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Great saphenous vein diameter at different regions and its relation to reflux

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Abstract

Background

Great saphenous vein (GSV) incompetence is involved in most cases of varicose disease. Standard preinterventional assessment is required to decide the treatment modalities. GSV diameter was measured at saphenofemoral junction, proximal thigh, distal thigh, knee, proximal leg, and distal leg. Analysis was done to find at which diameter size the reflux is expected to occur.

Patient and methods

The study involved 100 limbs from outpatient vascular clinic. GSV diameter was measured at the saphenofemoral junction, the proximal thigh, the distal thigh, below the knee, and mid-leg and correlated with reflux.

Results

Reflux in the sapheno-femoral junction (SFJ) (group I) occurred at 7.16±2.30 mm, proximal thigh (group II) at 6.60±1.89 mm, distal thigh (group III a) at 6.12±1.63 mm, knee (group III b) at 5.78±1.60 mm, proximal leg (group IV) at 4.61.24 mm, and mid leg (group V) at 3.59±1.16 mm.

Conclusion

Measurement at six sites revealed higher sensitivity and specificity to predict reflux. GSV diameter correlates with reflux.

Keywords: Comparison of clinical trials, great saphenous vein, varicose veins, vein diameter at different regions

Introduction

Varicose disease affects one-third of the population and has an effect on morbidity, quality of life, and health costs. The great saphenous vein (GSV) is involved in most cases [1].

Symptoms include distressing feelings of swelling and heaviness and frank pain. Objective findings are meandering and dilated superficial veins, edema, dermatitis, dermatosclerosis, and skin ulceration. These manifestations are the consequence of long-standing volume overload and hypertension in cutaneous veins caused by wall distension, valve incompetence, blood flow abnormality, and secondary phenomena such as allergy and inflammation [2].

Treatment is directed toward abolition of venous reflux. For decades, this has been accomplished by ligation of the GSV at its junction with the common femoral vein (CFV) and vein stripping, first of the entire GSV, later limited to its refluxing part. In the past decades, alternative options became available, such as hemodynamic surgery [3], endovenous thermal ablation [4], and foam sclerotherapy [5]. Duplex ultrasound (US) is widely employed to guide these interventions.

Comparison of treatment modalities requires exact documentation of the clinical, anatomical, and functional situation before whichever treatment is given [6].

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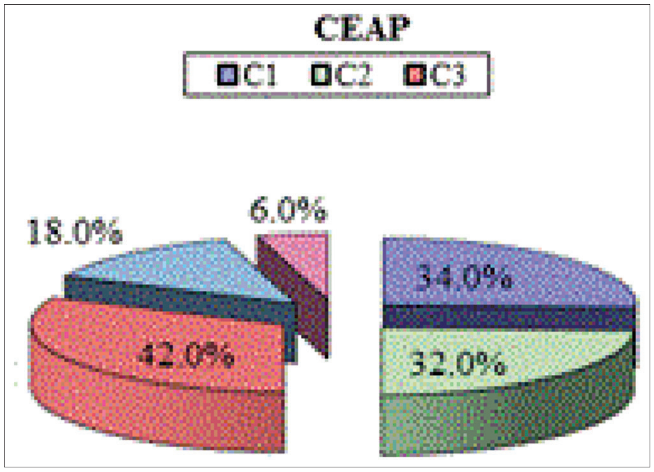

Figure 1: Clinical findings of a venous disorder were teleangiectasias (C1), which were found in 34%, branch varices (C2) in 32%, edema (C3) in 42%, dermatosclerosis (C4) in 18%, and active venous ulcer (C6) in 6%.

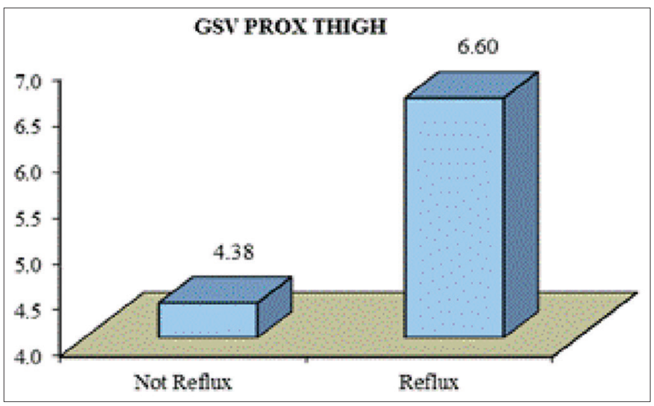

Figure 3: In patients with proximal thigh reflux (group II), reflux occurred at 6.60 ± 1.89 mm.

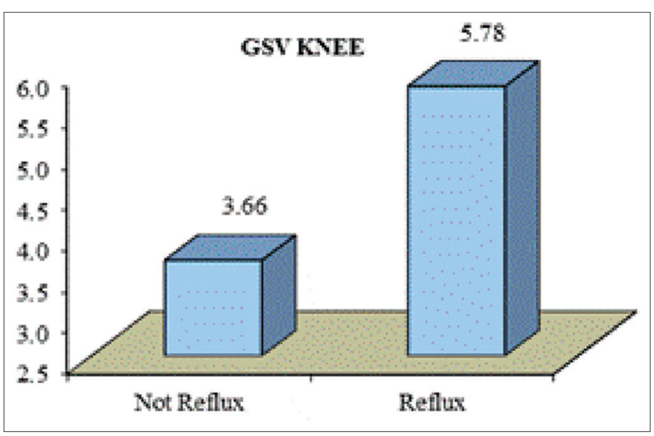

Figure 5: In patients with knee reflux (group IIIb), reflux occurred at 5.78 ± 1.60 mm.

Reflux and GSV diameter measurements may serve as surrogate parameters for disease severity and provide criteria for planning interventions and monitoring outcome. GSV diameters have been assessed at various sites with different techniques: upright

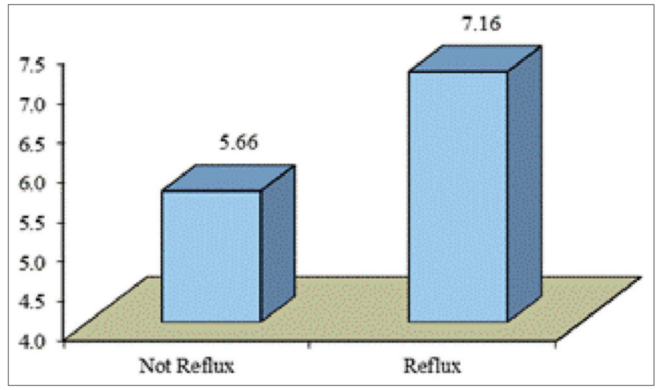

Figure 2: In patients with SFJ reflux (group I), reflux occurred at 7.16 ± 2.30 mm.

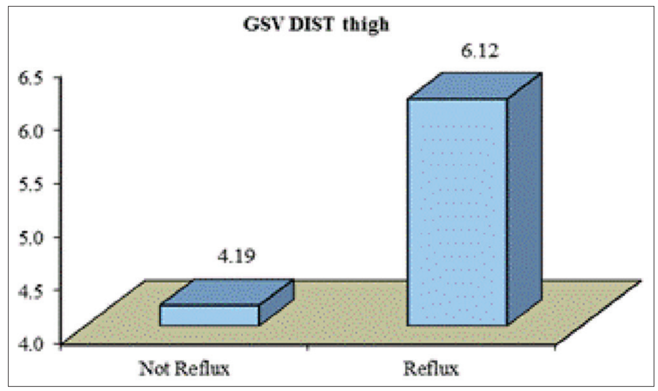

Figure 4: In patients with distal thigh reflux (group IIIa), reflux occurred at 6.12 ± 1.63 mm.

