ACTA PHLEBOLOGICA

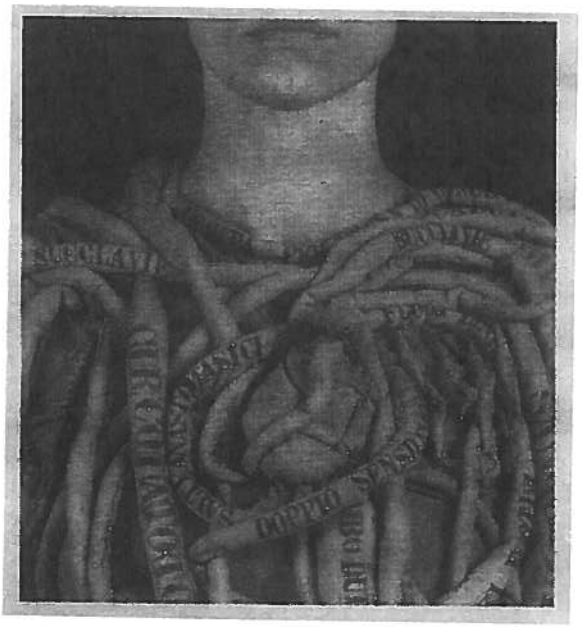
Volume 15 - No. 2 - August 2014

Official Journal of the Italian College of Phlebology

In this issue:

EDITORIAL
Crossectomy and recurrent varicose veins: positives and negatives
Allegra C.

THE ELOQUENCE OF SYMBOLS
Anatomy's celebration
Agus G. B.



REVIEWS
Update on the pharmacological treatment of chronic venous disease
Boucelma M.

Chronic venous ulceration of the lower limbs and thrombosis
De Franciscis S., Grande R., Buffone G., Serra R.

ORIGINAL ARTICLES
Symbolism and terminology of EchoColorDoppler map reporting of the main veins draining the brain: recommendations for a protocol
Mandolesi S., D'Alessandro A., Manconi E., Niglio T., Orsini A., Avruscio G., Bruno A., Bernardo B., Fedele F.

Postoperative varicose recurrence at the junctions. A multicentric study of 1056 patients by the Italian Society of Phlebolymphology. Conclusive considerations
Corcos L., Aloi T., Garavello A. U., Amato B., Botta G., Mattaliano V., Peruzzi G. P., Pontello D., Serra R., Spina T., Tondi P., Traina L., Zini F.

CORRESPONDENCE
***In vitro* antibacterial and anticell proliferation activities of silver sulfadiazine alone and in combination with hyaluronic acid**
Figura N., Collodel G., Biagi M., Gonnelli, Moretti E.

Organo Ufficiale del Collegio Italiano di Flebologia

EDIZIONI MINERVA MEDICA

PUBBLICAZIONE PERIODICA QUADRIMESTRALE - POSTE ITALIANE S.P.A. - SPED. IN A. P. D.L. 353/2003 (CONV. IN L. 27/02/2004 N° 46) ART. 1, COMMA 1, DCB/CN - ISSN 1593-232X TAXE PERCUE

ACTA PHLEBOL 2014;15:69-78

Postoperative varicose recurrence at the junctions. A multicentric study of 1056 patients by the Italian Society of Phlebolymphology. Conclusive considerations

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Aim. **Since new endovascular procedures and foam sclerotherapy have been developed for the treatment of varicose veins of the lower limbs the recent literature seems to demonstrate that surgery of the saphenofemoral and saphenopopliteal junctions (SFJ, SPJ) is the main responsible for varicose recurrence (VR) owing to neovascularization by neoangiogenesis (NN). Aim of the study was to verify the anatomical causes of postoperative VR at the SFJ and SPJ.**

Methods. **Fourteen centers belonging to the Italian Society of Phlebolymphology collected the data of 1056 patients (=1081 limbs-25 bilateral) affected with VR. Clinical feature ranged from C2 to C6. Limbs were studied by Duplex ultrasound (DUS) investigation and by surgical revision from 2001 up to now: N. 927 (85.7%) retrospectively, 154 (14.2%), prospectively. Distribution of the limbs was as follows: mean age of patients was 56.6 years; the study enrolled 291 males (27.5%) and 765 females (72.4%); right limbs were 532 (49.2%), left limbs were 549 (50.7%); symptoms from venous insufficiency were found in 1043 subjects (96.4%). Previous surgery data: SFJ+stripping 873 (80.7%), SFJ alone 156 (14.3%), SPJ 52 (4.8%). Only 611 (56.5%), were studied by Duplex ultrasound (DUS), 470 by DUS+introperative observation (43.4%). The surgical revision was performed by direct dissection in 200 limbs and by Li technique in 270. The following elements were investigated: saphenous stump (SS), identified and unidentified tributaries (IT, UT) of the SFJ, tributaries of the SPJ, common tributaries outlet, tributaries outlet into the deep veins, suspected NN.**

