A comprehensive ultrasound approach to lower limb varicose veins and abdominal-pelvic connections

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ABSTRACT

Objective: Pelvic venous reflux may be responsible for pelvic venous disorders and/or lower-limb (LL) varicose veins. Ultrasound investigation with Doppler allows a complete study of the entire infra-diaphragmatic venous reservoir. The aim of this study was to guide and standardize the investigation of the pelvic origin of venous reflux in female patients with LL varicose veins.

Methods: In this case-control study, we applied a comprehensive ultrasound investigation protocol, which involved four steps: (1) venous mapping of the lower limbs; (2) transperineal and vulvar approach; (3) transabdominal approach; and (4) transvaginal approach.

Results: Forty-four patients in group 1 (patients with LL varicose veins and pelvic escape points [PEPs]) and 35 patients in group 2 (patients with LL varicose veins without PEPs [control group]) were studied, matched by age. The median age was 43 years in both groups. The calculated body mass index was lower in group 1 (23.4 kg/m^2) compared with the control group (25.4 kg/m^2), and this difference reached statistical significance ($P < .001$). The presence of pelvic varicose veins (PVs) by transvaginal ultrasound was 86% in group 1 and 31% in group 2. Perineal PEPs were the most prevalent, being found in 35 patients (79.5%), more frequent on the right (57.14%) than on the left (42.85%) and associated with bilateral PVs 65.7% of the time. In group 1, 23 patients (52%) reported recurrent varicose veins vs eight patients (23%) in the control group ($P = .008$). Regarding the complaint of dyspareunia, a significant difference was identified between the groups ($P = .019$), being reported in 10 (23%) patients in group 1 vs one patient (2.9%) in the control group. The median diameters in the transabdominal approach of the left gonadal veins were 6.70 mm for group 1 and 4.60 mm for group 2 ($P < .001$). In patients with PVs in group 1, the median diameter of PEPs at the trans-perineal window was 4.05 mm. In the transvaginal examination, the mean diameter of the veins in the peri uterine region was 8.71 mm on the left and 7.04 mm on the right.

Conclusions: The identification of PEPs by venous mapping demonstrates the pelvic origin of the reflux and its connections with the LL varicose veins. For a more adequate treatment plan, we suggest a complete investigation protocol based on the transabdominal and transvaginal study to rule out venous obstructions, thrombotic or not, and confirm the presence of varicose veins in the pelvic adnexal region. (J Vasc Surg Venous Lymphat Disord 2024;12:101851.)

Keywords: Chronic pelvic pain; Color Doppler ultrasound; Pelvic varicose veins; Pelvic escape point; Venous compression

Pelvic venous insufficiency may be responsible for varicose veins located in the pelvic reservoir or for varicose veins in the perineal region and/or lower limbs,[1,2] being frequently one of the causes of chronic pelvic pain, known as pelvic congestion syndrome (PCS), which was recently defined in the document of Transatlantic Interdisciplinary Consensus (VEIN-TERM) as chronic symptoms that may include pelvic pain, perineal heaviness, urination urgency, and post-coital pain, caused by reflux and/or obstruction of pelvic veins, which may be associated with vulvar, perineal, and/or lower-limb varicose veins. PCS most commonly affects women of reproductive age (20-45 years), and the incidence is related to the number of pregnancies.[3] Doppler ultrasonography is considered the first-line investigation method for pelvic venous disorders, as it is noninvasive, easily accessible, and inexpensive, in addition to allowing the exclusion of other pelvic pathologies.[4] Pelvic escape points (PEPs) connect pelvic reflux with lower-limb varicose veins and are easily identified by studying the transperineal region during venous mapping.[5] Unsatisfactory results of

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Additional material for this article may be found online at www.jvsvenous.org.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2213-333X

https://doi.org/10.1016/j.jvsv.2024.101851

Epidemiological and clinical variables

- Age, gender, weight, height, body mass index
- Number of pregnancies
- Pelvic and/or lower limb symptoms
- Prior surgery and recurrence of varicose veins
- Family history of varicose veins

Vascular examination

- SVP and CEAP classifications
- Venous mapping of the lower limbs and transperineal
- Transabdominal ultrasound
- Transvaginal ultrasound

Fig 1. Collected variables. *CEAP,* Clinical-Etiology-Anatomy-Pathophysiology; *SVP,* Symptoms-Varices-Pathophysiology.

traditional treatments for PCS may be related to an incomplete investigation.[6] Based on this, an accurate diagnosis protocol of the entire infra-diaphragmatic venous reservoir becomes indispensable for hemodynamic compression of all these connections.

METHODS

This is a case-control study in which a group of patients with varicose veins in the lower limbs and PEPs with reflux and another group with varicose veins in the lower limbs without PEPs (control group) were evaluated using an ultrasound investigation protocol for confirmation or not of pelvic varicose veins. Epidemiological, anthropometric, and clinical data and variables resulting from the ultrasound evaluation were collected. This study was approved by the local Research Ethics Committee under approval number 5.931.954.

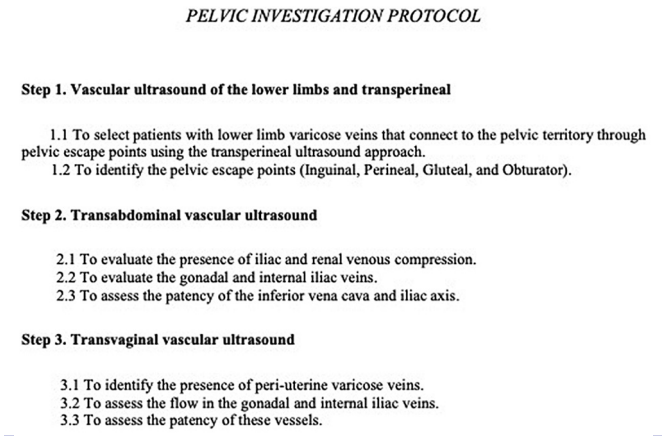
Study population

A convenience sample was used, consisting of 79 patients referred to the researcher's vascular laboratory from March 2022 to March 2023. Of these, 44 patients had varicose veins in lower limbs and PEPs with reflux (group 1), and 35 patients had varicose veins in the lower limbs without PEPs (group 2), all of them female and matched by age. After orienting the patient and signing the Free and Informed Consent Form, the consultation was carried out, consisting of the following steps: anamnesis, physical examination, Symptoms-Varices-Pathophysiology classification (SVP),[7] and Clinical-Etiology-Anatomy-Pathophysiology classification (CEAP)[8] (Fig 1); all patients underwent ultrasound examination of the veins of the lower limbs, abdomen, and pelvis following a standard protocol performed by the same examiner. On average, the complete examination took 60 minutes per patient. The exams were performed with the Epiq 5G Philips device, and the transducers used were: linear 3-12 MHz, convex pure wave 1-5 MHz, and endocavity 3-10 MHz.

The sample size was calculated to test the difference in the values of a quantitative variable between two groups, for paired samples. The Wilcoxon test for paired samples was considered. At a significance level of 5%, minimum power of 80%, for an average effect size, at least 35 cases and 35 controls would be needed to conduct the study.

