

# Efficacy of endovascular treatment of pelvic varicose veins: A single-center retrospective observational study

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## ABSTRACT

**Objective:** To evaluate the efficacy of endovascular embolization of pelvic varicose veins in the treatment of pelvic venous disorders (PeVD).

**Methods:** A single-center retrospective study was performed, including 156 women referred to the Erasmus University Medical Center between January 2011 and October 2020 for an evaluation of PeVD. Data on presenting symptoms, clinical workup, treatment, and clinical outcomes were collected. The primary end point was resolution of symptoms after treatment. Secondary outcomes were correlation between symptoms at presentation and relief of symptoms after treatment, minor or major procedural complications, recurrences, and additional treatments needed.

**Results:** Ninety patients underwent a pelvic phlebography, of which 75 received embolization of pelvic varicose veins. Median follow-up after phlebography was 13.2 months (interquartile range, 6.0-40.1 months). Of the treated patients, 53 (70.7%) had partial or complete relief of symptoms. Forty-six women (61.3%) who received embolization of pelvic varicose veins required additional treatments for leg and/or vulvar varicose veins.

**Conclusions:** This study found that endovascular embolization of pelvic varicose veins can be an effective treatment for PeVDs. However, additional treatments are often required for leg and/or vulvar varicose veins. (J Vasc Surg Venous Lymphat Disord 2022;■:1-8.)

**Keywords:** Pelvic venous disorders; Pelvic varicose veins; Endovascular embolization; Varicosities; Phlebography

Pelvic venous disorders (PeVD) are thought to be one of the mayor underlying causes of women presenting with chronic pelvic pain.<sup>1,2</sup> PeVD are characterized by chronic complaints of pelvic pain, dyspareunia, and vulvar varicose veins in women, which usually develop after multiple pregnancies.<sup>3</sup> It can present with a large variety of other symptoms, such as urogenital, gastrointestinal, and musculoskeletal complaints and can be caused by multiple anatomic etiologies, such as obstruction, reflux, or both. This heterogeneity makes it difficult to differentiate PeVD from other abnormalities.<sup>4</sup> The diagnosis is based on a combination of complaints and the presence

of pelvic varicose veins. Because the symptoms are nonspecific and pelvic varicose veins can also be present in asymptomatic women,<sup>5,6</sup> the diagnosis and treatment of PeVD can be challenging.

Transcatheter embolization has been proposed as the treatment of choice for pelvic varicose veins.<sup>7-9</sup> The embolization of pelvic varicose veins is performed during a pelvic phlebography using either coils, a sclerosans, vascular plugs, or a combination of these depending on the extent and localization of the varicose veins.<sup>10</sup> The procedure encompasses several risks, such as bleeding, allergic reactions to contrast agent, pulmonary embolisms (owing to migration of coils), or even death.<sup>11-13</sup> It is an invasive procedure and the patients' clinical complaints should carefully be taken into account to decide which patients will benefit from this intervention. To this day, this is one of the major problems clinicians face in the treatment of PeVD, and there is a need for clear evidence-based guidelines to decide which patients qualify for endovascular embolization of pelvic varicose veins.<sup>14</sup>

Therefore, the aim of this study was to retrospectively assess the resolution of symptoms for patients who underwent endovascular treatment of pelvic varicose veins and to determine which patients are most likely to benefit from endovascular treatment of pelvic varicose veins based on their presenting symptoms.

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## METHODS

**Study design.** A retrospective analysis was conducted of 156 women referred to the Erasmus University Medical Center in Rotterdam between January 2011 and October 2020 for an evaluation of PeVD.

Clinical data of patients was obtained retrospectively through the hospitals electronic patient files. All electronic patient files coded as pelvic varicose veins were assessed and only patient files in which a patient was evaluated based on a suspicion of PeVD were included. Data were obtained on age, gravidity, parity, menopausal state, other venous pathology, symptoms at intake, treatments, treatment outcome, complications, and (relief of) symptoms after treatment. If a patient did not report a symptom at intake, it was assumed that it was not present. Symptoms and etiology were retrospectively categorized according to the Symptoms-Varices-Pathophysiology (SVP) classification.<sup>15</sup>

This study was approved by the Medical Ethics Committee of the Erasmus University Medical Center (MEC-2021-0377); the need for informed consent for use of the data was waived because of the retrospective nature of the study. The database was anonymized and deidentified in accordance with European privacy guidelines.

