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Efficacy of endovenous embolization for pelvic congestion syndrome and its impact on ovarian reserve

Haluk Caglar Karakaya^{1*} , Busranur Dirican Ozen², Pelin Eskin¹, Ege Dursun¹, Murat Ugur³, Ecem Ozsoy⁴ and Melike Yurttas¹

Abstract

Background Pelvic congestion syndrome (PCS) is a complex condition, with ongoing controversies regarding its diagnosis, treatment, and long-term effects, especially concerning reproductive health. Endovenous embolization performed for PCS may alter pelvic hemodynamics and ovarian perfusion, which may change ovarian reserve and menstrual cycle characteristics. This study aimed to investigate the efficacy and impact of endovenous embolization on ovarian reserve and menstrual cycle parameters in patients with PCS.

Methods This retrospective, single-centre study analysed data from 81 patients diagnosed with PCS who underwent endovenous embolization. Symptom-specific Visual Analogue Scale (VAS) scores, serum anti-Müllerian hormone (AMH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol (E2), prolactin levels, and menstrual cycle characteristics were evaluated before and 6 and 12 months after the procedure. The primary outcome of this study was improvement in symptoms. Secondary outcomes included changes in serum hormone levels and menstrual cycle characteristics. We categorized our study population into four age groups (< 30, 30–34, 35–39, and 40–44 years) to minimize the impact of age as a confounding variable. These groups were designated as G1, G2, G3, and G4, respectively.

Results A statistically significant decrease was observed in VAS scores related to chronic pelvic pain (CPP), dyspareunia, and dysmenorrhea. A statistically significant decrease in serum AMH levels was observed 6 and 12 months after endovenous embolization. We observed a decline in AMH levels in G1, G2, G3, and G4 ($9.75 \pm 6.67\%$, $9.48 \pm 4.38\%$, $12.49 \pm 12.11\%$, and $13.79 \pm 11.46\%$, respectively). No significant changes were found in serum FSH, LH, E2, and prolactin levels. Additionally, a statistically significant decrease in menstrual cycle duration was detected after the procedure.

Conclusions Our study demonstrated that endovenous embolization appears to be an effective treatment modality for symptom relief. The effect of endovenous embolization on ovarian reserve was generally consistent with physiological changes associated with age, but changes in patients under the age of 30 should not be overlooked.

*Correspondence:
Haluk Caglar Karakaya
halukcaglar@karakaya@gmail.com

Full list of author information is available at the end of the article



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Larger, prospective, multi-centre studies are warranted to validate these findings and explore the long-term effects of endovenous embolization regarding reproductive health.

Trial registration Not applicable.

Keywords Chronic pelvic pain, Pelvic congestion syndrome, Pelvic vein incompetence, Endovenous embolization, Ovarian reserve, Anti-Müllerian hormone

Background

Pelvic congestion syndrome (PCS) is a frequently under-diagnosed cause of chronic pelvic pain (CPP) in women of reproductive age [1]. It predominantly affects multiparous women and is characterized by persistent, noncyclic pelvic pain lasting longer than six months [2]. The exact etiology of primary PCS is not fully understood but is thought to be multifactorial. Anomalies in pelvic venous anatomy, physiological changes in hemodynamic and hormonal profiles during pregnancy, and incompetent valves within the ovarian and pelvic veins are thought to be possible causes of PCS [3]. Secondary causes of PCS are vascular compression syndromes, such as May-Thurner syndrome or Nutcracker syndrome, which lead to increased venous pressure and subsequent variceal formation in the pelvic region. PCS may cause pelvic symptoms such as CPP, dyspareunia, dysmenorrhea, and lower extremity and/or vulvovaginal varicose veins [1, 4]. The symptoms usually worsen at the end of the day, while standing, walking, and after sexual intercourse [5]. Ultimately, this condition can significantly diminish a patient's quality of life [2].

Among medical, hormonal, surgical, and endovascular treatment options, recent guidelines recommend endovenous embolization as the standard treatment modality for PCS due to its minimally invasive nature and high success rate [6]. Several studies revealed that endovenous embolization is a safe and effective treatment [7, 8]. However, there is still insufficient data in the literature regarding the potential effects of this treatment on ovarian reserve and menstrual cycle characteristics. In their study, Wang et al. found that hormone therapy combined with endovenous embolization had no effect on AMH levels during a 6-month follow-up period [9]. However, their study did not evaluate menstrual cycle parameters. Venbrux et al. evaluated the efficacy of endovenous embolization on symptom improvement and the impact of treatment on menstrual cycle characteristics. While their study lacked the analysis of hormone levels, they reported that endovenous embolization had no significant effects on menstrual cycle length [10]. The potential impact of the treatment on ovarian reserve and menstrual cycle remains unknown. These uncertainties restrict its applicability, particularly in nulliparous patients or patients desiring future fertility. We hypothesize that endovenous

embolization is an effective treatment modality without a significant impact on ovarian reserve or menstrual cycle.