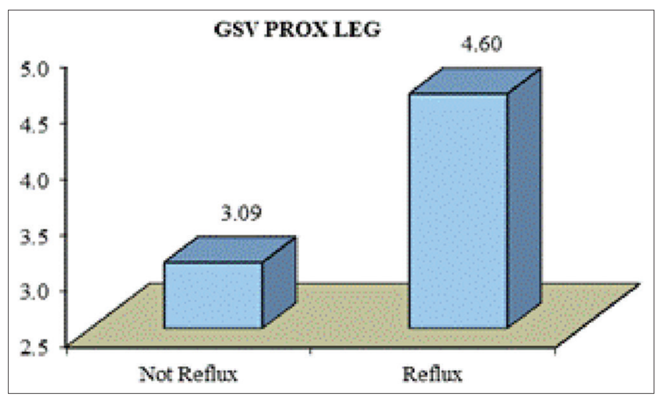

Figure 6: In patients with proximal leg (group IV), reflux occurred at 4.6 ± 1.24 mm.

or recumbent patient position, cross-sectional or longitudinal imaging, and various sites of interest [2].

A consensus-based manual recommends two sites where GSV diameters should be measured, 3 cm below the SFJ and mid-thigh [6], whereas earlier studies used a site 15 cm below the SFJ [7]. Thus far, neither the clinical relevance of these measurements nor the relative significance of the site of measurement has been clarified. In this thesis, an

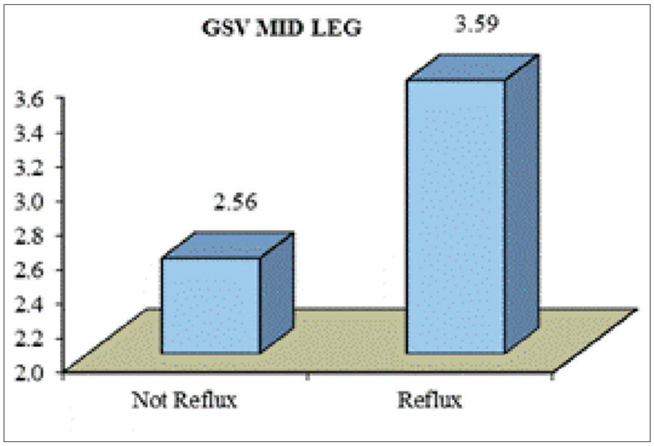

Figure 7: In patients with mid leg reflux (group V), reflux occurred at 3.59 ± 1.16 mm.

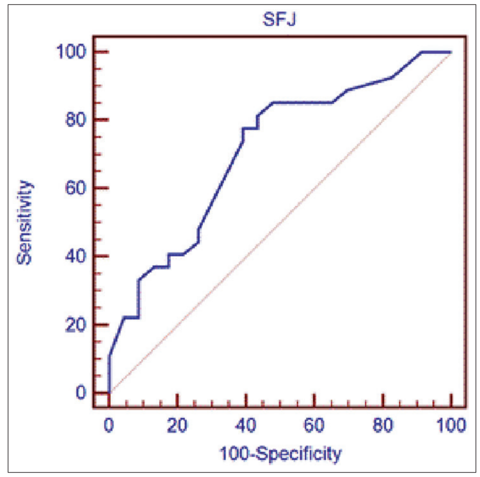

Figure 8: Cutoff point at SFJ greater than 5.7 mm, with sensitivity of 77.7%.

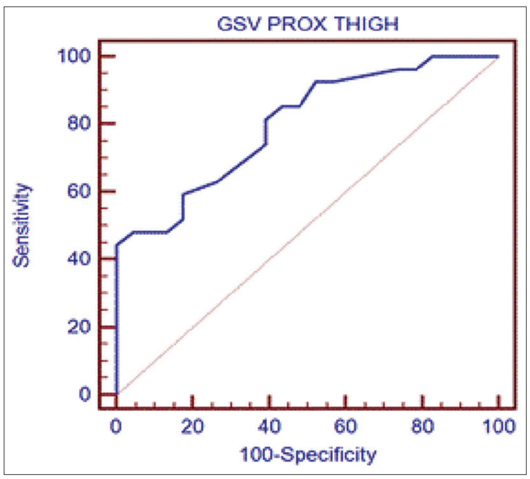

Figure 9: Cutoff point at proximal thigh greater than 7 mm, with sensitivity of 44.4%.

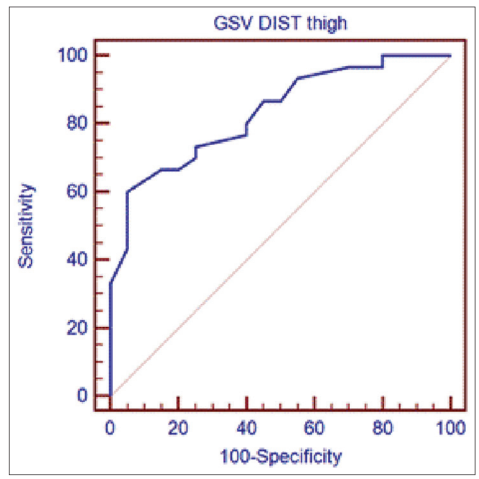

Figure 10: Cutoff point at distal thigh greater than 5.5 mm, with sensitivity of 60%.

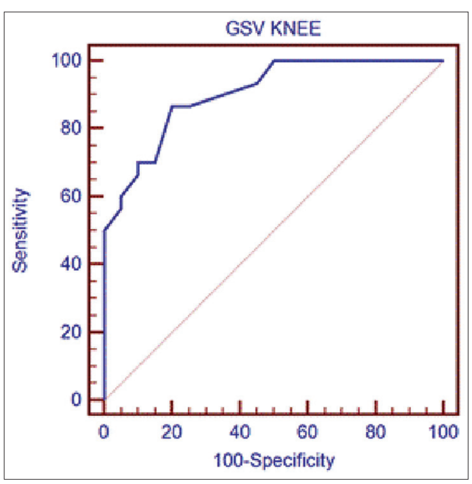

Figure 11: Cutoff point at knee greater than 4.2 mm, with sensitivity of 86.6%.

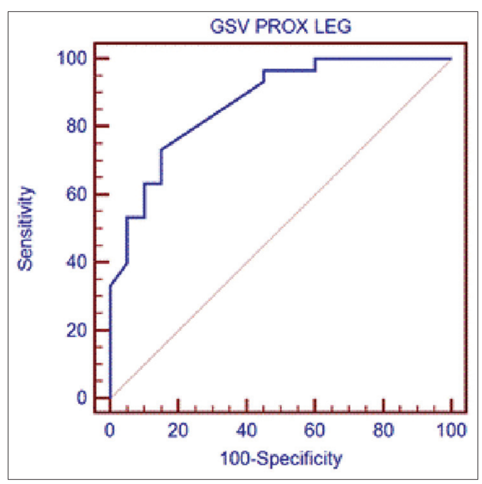

Figure 12: Cut of point at proximal leg greater than 3.5 mm with sensitivity of 73%.

investigation was done to find a possible correlation of GSV diameters measured at different regions and their relation to the reflux.

Various investigations have been carried out to establish the duration of reflux standing, which correlates with venous disease [8–10].

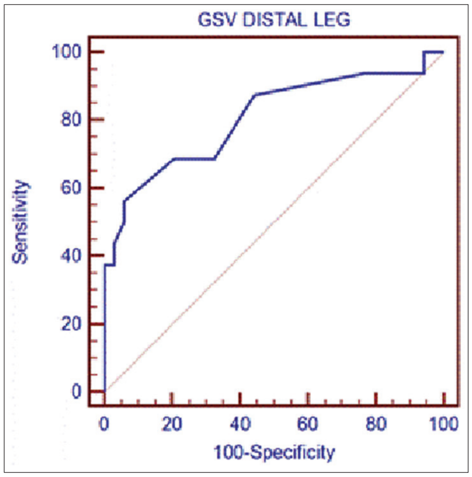

Figure 13: Cutoff point at distal leg greater than 3 mm, with sensitivity of 56%.