**Diagnosis and treatment.** Suspicion of PeVD and the decision whether or not to undertake phlebography were based on the clinician's assessment of subjective clinical symptoms, a physical examination, and a duplex ultrasound examination of the pelvic veins and leg veins. Additional axial imaging, such as magnetic resonance imaging or a computed tomography scan were done on indications only. Reasons for doing magnetic resonance imaging were, for example, suspicion of other pathologies or doubt about the etiology (eg, obstruction). The definitive diagnosis of PeVD was later confirmed by phlebography of the pelvic veins by identifying either reflux in or dilatation of the pelvic or ovarian veins, with or without a Valsalva maneuver. Phlebography was performed of the left and right internal iliac and ovarian veins. Renal veins were visualized on indication. Patients with obstruction were excluded in the final analysis.

Treatment of pelvic varicose veins was performed in the same session as the diagnostic phlebography, with the exception of two patients. Varicose veins were treated by an experienced interventional radiologist. Access to the venous system was obtained via the jugular vein or—in a few cases—the femoral vein using a 5F short vascular sheath, because these routes were perceived as the easiest and shortest. The interventional radiologist then embolized any present varicose veins using coils, plugs, and/or 2% to 3% aetoxysclerol foam, depending on the clinician's assessment at the time. The criteria for embolization were presence of reflux, dilatation, or extensive varicosities. After phlebography, patients remained in the hospital ward for observation for a few hours. If no

## ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center retrospective cohort study
- **Key Findings:** Endovascular treatment of pelvic varicose veins in 75 patients resulted in partial or complete relief of symptoms in 53 patients (70.7%). However, the majority of 61.3% (46 patients) required additional treatments for leg and/or vulvar varicose veins.
- **Take Home Message:** Endovascular embolization can be an effective treatment for pelvic varicose veins. However, before embolization, women should be clearly counseled and informed as to expectations of treatment outcomes.

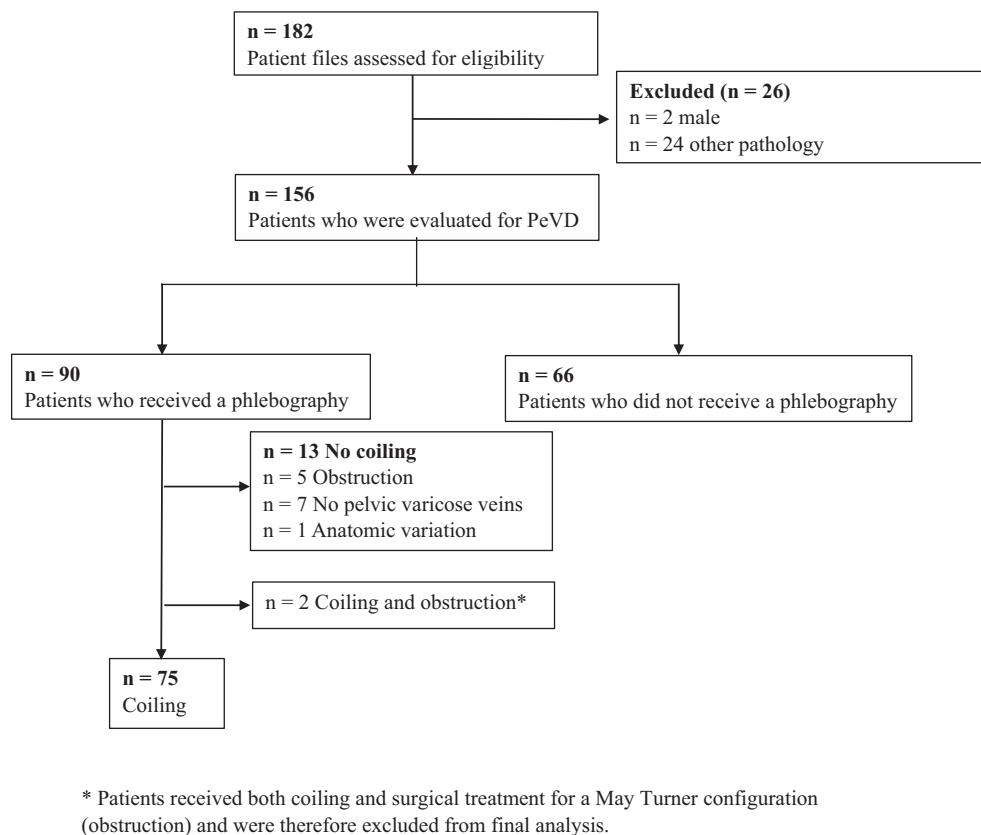
complications occurred, they were discharged the same day.

