jump, exploiting the RP that is focused along the saphenous trunk.

An eventually present incompetent tributary (Type 1+N3 shunt) can be flush ligated and let be drained by its own RP.

The name CHIVA 1 refers to the fact that the procedure is designed with both the high ligation and the eventually incompetent collaterals disconnection to be performed in *one* single shot (Fig. 6).

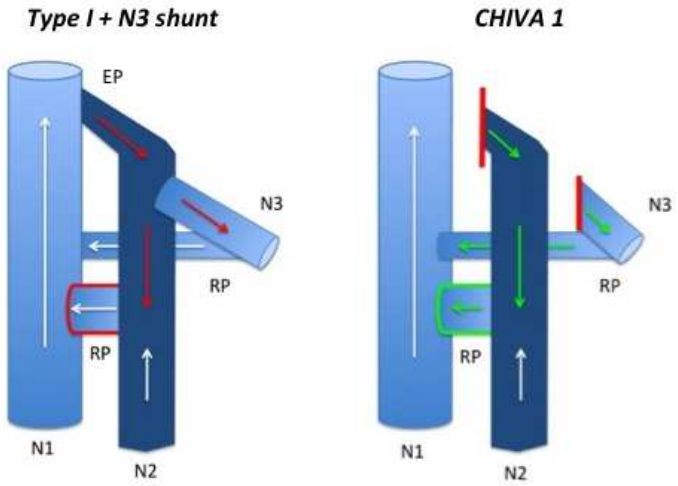

Fig.6: *Type 1 + N3 shunt and indicated hemodynamic correction strategy (CHIVA 1): under local anesthesia a high tie is performed to treat the N1-N2 leaking point.The previously refluxing saphenous trunk is still draining in a retrograde direction also after the procedure, but into the RP focused on the saphenous trunk. At the following muscular diastole, no recirculation will occur because of the EP interruption. In case of an incompetent saphenous tributary, this will be flush ligated during the same procedure and its flow will be aspirated by the same tributary RP directly into the N1 compartment.*

On the contrary, in ***type 3 shunts***, the lacking of a valid RP focused on the saphenous trunk, prohibits the high ligation in the first step approach. In fact, performing a CHIVA

1 procedure in a type 3 shunt would lead to a venous stasis, because of no energy gradient aspirating the saphenous blood column. The hydrostatic and lateral pressure inside the saphenous trunk would increase according to the Bernoulli Theorem, dilation would raise rather than diminish. A high risk of saphenous thrombosis would occur (Fig.7).

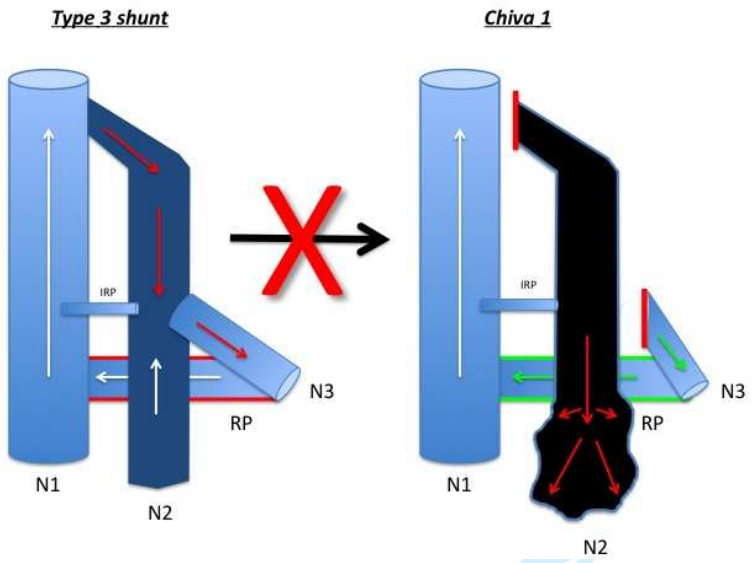

Fig.7: *Incorrect indication to a CHIVA 1 procedure in a type 3 shunt. An inefficient re-entry perforator (IRP) along the saphenous trunk impedes a proper drainage, so leading to stasis and thus to a high thrombotic risk. On the contrary, the incompetent N3 tributary can efficiently drain into its own RP after its disconnection from the N2 network.*

The right strategy for this hemodynamic pattern is the ***CHIVA 2 procedure***, so-called because designed in two surgical steps.

In ***CHIVA 2 first step***, a simple flush ligation of the incompetent collaterals is performed (Fig.8).

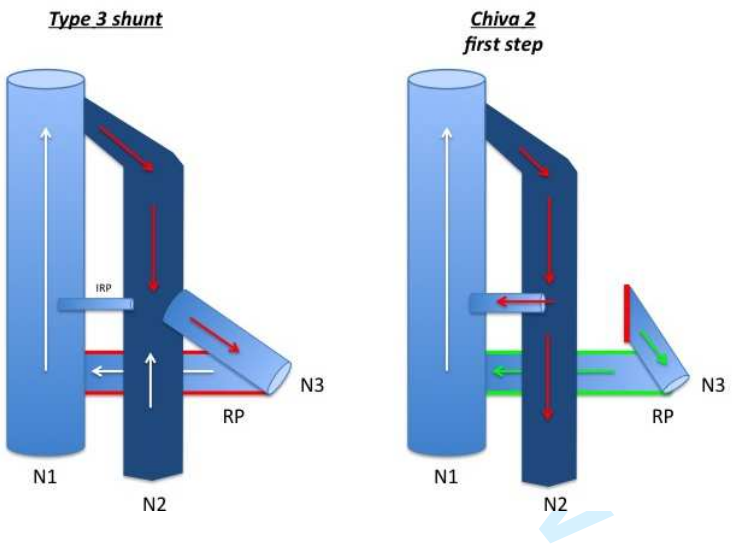

Fig.8: *First step of CHIVA 2 procedure for type 3 shunt. A simple flush ligation of the incompetent N3 tributary is performed. IRP: inefficient re-entry perforator.*

Considering the ***type 2 shunt*** compartment jump (from N2 to N3), it becomes obvious how CHIVA 2 first step represents the correct indication also for this kind of reflux treatment. No further procedures are to be planned in a type 2 shunt (Fig.9,10).