ARTICLE HIGHLIGHTS

- **Type of Research:** Case-control study
- **Key Findings:** Forty-four patients in group 1 (patients with lower-limb varicose veins and pelvic escape points [PEPs]) and 35 patients in group 2 (patients with lower-limb varicose veins without PEPs [control group]) were studied, matched by age. The median age was 43 years in both groups. The calculated body mass index was lower in group 1 (23.4 kg/m^2) compared with the control group (25.4 kg/m^2), and this difference reached statistical significance ($P < .001$). The presence of pelvic varicose veins (PVs) by transvaginal ultrasound was 86% in group 1 and 31% in group 2. Perineal PEPs were the most prevalent, being found in 35 patients (79.5%), more frequent on the right (57.14%) than on the left (42.85%) and associated with bilateral PVs in 65.7% of the time. In group 1, 23 patients (52%) reported recurrent varicose veins vs eight patients (23%) in the control group ($P = .008$). Regarding the complaint of dyspareunia, a significant difference was identified between the groups ($P = .019$), being reported in 10 (23%) patients in group 1 vs one patient (2.9%) in the control group. The median diameters in the transabdominal approach of the left gonadal veins were 6.70 mm for group 1 and 4.60 mm for group 2 ($P < .001$). In patients with PVs in group 1, the median diameter of PEPs at the trans-perineal window was 4.05 mm. In the transvaginal examination, the mean diameter of the veins in the peri uterine region was 8.71 mm on the left and 7.04 mm on the right.
- **Take Home Message:** Understanding the venous connection between abdomen, pelvis, and the lower limbs holds promise for tailoring more precise treatment strategies, potentially diminishing recurrence rates and enhancing patient outcomes. The proposed methodology presents distinct advantages in diagnosing and managing lower-limb varicose veins by directly addressing pelvic venous reflux, offering a more comprehensive investigative approach than current methods.


PELVIC INVESTIGATION PROTOCOL

Step 1. Vascular ultrasound of the lower limbs and transperineal

1.1 To select patients with lower limb varicose veins that connect to the pelvic territory through pelvic escape points using the transperineal ultrasound approach.
1.2 To identify the pelvic escape points (Inguinal, Perineal, Gluteal, and Obturator).

Step 2. Transabdominal vascular ultrasound

2.1 To evaluate the presence of iliac and renal venous compression.
2.2 To evaluate the gonadal and internal iliac veins.
2.3 To assess the patency of the inferior vena cava and iliac axis.

Step 3. Transvaginal vascular ultrasound

3.1 To identify the presence of peri-uterine varicose veins.
3.2 To assess the flow in the gonadal and internal iliac veins.
3.3 To assess the patency of these vessels.

Fig 2. Pelvic varicose veins investigation protocol.

The sample size was calculated using the G*Power 3.1.9.4 program.

Patients with lower-limb varicose veins and PEPs identified during venous mapping, aged between 25 and 60 years, were included in group 1. Patients with isolated lower-limb varicose veins and with corresponding age were included in the control group (group 2). All patients had previous gynecological ultrasounds without alterations, such as endometriosis, uterine myomatosis, and adenomyosis. Male patients, patients with deep venous thrombosis or post-thrombotic sequelae, pregnant women, and female subjects who had not attained menarche or undergone penetrative intercourse were not included in the study.

Pelvic varicose veins investigation protocol—step by step

Step 1: Conventional venous mapping. The first step of the investigation protocol for pelvic varicose veins follows the same recommendations proposed for the venous mapping of lower-limb varicose veins,[9] paying attention to varicose veins connected to the pelvic territory (Fig 2).

Step 2: Investigation of pelvic leak points. With the patient in a standing position, reflux in the PEPs was induced with the Valsalva maneuver. A linear transducer was used for the conventional venous mapping. The PEPs and their anatomical relationships are shown in Fig 3 and described below.[10]

Perineal point (P point). The transducer was positioned at the junction of the posterior one-quarter and anterior three-quarters laterally to the labia majora, close to Alcock's canal, where the perineal veins continue after receiving the labial tributaries, thus connecting the internal and external pudendal systems. Slight movements are made in a medial direction towards the pubis with the thigh slightly flexed (Fig 4, Video 1).

Inguinal point (I point). The transducer was placed on the inguinal ligament, above the saphenofemoral junction, and moved in the superior and medial direction to about 1 cm above and lateral to the pubic bone to assess for the presence of varicose veins exteriorizing in the superficial inguinal ring. This escape point has three peculiarities: an ultrasound image with a concave aspect, it is associated with varicose veins in the pubic region, and, in most cases, it is related to varicose veins in the peri uterine or parametrical region (Fig 5, Video 2).

Gluteal point (G point). In the greater sciatic notch, the superior gluteal vein passes above the piriformis muscle, whereas the inferior gluteal vein passes below the piriformis muscle, and the gluteal point is located along the intrapelvic passage of the gluteal veins. The venous plexus of the sciatic nerve can be seen in the posterior proximal aspect of the thigh and is drained by the inferior gluteal vein (Fig 6, Video 3).

Obturator point (O point). It is located at the level of the saphenofemoral junction, in the obturator canal, and connects the deep veins of the anterior thigh muscles with the internal iliac vein. The transducer is placed between the great saphenous vein and the femoral vein in the inguinal region to visualize this point (Fig 7, Video 4).

Step 3: Transabdominal approach. The patient was examined in the supine and left lateral positions to assess the iliac axis and renal veins for compression. We used anatomical and velocimetry criteria for diagnosing iliac and renal venous compression.[12-14] The gonadal vein was identified using the psoas major muscle and the iliac vessels as a reference. Caliber and flow direction were evaluated bilaterally (Fig 8).

Step 4: Transvaginal approach. The patients with empty bladders were placed in the lithotomy/reverse Trendelenberg position, and the following criteria were used to assess the pelvic varicose veins: (1) the diameter of the parametrical veins greater than 7 mm; and (2) alteration in the amplitude of the retrograde flow during the Valsalva maneuver.[15,16] The gonadal veins, peri-uterine and perivaginal venous plexuses, internal iliac veins, and perineal escape points were evaluated (Fig 9). All patients received a cartography of the pelvis and abdomen with all the data found during the examination attached to the medical report[11] (Fig 10).

Statistical analysis

Qualitative variables were presented as frequencies, and quantitative variables as mean ± standard deviation or median (interquartile range [IQR]). Quantitative variables were submitted to the Shapiro-Wilk normality test. To compare quantitative variables between cases and controls, the Student *t*-test or Wilcoxon test for paired samples were used, and the McNemar χ^2 test was used to verify the association between qualitative variables. Analyzes were performed using the R program (version 4.2.0), and $P < .05$ was considered significant.

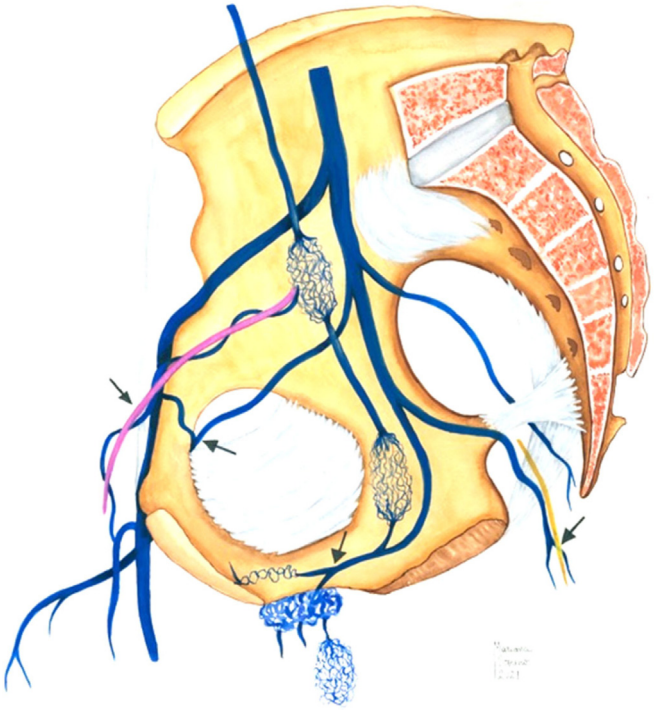


Fig 3. Watercolor painting with emphasis on pelvic veins and pelvic escape points (PEPs) (*arrows*). Authors archive.