In this study, we aimed to evaluate the efficacy of endovenous embolization on symptom management and compare ovarian reserve parameters, such as anti-Müllerian hormone (AMH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol (E2), prolactin and menstrual cycle changes at baseline and 6 and 12 months after endovenous embolization in women diagnosed with PCS.

Methods

Study design

This retrospective study included 81 patients diagnosed with PCS between January 2022 and January 2025 who subsequently underwent endovenous embolization therapy at the University of Health Sciences Sancaktepe Sehit Prof. Dr. İlhan Varank Training and Research Hospital. The primary outcome of this study was improvement in symptoms, including CPP, dyspareunia, dysmenorrhea, dysuria, and stress incontinence. Secondary outcomes included changes in serum AMH, FSH, LH, E2, prolactin levels, and menstrual cycle duration. The study was conducted at a single institution and received approval from the institutional ethics committee. (Approval Number: 2025/100) The study was conducted in accordance with the Declaration of Helsinki. All the patients signed informed consent and agreed to participate in the study. Data on demographic characteristics, preprocedural, and postprocedural clinical/laboratory data were obtained from patient files and the hospital database for analyses.

Patient population

Out of 117 patients who were diagnosed with PCS and treated with endovenous embolization therapy, 81 patients in the age range between 18 and 45 years were selected for inclusion. The diagnosis of PCS was based on both clinical and radiological signs regarding PCS. Pain symptoms in the pelvic region lasting more than 6 months were defined as CPP [11]. All patients underwent gynaecological, gastroenterological, and neuropsychiatric evaluations to rule out nonvascular reasons for CPP. Transabdominal or transvaginal Doppler ultrasound (DUS) was performed in all patients. In patients in whom DUS assessment was inadequate or suboptimal, computed tomography phlebography or magnetic

resonance phlebography was performed to confirm diagnosis. Radiological criteria included an ovarian vein diameter of ≥ 6 mm, a slow blood flow of < 3 cm/s, and grade 2 or 3 reflux according to Hiromura classification in the left ovarian vein (LOV) [12, 13]. Other PCS symptoms, such as dysmenorrhea, dyspareunia, and dysuria, were also assessed with the Visual Analogue Scale (VAS) subjectively before the procedure and 6 and 12 months postprocedure. Exclusion criteria included patients with gynaecological diseases such as polycystic ovary syndrome, endometriosis, pelvic inflammatory disease, any systemic diseases, gastrointestinal diseases like irritable bowel syndrome, psychosomatic diseases, neuromuscular diseases, a history of use of oral contraceptives, the presence of a levonorgestrel intrauterine device, a history of prior abdominal or pelvic surgery or radiotherapy. Patients with vascular compression syndromes, such as Nutcracker syndrome or May-Thurner syndrome were also excluded to reduce clinical heterogeneity. A non-treatment control group was not established due to the ethical implications of withholding necessary intervention. No patients were lost to follow-up during the 12-month follow-up period. The study process is shown in Fig. 1.

Procedural technique

All procedures were performed under local anaesthesia. Venous access was provided through the right or left femoral vein or right brachial vein under ultrasound guidance. A 6 F standard vascular introducer was used for vascular access. A 0.035-inch diameter hydrophilic guidewire and 6 F guiding catheters (Cobra[®], Terumo, Europe, or Simmons1[®], Cordis Johnson & Johnson,