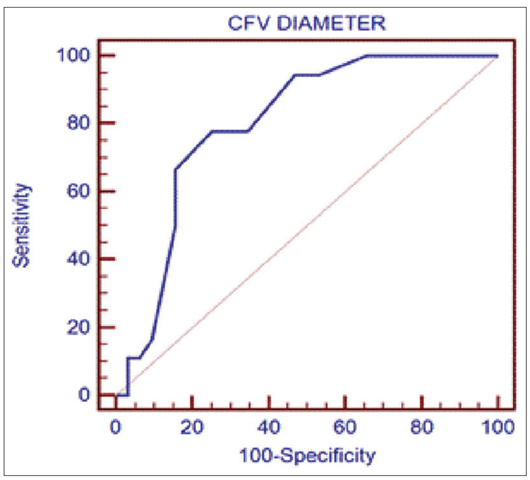

Figure 15: Sensitivity and specificity are calculated for thresholds at the CFV: cutoff point greater than 10.5 mm, with sensitivity of 77.8%. CFV, common femoral vein.

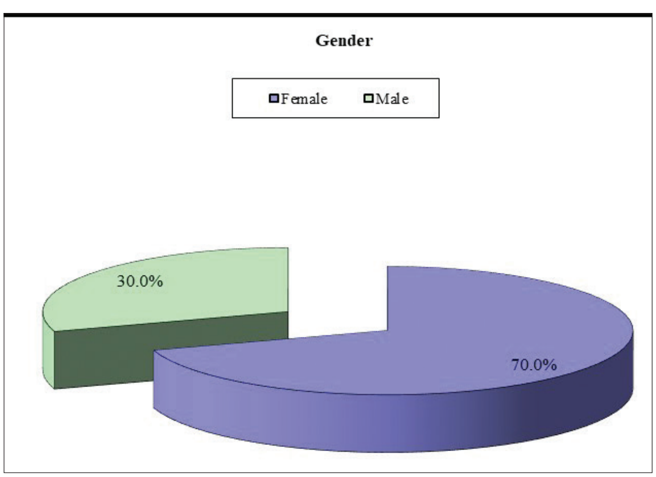

Figure 17: Demography of patients.

In general, no difference was found between durations of 0.5 and 1 s. In other words, the number of legs determined

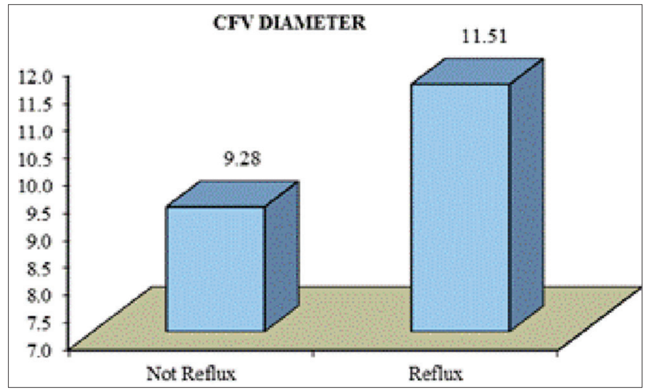

Figure 14: CFV was screened to make a relation between the diameter and reflux also. CFV, common femoral vein.

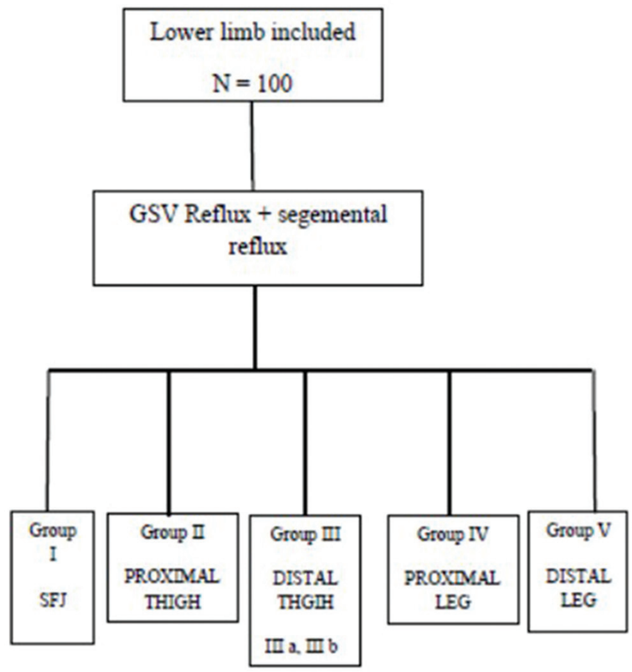

Figure 16: Study flow chart.

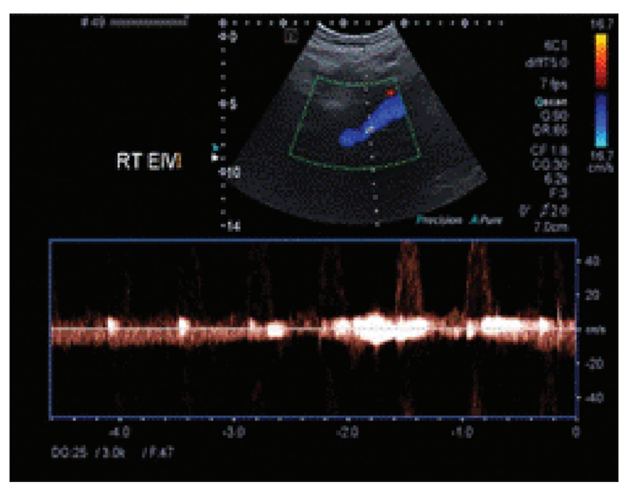

Figure 18: Case 1.

Figure 19: Case 1.

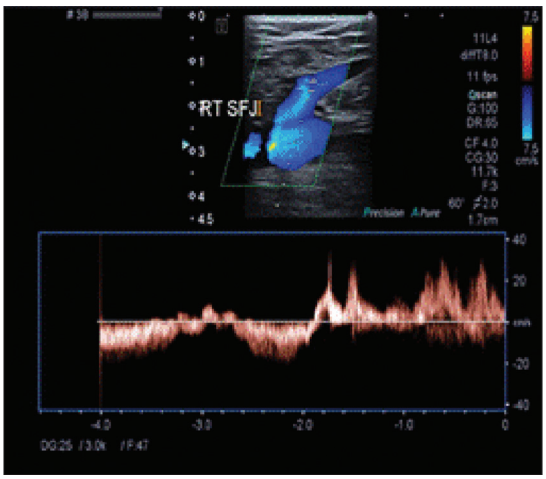

Figure 21: Case 1.

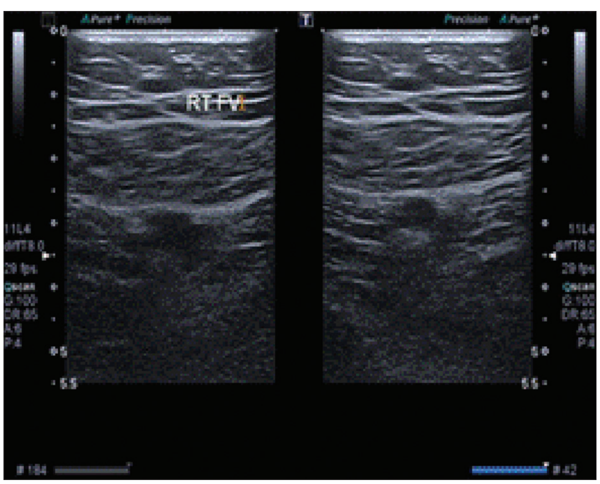

Figure 23: Case 1.

to experience reflux did not alter significantly depending on whether the duration of reflux was set at 0.5 or 1 s.

Although the cutoff value was set at 0.5 s, a definition of reflux set at 1 s may avoid diagnosing pathology at borderline values when there are no clinical signs.