RESULTS

Forty-four patients in group 1 (patients with lower-limb varicose veins and PEPs with reflux) and 35 patients in group 2 (patients with lower-limb varicose veins without PEPs [control group]) were studied, matched by sex and age. The median age was 41 years in group 1 and 44 years in group 2. The calculated body mass index (BMI) was lower in group 1 23.4 kg/m^2 (IQR, 21.3-25.1 kg/m^2) compared with the control group, which was 25.4 kg/m^2 (IQR, 23.9-29.2 kg/m^2), and this difference reached statistical significance ($P < .001$). The number of previous pregnancies ranged from zero to five in

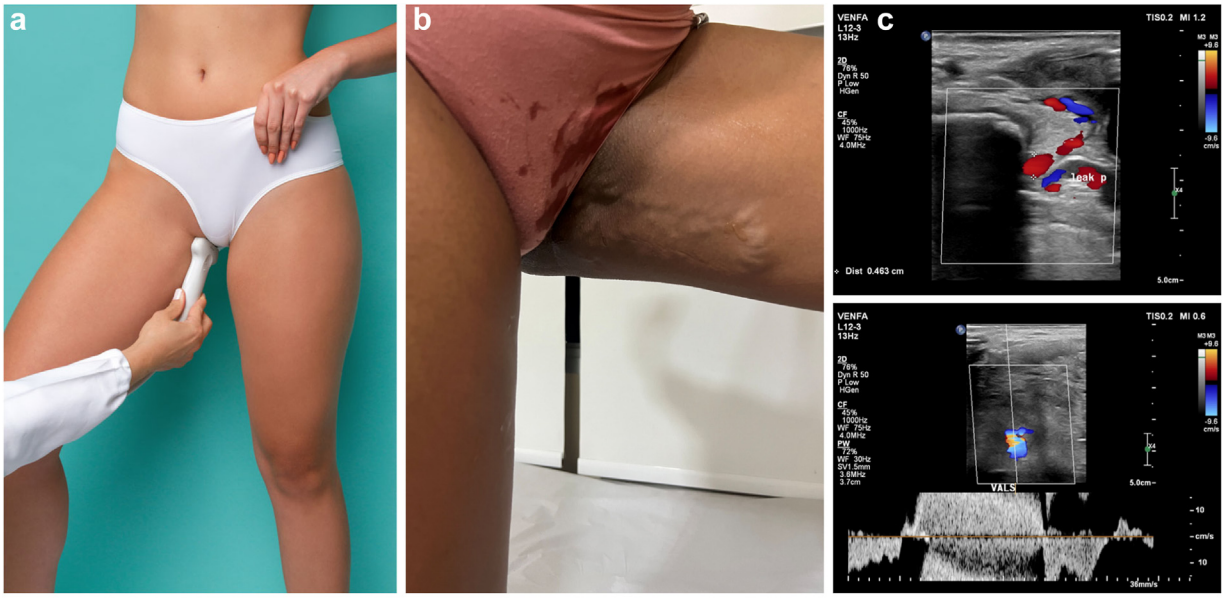


Fig 4. **A**, Location of the perineal escape point on transperineal ultrasound examination. **B**, Varicose veins in the perineal region and root of the thigh. **C**, Perineal escape point with reflux on color Doopler. Authors archive.

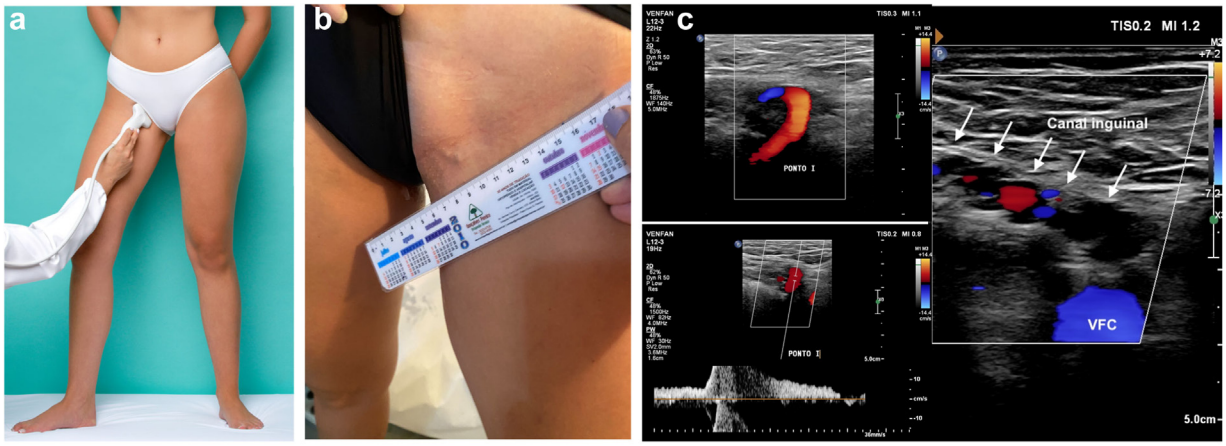


Fig 5. A, Location of the inguinal escape point on transperineal ultrasound examination. **B**, Varicose veins in the inguinal region. **C**, Inguinal escape point with reflux on color Doppler. Authors archive.

both groups, with a predominance of two pregnancies, corresponding to 42% in group 1 and 37% in group 2. No patient had iliac venous compression, and only one patient in group 1 had compression of the left renal vein (Table I).

The presence of pelvic varicose veins by transvaginal ultrasound according to the pre-established criteria for its diagnosis was 86% in group 1 and 31% in group 2 (Fig 11). In group 1, pelvic varicose veins on transvaginal ultrasound were bilateral in 59.1% of cases, left in 22.7% of cases, right in 4.5% of cases, and absent in 13.6% (Fig 12).

Perineal PEPs were the most prevalent, being found in 35 patients (79.5%) in group 1, more frequent on the right (57.14%) than on the left (42.85%) and is associated with bilateral pelvic varicose veins 65.7% of the time (Fig 13).

Inguinal PEPs were observed in 11 patients (25%) in group 1, being more frequent on the left (63.6%) and associated with bilateral pelvic varicose veins in 44.5% of cases, and without pelvic varicose veins in 27.3% of cases.

