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ORIGINAL RESEARCH

Analysis of the Clinical Efficacy of Interlock Detachable Coil Interventional Embolization on Pelvic Congestion Syndrome and Ovarian Reserve Function: A Retrospective Study

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Objective: This study aimed to examine the effects and the efficacy of a combination of interventional embolization and endocrine hormone therapy for Pelvic congestion syndrome (PCS).

Methods: We retrospectively analyzed 132 patients diagnosed with PCS, and divided them into three groups based on their therapeutic schedule. The visual analog scale (VAS), pelvic venous blood flow parameters, and serum hormone levels of the three groups were compared before and after treatment. Moreover, the clinical efficacy and long-term changes in ovarian reserve functions were analyzed. For the comparison of measurement data before and after treatment within the group, paired - sample *t* - test was used for analysis. For the comparison between groups, one - way analysis of variance was applied. A P - value less than 0.05 indicated a statistically significant difference.

Results: Patients in the study group had significantly lower pain degrees than in the control group I and the control group II at 24 h and the first month after the operation ($p < 0.05$). The degree of pain in patients in the study group was significantly lower than that in the control group I at the third and 6 months following the treatment ($p < 0.05$). The parameters of venous blood flow and ovarian reserve in patients treated with the combined endocrine hormone therapy were significantly better than those in patients not treated with endocrine hormone therapy ($p < 0.05$). The total effective rate of the study group was significantly higher than that of the control groups ($p < 0.05$).

Conclusion: A combination of precise interventional embolization and endocrine hormone therapy can rapidly and effectively relieve pain in patients with PCS. Compared with free coil embolization, this combination can effectively increase vascular tension, reduce congestion, inhibit ovarian function, reduce pelvic congestion, and relieve symptoms.

Keywords: endocrine hormone therapy, interventional embolization, interlock detachable coil, ovarian reserve function, pelvic congestion syndrome

Introduction

Pelvic congestion syndrome (PCS) is a chronic clinical syndrome mainly characterized by aperiodic pelvic pain, low back pain, and dyspareunia. During gynecological examinations, it shows few positive signs, and patients often experience symptoms like frequent and urgent urination, increased menstrual flow and vaginal discharge. These symptoms persist for over 6 months, especially during prolonged standing, sexual intercourse, and menstruation. PCS may be associated with superficial varicose veins in the vulva, perineum, and lower limbs.[1,2] Research shows that PCS mostly affects 20 - 45 - year - old women of childbearing age. Around 10% of them have ovarian vein dilatation, and 60% of those with dilated veins develop PCS.[3] The prevalence of PCS in symptomatic female groups is 31%.[4] The

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pathogenesis of PCS is complex, related to anatomy, circulation, hormones, and other factors. The pelvic cavity has abundant but structurally weak veins.[5–7] Some people have congenital pelvic defects, and the interconnected anastomotic branches of the pelvic venous plexus are vulnerable to pelvic pressure and hormonal changes during pregnancy.[8,9] Abnormalities in blood vessel structure and function make pelvic veins prone to varicosity, reflux, and congestion, leading to PCS. Additionally, factors like familial inheritance[10], psychological factors[11], and others also play a role.[12,13] Interestingly, PCS is more likely in those with a normal body mass index, while obese women have a lower incidence.[14] Currently, PCS treatments include drug, surgical, and interventional therapies. Drugs like medroxyprogesterone and medroxyprogesterone acetate can relieve symptoms in the short - term but have poor long - term efficacy.[10] Surgical methods, such as hysterectomy, oophorectomy, and bilateral ovarian vein ligation or resection, can affect fertility and hormone secretion. In contrast, interventional treatment has better effects, less trauma, and fewer complications.[15] With the development of interventional technology and embolization materials, 60% - 100% of patients experience significant symptom relief after interventional treatment, with a recurrence rate of less than 8%.[16,17] Endovascular embolization is now the first - choice treatment for PCS.[18] However, when ovarian vein dilation exceeds 6 mm, especially when the right ovarian vein directly drains into the inferior vena cava, using free coils in interventional embolization may cause excessive blood flow, leading to coil drift into the inferior vena cava and increasing the risk of ectopic embolism like pulmonary embolism.[19] Interventional embolization not only reduces blood flow but also inhibits estrogen secretion. Although interventional combined with endocrine therapy can significantly relieve symptoms, the mechanism remains unclear[20] An interlock detachable coil can achieve precise embolization and prevent ectopic embolism,[21] but its effect on PCS and the symptom relief provided by combined endocrine therapy have not been well - studied. In this study, we compared the efficacy of free coil embolization alone, free coil embolization with endocrine therapy, and interventional embolization with an interlock detachable coil combined with endocrine therapy through a clinical randomized control trial. We analyzed the clinical and long - term efficacy of these treatments for PCS, aiming to offer new treatment methods and ideas for clinical PCS treatment.