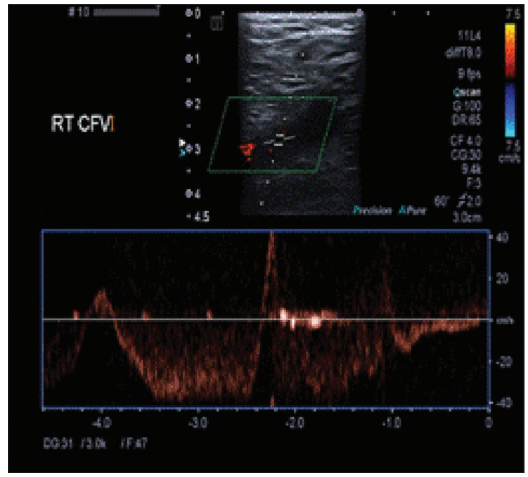

Figure 20: Case 1.

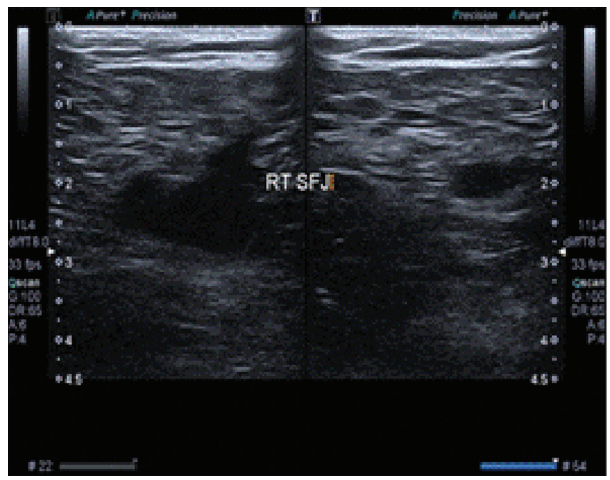

Figure 22: Case 1.

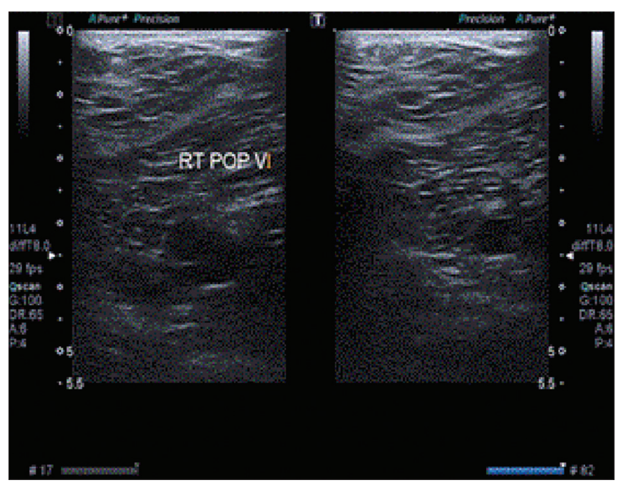

Figure 24: Case 1.

Reflux duration decreases with severity of disease and has been described as the time taken for the antigravitational mechanisms of the leg to fail [11].

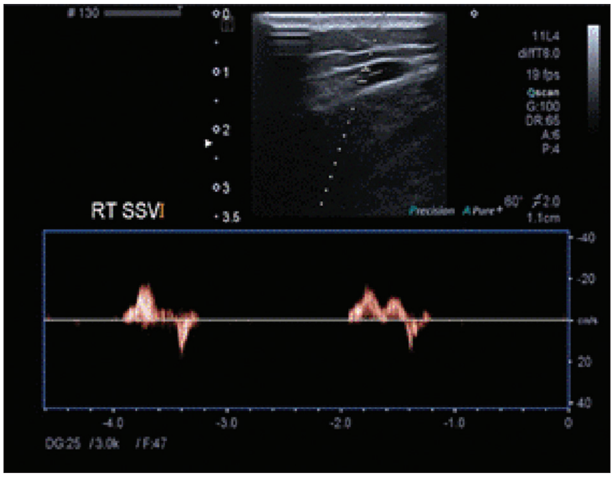

Figure 25: Case 1.

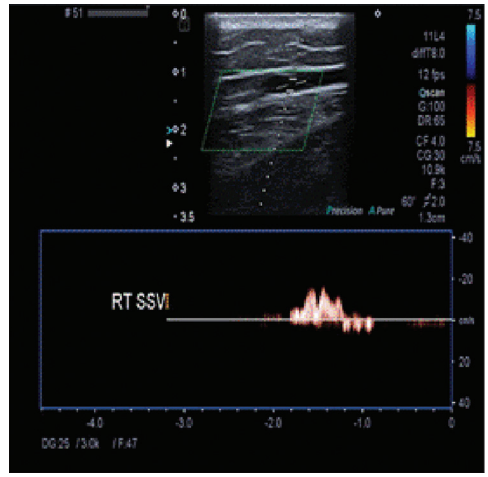

Figure 26: Case 1.

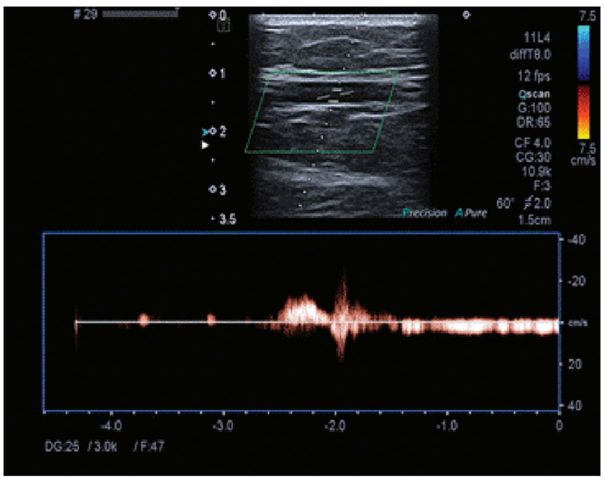

Figure 27: Case 1.

Figure 28: Case 1.

Figure 29: Case 1.

Figure 30: Case 1.

Venous arterial flow index

The first noninvasive option for a quantitative measurement of hemodynamic parameters is duplex US. This can measure the velocity of blood flow in a vein. This parameter can be used to calculate the volume flow (VF) (l/min) by multiplying the average blood flow velocity (cm/s) by the cross-sectional area of the vein.

Cross-sectional area=$\pi \times r^2$ or $\pi \times d^2/4$. Once the diameter ($d = 2r$) is measured by positioning the cursors on the machine, the time-averaged mean velocity (TAMV) and VF are automatically calculated and displayed on the screen.

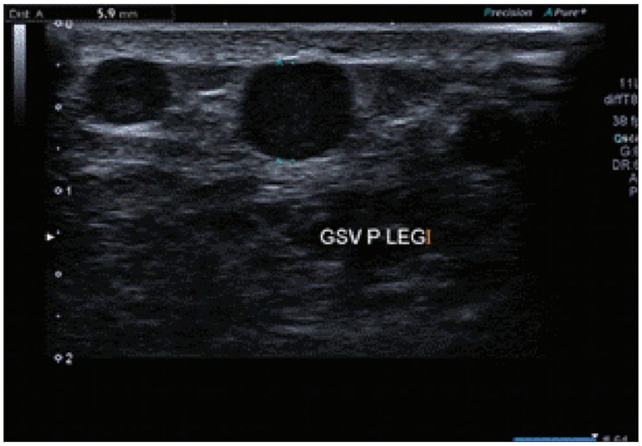

Figure 31: Case 1.

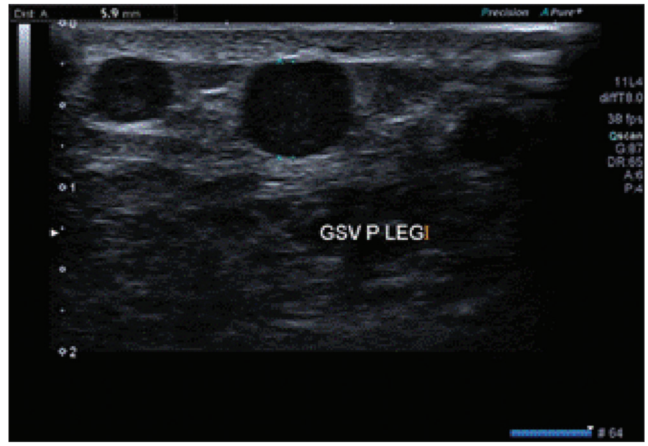

Figure 32: Case 1.