Gluteal PEPs were identified in six patients (13.6%) in group 1, being more prevalent on the right (83.3%) and being associated with bilateral pelvic varicose veins

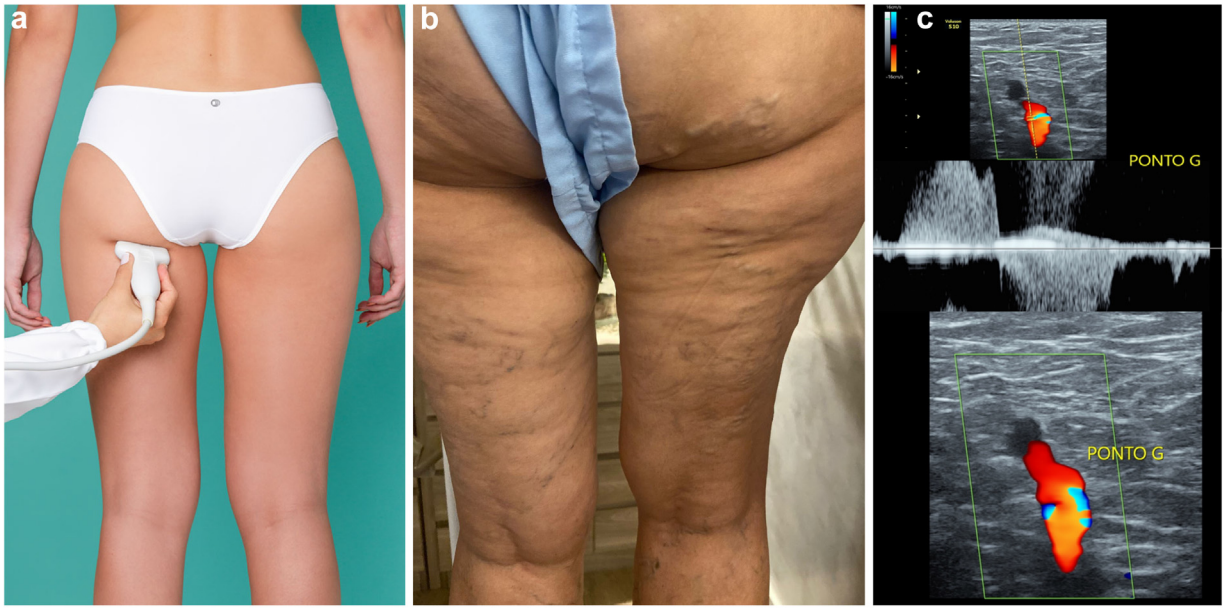


Fig 6. A, Location of the gluteal escape point on transperineal ultrasound examination. **B**, Gluteal and posterior thigh varicose veins **C**, Gluteal escape point with reflux on color Doppler. Authors archive.

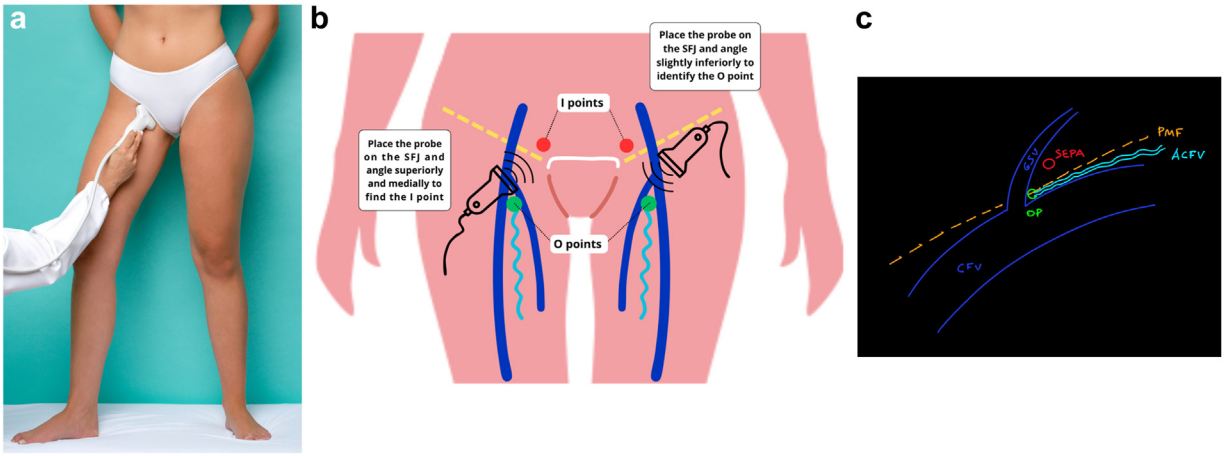


Fig 7. A, Location of the obturator escape point on transperineal ultrasound examination. **B**, Adapted schematic from Gail PS, 2023 demonstrating probe placement.[11] **C**, Illustration depicting anatomical landmarks of the obturator escape point. *ACFV*, Anterior circumflex femoral vein; *CFV*, common femoral vein; *GSV*, great saphenous vein; *OP*, obturator point; *PMF*, pectineus muscle fascia; *SEPA*, superficial external pudendal artery; *SFJ*, saphenofemoral junction. Authors archive.

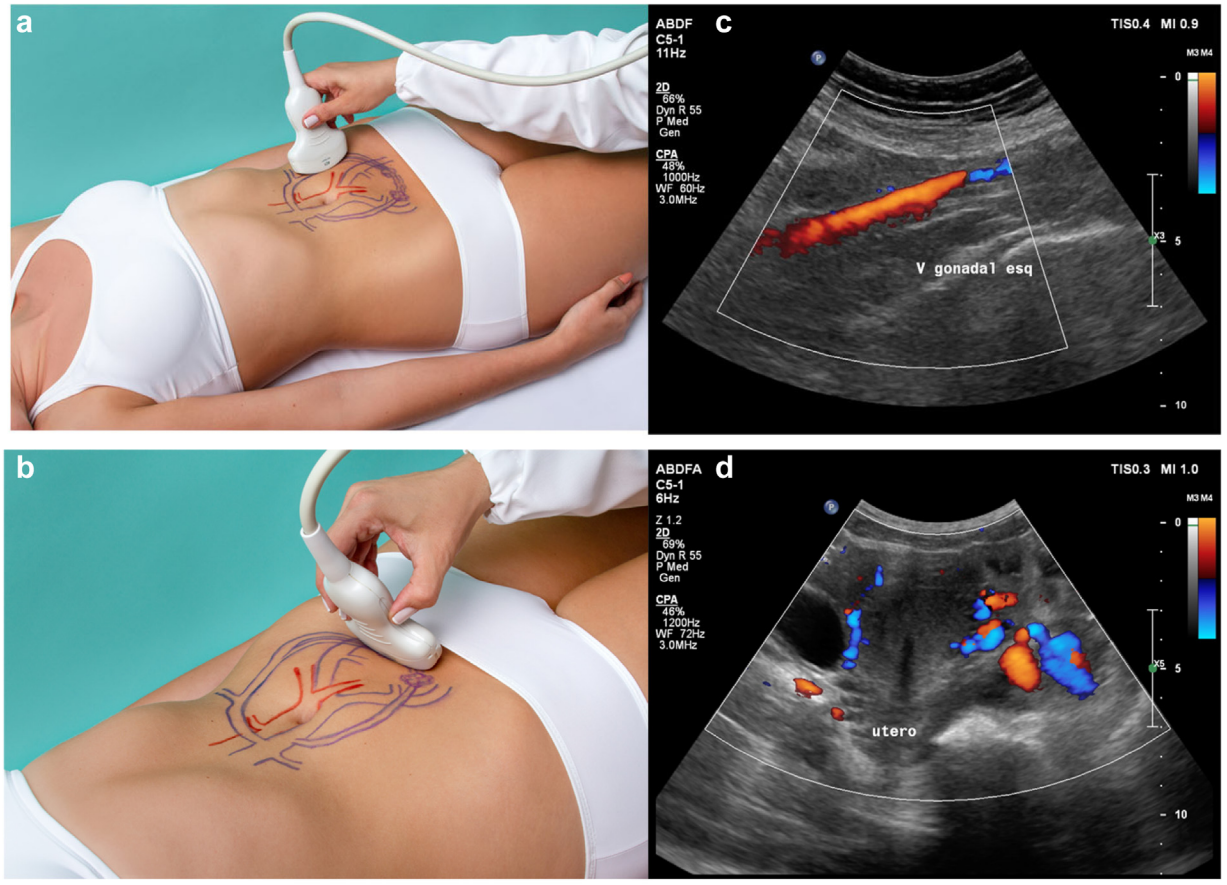


Fig 8. A and **B**, Location of the left gonadal vein and peri-uterine veins on transabdominal ultrasound examination. **C** and **D**, Left gonadal vein and peri-uterine veins on color Doppler. Authors archive.