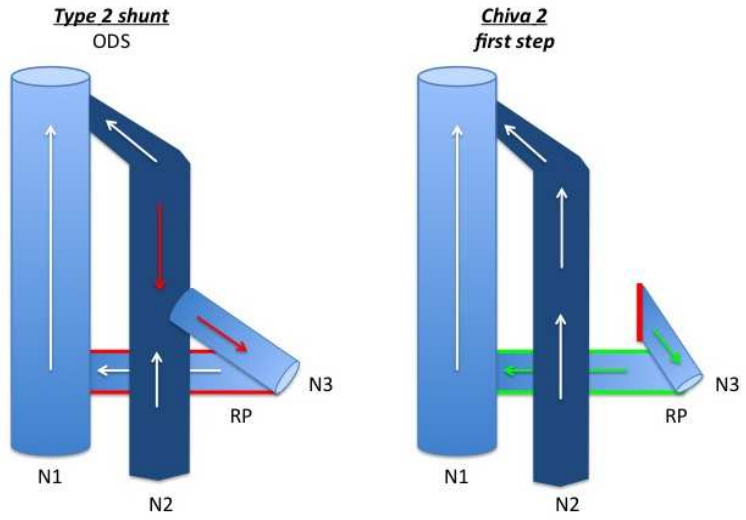

Fig.9: *First step of CHIVA 2 procedure for type 2 open deviated shunt.*

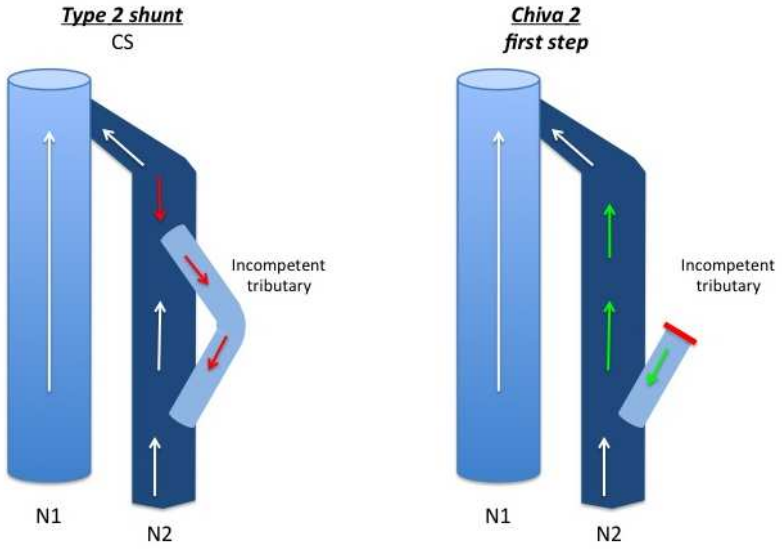

***Fig.10**: First step of CHIVA 2 procedure for type 2 closed shunt.*

On the contrary, after the first step in a ***type 3 shunt***, a pathological saphenous reflux can remain into the hemodynamic project, until it will enlarge a previously inefficient perforator focused on N2. Whenever the above quoted perforator will reach a proper caliber and aspirating property, a closed shunt will be formed among N1 and N2 networks, transforming the type 3 shunt in a type 1 shunt, thus allowing the ***second step of CHIVA 2 procedure***, which simply coincides with a CHIVA 1 procedure (high ligation)(Fig.11).

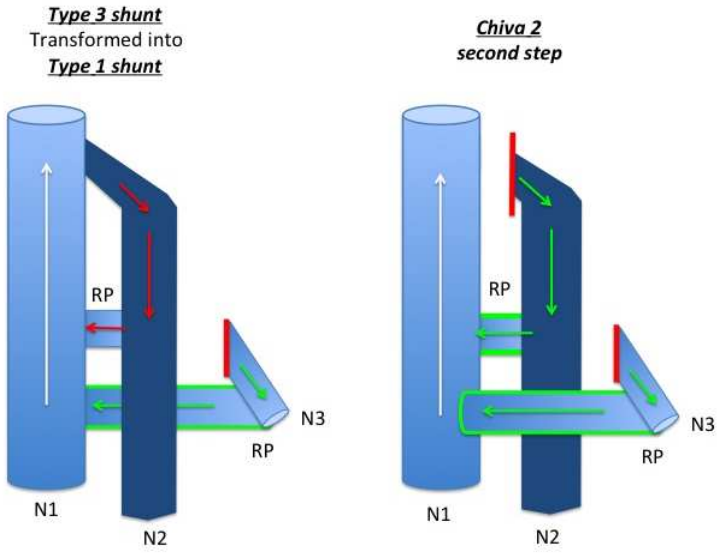

Fig.11: *Type 3 shunt being transformed into a type 1 shunt by the first step of a CHIVA 2 procedure and then treated by a CHIVA 2 second step intervention (equal to CHIVA 1).*

In case the saphenous reflux was fed just by a vessel dilation linked to the N3 aspiration, the N2 valves will recover their functionality thanks to the saphenous calibre reduction, thus avoiding the necessity of a second step (Fig.12).