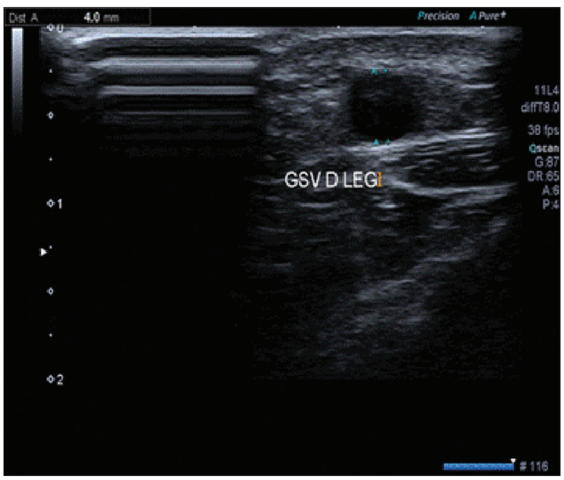

Figure 33: Case 1.

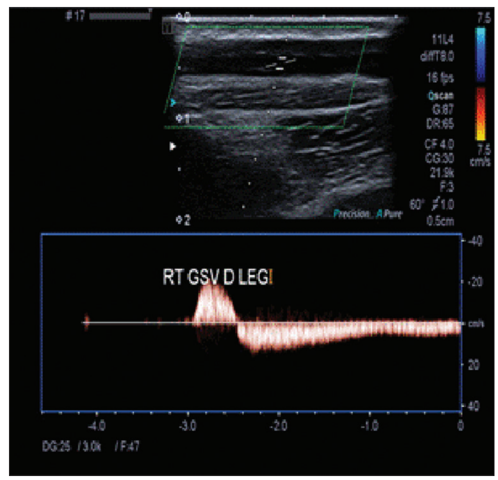

Figure 34: Case 1.

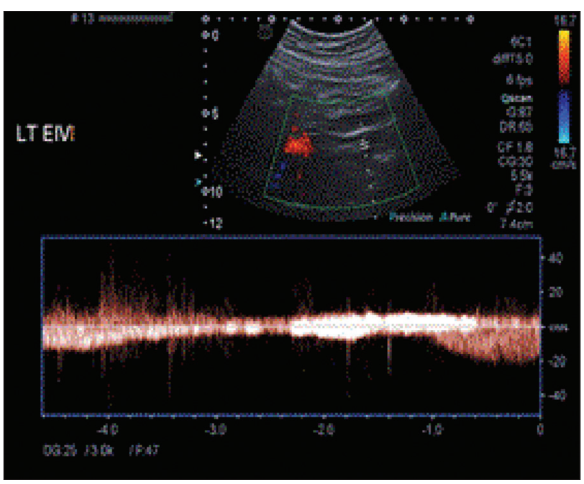

Figure 35: Case 2.

Figure 36: Case 2.

The CFV can be taken as a representative vessel from which the VF can be measured. VF can also be measured in the saphenous vein [12].

Conclusions can then be made on the venous hemodynamics draining the affected leg. Arterial parameters should be included in the quantitative assessment as they influence venous hemodynamics. For this reason, a ratio can be calculated for the venous and arterial VF in the CFV and the common femoral artery, respectively. This ratio is called the venous arterial flow index (VAFI).

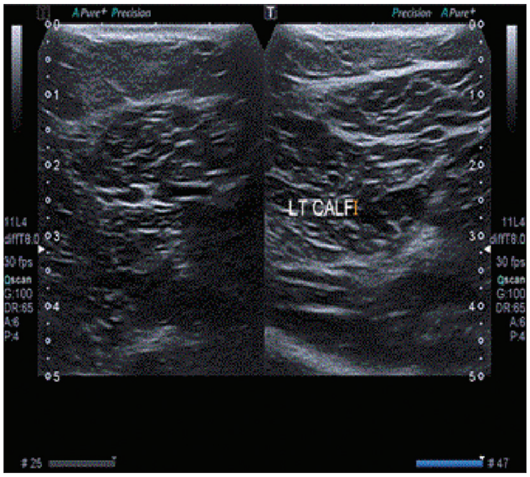

Figure 37: Case 2.

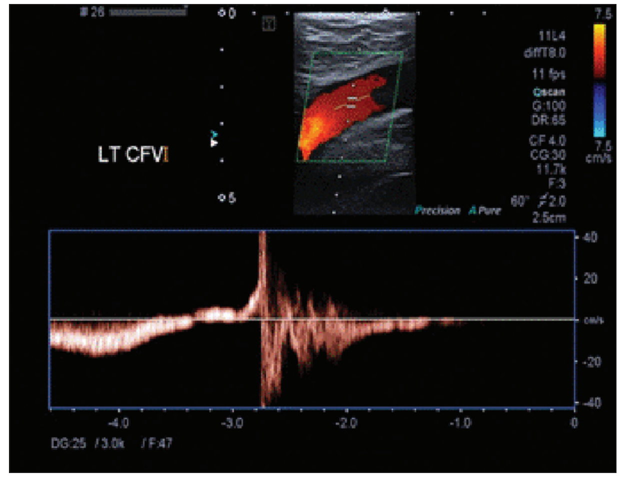

Figure 38: Case 2.

Figure 39: Case 2.

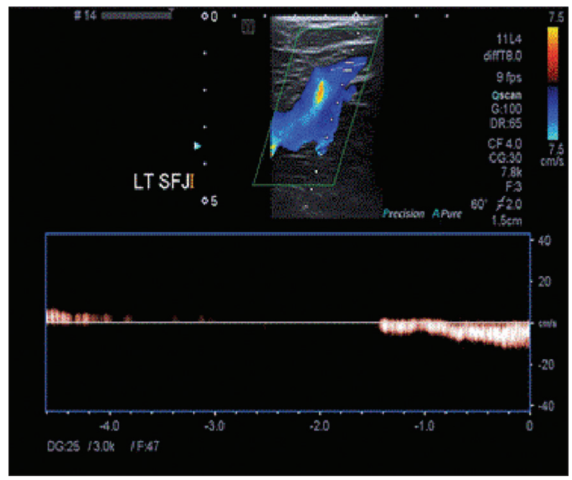

Figure 40: Case 2.

Figure 41: Case 2.

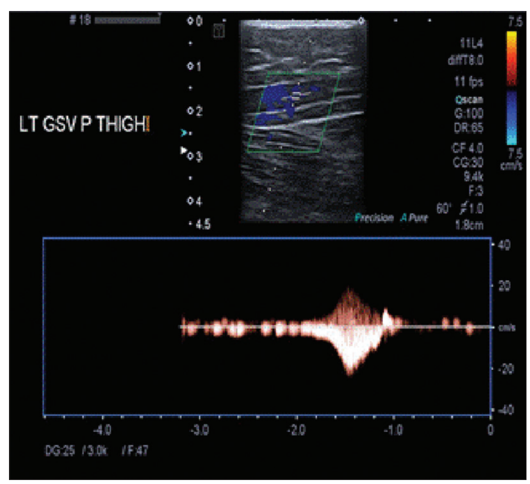

Figure 42: Case 2.

VF is measured in the relaxed, lying patient, with the leg rotated slightly outward and the head supported on a pillow. While the measurements are taken, it is important that the patient should breathe calmly and that the vein should not be compressed by excessive pressure of the probe on the skin. The diameters of the common femoral artery and CFV are then measured in transverse view. VF is measured in longitudinal view.

Figure 43: Case 2.