The end of follow-up was defined as the last entry in the electronic patient file. If a patient was never contacted after treatment, they were considered as lost to follow-up. Two patients were lost to follow-up.

The primary end point was resolution of symptoms after treatment of pelvic varicose veins, classified as complete improvement (CI) (patient reported 100% improvement of symptoms), partial improvement (PI) (patient reported some improvement of their symptoms) and no improvement (NI) (patient reported NI of symptoms). Secondary outcomes were correlation between symptoms at presentation and relief of symptoms after treatment, minor or major procedural complications, recurrences, and additional treatments needed after coiling. A complication was classified as major if additional interventions were required, such as anticoagulant therapy. A recurrence was classified as the need for a second pelvic phlebography at least 3 months after the first one.

**Statistical analyses.** Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, Armonk, NY) version 25.0 and R statistical software (version 4.0.3, The R Foundation for Statistical Computing, Vienna, Austria). Data on age, gravidity, and parity had a normal distribution and are, therefore, presented as means  $\pm$  standard deviation. For numeric outcome variables, an independent samples *t* test was used. For dichotomous outcome variables a Z-test was performed. Because of the small sample size, an additional Yates' correction was done if outcome variables contained five or fewer patients.

There were missing data regarding the menopausal state, gravidity, and parity of the included patients. Missing data were not imputed, because of the small number of included patients and were accepted and reported as such in the outcomes.



**Fig.** Flowchart of the study design. . PeVD, pelvic venous disease.

## RESULTS

**Participants.** We assessed 182 patient records for eligibility (Fig). A total of 156 records of women referred to the hospital for evaluation of PeVD were included in this retrospective study. This group was divided into women who underwent pelvic phlebography with or without embolization ( $n = 90$ ) and women who did not undergo pelvic phlebography ( $n = 66$ ).

**Patient characteristics.** Average age was  $43.0 \pm 10.4$  years, gravidity  $3.0 \pm 1.7$ , parity  $2.7 \pm 1.4$ ; 64.1% ( $n = 100$ ) were premenopausal, 58.3% ( $n = 91$ ) had a previous history of treatment for varicose veins of the legs, and 79.5% ( $n = 124$ ) presented with vulvar varicose veins or varicose veins of the legs at intake. There were no statistically significant differences in characteristics at first presentation of patients who underwent pelvic phlebography and who did not (Table I). The median follow-up time was 7.2 months (interquartile range, 2.4-20.2 months).

Differences in clinical presentation and results of the duplex ultrasound examination between patients who underwent phlebography and those who did not are presented in Table II and Supplementary Table I (online only). Clinicians were most likely to perform phlebography if a patient presented with a heavy feeling

in the lower abdomen ( $P = .024$ ), a heavy feeling in the vulvar area ( $P = .002$ ), if symptoms worsened after pregnancy ( $P = .0001$ ), or if there was a suspicion of PeVD on duplex ultrasound examination ( $P = .030$ ). Abdominal pain and dyspareunia were more frequent in the group that underwent pelvic phlebography, but this difference was not statistically significant ( $P = .105$  and  $.161$ ).

**Treatment outcomes.** Of the 90 patients who underwent phlebography, 75 solely received embolization of pelvic varices, 7 patients had an obstructive venous pathology, 1 patient presented with an anatomic anomaly, and in 7 patients no varicose veins could be found (Fig). Embolization was performed most frequently in the left ovarian vein (71.1% [ $n = 54$ ]) and varicosities originating from the right internal iliac vein (48.7% [ $n = 37$ ]) (Table III). In nine patients, additional veins were embolized: varicose veins toward the labia/perineum ( $n = 4$ ), veins going toward the hip ( $n = 2$ ), varicosities originating from the external iliac vein ( $n = 2$ ), and percutaneous treatment of a vulvar varicosity during phlebography ( $n = 1$ ).