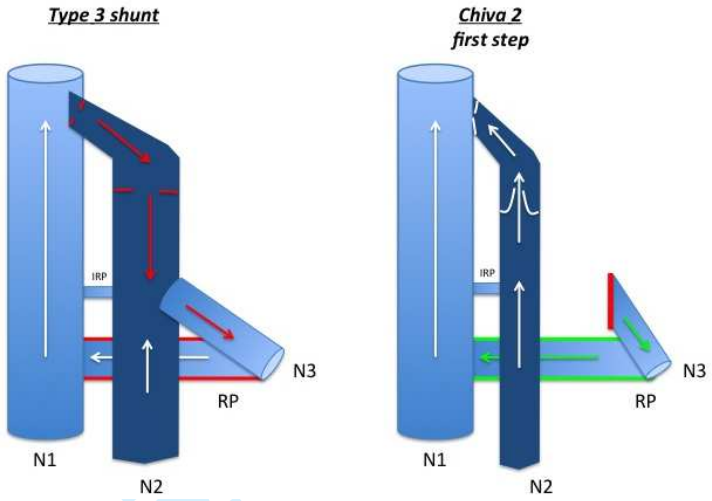

***Fig.12**: Saphenous vein caliber reduction following a CHIVA 2 first step, with consequent valve leaflets regained functionality and drainage restoration.*

A simple but really effective sonographic test is able to identify the presence of a valid RP focused on the saphenous vein: the ***Reflux Elimination Test***.[2]

A digit compression of the incompetent tributaries will eliminate the aspiration effect provoked by the re-entry perforators focused on N3 (Fig.13).

The Doppler must be placed cranially to the investigated saphenous RP. If the evoked sapheonus reflux will be eliminated by the N3 escape points compression, the energy gradient addressed to the blood column aspiration through that RP must be considered inefficient. Consequently, it will be mandatory to avoid the high ligation in a single step procedure (CHIVA 1), since dealing with a type 3 shunt. The correct indication will be a first step of CHIVA 2 procedure.

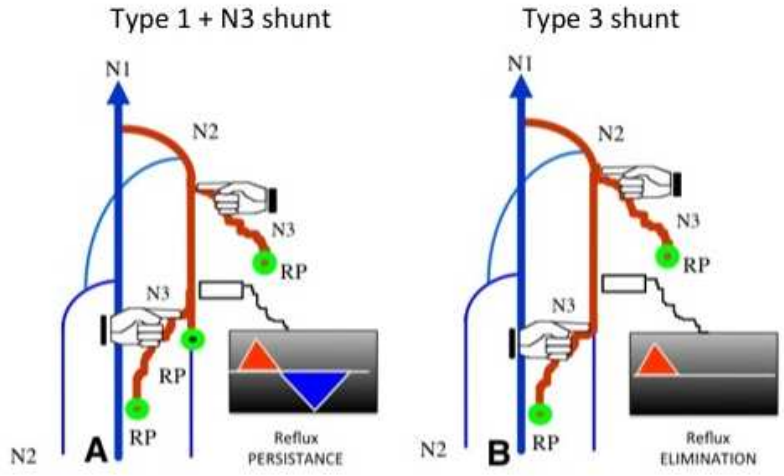

Fig.13: *Reflux elimination test. A simple digit compression of the incompetent tributary that is endowed with its own RP will permit to discriminate among a type 1 + N3 and a type 3 shunt. In case of saphenous reflux persistence at the digit compression, a RP must be keeping the energy gradient present, thus indicating the perforating vein along the not compressed saphenous trunk (type I + N3 shunt). In case of reflux disappearance at the finger compression, the RP must be expected along the same N3 tributary (thus a Type 3 shunt), being excluded by the finger compression, so temporarily eliminating the energy gradient.*

Hybrid techniques

In specific reflux patterns, the CHIVA strategy can be also performed by means of hybrid tecniques. This is the case for example of N1-N2 compartment jumps arising not from an incompetent sapheno-femoral junction, but rather by an incompetent hunterian perforating vein, feeding a Type 1 + N3 shunt.(Fig. 14).

A flush ligation of the incompetent Hunterian perforating vein would require a too big skin incision nowadays. A mini-access is herein proposed, aimed to the saphenous trunk isolation at the perforating vein confluence. Once the latter is flush disconnected, the remaining perforating vein tract is easily treated by an intraluminal injection of foam sclerotherapy while twisting the same vessel. During the same procedure, a flush ligation of the incompetent N3 tributary can be performed according to the traditional CHIVA strategy.