Results. **Residual veins detected: saphenous stump+identified tributary (IT) 711 (65.7%), anterior accessory 298 (27.5%), superficial iliac circumflex 127 (11.7%), superficial epigastric 96 (8.8%), residual greater saphenous 95 (8.7%), medial accessory 88 (8.1%), superficial external pudendal 44 (4%), deep external pudendal 4 (0.3%), common outlet into the common femoral 14 (1.3%), independent outlet into the common femoral 7 (0.6%), unidentified tributaries (UT) at the SFJ 290 (26.8%), UT at the SPJ 52 (4.8%), complex varicose collateral circulation (CVC) total 386 (35.7%), CVC+IT 147 (13.5%), CVC+UT 149 (13.7%), CVC without IT/UT (unrecognized-suspected NN) 90 (8.3%). Unrecognized IT/UT at the SFJ (suspected NN) 45 (4.1%); unrecognized IT/UT at the SPJ (suspected NN) 2 (0.1%), surgically assessed NN 5 (0.4%).**

Conclusion. **The causes of VR must be investigated by detailed DUS examination. Direct observation by surgical dissection leads to a verify better than by the Li technique. CVC is a consequence of VR and renders more difficult the detection of IT/UT both by DUS and surgical revision. NN plays a minimal role in VR at the groin and at the popliteal region but is not yet sufficiently demonstrated. Residual saphenous stump and IT/UT caused by inadequate surgery appeared to be the main causes of VR at the saphenous junctions.**

KEY WORDS: Varicose veins - Recurrence - Postoperative period.

In 1891, F. Trendelemburg described using greater saphenous vein (GSV) ligation and interruption at the upper third of the thigh to treat varicose veins of the lower limbs (VVLL). He reported a 22% varicose recurrence (VR) rate after 4 years. Between 1906 and 1907, Mayo and Babcock improved

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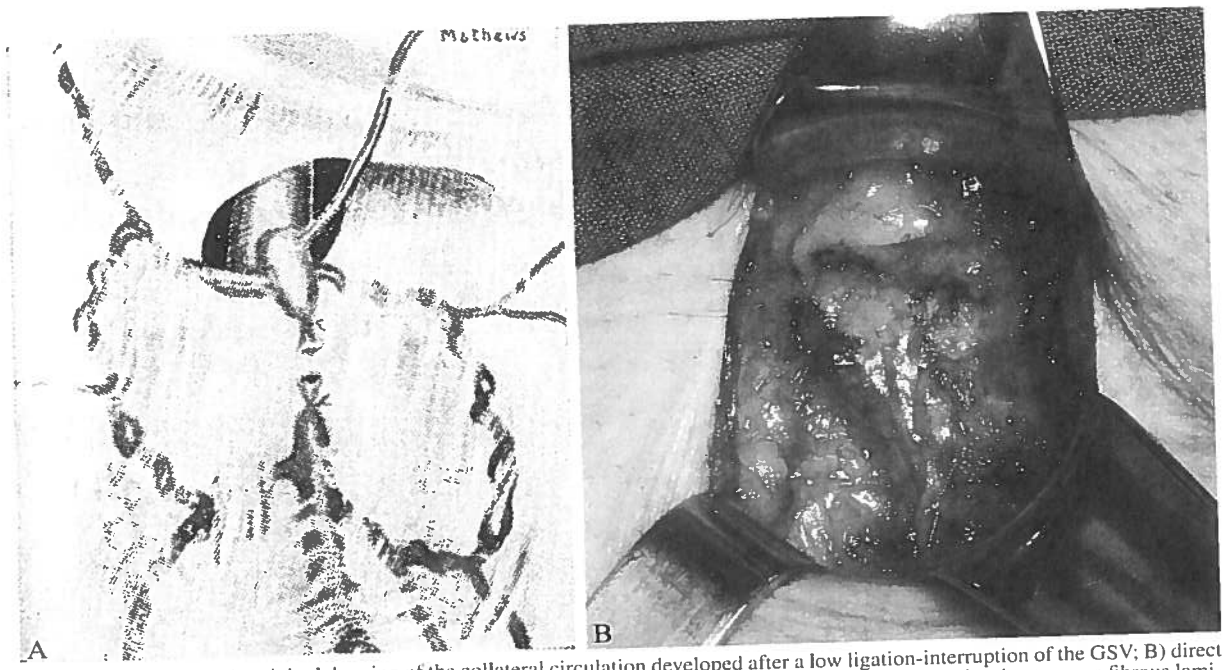