Of the 75 patients who solely received embolization of pelvic varicose veins, 26.6% ( $n = 20$ ) showed NI at the

**Table I.** Patient characteristics at presentation

Intake	Phlebography (n = 90)	No phlebography (n = 66)	P value
Age, years	41.9 ± 9.4	44.6 ± 11.5	.098
Menopausal state			
Premenopausal	61 (67.8)	40 (60.1)	.449
Postmenopausal	7 (7.8)	8 (12.1)	
Missing	22 (24.4)	18 (27.3)	
Gravidity	3.0 ± 1.5	3.0 ± 1.9	.937
Missing	5 (16.7)	7 (10.6)	
Parity	2.7 ± 1.3	2.7 ± 1.6	.945
Missing	12 (13.3)	6 (9.1)	
Clinical history of treatment of varicose veins	53 (58.9)	38 (57.6)	1.0
ST <sup>a</sup>	22 (24.4)	18 (27.3)	.830
UGFS <sup>a</sup>	12 (13.3)	5 (7.6)	.379
Ambulatory phlebectomy <sup>a</sup>	13 (14.4)	10 (15.2)	1.0
EVLA <sup>a</sup>	14 (15.6)	12 (18.2)	.829
RFA <sup>a</sup>	3 (3.3)	0 (0)	.364
Crossectomy <sup>a</sup>	6 (6.7)	2 (3.0)	.516
Stripping <sup>a</sup>	13 (14.4)	9 (13.6)	1.0
Stent <sup>a</sup>	1 (1.1)	0 (0)	1.0

EVLA, Endovenous laser ablation; RFA, radiofrequency ablation; ST, sclerotherapy; UGFS, ultrasound-guided foam sclerotherapy. Values shown are mean ± standard deviation or number (%). Differences between groups were tested through the Student *t* test and Z tests. For the Z tests an additional Yates's continuity correction was performed.  
<sup>a</sup>Percentages are for the whole phlebography and whole no phlebography group.

end of follow-up, 50.6% (n = 38) showed PI of symptoms at the end of follow-up, and 20.0% (n = 15) had CI of symptoms at the end of follow-up. The median follow-up in the group that underwent pelvic phlebography was 13.2 months (interquartile range, 6.0-40.1 months). Two patients were lost to follow-up.

**Predictive symptoms.** Symptoms reported at presentation did not seem to be an indicator for improvement of complaints after treatment. Although not statistically significant, patients that experienced improvement of symptoms after treatment, more often presented with varicose veins of the legs (73.6% vs 50.0; *P* = .094), a heavy feeling in the vulvar area (32.1% vs 15%; *P* = .145), and less frequently presented with dyspareunia (39.6% vs 55.0%; *P* = .238) (Table IV).

When examining the difference between NI, PI, and CI, patients who had CI or PI less frequently presented with dyspareunia (CI 26.7% vs PI 44.7% vs NI 55.0%) and more frequently presented with varicose veins of the legs (CI 80.0% vs PI 71.1% vs NI 50.0%). However, the trend for a heavy feeling in the vulvar area disappeared (CI 6.7% vs PI 42.1% vs NI 15.0%). Additionally, patients with CI of

**Table II.** Symptoms and duplex ultrasound results at presentation for women who underwent pelvic phlebography and those who did not

	Phlebography (n = 90)	No phlebography (n = 66)	P value
S2			
Abdominal pain	50 (55.6)	28 (42.4)	.105
Dyspareunia	40 (44.4)	22 (33.3)	.161
Heavy feeling lower abdomen	26 (28.9)	9 (13.6)	.024
Increase of complaints standing, increased pressure, cycling	37 (41.1)	25 (37.9)	.684
Worsening during menstruation	33 (36.7)	19 (28.8)	.302
Worsening after pregnancy	54 (60.0)	19 (28.8)	.0001
Dysuria, urge, irritation with miction	3 (3.3)	5 (7.6)	.235
S3			
Heavy feeling vulvar area	26 (28.9)	6 (9.1)	.002
Heavy feeling legs	55 (61.1)	41 (62.1)	.898
V3			
Vulvar varicose veins	51 (56.7)	37 (56.1)	.940
Varicose veins of the legs	60 (66.7)	48 (72.7)	.418
Duplex ultrasound examination			
Suspicion of PeVD	44 (48.9)	20 (30.3)	.030
Missing	4 (4.4)	1 (1.5)	