Methods

Research Patients

We retrospectively selected 132 patients diagnosed with PCS at the Affiliated Hospital of Jiangnan University from November 2021 to March 2023. According to their therapeutic schedules, patients were divided into three groups: free coil embolization alone (control group I), free coil combined with endocrine hormone therapy (control group II), and precise interventional embolization combined with endocrine hormone therapy (Study Group). This study was approved by the medical ethics committee of Affiliated Hospital of Jiangnan University and complies with the Declaration of Helsinki. The study process is shown in Figure 1.

Inclusion criteria: (I) meeting the diagnostic criteria of pelvic congestion syndrome, (II) patients in the age range of 25 to 45 years, and (III) patients signed the informed consent form and agreed to join the trial.

Exclusion criteria: (I) other diseases with uterine fibroids, adenomyosis, pelvic inflammatory diseases, and other manifestations such as lower abdominal pain, waist and sacral pain, (II) patients with underlying diseases such as severe cardiovascular diseases, hepatic and renal dysfunction, advanced-stage malignant tumors, severe hematological diseases, and severe respiratory system diseases, (III) patients with mental disorders, (IV) women who are lactating, pregnant, or preparing for pregnancy.

Clinical and angiographic diagnostic criteria of PCS included a history of CPP, especially sexual intercourse pain, cervical tenderness or ovarian tenderness on physical examination, Valsalva maneuver angiography showing blood countercurrent in at least one ovarian vein, at least one ovarian vein diameter > 6 mm, and open pelvic collateral veins and delay in intravenous contrast agent emptying.[8]

Therapeutic Regimen

Control group I: Patients were treated with simple free coil embolization, punctured into the inferior vena cava. A 5-cobra catheter or Simon catheter was used to select the left renal vein for angiography and assess the presence of