Figure 1.—A) Schematic original drawing of the collateral circulation developed after a low ligation-interruption of the GSV; B) direct surgical revision of SFJ. A complex varicose collateral circulation (CVC) appears in the thickness of week subcutaneous fibrous laminae. The surgical dissection will show the connection to the saphenous stump by residual tributaries.

these results by adding the GSV stripping. In 1916, Homans proposed using high ligation of the saphe-no-femoral junction (SFJ) with a tributaries flush to the common femoral vein to reduce the recurrence rate. The 1960 textbook by R. Foote [1] clearly showed that the low GSV ligation is the main cause of the so-called neovascularisation, which is provoked by the persistence of the tributaries and the development of an incompetent collateral circulation (Figure 1). This observation is still accepted by the majority of authors both for the SFJ and the sapheno-popliteal junction (SPJ), in which the anatomical variants and incompetent communicating veins appear to be of great importance.[2-6]

In 1968, Leu demonstrated [7] that varicose postoperative recurrence occurred after 34% of the operations performed by general surgeons, 6.5% of the operations by vascular surgeons and <6% of the operations performed by vascular surgeons who specialize in venous surgery. After more than three decades, a recent study [8] demonstrated that traditional surgery remains the most commonly offered treatment for VVLL patients.

New therapeutic strategies and endovascular techniques using lasers and radio-frequencies, such as conservative surgical procedures and foam sclerotherapy, have been recently described. In spite of a history and evidence of efficacy, numerous attempts have been made to replace traditional surgery with these new techniques by demonstrating that the surgical trauma and high pressure on the venous wall are responsible for the development of neovascularisation by neoangiogenesis (NN) and, consequently, high postoperative recurrent rates.[9] However, great importance is still assigned to inadequate surgery, anatomical variants and pelvic reflux; hence, the problem of varicose and the new techniques are still being debated.[10]

Aim of the study was to verify the anatomical causes of postoperative VR at the SFJ and SPJ.

Materials and methods

Fourteen centres belonging to the Italian Society of Phlebolymphology collected the requested data from 1056 patients (1081 limbs, 25 bilateral).

The following inclusion criteria were applied: patients who were previously subjected to ligation-interruption of SFJ and/or SPJ. Patients with VR caused by conditions unrelated to the previous surgery, such as deep venous insufficiency, pelvic reflux or congenital malformations and limbs affected with complications, such as deep or superficial venous thrombosis, post-thrombotic syndrome, chronic lymphedema, and isolated peripheral VVLL, were excluded.

A total of 927 (85.7%) limbs from the previous period (2001-2010) were studied retrospectively. Data that were necessary for the study were collected from 668 (61.8%) of the limbs. Then, 154 (14.2%) limbs that were investigated and treated in the last two years (2011-2012) were prospectively studied.

The limbs were divided into two groups. The first group comprised 611 limbs (56.5%) that were examined by DUS examination only, and the second group comprised 470 limbs (43.4%) that were subjected to DUS examination and surgical revision. The distribution and feature of the patients and limbs are shown in Table I. The source of the findings and the study period are shown in Table II.

At each center, the DUS examinations were performed on all limbs by the same trained researcher following the recommended criteria but using different instrumentation and 7.5 mHz probes.[2, 5-16] Incompetent anatomical venous residuals with a reflux time >3 seconds [16] were investigated in standing and supine positions with cross and longitudinal scanning. The residual saphenous stump (SS), all residual tributaries with their outflows into the stump or directly into the common femoral or popliteal veins and their anatomical variants were investigated, as shown in Figure 2. Based on findings in the literature, neovascularisation by neoangiogenesis was investigated,[11] searching for thin and tortuous veins measuring <2 mm in diameter and connected with an SS, with the common femoral vein or with thin-

TABLE I.—*Characteristics and distribution of 1.081 limbs belonging to 1.056 patients (25 bilateral) affected with postoperative varicose recurrence at the SFJ and SPJ.*

Characteristics		
Mean age years	56.6	min 19 - max 90
	N.	%
Males	291	27.5
Females	765	72.4
Right	532	49.3
Left	549	50.5
Symptomatic (C2-C6)	1,043	96.4
SFJ + Stripping	873	80.7
SFJ alone	156	14.3
SPJ +/- SSV removal	52	4.8

SFJ: interruption of the sapheno-femoral junction; SPJ: interruption of the sapheno-popliteal junction; GSV: greater saphenous vein; SSV: smaller saphenous vein; prox.; GSV: proximal saphenous vein; IO: intraoperative observation.