S2, Chronic pelvic pain of venous origin; S3, extrapelvic symptoms venous origin; V3, varices pelvic origin extrapelvic varices; PeVD, pelvic venous disease. Symptoms are categorized according to the Symptoms-Varices-Pathophysiology (SVP) staging system. Values are number (%). *P* values were calculated using a Z test.

symptoms after embolization more often presented with worsening of symptoms after pregnancy at intake (CI 86.7% vs PI 57.9% and NI 55.0%) (Supplementary Table II, online only). The type of pelvic veins treated was also not an indicator for the resolution of symptoms and clinical improvement (Supplementary Table III, online only).

No statistically significant differences were found in clinical presentation between patients who underwent embolization of pelvic varicose veins during pelvic phlebography and those who did not (Table V).

**Complications.** Eight patients (8.9%) experienced complications owing to or during the procedure. Minor complications were a small extravasation of contrast agent

**Table III.** Coiling of pelvic varicose veins according to different anatomic localizations

n = 76	n (%)
Coiling v. ovarica sinistra	54 (71.1)
Coiling right VII <sup>a</sup>	37 (48.7)
Coiling v. ovarica dextra	32 (42.1)
Coiling left VII <sup>a</sup>	27 (35.5)
Coiling left and right VII <sup>a</sup>	18 (23.7)
VII, V. iliaca interna.	
<sup>a</sup> Coiling from, in, and/or around the v. iliaca interna.	

(n = 3), abdominal pain during the procedure (n = 2), and pain at the access point in the jugular vein during the procedure (n = 1). Major complications were a thrombosis of the v. pudenda requiring anticoagulant treatment (n = 1) and allergic reactions to contrast agent requiring temporary additional treatment without any further clinical consequences (n = 2).

Additionally, 18.9% of patients (n = 17) complained of worsening of pelvic pain in the first weeks after embolization, 6.7% (n = 6) complained of pain in back or buttock after the procedure, and 3.3% (n = 3) complained of pain at the puncture site after the procedure. Additionally, after the procedure 2.2% (n = 2) complained of a tingling sensation in the leg, 2.2% (n = 2) experienced palpitations, 2.2% (n = 2) reported swelling of the groin, and 1.1% (n = 1) had a urinary tract infection that was treated with antibiotics without further complications.

**Recurrences and additional embolization.** Eighteen patients (20.0%) underwent a second pelvic phlebography: 10 patients (11.1%) who previously had complete or PI of their symptoms had a recurrence of their pre-treatment symptoms after a median of 35 months (range, 3.6-85.6 months); 6 patients (6.7%) received a second pelvic phlebography because the first had no effect on their symptoms; and 2 patients (2.2%) received a second (therapeutic) pelvic phlebography, because the first one had only been of diagnostic nature. Of the 18 patients who underwent a second pelvic phlebography, 10 women (55.6%) received embolization of pelvic varices. Of these 10 women, 6 (60.0%) reported NI of symptoms after pelvic embolization and 4 (40.0%) reported CI of symptoms.

Six patients (6.7%) underwent a third pelvic phlebography, of which five were those who showed NI of symptoms after the second phlebography. One patient did not undergo embolization during the second, but requested another pelvic phlebography because of persistent symptoms. During the third pelvic phlebography, all patients received embolization of varicose veins. Four patients (66.7%) had PI of their symptoms and two (33.3%) reported NI of symptoms.

**Additional treatments.** Of the patients who received embolization of pelvic varicose veins, 46 (61.3%) received additional treatment for varicose veins of the legs and/or vulvar varicose veins. Twenty patients (26.6%) had additional sclerotherapy, respectively of the leg veins (n = 13), vulvar veins (n = 5), or both (n = 2). Seventeen patients (22.7%) underwent ultrasound-guided sclerotherapy and 31 (41.3%) underwent an ambulatory phlebectomy. Eleven patients (14.7%) had an endovenous laser ablation owing to insufficiency of the great saphenous vein (n = 8) or the small saphenous vein (n = 3), and one patient (1.3 %) was treated with radiofrequency ablation.