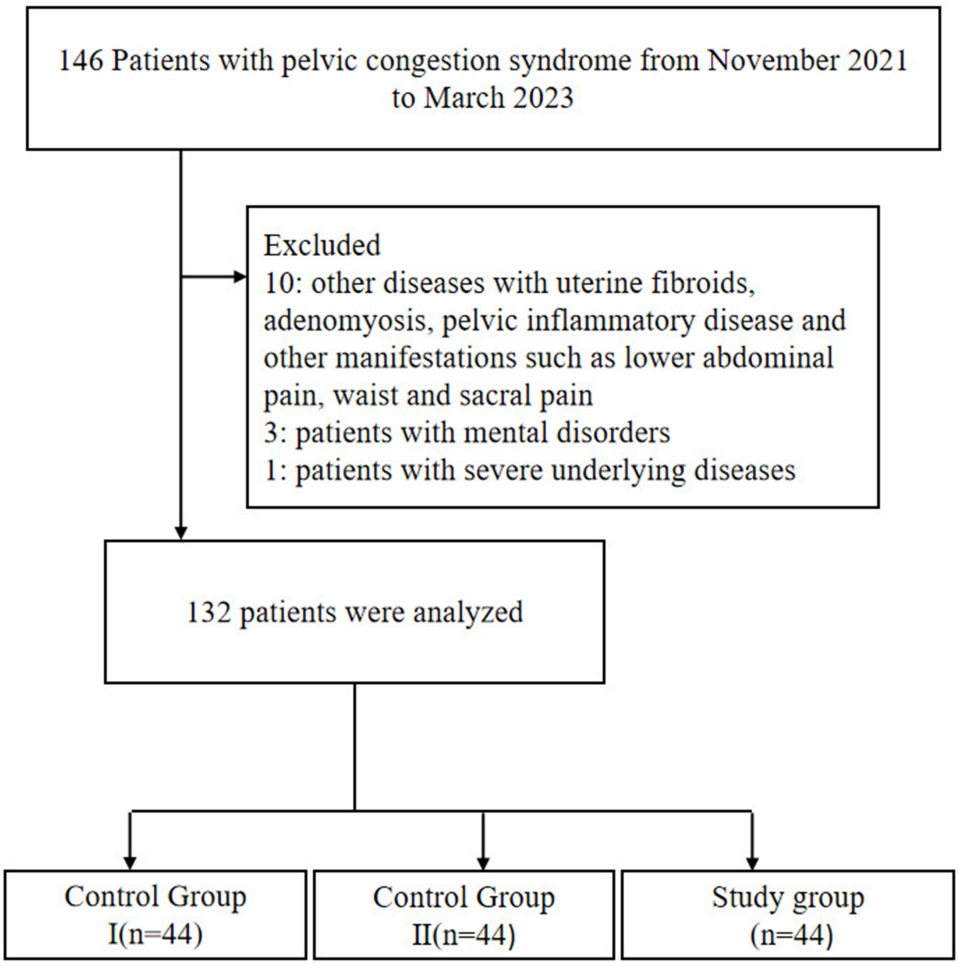

Figure 1 Flow Chart.

stenosis caused by nutcracker syndrome and left ovarian vein regurgitation. The patient took the reverse Trendelenburg position, ovarian vein dysfunction showed venous dilatation and contrast agent regurgitation. In the case of reflux in the left ovarian vein, the ovarian vein was selected using a guide wire for angiography to identify the dilated venous plexus and the contralateral communicating branch. After the catheter was withdrawn and the left ovarian vein trunk was blocked by a balloon or coil, a sclerosing agent was injected into the dilated venous plexus, and coil embolization was placed in the proximal ovarian vein for consolidation after degeneration. Similarly, the right ovarian venography was selected from the inferior vena cava, and embolization was repeated by advancing to the dilated venous plexus using the guide wire. Finally, the left renal vein and right ovarian vein angiography were performed again, and no reflux was found, confirming the success of the treatment.

Control group II: The free spring coil combined with endocrine hormone therapy was used. The interventional operation was the same as that in control group I. Depending on the patient's serum results, the dosage was dynamically adjusted with oral medroxyprogesterone acetate (MPA) (2 mg/tablet).

Study Group: Precise interventional embolization combined with endocrine hormone therapy was included using an interlock detachable coil interventional embolization combined with endocrine hormone therapy. The endocrine hormone treatment scheme was the same as the control group II, using an interlock detachable coil instead of the ordinary spring coil. The following are the key points of interventional embolization technology: connect the Y valve, introduce the appropriate length and size of the interlock detachable coil along the catheter, and release it accurately. The spring coil remains locked before release and can be withdrawn before full release. The spring coil drifting into the inferior vena cava should be avoided, causing ectopic embolization. Pelvic angiography is shown in Figure 2.