Europe NV, Roden, Netherlands) were used. Bilateral ovarian veins, all iliac veins, the left renal vein, the ilio-caval confluence, and all relevant venous structures were evaluated with phlebography. During phlebography, imaging was supported by applying the Valsalva manoeuvre to make the reflux more apparent. For coil embolization, the target veins were selectively entered with a microcatheter (Renegade[®], Boston Scientific, USA, or Rebar[®], Medtronic, Minneapolis, MN, USA), and the embolization procedure was initiated. The embolization protocol and materials used were left to the operator's discretion. Platinum-based detachable coils (Interlock[®], Boston Scientific, USA, or Concerto[®], Medtronic, Minneapolis, MN, USA) of different sizes depending on the targeted vessels were placed starting from the segment closest to the distal and moving towards the proximal. In some cases, in patients who could not achieve complete occlusion with the coil, complementary embolization was performed with a liquid embolizing agent (Onyx[®], Medtronic, Irvine, CA, USA). No microcatheter was used for plug (Multibeam[®], Invamed, Ankara, Turkey) embolization. Plugs were implanted through a standard 6 F guiding catheter. After each embolization, control phlebography was performed to confirm embolization of all varicose pelvic veins and escape points. The patients were kept under observation postprocedure for a day for possible complications and then discharged the day after. The access site was routinely evaluated via physical examination. DUS was performed when access site complications were suspected. Postembolization syndrome was defined as increased pelvic pain, the occurrence of tenderness along the embolized vein, and the presence of hyperthermia [14]. Analgesic treatment with

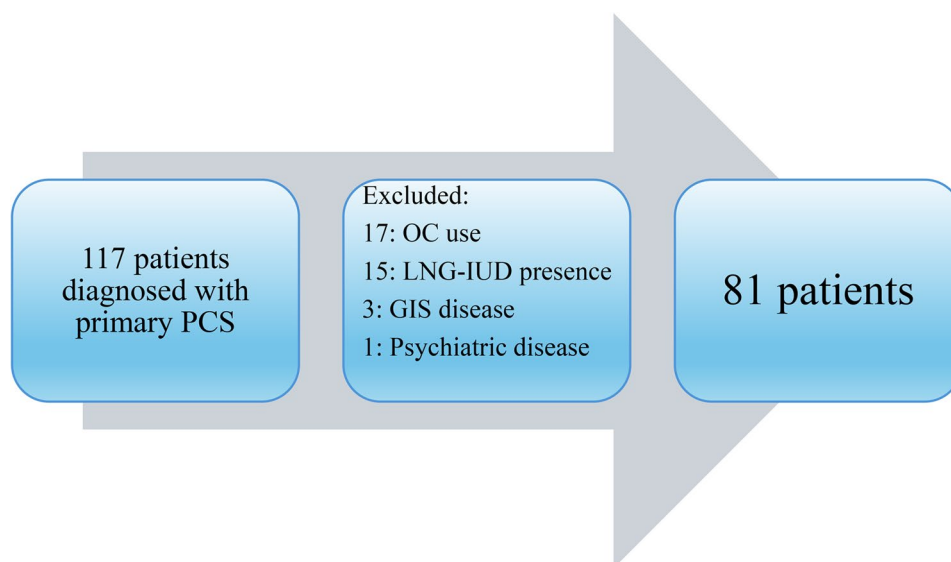


Fig. 1 Flowchart of patient inclusion and exclusion in the study. OC: Oral contraceptive, LNG-IUD: Levonorgestrel intrauterine device, GIS: Gastrointestinal system

non-steroidal anti-inflammatory drugs was given to the patients suffering from postembolization syndrome. No additional medications were given to the patients. The endovenous embolization success rate was 100%.

Follow up

All related pelvic symptoms like CPP, dysmenorrhea, dyspareunia, postcoital pain, and dysuria were assessed with VAS and scores ranging from 0 to 10 were recorded for each symptom. The VAS is a horizontal scale, where 0 indicates “no pain” and 10 indicates “worst imaginable pain” [15]. VAS was preferred because it is a reliable method that objectively measures patients’ subjective pain perception. Also, the presence of stress incontinence was noted. Measurements were made during the pre-procedure evaluation, considering the general health status of the patients regarding their symptoms. All patients were called to the outpatient clinic for control purposes at 1, 3, 6, and 12 months after the procedure, respectively. During these visits, the general clinical condition of the patients, changes in their symptoms, possible complications that may arise after the procedure, and newly developing complaints, if any, were evaluated in detail. Patients whose symptoms persisted or worsened underwent control imaging with transvaginal DUS. Repeat phlebography was indicated upon the detection of pelvic vein dilation (>3 mm) and reflux flow. Detection of collateral pelvic veins presenting with dilation or reflux was also considered an indication for repeat phlebography. Computed tomography phlebography or magnetic resonance phlebography was performed when transvaginal DUS findings were inconclusive. In patients who underwent repeat phlebography, collateral veins, pelvic escape points, and contralateral venous structures were evaluated to identify the cause of recurrence. When reflux flow and dilation were detected, a decision was made to perform reintervention. In addition to symptom assessment during follow-ups, any need for medical treatment, changes in daily life activities, frequency of analgesic use, and patient satisfaction levels were also recorded. VAS was applied to the patients again at 6 and 12 months and compared with the pre-procedure values to evaluate the long-term symptomatic response. All evaluations were conducted by the same vascular surgery and gynaecology team, and the records were documented using a standard clinical follow-up form. No additional medical treatment was applied to the patients during this period.