## DISCUSSION

In this study, we retrospectively evaluated the clinical outcomes after embolization of pelvic varicose veins in the treatment of PeVD. Of the patients who underwent embolization of pelvic varicose veins, 71.1% had partial or complete relief of their symptoms after treatment; only a minority was completely symptom free (19.7%) and there was a relatively high rate of recurrences (21.3%). Patients who reported dyspareunia less frequently experienced improvement of symptoms after treatment and there was a higher incidence of varicose veins of the legs for patients who reported partial or CI of symptoms after treatment. The majority of patients (61.3%) required additional treatments for varicose veins of the legs and vulvar varicose veins. These results show that, even though embolization is the standard treatment for pelvic varicose veins, not all patients benefit from this treatment and selection of patients who will most likely benefit from this treatment is difficult.

Several studies have investigated the efficacy of embolization of pelvic varicose veins as the treatment of PeVD. A systematic review by Mahmoud et al,<sup>16</sup> including 17 studies with a total of 540 patients, showed that on average there is an effectivity of 86.6% (range, 60.0%-100%) at long-term follow-up (range, 3 months to 5 years). However, when subdividing these results in significant relief of symptoms (in this study defined as relief of 80%-100%), the effectiveness is only 42%. A more recent review, which focuses on overall effectivity shows similar results.<sup>17</sup> In our cohort, we found a slightly lower overall effectivity (70.6%). Complete relief of symptoms was only achieved in 20.0%, which is substantially lower than previously suggested. A possible explanation for this is heterogeneity in the way outcome of treatment is presented. Many studies do not differentiate between different degrees of symptom improvement and do not take into account recurrences at long-term follow-up or the need for additional treatments. This practice may result in an overly optimistic display of reality. Therefore, we expect that effectivity of treatment is somewhat lower than previously reported.

Furthermore, our results illustrate that, when treated, 21.3% of women experience a recurrence of their



**Table IV.** Symptoms at presentation for women who underwent coiling, divided into two groups: No improvement (NI) and improvement (partial or complete) of symptoms after embolization

Symptoms	NI (n = 20)	Improvement (n = 53)	P value
<b>S2</b>			
Abdominal pain	13 (65.0)	29 (54.7)	.428
Dyspareunia	11 (55.0)	21 (39.6)	.238
Heavy feeling lower abdomen	6 (30.0)	15 (28.3)	.886
Increase of complaints standing, increased pressure, cycling	6 (30.0)	22 (41.5)	.367
Worsening during menstruation	8 (40.0)	21 (39.6)	.976
Worsening after pregnancy	11 (55.0)	35 (66.0)	.384
Dysuria, urge, irritation with miction	1 (5.0)	2 (3.8)	.818
<b>S3</b>			
Heavy feeling vulvar area	3 (15.0)	17 (32.1)	.145
Heavy feeling legs	13 (65.0)	33 (62.3)	.829
<b>V3</b>			
Vulvar varicose veins	11 (55.0)	31 (58.5)	.788
Varicose veins of the legs	10 (50.0)	39 (73.6)	.094

S2, Chronic pelvic pain of venous origin; S3, extrapelvic symptoms venous origin; V3, varices pelvic origin extra-pelvic varices.

Symptoms are categorized according to the Symptoms-Varices-Pathophysiology (SVP) staging system. Values are number (%). P values are differences between the no improvement and improvement group, calculated using a Z test.

symptoms after a few months or years, requiring an additional phlebography. This finding is in line with previous studies. In a study by van der Vleuten et al,<sup>18</sup> with a mean follow-up time of 18.1 months, up to 42.9% of patients had a recurrence, requiring additional phlebography. Other studies reporting on the need for an additional phlebography showed lower rates of recurrences, ranging from 10.0% to 23.5%.<sup>19-22</sup> We hypothesize

that with time—and thus a longer follow-up—pelvic varicose veins often recur despite adequate embolization in the first session. This notion emphasizes that, even if treatment is effective, symptoms may return and additional treatments might be needed.