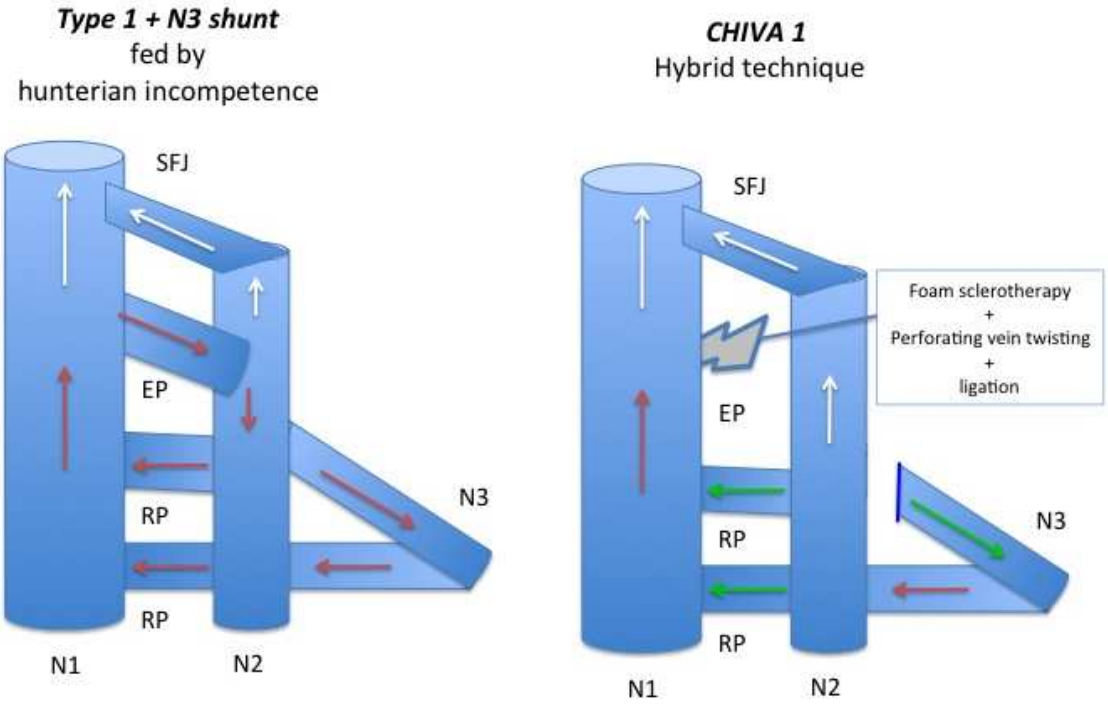

Fig.14: *Type 1+N3 shunt, fed by an EP coming out from an incompetent hunterian perforating vein.In order to minimize the incision length, a mini skin access is performed in correspondence of the hunterian perforating vein confluence with the saphenous trunk. After its flush ligation, an intraoperative endovenous foam sclerotherapy is directly performed inside the perforating vein lumen, while twisting it. In this way all the remain leaking vein is treated, avoiding a deeper and wider*

dissection to obtain a flush ligation on the femoral vein. A traditional CHIVA strategy is then applied to treat the coexisting N3 incompetent tributary.

CHIVA strategy in case of recurrences

A very interesting CHIVA strategy feature is the chance to treat recurrences by means of the same strategy.

A recurrence can originate from a reunion of the two previously separated stumps (the saphenous trunk and the femoral/popliteal vein in case of a high-ligation or of a sapheno-popliteal ligation, the saphenous trunk and its tributary in case of an incompetent N3 branch).

A reflux re-appearance can come out also from a new N1-N2 or N2-N3 leaking point (Fig. 15).

In all these cases a CHIVA strategy can be applied according to the indications that were above reported.

The only technical difference in case of an high-ligation in a recurrent sapheno-femoral reflux is the identification and isolation of the junction dissecting from the femoral vein downward, instead that from the saphenous trunk upward. In this way it is possible to avoid all the post-operative scars that were created following the first high-ligation, according to the procedure named Li's operation (Fig. 16).

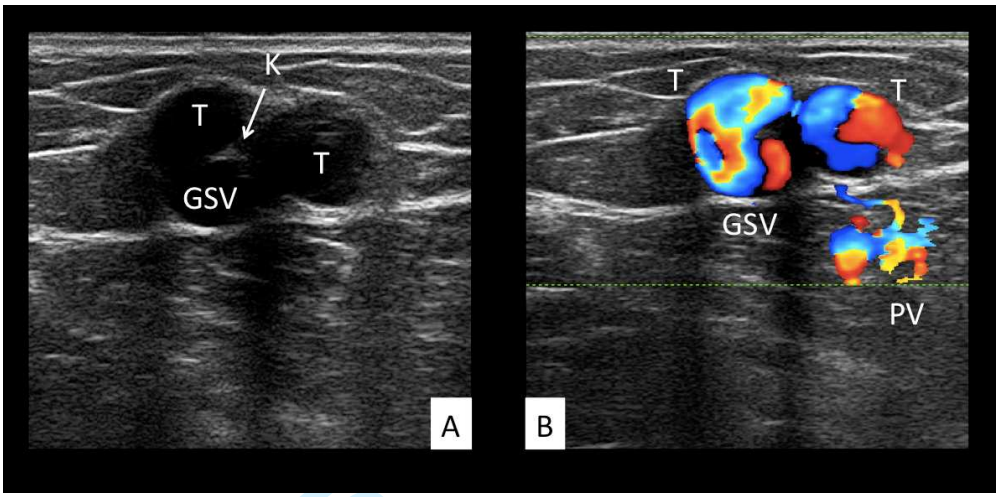

Fig. 15 Recurrent N2-N3 leaking point*: A) a previously flush ligated N2-N3 leaking point recurred. The previous ligature knot (K) is clearly detectable by echo-color-Doppler, together with the saphenous trunk (GSV) and the recurrent incompetent tributary (T). B) Colour evidence of the recurrent leaking point, together with the appearance of a perforating vein (PV) not properly draining.*