Hormonal analyses and laboratory method

AMH, FSH, LH, E2, and prolactin levels were examined in all patients. All hormone analyses were performed at an accredited central laboratory (ISLAB Göztepe, Istanbul, Turkey). Blood specimens (2 mL) were obtained under sterile conditions from patients and maintained at

-20°C for subsequent biochemical analysis. Serum hormone levels were measured using the electrochemiluminescence immunoassay (ECLIA) method on a Roche® Cobas® 8000 device. Other hormone parameters were measured in the same laboratory using the same device and method. Blood samples were collected during the early follicular phase of the menstrual cycle before and at 6 and 12 months after endovenous embolization. Units were ng/mL for AMH and prolactin, mIU/mL for FSH and LH, and pg/mL for E2.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0. Descriptive statistics are presented as n and % for categorical variables. Data were evaluated for normality using the Kolmogorov-Smirnov test, with $p > 0.05$ indicating a normal distribution. Log transformation was performed to enable comparison with normative data. Therefore, the paired samples t -test and McNemar test were used to compare repeated measurements. We categorized our study population into four age subgroups (<30 , 30–34, 35–39, and 40–44 years) to minimize the impact of age as a confounding variable. In addition, subgroup analyses were performed by excluding patients with a body mass index (BMI) outside the normal range and smokers in order to reduce potential confounding effects. The annual change was calculated by dividing the difference in hormone levels (Δ from baseline and 12-month measurements) by the measurement interval (Δ/year). A p -value of less than 0.05 was considered statistically significant.

Sample size justification

Cohen’s d effect size measure was used to calculate the sample size. Although this study was retrospective in design, we performed a sample size calculation to ensure that the available cohort was adequate to test our primary hypothesis. The calculation was conducted using G*Power version 3.1.9.4 (Heinrich Heine University, Düsseldorf, Germany), with an α level of 0.05, a power ($1-\beta$) of 0.95, and an assumed effect size of 0.50 derived from the preprocedural AMH values reported by Wang et al. [9], in which the mean $\pm$ SD AMH levels were 0.64 ± 0.24 ng/mL in Control Group 1, 0.62 ± 0.29 ng/mL in Control Group 2, and 0.63 ± 0.29 ng/mL in the Study Group. Based on these parameters, the minimum required sample size was calculated as 66 patients. Our final cohort ($n = 81$) exceeded this threshold, indicating sufficient statistical power.

Results

The demographic and clinical characteristics of the study population are presented (Table 1).

Table 1. Demographic and Clinical Characteristics of the Study Population

Variables(<i>n</i> = 81)	<i>n</i>	%
Age		
Mean ± SD	35.14 ± 5.49	
Median (min-max)	36.0 (23–44)	
BMI		
Mean ± SD	23.79 ± 3.75	
Median (min-max)	23.1 (18.3–34.1)	
History of lower extremity CVI		
No	26	32.1
Yes	55	67.9
Gravidity		
1	9	11.1
2	16	19.8
3	24	29.6
4	22	27.2
5	9	11.1
6	1	1.2
Parity		
1	12	14.8
2	19	23.5
3	37	45.7
4	10	12.3
5	3	3.7
Abortus		
0	50	61.7
1	26	32.1
2	5	6.2
Localization of visible varicose veins		
Lower extremity		
No	26	32.1
Yes	55	67.9
Vulvovaginal		
No	72	88.9
Yes	9	11.1
Gluteal		
No	75	92.6
Yes	6	7.4
Lower abdomen		
No	73	90.1
Yes	8	9.9

Abbreviations: *BMI* body mass index, *CVI* chronic venous insufficiency

Baseline clinical features of CPP and other symptoms are summarized (Table 2).

Technical success rate of the endovenous embolization was 100%. The most common complication was ovarian vein rupture. Regarding access site complications, one patient experienced a localized hematoma in the left groin that did not require intervention and was treated conservatively. No migration was observed (Table 3).