TABLE II.—*Period of the study, methods of investigation and data collection of 1.081 limbs belonging to 1.056 patients (25 bilateral).*

Period of the study		N.	%
2001-2010	Retrospective	927	85.7
2011-2012	Prospective	154	14.2
Total		1,081	100.0
Method of investigation		N.	%
DUS findings		611	56.5
DUS + IO observation		470	43.4
(Direct surgical dissection)		(200/470)	(42.5)
(Li technique)		(270/470)	(57.4)
Total		1,081	100.0

DUS: Duplex ultrasound.

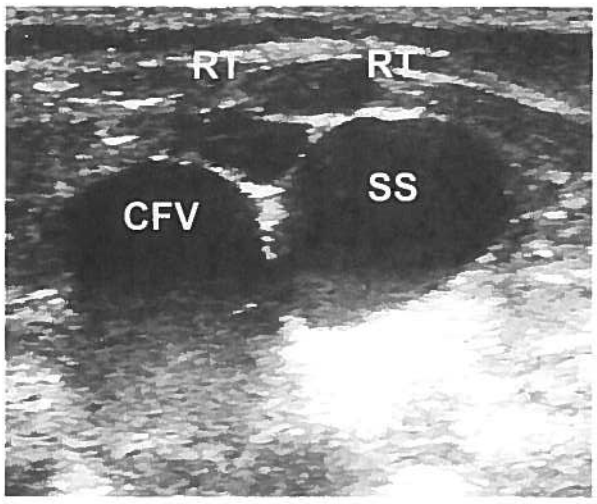

Figure 2.—High resolution echography by 7.5 mHz probe and cross scanning of a varicose postoperative recurrence at the SFJ. A dilated saphenous stump (SS) in continuity with the common femoral vein (CVF) and a number residual tributaries (RT) (CVC) connected with the SS are visible.

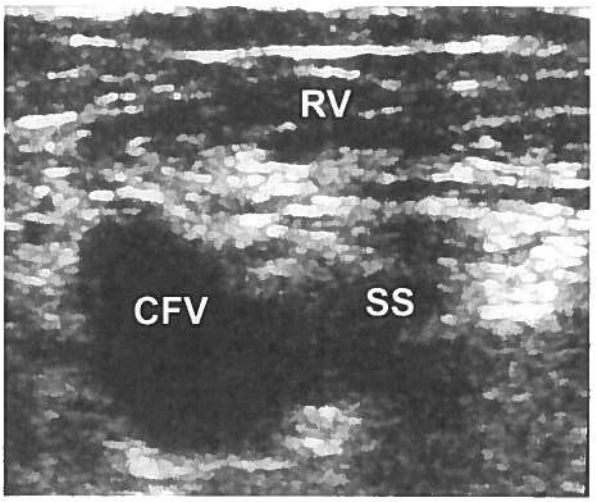

Figure 3.—High resolution echography by 7.5 mHz probe and cross scanning of a varicose postoperative recurrence at the SFJ. Small (<2 mm) and tortuous recurrent varices (RV) are visible in the thickness of the subcutaneous tissue apparently not connected with the common femoral (CFV) or with the saphenous stump (SS).

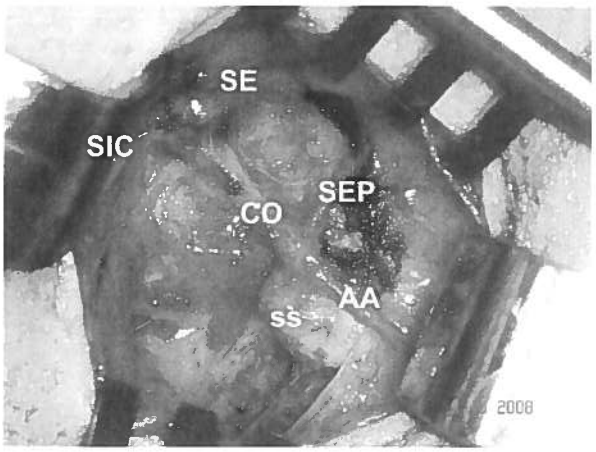

Figure 4.—Surgical revision of a previously operated SFJ performed by direct dissection. Opening and partial elimination of the fibrous tissue. A large residual saphenous stump (SS) together with the superficial epigastric and superficial iliac circumflex (SIC), connected by a common outlet (CO) into the SS and the residual superficial external pudendal vein are visible. They all supply with reflux the anterior accessory vein (AA).