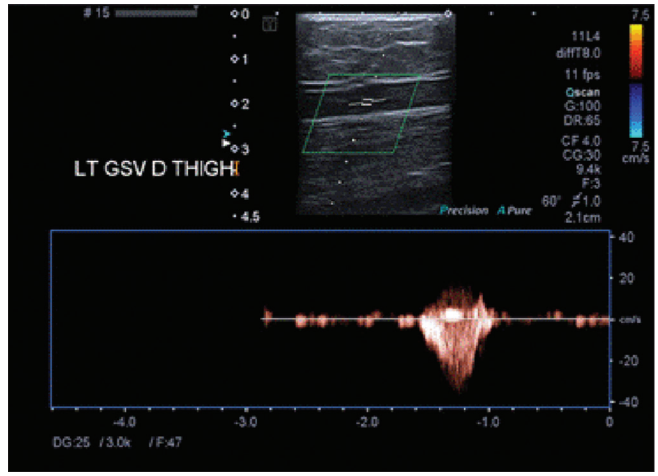

Figure 44: Case 2.

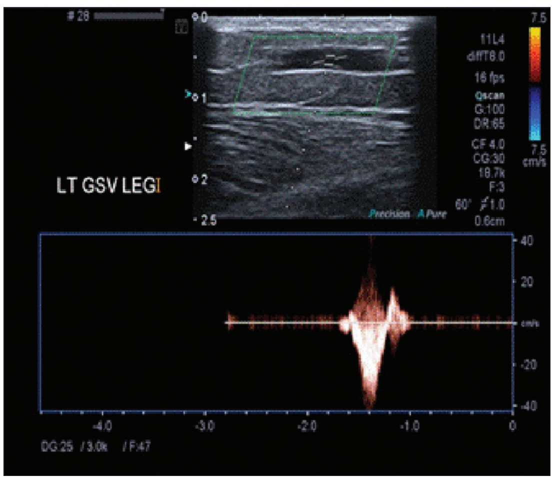

Figure 45: Case 2.

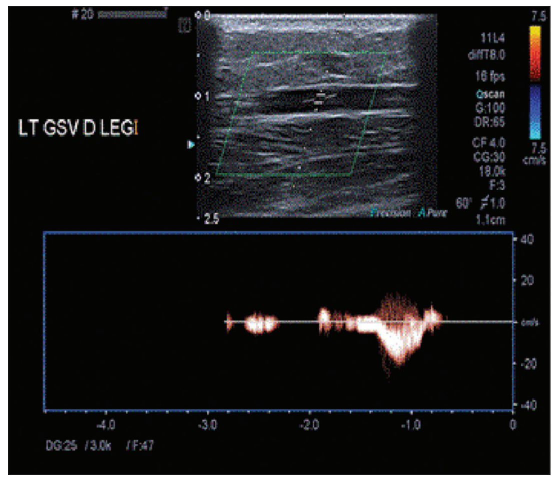

Figure 46: Case 2.

Figure 47: Case 2.

Figure 48: Case 2.

In artery, it is recommended to measure the flow over several pulses to calculate the TAMV. This function is usually configured in the machine.

In vein, the typical flow pattern is slow and relatively constant, modulated by respiration. It should be measured over several seconds, and then the average calculated as with the artery.

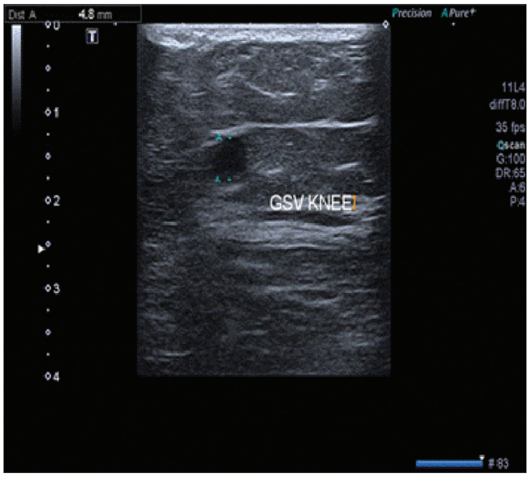

Figure 49: Case 2.

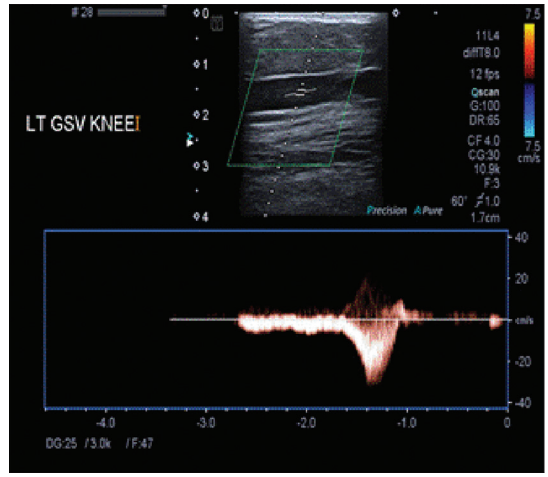

Figure 50: Case 2.

As the artery and the vein flow in opposite directions, the flow in the vein appears as a negative value. It must be treated as positive for calculating the VAFI. The flow velocity is given in m/s, m/min, or cm/s, at the site of the measured vessel diameter (*d*). The VF in each vessel is calculated from the diameters and flow velocities using the following formula:

$$VF\left[\mathrm{cm}^3/\mathrm{s}\right] = TAMV\left[\mathrm{cm/s}\right] \times \pi \times d^2/4\left[\mathrm{cm}^2\right]$$

$$1\ \mathrm{cm}^3 = 1\ \mathrm{ml\,area\,is}\ \pi \times r^2 \mathrm{or}\ \pi \times d^2\ /4$$

If the VF in the CFV and common femoral artery are designated VFa and VFv, respectively, then

$$VAFI = VFv\left[\mathrm{ml/min}\right]/VFa\left[\mathrm{ml/min}\right]$$

In subjects with healthy veins, the VAFI is less than or equal to 1.0. In patients with hemodynamically significant impairment, the VAFI increases to more than 1.2. It can even increase up to 2.0 [13]. This means that the flow in the femoral vein is much higher than the arterial inflow into the leg. This occurs when there is a recirculation loop. The VAFI is also very useful for measuring the hemodynamic situation before and after intervention. The influence of intervention on hemodynamics is seen after only a few days when the high preoperative values return to normal. The noninvasive nature of US in measuring VF is a clear advantage compared with invasive measurement techniques.

Validation of the venous arterial flow index

The index was measured in patients with different venous diseases under different conditions. It was shown that in those with primary varicose veins, significantly higher values were measured than those found in healthy subjects [13]. A similar pattern was found in patients with postthrombotic syndrome compared with healthy subjects[13] and that the level of the VAFI values correlated with the clinical severity of the disease. In the aforementioned studies, subjects with healthy veins were found to have an average VAFI of less thsn or equal to 1.0. This may be interpreted to mean that there is a point of equivalence between arterial inflow per unit of time and the corresponding venous outflow per unit of time. The high VAFI values found in patients with varicose vein may be an index of recirculation, which normalizes after intervention. With respect to the reliability of the measurement results, it was shown that the VAFI remained stable both during uninterrupted examination for 1 h and over 3 consecutive days [13]. The VAFI is a repeatable, sensitive parameter for venous hemodynamics, which has been confirmed with modern phase-contrast MR techniques [14].

The GSV at the proximal thigh was more uniform, easier to measure, and more representative as a single measurement point. The average diameter in subjects with healthy veins was 7.5 ± 1.8 mm at the saphenofemoral junction and 3.7 ± 0.9 mm in the proximal thigh. In subjects with reflux, the average diameter was 10.9 ± 3.9 mm at the saphenofemoral junction and 6.3 ± 1.9 mm in the proximal thigh. The diameter did not correlate with the Hach Class [2].

Diameter measurements should be taken as a transverse image. For the aforementioned reasons, it is preferable to measure the diameter in the thigh, 10–15 cm from the groin, in a segment where the walls of the GSV run parallel and there are neither inflows nor outflows.

Patients and Methods

A survey of the GSV was undertaken in consecutive outpatients who presented with the suspicion or presence of a primary venous disorder. This was a practitioner-initiated prospective study performed in a vein clinic in Cairo and Menoufia from January 2018 to January 2019. The protocol was accepted by the Ethics Committee of the Menoufia University, Egypt.