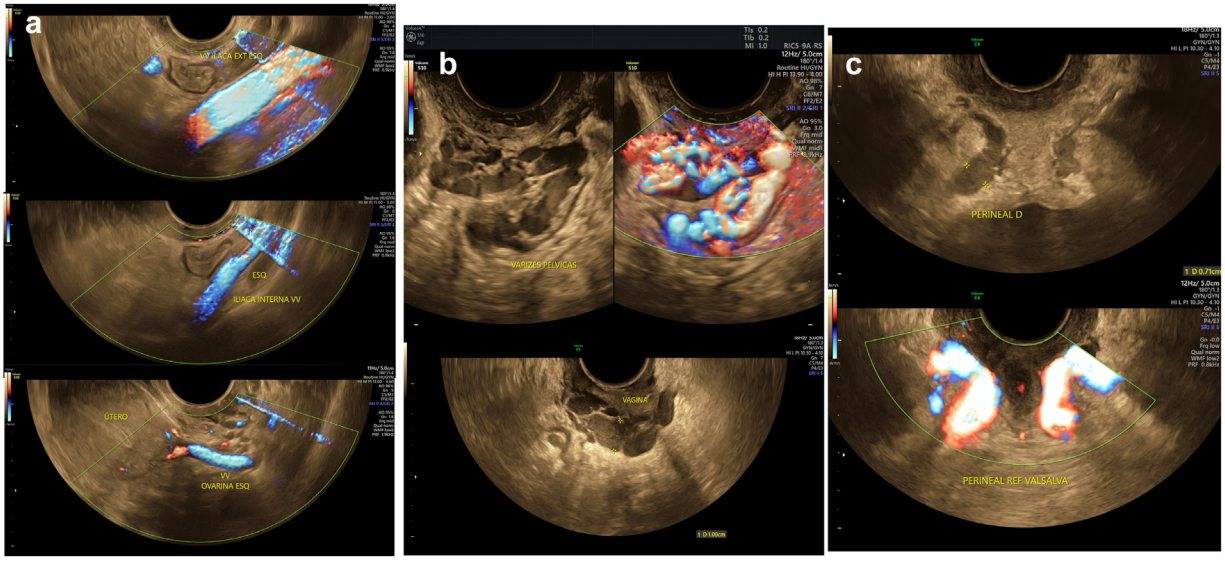


Fig 9. **A**, External iliac, internal iliac, and left gonadal veins. **B**, Dilated and insufficient peri-uterine and peri-vaginal plexuses. **C**, Perineal escape point on transvaginal ultrasound examination. Authors archive.

in 66.7% of cases. Obturator PEPs were the least prevalent, being observed in only three patients (6.8%), found more to the right (66.7%), and is associated with bilateral pelvic varicose veins in two-thirds of the cases.

Of the 38 patients with pelvic varicose veins confirmed by transvaginal ultrasound in group 1, five patients (13.2%) had one previous pregnancy, 16 (42.1%) had two previous pregnancies, 14 (36.8%) had three previous pregnancies, one (2.5%) had four previous pregnancies, and two (5.3%) had five previous pregnancies.

The rate of recurrence of lower-limb varicose veins was determined for all patients who underwent surgical intervention/removal of superficial varicose veins (crossectomy, stripping, phlebectomy, sclerotherapy with polidocanol foam). In group 1, 23 patients (52%) had recurrent varicose veins vs eight patients (23%) in the control group, with a *P*-value of .008 (Table II). Of these 23 patients with recurrent varicose veins in the lower limbs in group 1, 19 (82.6%) had pelvic varicose veins on transvaginal examination, with the number of previous interventions ranging from one to three. In group 1, 17 patients (39%) underwent one previous intervention, five patients (11%) underwent two previous interventions, and one patient (2.3%) underwent three previous interventions. In the control group, six patients (17%) underwent one previous intervention, one patient (2.9%) underwent two previous interventions, and one patient (2.9%) underwent three previous interventions. It is indicated that the groups are not independent, that is, there is a statistically significant association. In the control group, in which eight patients (23%) had recurrent and/or recurrent varicose veins, three (37.5%) had pelvic varicose veins on transvaginal ultrasound. There were 22 patients in total with recurrent lower-limb varicose veins in both groups; 15 patients (68%) had bilateral pelvic varicose veins on transvaginal ultrasound.

Regarding pelvic symptoms, pelvic pain was reported in 11 patients (25%) in group 1 and in five patients (14%) in group 2, without reaching statistical significance between groups. Regarding the complaint of dyspareunia, the Fisher exact test showed that there is a significant difference between the groups ($P = .019$), with dyspareunia being reported in 10 (23%) patients in group 1 and in one patient (2.9%) in group 2 (Table III). The median diameter of the left peri-uterine plexus was significantly greater ($P = .037$) in patients with dyspareunia (9.00 mm; IQR, 8.45-9.28 mm) than in patients without dyspareunia (7.45 mm; IQR, 6.00-9.30 mm) in group 1 (Table IV).

The difference in diameters in the transabdominal approach of the gonadal veins between the groups reached statistical significance ($P < .001$), being 6.70 mm (IQR, 6.10-7.30 mm) for group 1 and 4.60 mm (IQR, 4.00-5.50 mm) for group 2 on the left. On the right, it was 5.10 mm (IQR, 4.45-5.60 mm) for group 1 and 4.00 mm (IQR, 3.20-4.50 mm) for group 2 (Table V). In patients with pelvic varicose veins (n = 38) in group 1, the diameter of the right gonadal vein was 5.20 mm (IQR, 4.60-5.68 mm) and that of the left gonadal vein was 6.70 mm (IQR, 6.30-7.40 mm) in transvaginal ultrasound, with no significant difference with the measurements taken in the transabdominal stage. Of these 38 patients, the median diameter of PEPs in the transperineal window was 4.05 mm (IQR, 3.58-4.65 mm) (Table VI), in the transvaginal examination, the average diameter of the