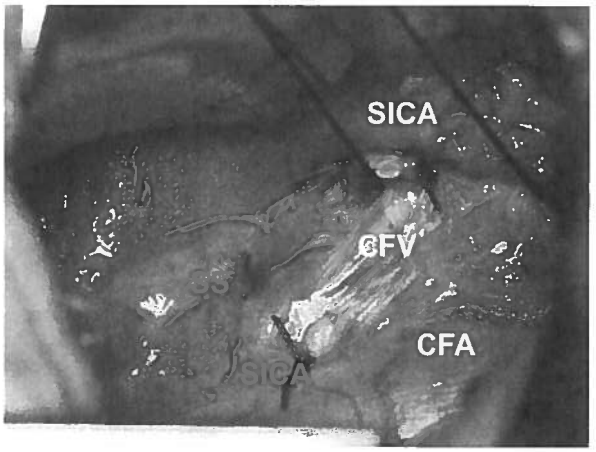

Figure 5.—Surgical revision of a previously operated SFJ performed by lateral approach according with Li technique.[22] So it is possible to directly expose the fossa ovalis, the anterior wall of the common femoral vein (CFV) and the residual veins. In this case the residual saphenous stump (SS) is dissected and interrupted flush to the CFV. The common femoral artery (CFA) and the two stumps of the interrupted superficial circumflex artery (SICA) are visible too. The operating site is free from fibrous tissue.

ner subcutaneous veins (Figure 3). No histological examinations were performed.

A total of 470 limbs (43.4% overall) were subjected to the surgical revision of the recurrent junction. The direct dissection was performed in 200 of 470 cases (42.5%) (Figure 4), and the Li technique, consisting of a deep lateral approach to the fossa ovalis,[17] was applied in 270 of 470 cases (57.4%)

(Figure 5).[18-22] In 259 limbs operated on using the Li technique (23.9% overall) the SSs that were connected with one or more tributaries measuring more or less than 2 mm were investigated by both the preoperative DUS investigation and the surgical observation (Table II).

All SSs were exposed and removed flush to the anterior wall of the common femoral vein in both techniques. The residual tributaries were exposed, identified in the majority of the cases and separately interrupted only by the direct dissection technique (Figure 4). The anterior wall of the common femoral vein was repaired when necessary (3 cases). The residual tributaries of the SFJ were identified (IT) and defined according to the international nomenclature in 822 cases (76% overall).[18, 19] Those which did not correspond to any official nomenclature were defined as "unidentified tributary" (UT). In 30 VR cases at the SPJ (3.5%), only UTs were detected (Table IV). No perforators or non-saphenous veins of the popliteal fossa were reported.

The majority of the SS were found to be combined with residual IT or UT. In many cases, the VR consisted of a complex varicose collateral circulation (CVC). The Li technique made it possible to expose the anterior wall of the common femoral vein (CFV) and the SS to avoid the surgical dissection of the varicose and fibrous tissue, without the need for surgical revision and detection of every single tributary. UT and IT were always detected by preoperative DUS examination (Tables III, IV). NN was assumed to be evident when the findings responded to the specific standards and were verified by surgical dissection. In all cases in which no tributary vein was visible, it was assumed to be only a suspected hypothesis.

TABLE III.—*Source, number and percentage of the anatomical classification.*

Main source of the anatomical classification	N.	%
DUS findings (±CVC)	462	42.7
DUS + Surgery by direct dissection (±CVC)	200	18.5
Total	662	61.2
Main source of the unclassified tributaries	**N.**	**%**
DUS + P cavernoma	149	13.7
DUS + Surgery by Li technique (retrospective only)	259	23.9
DUS + Surgery by direct dissection (+ CVC)	11	1.0
Total	419	38.7

DUS: Duplex ultrasound; PC: pseudo-cavernoma.

TABLE IV.—*Veins and anatomical findings at the groin and popliteal region studied by DUS or by DUS+intraoperative observation in 1081 limbs belonging to 1056 patients (25 bilateral) affected with postoperative varicose recurrence at the SFJ and SPJ.*

Veins and anatomical findings	Initials	N.	%
Saphenous stump ±residual tributary	SS	711	65.7
Anterior accessory	AA	298	27.5
Unclassified tributaries at SFJ	UT	290	26.8
Superficial iliac circumflex	SIC	127	11.7
Superficial epigastric	SE	96	8.8
Residual greater saphenous	GSV	95	8.7
Medial accessory	MA	88	8.1
Superficial external pudendal	SEP	44	4.0
Common outlet into the SS or CFV	CO	14	1.3
Independent outlet into the CFV	IO	7	0.6
Deep external pudendal	DEP	4	0.3
Incompetent valvuloplasty of GSV	GSV	4	4.0
Unclassified tributaries at the SPJ	UT	52	4.8
Total limbs with anatomical residuals		939	86.8

SFJ: sapheno-femoral junction; SPJ: sapheno-popliteal junction; GSV: greater saphenous vein; SSV: smaller saphenous vein; CVF: common femoral vein. Initials of the various tributaries and findings are reported in order to make easier the reading of figures.