When embolization of pelvic varicose veins is not sufficient, a second embolization can be performed. However, often other forms of additional treatments are necessary

**Table V.** Symptoms at presentation for women who underwent phlebography, coiling versus no coiling

Symptoms	Coiling (n = 76)	No coiling (n = 14)	P value
Gravidity	3.0 ± 1.5	2.8 ± 1.6	.605
Postmenopausal	4 (5.3)	3 (21.4)	.354
<b>S2</b>			
Abdominal pain	43 (56.6)	7 (50.0)	.870
Dyspareunia	33 (43.4)	7 (50.0)	.871
Heavy feeling lower abdomen	22 (28.9)	4 (28.6)	1.0
Increase of complaints standing, increased pressure, cycling	29 (38.2)	8 (57.1)	.302
Worsening during menstruation	30 (39.5)	3 (21.4)	.324
Worsening after pregnancy	48 (63.2)	6 (42.9)	.259
Dysuria, urge, irritation with miction	3 (3.9)	0 (0)	1.0
<b>S3</b>			
Heavy feeling vulvar area	20 (26.3)	6 (42.9)	.324
Heavy feeling legs	47 (61.8)	8 (57.1)	.974
<b>V3</b>			
Vulvar varicose veins	43 (56.6)	8 (57.1)	1.0
Varicose veins of the legs	51 (67.1)	9 (64.3)	.916

S2, Chronic pelvic pain of venous origin; S3, extrapelvic symptoms venous origin; V3, varices pelvic origin extrapelvic varices.

Symptoms are categorized according to the Symptoms-Varices-Pathophysiology (SVP) staging system. Values are number (%) or mean ± standard deviation. P values were calculated using a Z test with a Yates's continuity correction or a Student t test.

for varicose veins of the legs or vulvar region, as was also the case in our population. Castenmiller et al<sup>23</sup> partly support this finding and show that patients frequently need additional treatments for leg varicosities after embolization of pelvic varicose veins. Other studies suggest that by treating pelvic varicose veins, limb varicosities can disappear or require less extensive treatment.<sup>24,25</sup> This finding suggests that, by treating pelvic varicose veins, varicose veins of the legs or vulva are treated as well. The nature of the current study did not allow us to investigate the direct effect of embolization of pelvic varicose veins on varicose veins of the leg or vulvar. The exact interaction between pelvic varicose veins and varicose veins in the leg or vulva remains unclear and needs to be elucidated. For each patient the nature of the varicose veins should be examined. Depending on the symptoms, extent, and localization, a clinician should decide whether to first treat leg or vulvar varicosities or pelvic varicose veins.

One of the major challenges clinicians face is which patients should qualify for the embolization of pelvic varicose veins. The heterogeneity of the symptoms and presentation make it difficult to predict which patients will benefit from embolization. In this study, we found that the presence of varicose veins of the legs seemed to be associated with a more favorable outcome of treatment, whereas the presence of dyspareunia seemed to be associated with less favorable outcome of treatment, although this was not statistically significant. This is partially in line with previous studies. Nasser et al<sup>26</sup> found that the presence of urinary urgency, lower limb symptoms, and vulvar and lower limb varicosities were related to incomplete treatment success. Capasso et al<sup>27</sup> also found the presence of dyspareunia to be a poor prognostic factor for the effectiveness of embolization. However, it can be difficult to distinguish dyspareunia from a heavy feeling in the vulvar area. Therefore, dyspareunia might encompass a wider range of symptoms than currently described in this study and the PeVD literature. We hypothesize that symptoms such as a heavy feeling in the vulvar area and heavy feeling in the legs are caused by symptomatic vulvar or leg varicose veins. These could be varicose veins that remain unaffected by embolization of pelvic varicose veins and that are therefore responsible for a less favorable outcome. However, these symptoms could also be signs of more severe PeVD, which is refractory to treatment. These findings emphasize the complexity of the disease, stressing the need for better selection criteria. Future prospective studies should classify patients according to the new PeVDs staging system,<sup>15</sup> to further investigate which patients might benefit most from which treatment.

This study had several limitations. First, the retrospective nature of the study did not allow for a standardized questionnaire. Therefore, it could be that patients did not report all their symptoms at first presentation, which could lead to information bias. Second, there was no

objective measure for outcome after treatment. Scoring of outcome was based on reports in the medical system and is subjective to information bias. The authors tried to score the reported outcome as objectively as possible by using three clearly defined outcome possibilities. Third, because of the retrospective nature of the study patients were not actively pursued beyond reported follow-up. It is, therefore, possible that patients experienced a recurrence, but did not report this. Therefore, the incidence of recurrences in this study could be underestimated. Fourth, because of the retrospective nature, patients could not be completely classified according to the new classification of PeVDs.<sup>15</sup> Therefore, even though the authors tried to limit heterogeneity, different etiologies in symptom presentation and location of varices might be included in the final population. Finally, because this was a retrospective study, we were only able to evaluate treatment of PeVD according to standard of care in our hospital and were unable to use a pre-defined standardized intervention protocol.