Inclusion criteria

The following were the inclusion criteria:

(1) Primary varicose vein.
(2) Age: 18–60 years.

(3) Eligible legs were included irrespective of the findings on the other leg, and this study involved 100 limbs.

Exclusion criteria

The following were the exclusion criteria:
(1) Secondary varicose vein.
(2) Recurrent varicose vein.
(3) Deep venous reflux.
(4) Acute disorders (thrombosis/phlebitis/cellulitis).
(5) Lymphedema or pregnancy.
(6) Below 18 years and above 60 years.

Assessments included history taking, which involved previous DVT, surgery, and any comorbidity; clinical examination, both general and local, including clinical, etiologic, anatomic, and pathophysiologic (CEAP) classification; and Duplex US.

Examination

(1) History taking.
(2) Clinical examination: general and local.
(3) Clinical findings were documented.

CEAP classification

(1) The protocol for examination of varicose vein with duplex US was as follows:
    (a) Done in standing position.
    (b) Superficial systems were SFJ and GSV reflux. Vein diameters were measured in transverse view at SFJ distal to terminal valve (2 cm), proximal thigh (15 cm after SFJ), distal thigh (just above medial trochanter 2 cm), below the knee (proximal leg) (below medial trochanter 2 cm), mid leg (below medial trochanter 10 cm), anterior accessory saphenous vein, posterior accessory saphenous vein, saphenopopliteal junction, and small saphenous vein.
    (c) Deep systems were inferior vena cava (IVC), common iliac vein (CIV), External iliac (EIV), CFV, femoral vein and deep femoral vein, popliteal vein, posterior tibial vein, and anterior tibial vein.

Duplex US examinations were performed by a single investigator with a (TOSHIBA AMERICA MEDICAL SYSTEMS. INC. 2441 Michelle Drive, Tustin,USA CA 92780)Toshiba Apolio 400 color-coded duplex scanner fitted with a 7.5-MHz linear probe and 2–5 MHz curved probe [6,15].

Steps of examination to assess patency and competency were as follows:

In standing position, SSV, intersaphenous V, PASV, SPJ, Calf v, GSV (SFJ, proximal thigh, distal thigh, knee, proximal leg, distal leg), AASV, and SASV were examined, and in lying position, CFV, SFJ, FV, deep FV, POP V, PTV, ATV, EIV, CIV and CIV diameter, and IVC.

The GSV was examined in the standing position applying toe movements, manual compression, and decompression as well as Valsalva maneuvers to assess orthograde flow and reflux. Reflux lasting longer than 1 s was considered pathologic [16].

Patients were classified into five groups

Group I	SFJ reflux
Group II	Proximal thigh GSV reflux (15 cm after SFJ)
Group III	(a) Distal thigh (just above medial trochanter 2 cm) (b) Knee GSV reflux
Group IV	Below-knee GSV reflux (proximal leg) (below medial trochanter 2 cm)
Group V	Mid-leg GSV reflux (below medial trochanter 10 cm)

No assessment was made of dilated distal branch veins and eventually incompetent perforator veins. Excluded lower limbs with reflux through the AASV, PASV, and SSV. Trunkal GSV was examined only.

Clinical findings were documented according to the highest CEAP class. Legs range from teleangiectasias (C1) to active venous ulcers (C6). In all cases, the etiology was primary (Ep) and pathophysiology reflux (Pr). The anatomy was varicose GSV trunk with or without branch varices.

Vein diameters were measured holding the probe transversely with no pressure. Duplicate measurements were taken at five sites: at the SFJ distal to the terminal valve and 15 cm below the junction [this site, chosen by CHIVA (conservative ambulatory hemodynamic management of varicose veins) group members, shows parallel walls of the GSV and is located above the junction of the most proximal branch veins [7,17]], at the knee, at the proximal leg, and mid leg.

Results

Patients were randomized 100 lower limbs included with trunkal GSV reflux or segmental reflux.

Study flow chart

Regarding demographics of the patients, median age was 36 years, female represented 70% of lower limbs examined, weight ranged from 50 to 130 kg, with BMI of 28–30, and C2 and C3 represented 74% of patients. Correlations were found with body weight in each group and with BMI but not with height.

Demography of patients	*n*=100
Age	
Mean±SD	35.74±7.76
Range	18-52
Sex [*n* (%)]	
Female	70 (70.0)
Male	30 (30.0)
Weight	
Mean±SD	91.78±16.39
Range	50-130
CEAP [*n* (%)]	
C1	2 (2.0)
C2	32 (32.0)
C3	42 (42.0)
C4	18 (18.0)
C6	6 (6.0)

Clinical findings of a venous disorder were teleangiectasias (C1), which were found in 34%, branch varices (C2) in 32%, edema (C3) in 42%, dermatosclerosis (C4) in 18%, and active venous ulcer (C6) in 6%.

In patients with SFJ reflux (group I), reflux occurred at 7.16±2.30 mm.

SFJ	Not reflux (*n*=46)	Reflux (*n*=54)	Test value	*P*	Significance
Mean±SD	5.66±1.59	7.16±2.30	−3.743	<0.001	HS
Range	3.50-9.50	4.00-14.00			

HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

In patients with proximal thigh reflux (group II), reflux occurred at 6.60±1.89 mm.

GSV prox. thigh	Not reflux (*n*=42)	Reflux (*n*=58)	Test value	*P*	Significance
Mean±SD	4.38±0.93	6.60±1.89	−7.031	<0.001	HS
Range	2.40-6.00	3.60-11.00			

GSV, great saphenous vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

In patients with distal thigh reflux (group IIIa), reflux occurred at 6.12±1.63 mm.

GSV DIST thigh	Not reflux (*n*=40)	Reflux (*n*=60)	Test value	*P*	Significance
Mean±SD	4.19±1.04	6.12±1.63	−6.619	<0.001	HS
Range	2.50-6.50	3.10-9.50			

GSV, great saphenous vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

In patients with knee reflux (group IIIb), reflux occurred at 5.78±1.60 mm.

GSV knee	Not reflux (*n*=40)	Reflux (*n*=60)	Test value	*P*	Significance
Mean±SD	3.66±0.82	5.78±1.60	−7.711	<0.001	HS
Range	2.30-5.50	3.60-11.00			

GSV, great saphenous vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

In patients with proximal leg (group IV), reflux occurred at 4.6±1.24 mm.

GSV prox leg	Not reflux (*n*=40)	Reflux (*n*=60)	Test value	*P*	Significance
Mean±SD	3.09±0.74	4.60±1.24	−6.933	<0.001	HS
Range	2.00-4.80	2.80-7.50			

GSV, great saphenous vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

In patients with mid-leg reflux (group V), reflux occurred at 3.59±1.16 mm.

GSV mid leg	Not reflux (*n*=68)	Reflux (*n*=32)	Test value	*P*	Significance
Mean±SD	2.56±0.46	3.59±1.16	-6.396	<0.001	HS
Range	1.50-3.80	1.90-6.00			

GSV, great saphenous vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

Vein diameters were larger in the presence of reflux, compared with its absence. GSV diameters were assessed regarding their value to predict reflux. Curves were used to assess the relative performance of the five sites of measurement.

Sensitivity and specificity are calculated for thresholds at the mean:

(1) Cutoff point at SFJ greater than 5.7 mm with sensitivity 77.7%.
(2) Cutoff point at proximal thigh greater than 7 mm with sensitivity 44.4%.
(3) Cutoff point at distal thigh greater than 5.5 mm with sensitivity 60%.
(4) Cutoff point at knee greater than 4.2 mm with sensitivity 86.6%.
(5) Cutoff point at proximal leg greater than 3.5 mm with sensitivity 73%.
(6) Cutoff point at distal leg greater than 3 mm with sensitivity 56%.