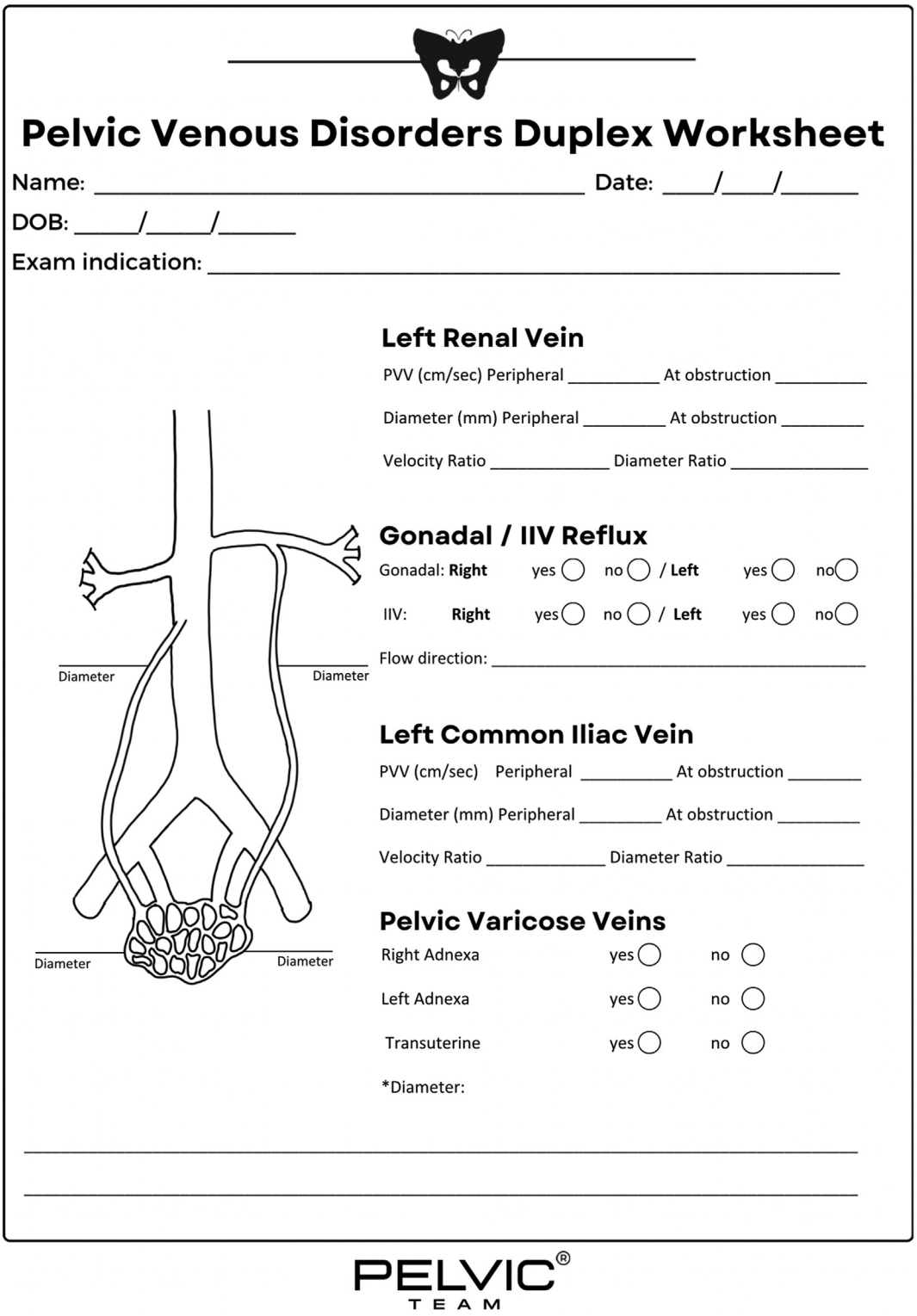


Fig 10. Pelvic venous disorders duplex worksheet. Adapted from inside ultrasound venous vascular reference guide, 2023.[11] *DOB*, Date of birth; *IIV*, internal iliac vein; *PVV*, peak systolic vein velocity.

Table I. General characterization of the sample

Characteristics	Total (N = 79)	Per group		*P* value[a]
		Group I (n = 44)	Group II (n = 35)	
Age, years	43 (37-50)	41 (37-50)	44 (38-51)	.2
BMI, kg/m^2	24.3 (22.2-26.8)	23.4 (21.3-25.1)	25.4 (23.9-29.2)	**<.001**
Weight, kg	65 (60-70)	64 (58-67)	68 (62-77)	**.007**
Pregnancies				>.9
0	3 (3.8)	1 (2.3)	2 (5.7)	
1	13 (16)	6 (14)	7 (20)	
2	32 (41)	19 (43)	13 (37)	
3	24 (30)	14 (32)	10 (29)	
4	4 (5.1)	2 (4.5)	2 (5.7)	
5	3 (3.8)	2 (4.5)	1 (2.9)	

BMI, Body mass index.
Data are presented as number (%) or median (interquartile range).
Boldface *P* values indicate statistical significance.
[a]Wilcoxon rank sum test; Fisher exact test.

peri-uterine plexus was 8.71 mm on the left and 7.04 mm on the right.

DISCUSSION

In our study, the median age of patients in the PEP group was 41 years, indicating that investigation in the age group over 40 years should be considered. The prevalence of pelvic symptoms tends to decrease with age, with a reciprocal effect on the increase in symptoms in the legs,[17] which could be explained by the flaccidity of the pelvic floor and drainage in the pelvic reflux towards the lower limbs through the leak points that become insufficient. We found a significant difference in BMI between groups 1 and 2 (23.4 kg/m^2; IQR, 21.3-25.1 kg/m^2 vs 25.4 kg/m^2; IQR, 23.9-29.2 kg/m^2), respectively ($P < .001$). This data suggests that pelvic venous disorders are more prevalent in patients with normal or lower BMI, consistent with the findings of

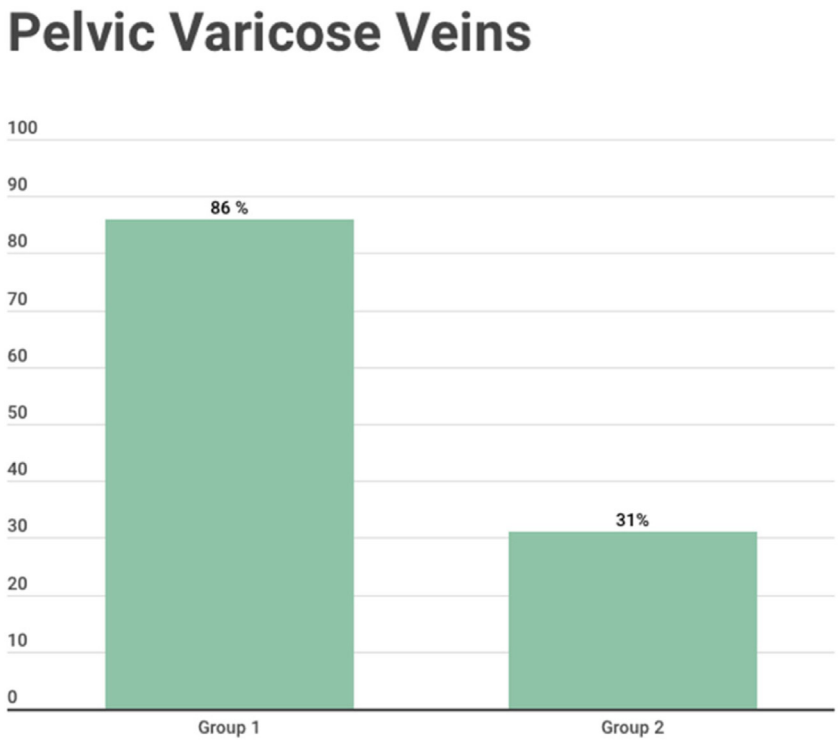


Fig 11. Prevalence of pelvic varicose veins on endovaginal ultrasound by group.