Despite these limitations, this study is one of the first focusing on the outcome of embolization of pelvic varicose veins based on clinical symptoms. This finding is especially relevant because of the heterogeneity of the disease, making it difficult for clinicians to decide which patients will benefit from this treatment. Our results are a first step in the right direction for improving future selection of patients for treatment.

## CONCLUSIONS

This study shows that embolization of pelvic varicose veins can be an effective treatment for PeVDs. However, for a majority of women, symptoms (partly) remained after treatment. Before embolization, women should be clearly counseled and informed as to expectations of treatment outcomes. If complaints of vulvar varicose veins or varicose veins of the legs are more prominent, additional treatments can be required.

Future research should focus on which patients are most likely to benefit from treatment and on the timing of treatment of leg or vulvar varicose veins in regard to pelvic embolization. Prospective cohort studies or randomized controlled trials should be performed to define better treatment criteria.

## AUTHOR CONTRIBUTIONS

Conception and design: ASG, MH, WM

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Data collection: ASG, MH, WM

Writing the article: ASG, MH, WM

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Final approval of the article: ASG, MH, RB, AM, MR, WM

Statistical analysis: ASG, MH, WM

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Overall responsibility: WM

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**Supplementary Table I (online only).** Suspicion of pelvic pathology seen during duplex ultrasound and confirmation during pelvic phlebography, stratified per type of pelvic pathology

	Pelvic pathology seen during phlebography				
	No	PeVD	Anatomic anomaly	Obstructive	No phlebography
Pelvic pathology suspected at DUS					
No	4	35	0	3	45
Yes	3	36	1	4	20
Missing, n	0	4	0	0	1
Total	7	75	1	7	66

*DUS*, Duplex ultrasound; *PeVD*, pelvic venous disease.  
Values are number.

**Supplementary Table II (online only).** Symptoms at presentation for women who underwent coiling divided into three groups: No improvement (*NI*), partial improvement (*PI*), complete improvement (*CI*) of symptoms after embolization

Symptoms	Improvement		
	NI (n = 20)	PI (n = 38)	CI (n = 15)
Abdominal pain	13 (65.0)	20 (52.6)	9 (60.0)
Dyspareunia	11 (55.0)	17 (44.7)	4 (26.7)
Heavy feeling lower abdomen	6 (30.0)	11 (28.9)	4 (26.7)
Heavy feeling vulvar area	3 (15.0)	16 (42.1)	1 (6.7)
Heavy feeling legs	13 (65.0)	26 (68.4)	7 (46.7)
Vulvar varicose veins	11 (55.0)	22 (57.9)	9 (60.0)
Varicose veins of the legs	10 (50.0)	27 (71.1)	12 (80.0)
Increase of complaints standing, increased pressure, cycling	6 (30.0)	16 (43.6)	6 (40.0)
Worsening during menstruation	8 (40.0)	14 (36.8)	7 (46.7)
Worsening after pregnancy	11 (55.0)	22 (57.9)	13 (86.7)
Dysuria, urge, irritation with miction	1 (5.0)	1 (2.6)	1 (6.7)

Values are number (%).

**Supplementary Table III (online only).** Type of pelvic vein treated and resolution of symptoms divided into three groups: No improvement (*NI*), partial improvement (*PI*), or complete improvement (*CI*) of symptoms after embolization

	NI	Improvement	
	NI (n = 20)	PI (n = 38)	CI (n = 15)
Ovarian vein(s) only	7 (35.0)	9 (23.7)	6 (40.0)
Internal iliac vein(s) only	2 (10.0)	4 (10.5)	4 (26.7)
Both ovarian and internal iliac vein(s)	9 (45.0)	23 (60.5)	3 (20.0)
Other <sup>a</sup>	2 (10.0)	2 (5.3)	2 (13.3)
Total	20	38	15

Values are number (%). Categories are based on the veins that were treated. Patients could be treated either on the left side, right side or both.  
<sup>a</sup>Other, are patients in which a combination of veins was treated that did not fall under the other categories, such as an ovarian vein in combination with the external iliac vein.