A comparison of preprocedural hormone levels with those at the 6th month revealed a statistically significant

Table 2 Clinical features of CPP and associated pelvic symptoms

Variables(<i>n</i> = 81)	<i>n</i>	%
Clinical features of CPP		
Increase at the end of the day		
No	8	9.9
Yes	73	90.1
Increase with standing		
No	8	9.9
Yes	73	90.1
Increase in premenstrual period		
No	20	24.7
Yes	61	75.3
Increase with physical activity		
No	16	19.8
Yes	65	80.2
Other Symptoms		
Dysmenorrhea		
No	51	63.0
Yes	30	37.0
Dyspareunia		
No	8	9.9
Yes	73	90.1
Dysuria		
No	74	91.4
Yes	7	8.6
Stress incontinence		
No	74	91.4
Yes	7	8.6
Symptom duration (month)	47.15 ± 23.58	
Mean ± SD		

Abbreviations: *CPP* chronic pelvic pain

decrease only in AMH levels ($p < 0.001$). No significant changes were observed in other hormone levels (Table 4).

A comparison of preprocedural hormone levels with those at the 12th month revealed a statistically significant decrease only in AMH levels ($p < 0.001$). No significant changes were observed in other hormone levels (Table 5).

At the 6-month mark, statistically significant decreases were observed in VAS scores related to CPP, dysmenorrhea, and dyspareunia (Table 9).

At the 12-month mark, statistically significant decreases were observed in VAS scores related to CPP, dysmenorrhea, and dyspareunia (Table 10).

Discussion

In this study, we aimed to investigate the efficacy and effects of endovenous embolization on ovarian reserve and menstrual cycle in the treatment of PCS. Our analysis revealed that endovenous embolization in the treatment of PCS provides prominent symptomatic relief and patient satisfaction without compromising ovarian and uterine functions. The clinical results obtained support the efficacy and safety of endovenous methods, which are

Table 3 Procedural data

Variables(n = 81)	n	%
Ovarian vein diameter		
Mean ± SD	9.33 ± 1.95	
Median (min-max)	9.1 (3.3–14.8)	
Reflux grade (Hiromura classification)		
2	35	43.2
3	46	56.8
Access vein		
RFV	59	72.8
RBV	18	22.2
LFV	4	4.9
Embolization material		
Plug	57	70.4
Coil + Onyx	24	29.6
Embolized veins		
LOV	51	63.0
LOV + LIIV	26	32.1
ROV	2	2.5
LOV + ROV + BIIV	2	2.5
Complication		
No	75	92.6
Yes	6	7.4
Access site complications		
No	80	98.8
Yes	1	1.2
Rupture		
No	77	95.1
Yes	4	4.9
Repeat embolization		
No	80	98.8
Yes	1	1.2
Postembolization syndrome		
No	51	63.0
Yes	30	37.0

Abbreviations: RFV right femoral vein, RBV right brachial vein, LFV left femoral vein, LOV left ovarian vein, ROV right ovarian vein, LIIV left internal iliac vein, BIIV bilateral internal iliac vein

Table 4 Comparison of serum hormone levels before the procedure and at 6 months

Serum hormone levels	Preprocedural Mean ± SD	At the 6th month Mean ± SD	p
AMH (ng/mL)	2.37 ± 0.82	2.26 ± 0.81	< 0.001
LH (mIU/mL)	7.37 ± 1.42	7.36 ± 1.43	0.973
FSH (mIU/mL)	7.27 ± 1.45	7.33 ± 1.47	0.772
E2 (pg/mL)	60.69 ± 12.80	60.12 ± 11.78	0.777
Prolactin (ng/L)	14.57 ± 5.25	13.23 ± 5.46	0.101

Paired Samples T test, $p < 0.05$ statistically significant

Abbreviations: AMH Anti-mullerian hormone, LH luteinizing hormone, FSH Follicle-stimulating hormone, E2 Estradiol

Table 5 Comparison of serum hormone levels before the procedure and at 12 months

Serum hormone levels	Preprocedural Mean ± SD	At the 12th month Mean ± SD	p
AMH (ng/mL)	2.37 ± 0.82	2.17 ± 0.83	< 0.001
LH (mIU/mL)	7.37 ± 1.42	7.26 ± 1.51	0.651
FSH (mIU/mL)	7.27 ± 1.45	7.32 ± 1.46	0.793
E2 (pg/mL)	60.69 ± 12.80	60.49 ± 11.54	0.918
Prolactin (ng/mL)	14.57 ± 5.25	13.29 ± 5.55	0.120

Paired Samples T test, $p < 0.05$ statistically significant

Abbreviations: AMH Anti-mullerian hormone, LH luteinizing hormone, FSH Follicle-stimulating hormone, E2 Estradiol

increasingly preferred as a minimally invasive option to surgical treatment. Notably, our study is among the few that specifically examine hormonal levels in the context of ovarian reserve, providing valuable insights that could inform future clinical practices and interventions.