CFV was screened to make a relation between the diameter and reflux also:

CFV diameter	Not reflux (*n*=64)	Reflux (*n*=36)	Test value	*P*	Significance
Mean±SD	9.28±2.52	11.51±1.28	−4.965	<0.001	HS
Range	4.00-15.00	9.00-14.00			

CFV, common femoral vein; HS, highly significant. *P*>0.05, nonsignificant. *P*<0.05, significant. *P*<0.01. highly significant. •Independent *t*-test.

Sensitivity and specificity are calculated for thresholds at the CFV. Cutoff point greater than 10.5 mm with sensitivity 77.8%.

A total of 100 limbs included, SFJ reflux (group I) at 7.16 ± 2.30 mm, proximal thigh (group II) at 6.60 ± 1.89 mm, distal thigh (group III a) at 6.12 ± 1.63 mm, knee (group III b) at 5.78 ± 1.60 mm, proximal leg (group IV) at 4.6 ± 1.24 mm, and mid leg (group V) at 3.59 ± 1.16 mm.

Measurement at six sites revealed higher sensitivity and specificity to predict reflux.

Discussion

Comparison of treatment modalities requires exact documentation of the clinical, anatomical, and functional situation in each patient using standardized and validated techniques. However, even the recommendations of the Union Internationale de Phlébologie regarding measurement of GSV diameter at different sites lack proper validation [6]. Diameter measurement at the PT seems to have some advantages as compared with measurement at the SFJ, which is a landmark easily identified with US. Although GSV reflux in the groin is readily identified, measurement of vein diameter right there is challenging for several reasons [18].

The curvature of the inguinal GSV renders adjustment of the US probe exactly perpendicular to the vein axis difficult. Furthermore, the shape of the vein is influenced by joining epigastric, pudendal, and accessory veins and eventual aneurysmatic dilatations caused by deep venous refluxes. Thus, diameter assessment in the groin appears less reliable [18].

The proximal thigh site 15 cm below the SFJ is located in the truncal portion of GSV where the vein is cylindrical and largely devoid of joining branches. The site is also well accessible, and diameter measurements can be taken reliably [18].

The CHIVA group measures diameters 15 cm distal to the SFJ because the PT site allows outcome assessment, as their treatment strategy leaves the GSV trunk *in situ* even when crossectomy is performed [7,17]

Data revealed a debatable finding: GSV diameter, venous hemodynamics (refilling times in photoplethysmography), and clinical disease class did not differ whether reflux was above knee only or above and below knee. The finding is in disagreement with the understanding that the length of reflux in the GSV would have an influence on disease severity [19–21].

The correlation between the two measurement sites permitted calculation of a conversion factor used to review selected publications. It disclosed a wide range of diameters in patients worked up for interventions with different techniques (Tables 1 and 2). The data suggest that some studies included patients with minor disease. The same may be true for a recent study that found no correlation between GSV diameter and quality of life. The reported diameters were within the limits of the control subjects of this study [22].

Diameter assessment at the PT seems suitable for stratification of patients allocated to future interventional trials as well as for outcome evaluation. With more data available, it may also become an argument in the discussion of treatment options with patients, which is not the case at the moment [2].

The study by Mendoza *et al*.[2] states the following:

(1) Measurements were took at the SFJ as proposed by the Union Internationale de Phlébologie and compared it with measurements at the PT as used and published by the CHIVA group because no data on the mid-thigh point have been published until 2010.

(2) Measurement at the PT as compared with measurement at the SFJ demonstrated higher accuracy and both higher sensitivity and specificity for venous disease class as well as for prediction of reflux. Thus, diameter measurement at the PT may develop as a surrogate parameter for specific clinical situations

(3) Results: of 182 legs, 60 had no GSV reflux (controls; group I), 51 had above-knee GSV reflux only (group II), and 71 had GSV reflux above and below knee (group III). GSV diameters in group I measured 7.5 ± 1.8 mm at the SFJ and 3.7 ± 0.9 mm at the PT. In groups II and III, they measured 10.9 ± 3.9 mm at the SFJ and 6.3 ± 1.9 mm at the PT ($P < 0.001$ each).

(4) Measurement at the PT revealed higher sensitivity and specificity to predict reflux and clinical class.

Table 1: Literature-derived preinterventional great saphenous vein diameters measured at one of the sites studied in this survey and converted to the other site

References (treatment investigated)	Number	Site of measurement	SFJ diameter	Proximal thigh diameter
Pittaluga *et al*. (P ASVAL)	303	SFJ	7.1±0.2	4.0±0.4
Gonzalez-Zeh *et al*. (Foam)	53	SFJ	7.6±3.0	4.3±1.7
Theivacoumar *et al*. (LASER)	84	SFJ	7.7±2.0	4.4±1.1
Theivacoumar *et al*. (LASER)	27	SFJ	7.9±1.6	4.5±0.9
Gonzalez-Zeh *et al*. (LASER)	45	SFJ	8.2±3.2	4.6±1.8
Pittaluga *et al*., (P HLS)	270	SFJ	8.4±0.3	4.8±0.5
Creton *et al*. (closure fast)	295	SFJ	8.4±2.3	4.8±1.3
Pannier *et al*. (laser)	85	SFJ	10.0±0.4	5.7±0.2
This study	122	SFJ and Proximal thigh	10.9±3.9	6.3±1.9
Parés *et al*. (Stripping)	167	Proximal thigh	11.5±1.1	6.5±1.9
Cappelli *et al*.[17] (CHIVA)	177	Proximal thigh	11.7±1.0	6.7±1.7
Doganci *et al*. (Laser)	54	SFJ	11.8±4.1	6.7±7.3
Parés *et al*. (CHIVA)	167	Proximal thigh	12.0±1.1	6.8±2.0
Doganci *et al*. (laser)	52	SFJ	12.1±4.3	6.8±7.6
Cappelli *et al*.[17] (CHIVA)	77	Proximal thigh	12.4±1.1	7.1±2.0

Data are sorted according to diameter size.

Table 2: Great saphenous vein diameters measured at the SFJ and PT as a function of the presence and extent of reflux

	Number	SFJ diameter (mm)	Proximal thigh diameter (mm)	*P*
Group I (no GSV reflux)	60	7.5±1.8	3.7±0.9	<0.001
Groups II and III (GSV reflux)	122	10.9±3.9	6.3±1.9	<0.001
Group II (thigh reflux only)	51	10.5±3.2	6.2±1.7	<0.001
Group III (lower leg reflux)	71	11.2±4.3	6.3±2.1	<0.001

GSV, great saphenous vein. Mendoza *et al*. (2).

(5) It concluded that GSV diameter correlates with clinical class, measurement at the PT being more sensitive and more specific than measurement at the SFJ.

In this study, patients were classified into five groups:

Group I	SFJ reflux
Group II	Proximal thigh GSV reflux (15 cm after SFJ)(2)
Group III	(a) Distal thigh (just above medial trochanter 2 cm) and (b) knee GSV reflux
Group IV	Below-knee GSV reflux (proximal leg) (below medial trochanter 2 cm)
Group V	Mid-leg GSV reflux (below medial trochanter 10 cm)

Reflux was classified according to the site of measurement. The number of patients was 100. Results were nearly equal as introduced by Mendoza *et al*.[2] at SFJ and proximal thigh. Measurement of GSV at knee joint can predict reflux if greater than 5.5 mm

Reflux at different sites

SFJ	7.16±2.30
Proximal thigh	6.60±1.89
Distal thigh	6.12±1.63
Knee	5.78±1.60
Proximal leg	4.60±1.24
Mid leg	3.59±1.16
CFV	11.51±1.28

CFV, common femoral vein.

Limitation of study

Duplex is operator dependent, so to avoid this conflict, one operator did all the cases. The number of patients was 100 only. The study target was only patients who came to vein clinic. There was no relation found between quality of life and diameter.

The paper adds toward sites to predict reflux not only at SFJ and proximal thigh, GSV measurement at knee joint can predict reflux, and CFV reflux can be affected by superficial venous system reflux (Figs. 1- 50).

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Conflicts of interest

There are no conflicts of interest.

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