Results

The residual SS (N. 711, 65.7%) was the most common finding, followed (by decreased frequency) by the anterior accessory of the GSV (N. 298, 27.5%), UT at the SFJ (N. 290, 26.8%), superficial iliac circumflex vein (N. 127, 11.7%), residual GSV (most likely from a previous duplicity), (N. 95, 8.7%), superficial epigastric (N. 60, 8.8%) and all others listed in Table III. A common trunk and outflow of the iliac circumflex vein, the superficial epigastric and the anterior accessory connected with then common femoral vein was found in 14 limbs (1.3%) [20] and, more seldom, an independent outlet of the anterior accessory vein into the common femoral vein was detected in 7 limbs (0.6%) (Table IV). One example is shown in Figure 4.

A large number of cases with development of a CVC (N. 386, 35.7%) were found in the supra-fascial subcutaneous (Figure 1B). Approximately half (N. 147, 13.5% overall) were connected with IT measuring >2 mm in diameter. The other half (N. 149, 13.7% overall) were connected with UT measuring >2 mm in diameter.

The anatomical residuals which were single or multiple and variously combined, previously detected by preoperative DUS examination, were found in a total of 939 operated junctions (86.8%).

In 90 CVC (8.3%), it was impossible to find a residual tributary vein >2 mm in diameter by DUS or surgical dissection (Table V). In these cases NN was suspected.

In 47 cases (4.3%) which were free from the presence of a CVC, the DUS investigation did not demonstrate an evident residual tributary vein of >2 mm in diameter, NN was more strongly suspected. NN was absolutely confirmed by the surgical dissection in only 5 cases (0.4%). In a total of 142/1081 cases (13.1%), neovascularisation was suspected or demonstrated (Table VI).

Discussion

Many patients suffered with subjective and objective symptoms from venous insufficiency ranging from C2 to C6 (N. 1043, 96.4%) (Table I).

The data obtained from the different centres appeared to be scarcely detailed to define the various tributary veins involved in the mechanism of recurrence; nevertheless, it is possible to assess the prevalence of SS connected with residual tributaries as major causes of recurrence in both the SFJ and SPJ (Tables I, IV). The comparison between the data concerning the UT of tables 4 and 5 shows that in 140 of the cases (12.9%), even in those free from CVC, it can be impossible to assign the correct definition of the residual tributaries on the basis of the official nomenclature. The difficulty in detecting and exactly define every single tributary often emerged during the DUS diagnostic and preoperative investigation, particularly when a CVC was present (N. 386, 35.7%) (Table V). However, the daily experience demonstrated that a longer investigation time

TABLE V.—*Presence of a complex varicose collateral circulation (CVC) combined with identified tributaries (IT), unidentified tributaries (UT) and suspected neovascularization by neoangiogenesis.*

Complex varicose collateral circulation (CVC)	N./1081	%
CVC *(+ IT))*	147	13.5
CVC *(+ UT)*	149	13.7
CVC without tributary *(suspected neovascularization)*	90	8.3
Total	386	35.7

TABLE VI.—*Suspected or assessed neovascularization by neoangiogenesis at the junctions combined with pseudo-cavernoma, by DUS unrecognized residual tributary or surgically demonstrated.*

Neovascularization	N./1081	%
Suspected neovascularization + CVC at SFJ	90	8.3
At the SFJ *(unrecognized tributary)*	45	4.1
At the SPJ *(unrecognized tributary)*	2	0.1
Neovascularization*(surgical assesment)*	5	0.4
Total suspected or assessed neovascularization	142	13.1

often makes it possible to detect the residual tributaries that are connected with the SS or directly to the common femoral vein. Occasionally, the direct surgical dissection became difficult because of the presence of a thick fibrous tissue produced by the previous surgical wound and thin and often fragile varicose veins. However, the Li technique, which was devised for avoiding just such difficulties, does not allow visualisation of the residual tributaries connected with the SS, which is why in 259 cases (23.9%) submitted to the Li surgical revision and retrospectively studied, it was not possible to exactly determine the residual tributaries nature (UT). The UT represents a high number (N. 290, 26.8%), which includes unrecognised veins (*e.g.*, the AA, SE, and residual GSV) that most likely belong to a previous anatomical variant (*e.g.*, a variation of the outlet or a double GSV) that can supply the peripheral varicose veins with reflux. The source, number and percentages of the UT are reported in Tables IV, V.