In our study, a significant decrease was found in the VAS scores related to CPP and dyspareunia after endovenous coil embolization in patients diagnosed with PCS. A significant symptomatic improvement was observed in the majority of patients who presented with high VAS scores before the procedure at 6 and 12 months. This finding supports the effectiveness of endovenous embolization on CPP of venous origin due to PCS. Similar results are also available in the literature. Laborda et al. reported an improvement rate of over 80% in CPP after embolization. [16] In the 2024 series by Zhou et al., it was reported that a significant decrease in VAS scores was detected.[17] Our data, consistent with these results, show that endovenous embolization is an effective method for PCS-related symptom treatment. Although some authors claimed that there is a significant decrease in dysuria and urinary incontinence compared to before the procedure [18], we found no significant improvement in urinary incontinence and dysuria after endovenous embolization.

The role of PCS in the etiology of female infertility remains unclear. Although some studies reported pregnancies after endovenous embolization, it should be noted that these implications come from case series with limited methodology.[19] While the impact of endovenous embolization on ovarian reserve remains unclear, presenting it as an alternative treatment for infertility should be approached with caution. Our study did not evaluate fertility outcomes, and any interpretation in this context should be made carefully due to the limited available evidence. Regarding the effect of endovenous embolization on ovarian reserve, Wang et al. investigated serum hormone levels in patients who underwent endovenous embolization, but hormonal therapy was given to 2 of the 3 groups in the study after embolization. [9] They found no significant differences in serum AMH

Table 6 Changes in AMH levels and percentage variation 12 months after endovenous embolization across age groups

Variables	n	Preprocedural AMH levels (Mean ± SD) ng/mL	AMH levels at the 12th month (Mean ± SD) ng/mL	p	% Change in AMH levels (Mean ± SD)	p
Age						0.483 ^a
G1(< 30)	18	2,86 ± 0,69	2,58 ± 0,82	0.002 ^b	9,75 ± 6,67	
G2(30–34)	22	2,82 ± 0,76	2,59 ± 0,73	< 0.001 ^b	9,48 ± 4,38	
G3(35–39)	29	2,12 ± 0,64	1,97 ± 0,68	0.012 ^b	12,49 ± 12,11	
G4(40–44)	12	1,45 ± 0,32	1,26 ± 0,31	< 0.001 ^b	13,79 ± 11,46	

Abbreviations: AMH Anti-mullerian hormone

^aANOVA test^bPaired Samples t-test**Table 7** Log-transformed change in AMH levels 12 months after endovenous embolization across age groups

Age Group	n	Change in logAMH (Mean ± SD)
G1(< 30)	15	−0.04 ± 0.01
G2(30–34)	20	−0.08 ± 0.05
G3(35–39)	25	−0.16 ± 0.11
G4(40–44)	21	−0.12 ± 0.13

Abbreviations: AMH Anti-mullerian hormone

Table 8 Changes in AMH levels and percentage changes in non-smokers and patients with normal BMI

Variables	n	AMH Change (Mean ± SD) ng/mL	% Change in AMH Levels (Mean ± SD)
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Non-smokers	52	0.23 ± 0.21	11.26 ± 10.61
Patients with normal BMI	53	0.25 ± 0.18	11.49 ± 9.48

Abbreviations: AMH Anti-mullerian hormone, BMI Body mass index

Table 9 Comparison of symptom VAS scores before the procedure and at 6 months

Symptoms	Preprocedural (Mean ± SD)	At the 6th month (Mean ± SD)	p
CPP	5.41 ± 1.39	1.68 ± 1.74	< 0.001
Dysmenorrhea	1.88 ± 2.77	1.06 ± 1.87	< 0.001
Dyspareunia	5.35 ± 2.41	1.21 ± 1.73	< 0.001
Dysuria	0.31 ± 1.02	0.19 ± 0.69	0.082
Stress incontinence			
No	74 (%91.4)	76 (%93.8)	0.500*
Yes	7 (%8.6)	5 (%6.2)	