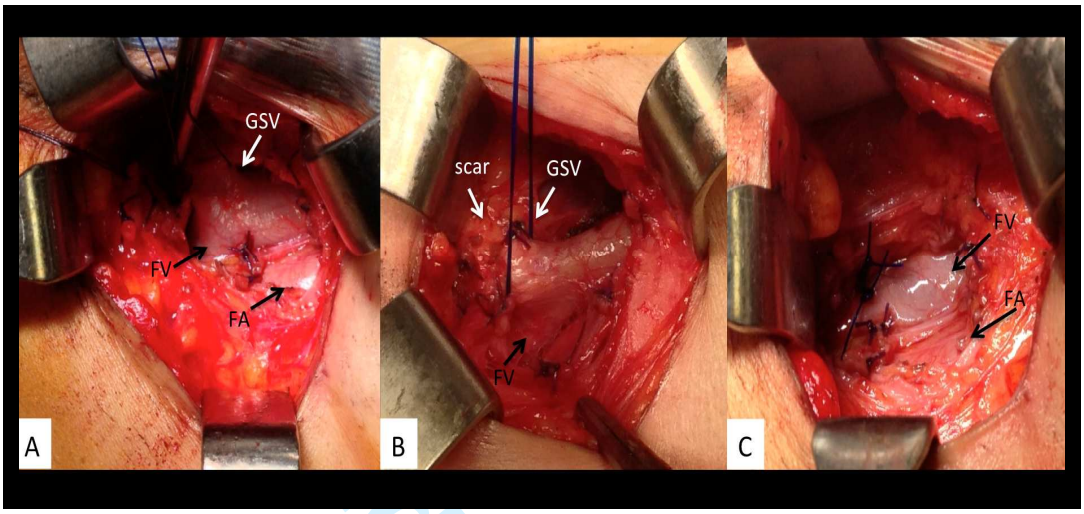

Fig. 16 Li's procedure*: A) identification of the femoral artery that by the arterial pulse guide the identification and isolation of the femoral vein above the recurrent sapheno-femoral junction. B) Isolation of the recurrent sapheno-femoral junction underneath the scar that was created following the previous high ligation. C) High tie with a flush ligation on the femoral vein. FV: femoral vein. FA: femoral artery. GSV: great saphenous vein*

TECHNICAL NOTES

Deep venous system assessment

Following the ECD diagnostic protocol, the first step is to verify that the deep venous system presents neither obstruction nor refluxes.

Subsequenlty, it is mandatory to test the iliac valve competence.

To do so, a simple Valsalva manoeuver while scanning the femoral vein above the sapheno-femoral junction (SFJ) will be indicative of the hydrostatic column overloading the same junction (Fig. 17). It is evident how an iliac valve absence/incompetence will increase the reflux risk risk along the SFJ.

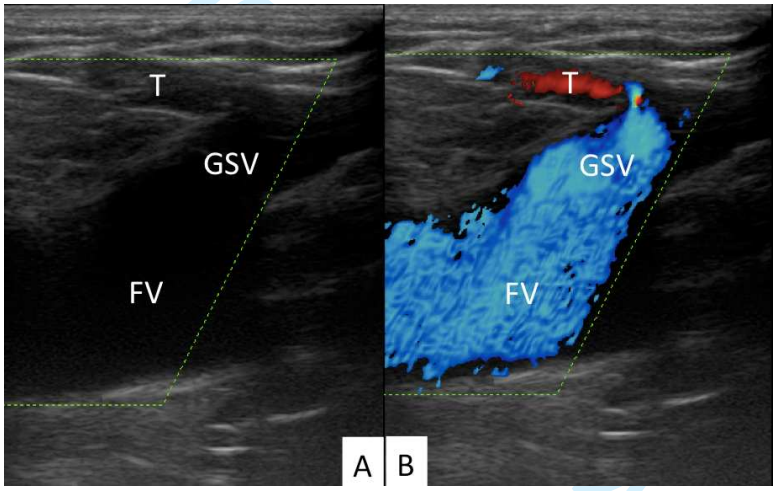

Fig. 17 Iliac valve competence scanning*: A) longitudinal section of the iliac vein just above the SFJ B) Valsalva manoeuver release in a competent iliac valve case: the color (the flow) appears just during the release phase, not during the systolic push. This is an indirect sign of valve competence. In case of incompetence, the colour*

would appear also during the systolic Valsalva push, so pointing out an incompetence/agenesia of the iliac valve.

Sapheno-femoral and sapheno-popliteal junction competence assessment

Both in CHIVA 1 and in CHIVA 2 second step, the indication to a junction ligation is a crucial moment in which an inadequate diagnostic assessment could ruin the entire haemodynamic correction.

The SFJ must be evaluated placing the sample volume on the femoral side of the terminal valve, performing both a Valsalva (VAL) and a compression/relaxation (CR) manoeuver.[7] Only in case of both the manoeuvers positivity the junction can be considered incompetent (Fig. 18).

In the same way, the sapheno-popliteal junction must be assessed both by active (Paranà) and passive (CR) manoeuvers, whose positivity must be contemporaneously present to diagnose a true junctional incompetence (Fig. 18).

In order to minimize the risk of venous stasis, the sapheno-femoral junction tributaries (superficial epigastric vein, external pudendal vein, superficial circumflex vein) and the Giacomini's vein should be spared during the sapheno-femoral and sapheno-popliteal disconnection, respectively. Moreover, the maximum cure should be placed in performing ligations without long stumps on

the femoral and popliteal side, in order to reduce the risk of recanalization and recurrence.