About neovascularisation

The word "neovascularisation" stems from residual venous elements used in the past to describe the development of a rich collateral circulation [1] and does not appear to be appropriate, as it refers to pre-existing veins that remain under the impulse of the venous reflux and progressively dilate. The word "neovascularisation" seems more appropriate to indicate the appearance of new vessels produced by the phenomenon of neoangiogenesis.

NN was recently described as the most dangerous enemy of surgeons and patients operated on for VVLL. It was described by Glass in 1988 [9] as an unavoidable consequence of neoangiogenesis because of the high venous pressure of the operated SS and as the main cause of VR. Such a discovery needs to be discussed for several reasons.

First, the presence of large and long residual SS at the SFJ and/or SPJ is in contrast to the main rules of traditional surgery and represents a surgical mistake. Conversely, the phenomenon of NN has never been taken into consideration in the past after appropriate surgery. Second, a strict correlation between neoangiogenesis and neovascularisation is not obligatory and has not been demonstrated. Third, Glass performed his study using radiological phlebography, which, as is well known, often gives false imaging because of the high density of the contrast medium. Fourth, no venous pressure measurements were performed, and the concept of a high venous pressure at the SS as a cause of NN remains an undemonstrated hypothesis. It has already been shown that even when the iliac and common femoral venous valves are absent or incompetent, the venous pressure at the groin can increase only by using the Valsalva manoeuvre.[21] Note that the so-called NN has never been used after peripheral venous disorder surgery, such as varicose veins and incompetent perforators at the lower leg in which the venous pressure is usually high in the limbs affected by chronic venous insufficiency. Further perplexities arose from the hypothesis that small and thin new veins [11] can be responsible for the transmission of high pressure and reflux in large recurrent VVLL. Lastly, why does neovascularisation appear only at the groin and never occurs at surgical sites with large arteries and veins (with high blood pressure, which can be measured) that are manipulated and traumatised? No answers were found in the literature. Nevertheless, many authors still trust in the theory of NN at the junctions as the main cause for VR while, after one century, the surgical results appear to be worsening and reaching unacceptable levels.[22-27]

Histologic observations have led other researchers [28, 29] to describe neoangiogenesis as a physiologic process which follows inflammation and mainly represents a constant product of large wounds, haematomas and thrombosis. The stem cells, histiocytes, platelets and plasmocytes migration of the inflammatory process lead to the appearance and increase of the endothelial vascular grow factor and endothelial progenitor cells.[29-32] During previous studies, we observed the thickness of spontaneous and post-laser thrombi [33] and the development of neoangiogenesis, which is characterised by the tubular and stratified profiles described in the literature [34] (Figures 6, 7). It can be easily understood that the same reparative process, leading to the appearance of specific progenitor cells, takes place in every anatomical district and in every kind of tissue, not only in veins. The development of smaller and larger vessels characterised by pathological morphology is commonly observed in congenital venous malformations and vascular tumours; in other tumours, the anarchic neovascularisation represents a marker of malignancy but appears to be similar to the physiological reparative process, which is why it was named "the wound that never heals".[35] None of these aspects can explain VR at the SFJ and SPJ.

Figure 6.—Histologic cross section of a proximal LSV containing an early thrombus 8 days after spontaneous phlebitis. A small parietal vessel in the thickness of the sub-intimal media, with endothelial wall, which is passed through by polymorpho-, mono-nucleated cells and hystiocytes. Possible presence of endothelial progenitor cells.[20-26] Original image. Ematoxilin-Eosin 600 X.

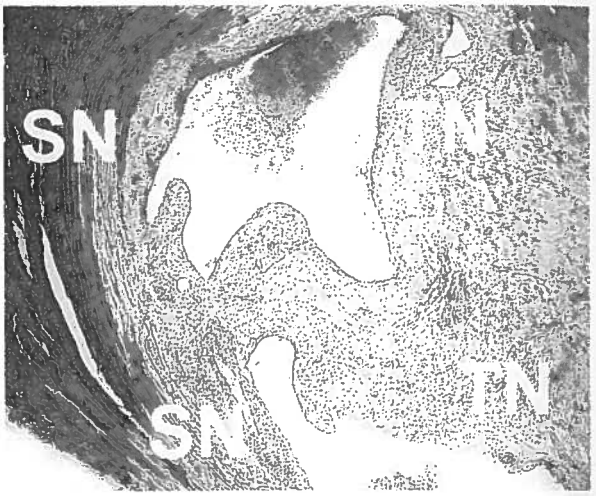

Figure 7.—Histologic cross section of a proximal LSV containing an advanced and organized thrombus 60 days after spontaneous phlebitis. A partial detachment of the thrombus from the venous wall with endothelized surfaces in the peripheral part: stratified neoangiogenesis (SN). In more central areas some thin small vessels of various diameter, with mono-stratified endothelial wall and sites of advanced recanalization: tubular neoangiogenesis (TN).[27, 28] Original image. Ematoxilin-Eosin 50 X.