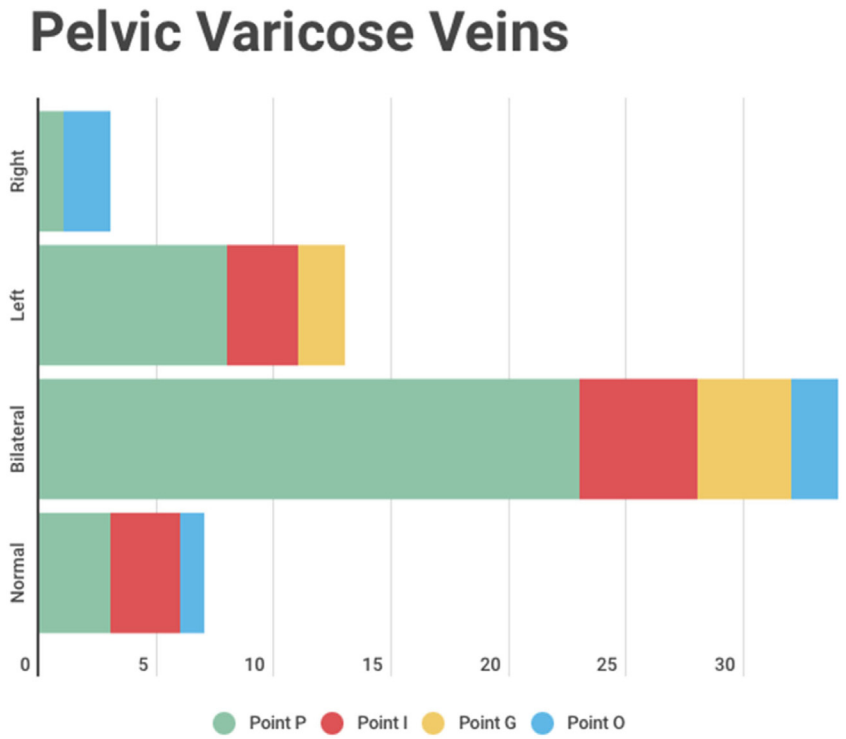


Fig 12. Relationship between pelvic escape points (PEPs) and pelvic varicose veins on endovaginal ultrasound.

Nanavati et al.[18] About 41% of the women in both groups had at least two pregnancies with no statistically significant difference between the groups, suggesting that the number of previous pregnancies may not be a risk factor for the presence of PEPs with reflux and pelvic varicose veins.

The transabdominal approach can assess for iliac and renal venous compression, pelvic varicosities, and

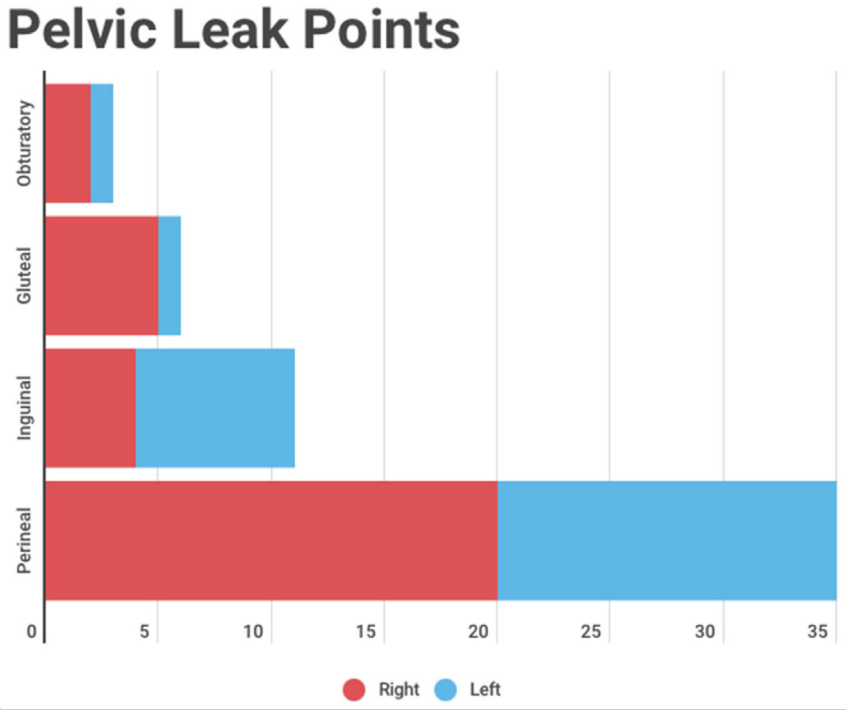


Fig 13. Laterality of pelvic escape points (PEPs).

Table II. Recurrent varicose veins and number of previous surgeries per group

Characteristics	Total (N = 79)	Recurrent varicose veins and previous surgeries by group		*P* value[a]
		Group I (n = 44)	Group II (n = 35)	
Recurrent varicose veins				**.008**
No	48 (61%)	21 (48%)	27 (77%)	
Yes	31 (39%)	23 (52%)	8 (23%)	
Surgery/varicose veins				**.030**
0	48 (61%)	21 (48%)	27 (77%)	
1	23 (29%)	17 (39%)	6 (17%)	
2	6 (7.6%)	5 (11%)	1 (2.9%)	
3	2 (2.5%)	1 (2.3%)	1 (2.9%)	

Data are presented as number (%).
Boldface *P* values indicate statistical significance.
[a]χ^2 independence test; Fisher exact test.

gonadal vein insufficiency. Whereas a 6 mm gonadal vein on transabdominal ultrasound has a 96% positive predictive value for pelvic varicose veins,[19] we identified that the median diameter of the left gonadal vein in group 1 was 6.70 mm (IQR, 6.10-7.30 mm) and reached statistical significance ($P < .01$) compared with group 2, which was 4.60 mm (IQR, 4.00-5.50 mm). Although diameter measurements by itself do not correlate well with gonadal vein reflux,[20] our study suggests a positive association between the diameter of the left gonadal vein with the presence of pelvic varicose veins and PEPs with reflux. There was no significant correlation between venous compressions and the finding of pelvic varicose veins, as no patient had iliac venous compression, and only one patient in group 1 had compression of the left renal vein.

Table III. Symptoms by group

Characteristics	Total (N = 79)	Symptoms by group		*P* value[a]
		Group I (n = 44)	Group II (n = 35)	
Leg pain				.3
No	35 (44)	17 (39)	18 (51)	
Yes	44 (56)	27 (61)	17 (49)	
Dyspareunia				**.019**
No	68 (86)	34 (77)	34 (97)	
Yes	11 (14)	10 (23)	1 (2.9)	
Pelvic pain				.2
No	63 (80)	33 (75)	30 (86)	
Yes	16 (20)	11 (25)	5 (14)	

Data are presented as number (%).
Boldface *P* values indicate statistical significance.
[a]χ^2 independence test; Fisher exact test.

Table IV. Relation of the symptom 'dyspareunia' with the diameters of the peri-uterine plexuses in the transvaginal ultrasound

Characteristics	Total (N = 44)	Dyspareunia		*P* value[a]
		n (n = 34)	s (n = 10)	
Peri-uterine plexus diameter on the right, mm	7.10 (5.08-7.80)	7.05 (4.78-7.80)	7.40 (6.13-7.55)	.5
Peri-uterine plexus diameter left, mm	7.95 (6.80-9.33)	7.45 (6.00-9.30)	9.00 (8.45-9.28)	**.037**

Data are presented as median (interquartile range).
Boldface *P* values indicate statistical significance.
[a]Wilcoxon rank sum test.

Table V. Diameter of gonadal veins in the transabdominal approach by group

Characteristics	Total (N = 79)	Diameter of gonadal veins by groups		*P* value[a]
		Group I (n = 44)	Group II (n = 35)	
Right gonadal vein diameter, mm	4.60 (4.00-5.20)	5.10 (4.45-5.60)	4.00 (3.20-4.50)	**<.001**
Left gonadal vein diameter, mm	6.25 (4.53-6.80)	6.70 (6.10-7.30)	4.60 (4.00-5.50)	**<.001**

Data are presented as median (interquartile range).
Boldface *P* values indicate statistical significance.
[a]Wilcoxon rank sum test.