Paired Samples T test, *McNemar test $p < 0.05$ statistically significant

Abbreviations: CPP chronic pelvic pain

Table 11 Comparison of menstrual cycle characteristics before the procedure and at 12 months

Variables	Preprocedural Mean ± SD	At the 12th month Mean ± SD	p
Menstrual cycle duration	5.23 ± 1.54	4.59 ± 1.38	< 0.001
Menstrual frequency	22.79 ± 1.91	23.07 ± 1.82	0.016

Paired Samples T test, $p < 0.05$ statistically significant**Table 10** Comparison of symptom VAS scores before the procedure and at 12 months

Symptoms	Preprocedural Mean ± SD	At the 12th month Mean ± SD	p
CPP	5.41 ± 1.39	1.06 ± 1.51	< 0.001
Dysmenorrhea	1.88 ± 2.77	0.90 ± 1.72	< 0.001
Dyspareunia	5.35 ± 2.41	0.79 ± 1.32	< 0.001
Dysuria	0.31 ± 1.02	0.15 ± 0.63	0.067
Stress incontinence			
No	74 (%91.4)	77 (%95.1)	0.250*
Yes	7 (%8.6)	4 (%4.9)	

Paired Samples T test, *McNemar test, $p < 0.05$ statistically significant

Abbreviations: CPP chronic pelvic pain

levels between or within the groups. However, there was a notable decrease in serum FSH and E2 levels, as well as the FSH/LH ratio. In our study, patients who underwent endovenous embolization were monitored, and no hormonal therapy was administered. In contrast to Wang et al., we observed no change in serum FSH, LH, E2, and prolactin levels. However, our analysis demonstrated a statistically significant decrease in AMH levels following endovenous embolization treatment. We observed a decline in AMH levels in each age subgroup (9.75 ± 6.67%, 9.48 ± 4.38%, 12.49 ± 12.11%, and 13.79 ± 11.46%, respectively). Similar decline rates were also observed in subgroup analyses conducted for non-smokers and patients with normal BMI (11.26 ± 10.61%, 11.49 ± 9.48%, respectively). While the observed decline in AMH may initially raise concerns regarding potential iatrogenic effects on fertility, it is crucial to acknowledge that AMH levels naturally diminish with advancing age, reflecting a decline in the quantity and quality of remaining oocytes. [20] This age-related decline is a well-established phenomenon in reproductive endocrinology and must be considered when evaluating the impact of any intervention on ovarian reserve. In our study, the estimated annual change for G1, G2, G3, and G4 was −0.04 ± 0.01, −0.08 ± 0.05, −0.16 ± 0.11, and −0.12 ± 0.13 log units/year, respectively. In a normogram study by de Kat et al., the estimated annual change in logAMH for age groups corresponding to our study's groups was −0.02 ± 0.16, −0.09 ± 0.12, −0.19 ± 0.07, and −0.33 ± 0.03 log units/year, in the same order. [21]

In G1, the decline in AMH levels was greater than that reported in normative data. The changes observed in groups G2, G3, and G4 remained within the expected range for age. This analysis suggests a potential impact on ovarian reserve among patients younger than 30 years old. When considering endovenous embolization for this patient group, patients' fertility expectations and the potential impact of the procedure on ovarian reserve should be discussed. This is particularly important for younger patients who desire future fertility. Furthermore, in this patient group, if a decision to intervene is made, closer monitoring of ovarian reserve parameters may be considered during follow-up period. The observed decline in AMH levels was generally consistent with the expected physiological decline associated with aging, but the possibility of an additional decline due to endovenous embolization in the younger age group should not be overlooked. Consequently, these findings should be interpreted with caution. Findings from this study should not be overgeneralized and require confirmation in larger, prospective, and long-term studies.

PCS is characterized by dilation in pelvic veins and reflux flow. [13] These hemodynamic changes may alter ovarian and uterine perfusion. Consequently, the pattern of endometrial shedding and the menstrual cycle duration may be influenced in response to changes in pelvic hemodynamics. One of the main goals of endovenous embolization is to normalize pelvic hemodynamics. Therefore, changes in menstrual cycle duration may occur after endovenous embolization. Venbrux et al. demonstrated nonsignificant change in menstrual cycle length.[10] In our study, we observed a decrease in menstrual cycle duration ($p < 0.001$). While the mean menstrual cycle duration was 5.23 ± 1.54 days before the procedure, it decreased to 4.59 ± 1.38 days after the procedure. Although this difference was statistically significant, it may be considered to have limited clinical impact. We believe that the reduction of the menstrual cycle duration is a natural result of venous decompression caused by endovenous embolization.