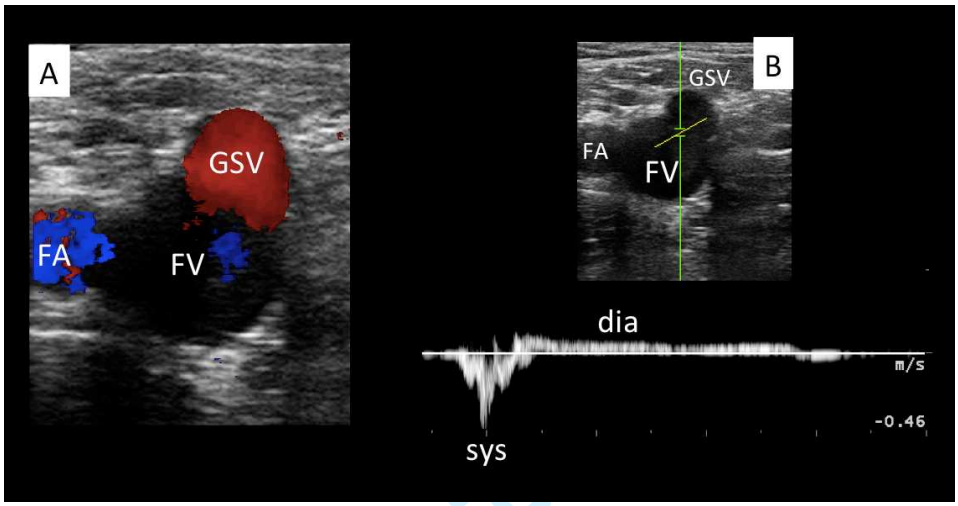

Fig. 18 Sapheno-femoral junction incompetence A) *Colour-mode evidence of a sapheno-femoral reflux during the diastolic phase.* ***B)*** *PW reflux detection. According to the literature,[7] it's mandatory to place the sample volume on the femoral side of the terminal valve.*

FA, FV and GSV transverse section form the so-called Miky-mouse image, a correct point of assessment for SFJ competence assessment

FA: femoral artery. FV femoral vein. GSV: great saphenous vein. Sys: muscular systole. Dia: muscular diastole

Saphenous incompetent tributaries identification

The ECD assessment proceeds with the B mode, color and PW mode identification of the eventually presents saphenous incompetent tributaries.

These last ones sometimes are easily detected even only by the B-mode because of their bigger calibre whenever compared with the saphenous trunk below their origin (Fig. 19): a phenomenon that is due to a shunting effect regarding mainly the tributary itself, very probably endowed with a particularly efficient RP.

Color and PW mode will determine the real eventual reflux presence into the tributary.

As for the N1-N2 compartment jumps, also in case of saphenoustributary ligation (N2-N3 compartment jump) maximum attention must be paid in not leaving long stumps during the disconnection, in order to diminish the recanalization risk.

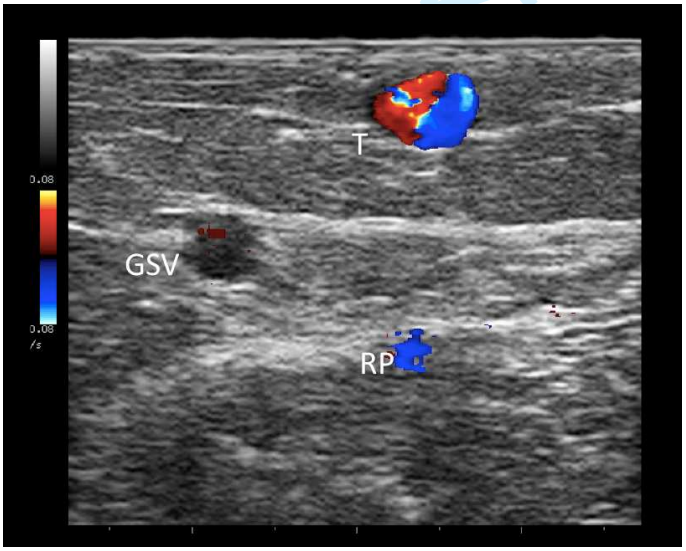

Fig. 19 Incompetent saphenous tributary scanning. *Colour-mode reflux detection into a saphenous tributary showing turbulence (Korean flag sign). The incompetent tributary (T) lies above the fascia (N3 compartment), presenting a significantly bigger calibre than the saphenous trunk (GSV)(N2 compartment) that is located underneath the same tributary outlet. A colour sign points out the presence of a re-entry perforator (RP)*

Re-entry point identification

Perforating veins have always represented an intriguing topic both in the diagnosis and in the treatment of CVD.[19,20]

Of course they can constitute the reflux origin (pathological perforating veins)(fig. 20) or, conversely, a re-entry point of the reflux itself (physiological function)(fig. 21).