The agreement between the lower-limb venous mapping and the transvaginal ultrasound regarding the identification of pelvic reflux was statistically significant in a previous publication of our group; however, the sensitivity was low (41.3%), which suggests that the venous mapping of the lower limbs alone cannot be used as a criterion for the diagnosis of pelvic varicose veins; instead, transvaginal ultrasound is required to confirm the diagnostic hypothesis. On the other hand, the specificity of 93.9% and the negative predictive value of 92.0% associated with the venous mapping of the lower limbs suggest that whenever this test is negative for pelvic varicose veins, no further investigation is necessary.[2]

The transvaginal investigation approach offers better visualization of the pelvic venous plexus compared with the transabdominal one, although its accuracy has not been validated by phlebography in all cases, and it is not able to assess renal and iliac veins.[3] The presence of pelvic varicose veins on transvaginal ultrasound according to the pre-established criteria for its diagnosis (presence of circular or linear venous structures with a diameter greater than 6 mm) was 86% in group 1 and 31% in group 2. This finding suggests PEPs with reflux are strongly correlated with pelvic varicose veins, corroborating the need for a broader study of the abdominopelvic territory in these patients, as well as the frequent finding (31%) of pelvic varicose veins in patients without clinical suspicion.

Due to the presence of avalvuled venous plexuses vertically and horizontally connecting all the pelvic viscera and the pelvic wall, the venous flow follows the pressure gradient.[21] This explains the finding that even perineal PEPs are unilateral most of the time (86.3%) and are associated with bilateral pelvic varicose veins in 59.1% of cases. This complex anatomy, combined with the fact that reflux often affects more than one pelvic region, makes it difficult to identify and treat all points of reflux, and, on the other hand, facilitates the development of collateral pathways, given the fact that one vein with reflux has been successfully treated.[22]

The perineal point was the most prevalent in our study, found in 35 patients (79.5%) in group 1, results comparable to 60% of all PEPs treated in women[23] and 70.8%[24] according to the literature. One data point to be considered is that it was more frequent on the right (57.14%) than on the left (42.85%) and was associated with bilateral pelvic varicose veins 65.7% of the time. The other points of pelvic leaks found (25% inguinal, 13.6% gluteus, and 6.8% obturator) also corresponded to the order of prevalence described in the literature.[21]

In recent years, many studies have evaluated patients with chronic venous disease of the lower limbs for evidence of pelvic venous reflux origin using pelvic phlebography and/or transvaginal and/or transperineal ultrasound. It was identified that approximately 15% to 20% of patients have reflux of pelvic origin.[25] The percentage rises to 30% in patients with recurrent varicose veins initially treated by conventional surgery or minimally invasive intravenous techniques.[16] Likewise, in Perrin's study of 170 patients, pelvic reflux was present in approximately 17% of patients with recurrent varices after surgery.[26] In our study, 23 patients (52%) in group 1 had recurrent varicose veins, and, of these 23, 19 (82%) had pelvic varicose veins on transvaginal ultrasound vs eight patients (23%) with recurrent veins in the control group, with a *P*-value of .008. These results corroborate the fact that pelvic reflux is an important risk factor to be considered for recurrence of lower-limb varicose veins.

Table VI. Pelvic escape point (*PEP*) diameter in the transperineal approach in patients with pelvic varicose veins

Characteristics	Total (N = 38)	Pelvic varicose veins transvaginal ultrasound			*P* value[a]
		Bilateral (n = 26)	Right (n = 2)	Left (n = 10)	
PEP diameter/transperineal window, mm	4.05 (3.58-4.65)	4.15 (3.60-4.80)	5.60 (5.60-5.60)	3.70 (3.50-4.40)	.2

Data are presented as median (interquartile range).
[a]Test of Kruskal-Wallis.

We did not find any studies in the literature evaluating the relationship between pelvic symptoms and peri-uterine plexus diameters. In our study, there was a significant difference between the groups ($P = .19$) from the complaint of dyspareunia in 10 of the patients (23%) in group 1 and in one patient (2.9%) in the control group, and the median diameter of the peri-uterine plexus on the left was significantly greater ($P = .37$) in patients with dyspareunia (9.00 mm) than in patients without dyspareunia (7.45 mm) in group1. This data leads us to believe that there is a significant correlation between the diameter of the pelvic venous plexuses and the complaint of dyspareunia. It is noteworthy that 20% of all patients evaluated (n = 79) reported chronic pelvic pain, with this being a prevalent complaint in 25% of patients in group 1 and 14% of patients in group 2, with no statistically significant difference between groups, and therefore takes us to raise intriguing questions regarding the potential influence of PEPs with reflux on pelvic pain symptoms, emphasizing the need for in-depth investigations to better understand the relationship between pelvic venous disorders and chronic pelvic pain. Among all patients with pelvic varicose veins in group 1 (n = 38), the median PEP diameter at the transperineal window was 4.05 mm (IQR, 3.58-4.65 mm). There is still no cutoff diameter for PEPs in the literature that is associated with the presence of pelvic reflux and dilation of the peri-uterine plexuses, but according to our results, we recommend values >3.5 mm. In the transvaginal stage, the median diameter of the peri-uterine plexus was 8.71 mm on the left and 7.04 mm on the right for patients in group 1 with pelvic varicose veins. However, taking into account only the diameter for treatment indication may be questionable.

The lack of knowledge and technical skills in assessing the flow of the gonadal and internal iliac veins for a better hemodynamic understanding of the origin of pelvic reflux can be a crucial factor for tactical errors in the treatment. Based on our experience, one of the main causes for the maintenance or recurrence of signs and symptoms of lower-limb varicose veins is PEPs. This protocol, recommended by us, involves the comprehensive investigation of the infra-diaphragmatic venous reservoir, making it the most comprehensive approach to studying this issue.

Our findings reveal a significant correlation between pelvic varicose veins, recurrent lower limb varicose veins, and dyspareunia in patients with PEPs. This association strongly suggests a connection between pelvic venous reflux and lower limb varicosities, providing a solid basis for investigating the pelvic origin of venous reflux. This includes exploring its role in post-procedural recurrent varicose veins, as well as in patients with groin, perineal, and vulvar varicosities, and dyspareunia. This approach allows for a more targeted investigation into the pelvic origin of venous reflux in individuals exhibiting these particular manifestations.

Understanding this connection holds promise for tailoring more precise treatment strategies, potentially diminishing recurrence rates and enhancing patient outcomes. The proposed methodology presents distinct advantages in diagnosing and managing lower-limb varicose veins by directly addressing pelvic venous reflux, offering a more comprehensive investigative approach than current methods.

Considering the practicality of implementing these methods, specialized training can render this protocol cost-effective and readily integrated into routine clinical practice. In our study, a singularly experienced vascular ultrasound specialist conducted the protocol, emphasizing the importance of expertise in its application. We recommend that these investigations be carried out by physicians or technologists specialized in this field within their respective countries.

One limitation of this study was the lack of a quality-of-life questionnaire to assess the extent of symptoms, as well as the absence of data regarding the specific time frames of prior surgical interventions on the lower limbs, which could enhance the understanding of varicose vein recurrence management.

CONCLUSIONS

The connection between lower-limb varicose veins and the pelvic and abdominal venous territory is well-established. This consideration underscores the creation of a comprehensive protocol that guides its investigation, consequently leading to a more precise treatment plan with a reduced risk of recurrence.

AUTHOR CONTRIBUTIONS

Conception and design: FB, JS, FF
Analysis and interpretation: FB, JS, NC, FF, MS, AB
Data collection: FB, JS, FF
Writing the article: FB, JS, NC, FF
Critical revision of the article: FB, NC, FF, MS, AB
Final approval of the article: FB, JS, NC, FF, MS, AB
Statistical analysis: JS, NC, FF
Obtained funding: JS, NC, FF
Overall responsibility: JS

DISCLOSURES

None.

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Submitted Sep 10, 2023; accepted Jan 30, 2024.

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