Another important finding in our study is related to the time to diagnosis. It was determined that the diagnosis of PCS was made in our patients after a long period of time, approximately 47 months. This situation shows that PCS comes to mind later in the differential diagnosis of CPP. Kashef et al. defined PCS as "a common but often underdiagnosed condition" and emphasized that delay in diagnosis has a negative impact on patients' quality of life. [1] This delay in diagnosis not only has a negative impact on the patient's comfort and quality of life but also significantly increases healthcare costs. [22] The lack of definitive clinical and radiological diagnostic criteria and the fact that the disease requires a multidisciplinary approach make it difficult to recognize PCS. One

of the most important reasons for the delay in diagnosis is that patients with CPP do not apply to the phlebology outpatient clinic at first. Gynaecologists need to remember PCS in the differential diagnosis of CPP, and the person who performs transvaginal ultrasound for diagnosis of primary pelvic pathologies should develop the habit of routinely evaluating pelvic vascular structures with DUS when presenting with a differential diagnosis of CPP. Considering all the aforementioned data, PCS should be made more visible in diagnostic algorithms and addressed with a multidisciplinary approach.

Conclusion

PCS is a complex clinical condition that still contains many controversies and uncertainties in terms of diagnosis, treatment, and long-term effects of the treatment. Our study demonstrated that endovenous embolization appears to be an effective treatment modality for symptom relief. Regarding reproductive health, the effect of endovenous embolization on ovarian reserve was generally consistent with physiological changes associated with age, but changes in patients under the age of 30 should not be overlooked. Moreover, a slight decrease in menstrual cycle duration was observed. Taken together, these findings underscore that it is of great importance that when evaluating suitability for treatment in this patient group, not only symptomatic improvement but also possible effects on reproductive health should be considered. Long-term results should be supported by further studies to reach a more solid scientific basis for the management of the disease.

Abbreviations

AMH	Anti-müllerian hormone
BIIV	Bilateral internal iliac vein
BMI	Body mass index
CPP	Chronic pelvic pain
CVI	Chronic venous insufficiency
DUS	Doppler ultrasound
E2	Estradiol
ECLIA	Electrochemiluminescence immunoassay
FSH	Follicle-stimulating hormone
GIS	Gastrointestinal system
LFV	Left femoral vein
LH	Luteinizing hormone
LIIV	Left internal iliac vein
LNG-IUD	Levonorgestrel intrauterine device
LOV	Left ovarian vein
OC	Oral contraceptive
PCS	Pelvic congestion syndrome
RBV	Right brachial vein
RFV	Right femoral vein
ROV	Right ovarian vein
VAS	Visual analogue scale

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Authors' contributions

Conceptualization, H.C.K., M.U.; methodology, H.C.K., M.U. and B.D.O.; validation, H.C.K., M.U. and B.D.O.; formal analysis, E.D., M.Y.; investigation, P.E.,

E.O.; resources, E.D., M.Y.; data curation, E.D., M.Y., P.E.; writing—original draft preparation, H.C.K., P.E., E.D., and B.D.O.; writing—review and editing, H.C.K., M.U. and B.D.O.; visualization, H.C.K., P.E., E.O.; supervision, H.C.K., M.U.; project administration, H.C.K., M.U. All authors have read and agreed to the published version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee. (Approval Date: 09.04.2025, Approval Number: 2025/100)

Consent for publication

Informed consent was obtained from all subjects involved in the study.

Competing interests

The authors declare no competing interests.

Author details

¹Department of Cardiovascular Surgery, University of Health Sciences, Sancaktepe Sehit Prof. Dr. Ilhan Varank Research and Training Hospital, Emek Mahallesi, Namik Kemal Cad. No:54, 34785 Sancaktepe, Istanbul, Istanbul 34785, Turkey

²Department of Obstetrics and Gynaecology, University of Health Sciences, Istanbul Education and Research Hospital, Istanbul, Turkey

³Department of Cardiovascular Surgery, Medicana Zincirlikuyu Hospital, Istanbul, Turkey

⁴Department of Obstetrics and Gynaecology, University of Health Sciences, Sancaktepe Sehit Prof. Dr. Ilhan Varank Research and Training Hospital, Istanbul, Turkey

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