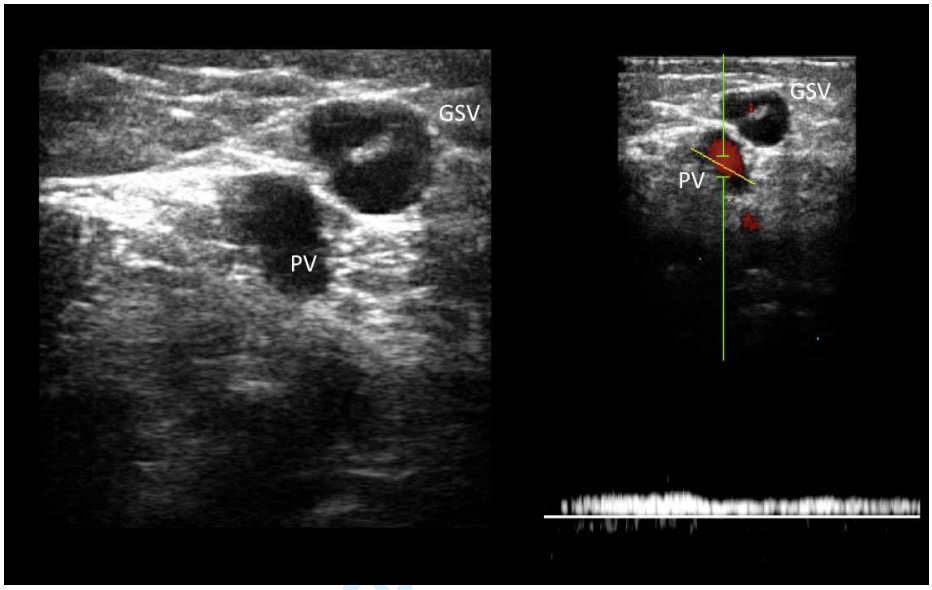

Fig. 20 Refluxing perforating vein*: a Hunterian perforating vein (PV) became incompetent, so originating a reflux from the deep venous system toward a saphenous vein (GSV) that was previously treated by a ligation. The consequent energy gradient has led to a recurrence that is clearly identified both by PW and color Doppler analysis.*

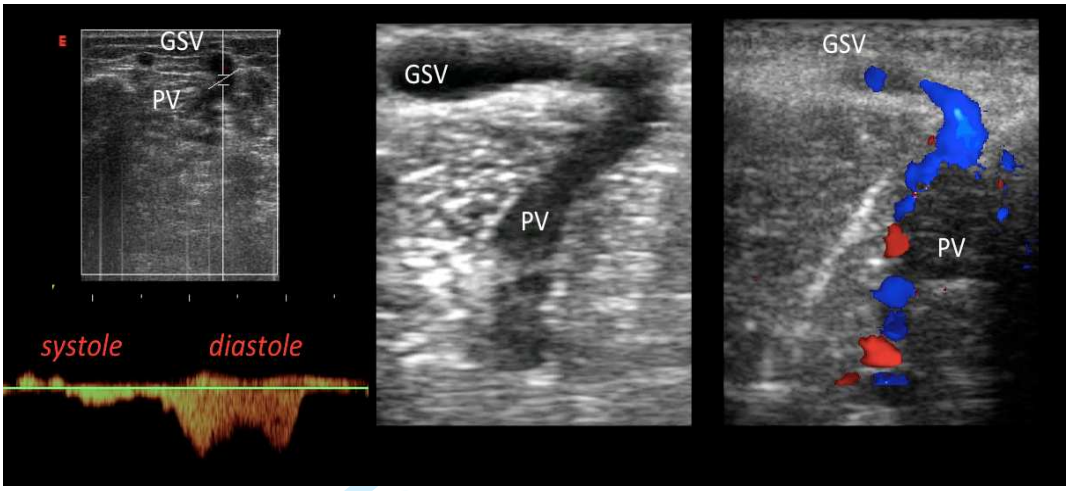

Fig. 21 Phsiological perforating vein*: a perforating vein (PV) that is focused on the great saphenous vein (GSV) trunk. It is mandatory to consider the net flow direction and not just the flow time. In the case herein reported the in-ward diastolic flow is clearly prevalent, thus, independently from its flow time, it can be considered physiological because draining from the more superficial compartment (the saphenous network) to the deepest one.*

Once the leaking points have been identified (N1-N2 and/or N2-N3 junctions), the RP must be found. Whenever there is a reflux, a RP must be expected: this is a consequence of the physical principle for which a flow, or a reflux, can exist only if an energetic gradient is present.[2]

This diagnostic step is fundamental: a mistake in the RP selection invariably leads to a not draining treated saphenous trunk, thus to a therapy failure.

The RP can be focused on the saphenous trunk and/or on the incompetent tributary. As above reported a simple reflux elimination test is able to discriminate among a type I (eventually +N3) and a type 3 shunt (Fig. 13, Fig. 22).

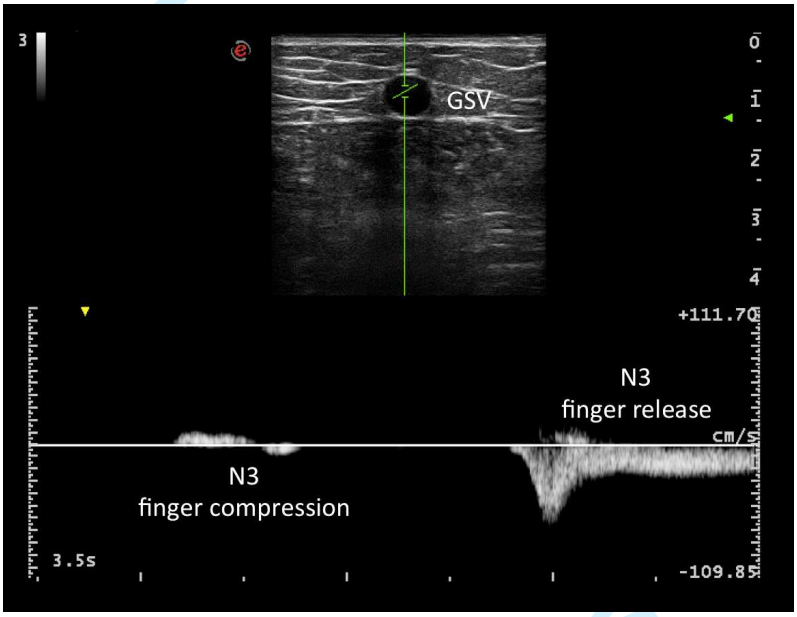

Fig. 22 Reflux elimination test *PW assessment of the great saphenous vein (GSV) above the outlet of an incompetent GSV tributary. Thanks to the reflux elimination test a simple finger compression of the incompetent tributary allows the localization of a valid re-entry perforator focused on the GSV or only on the incompetent tributary itself. In the herein reported specific case, during the finger compression of the incompetent tributary, carefully avoiding to compress also the GSV trunk, a flow*