About surgery

The presence of anatomical residuals at the SFJ and SPJ has been always indicated in the past as the main cause of VR.[1-6, 12-17, 20] In the year 2006, two studies [36, 37] were performed on a total of more than 1000 limbs subjected to the surgical revision for VR. The authors never observed NN at the junctions and they refused it as a cause of recurrence. Confirmations have come from many other authors. We report one of the more recent studies to seek the related references.[38] Note that in 1960, Girbes and Salleras had clearly indicated that the tributary veins of the proximal GSV and occasionally the common femoral vein at the SFJ were primarily responsible for VR. The authors recommended exposing and exploring the CFV, above and under the fascia cribrosa to interrupt the subfascial tributaries. The classical recommendation for cleaning the anterior surface of the common femoral vein and, if necessary, repairing the venous wall using longitudinal reconstruction is described in textbooks.[2]

Paradoxically, new interest in modern non-surgical techniques and technologies today has led to trade the danger and responsibility of VR for the surgical tradition and accuracy that was recommended in the past. More recent studies have clearly demonstrated that the only way to prevent VR is still traditional surgery.[15] The only trap is represented by the presence of anatomical variants at the junctions,[1-6] making it more difficult to use the diagnostic and surgical approach. Modern detailed DUS investigation systematically performed before applying any therapeutic technique can prevent such difficulties.[10-16] Based on the above considerations, it seems more appropriate to perform the surgical approach with direct dissection in cases that are free from severe anatomical alterations, such as PC, or the Li technique for treating residual SS and tributary veins >4 mm in diameter combined with PC.

About complex varicose collateral circulation (CVC)

In many cases, the VR was represented by a collateral circulation characterised by an anatomical anarchic development of the collateral circulation at the groin or at the popliteal region, which was occasionally quite similar to cavernous hemangiomas.

Such vascular changes were often defined as "cavernoma", and this definition was used primarily during several meetings in the last few years while discussing the problem of postoperative VR at the junctions. It has been difficult to find such a definition in the literature that indicates this phenomenon, except for one recent paper.[39] In the traditional literature, cavernoma or cavernous hemangioma clearly indicates a vascular condition belonging to vascular malformations or tumours. For this reason, we preferred to define this recurrent feature at the operated junctions as CVC. In the majority of these cases (N.=296, 27.2%), residual tributaries, IT or UT measuring >2 mm in diameter could be found. More likely, this condition can be seen in the cases in which no residual tributary could be detected, except for small, weak and tortuous veins (N.=90, 8.3%) as shown in Table V. Clear images concerning such venous changes because of recurrence were recently reported,[40] and their relationships with residual tributaries and/or neovascularisation were extensively evaluated, but the discussion is still open.

Conclusions

All limbs affected with recurrent VVLL should be carefully investigated by DUS examination in order to detect the anatomical causes of VR at the groin and popliteal region before planning any kind of treatment.

NN is a normal pathophysiologic entity that mainly depends on large traumatic or surgical wounds, haematomas and thrombosis. It represents the basis for the formation of new vessels in vascular tumours and malformations. It can be invoked as a cause of VR in a small percentage of cases, and it seems to play a minimal role at the groin and popliteal region of the operated limbs. Still, this hypothetical phenomenon has not been sufficiently demonstrated and, if necessary, it requires further study.

The development of a complex and anarchic collateral circulation, such as CVC (which occurs in a high number of limbs affected with VR at the junctions), is a frequent consequence of the persistence of the anatomical residuals. Moreover, the development of such circulation makes it more difficult to detect the residual tributaries by both DUS and surgical revisions which require to be performed with more attention and time. Residual SS and tributaries from inadequate surgery, which can lead to venous reflux and hypertension in the superficial veins, seem to be the main cause for the onset of VR in the limbs operated on for VVLL. Appropriate surgery should not be considered as the main cause of the onset of VR. A further analysis of more selected casuistry is required for assessing the objective of the study.

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Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Received on March 1, 2014.
Accepted for publication on March 4, 2014.