is detected at the compression/relaxation manoeuver. This finding testify the presence of a re-entry perforator also along the GSV. In fact, the re-entry perforator presence is responsible of that energy gradient maintenance that allows the detected flow. In case of an absence of re-entry perforators along the GSV, no energy gradient exists, thus no flow is detected. At the finger release, the re-entry perforator focused on the incompetent tributary allow a bigger energy gradient, that is manifested by an increased flow appearance. According to the reflux elimination test, if a flow is detected at the compression/relaxation during the finger compression of the incompetent tributary, a valid re-entry perforator is focused on the GSV and thus a high ligation can be performed (CHIVA 1 procedure). If no flow is detected, the correct indication is just for a flush ligation of the incompetent tributary (CHIVA 2 first step), because of the risk of creating a not draining venous system, thus leading to possible thrombosis and not following the CHIVA principles.

Subsequently, a color-mode analysis of a B-mode visible perforating vein will show a prevalent inward flow during calf muscle diastole, so indicating the efficient RP (Fig. 21).

Melting together the ECD informations concerning the deep venous system, the iliac valve, the N1-N2 junctions competence, the eventually present incompetent tributary and the RP localization will easily provide the shunt type recognition, and thus the consequent therapeutic strategy (Fig. 23).

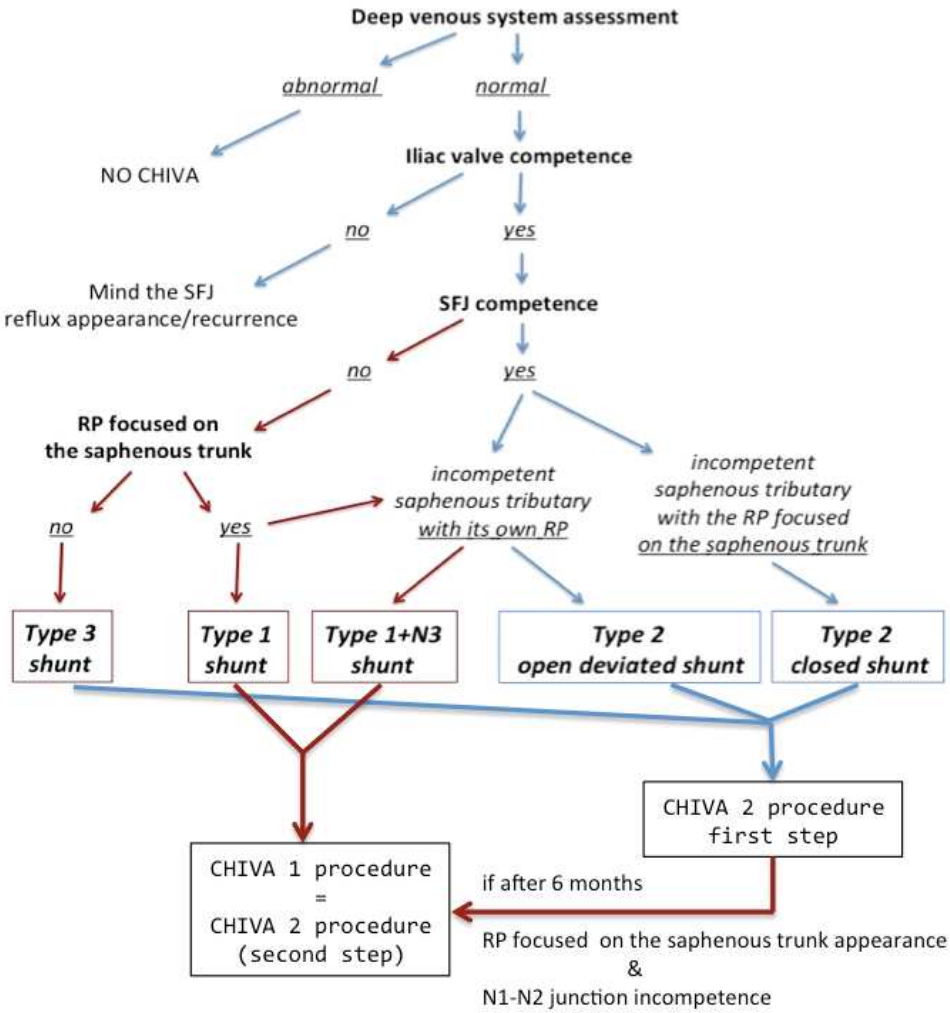

Fig. 23 *Shunt type identification flow chart, with corresponding surgical indications.*

CONCLUSIONS

CHIVA is a surgical strategy that is aimed to suppress the reflux escape points, restoring a draining venous system, by means of selective leaking points interruptions. This saphenous-sparing procedure is minimally invasive, accessible under local anesthesia, in an office-based setting.

It requires no particular devices, so representing also a highly cost-effective option.

The required surgical skills are minimal, as demonstrated by its successful use also by not surgical physicians. To the contrary the learning curve become consistent concerning the sonographic assessment, for which an adequate and meticulous training is mandatory.

The consequent diagnostic effort seems to be rewarded by a significant reduction in varicose veins recurrences following a haemodynamic rather than an ablative strategy.[21]

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