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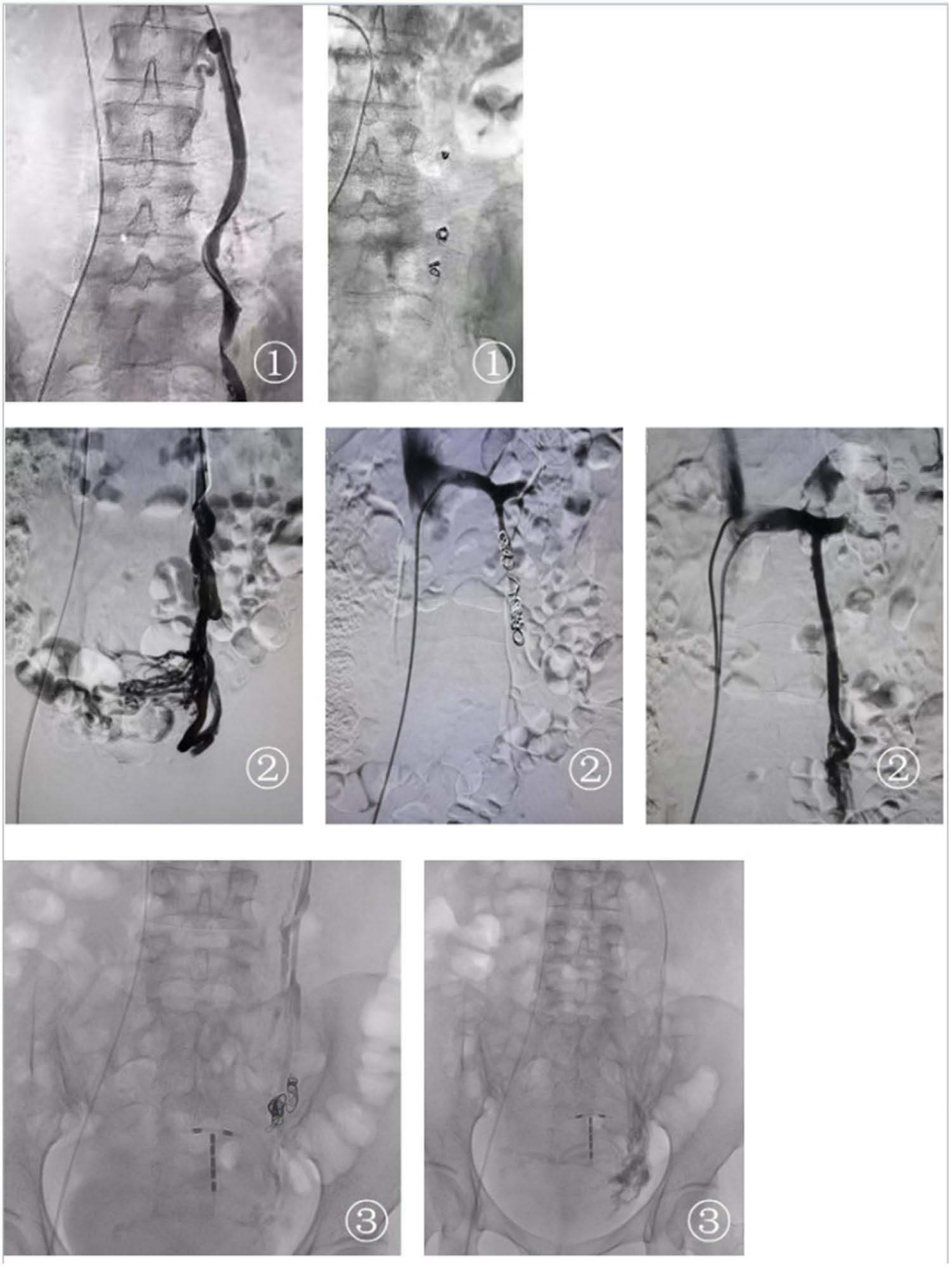

Figure 2 Pelvic vascular angiography (①: Control group I; ②: Control group II; ③: Study Group).

Observation Target

Pain evaluation parameters included the visual analog scale (VAS) used to score the degree of chronic pelvic pain as follows: 0 =no pain and 10 =the most severe pain. According to the pain score, the symptoms were divided into three grades: mild (VAS: 0–4, intermittent pain and discomfort), moderate (VAS: 5–7, persistent pain and discomfort), and severe (VAS: 8–10, persistent pain and discomfort and drug analgesic treatment). The VAS scores were retrieved from patients before and 24 h after the surgery.

Pelvic venous blood flow parameters included color Doppler ultrasound diagnostic instrument (GE x680, USA), the frequency of transvaginal ultrasound was 3–8 MHz, and the frequency of transabdominal ultrasound was 2–5 MHz applied to determine the pelvic venous blood flow parameters of patients. The changes in the internal diameter of the pelvic veins (thickened and tortuous veins in the uterus, ovary, and pelvic venous plexus) (D/mm), area of periovarian

varicose venous plexus (s/cm^2), the peak blood flow velocity (PSV/cm/s), and the resistance index (RI) before and after treatment in three groups of patients before and 6 months after the surgery.

Ovarian reserve function evaluation parameters included enzyme-linked immunosorbent assay (ELISA) (VIDAS rel99735 microplate reader, Meriere, France) was used to detect the levels of follicle-stimulating hormone (FSH), estradiol (E2), anti-Mullerian hormone (AMH), and the ratio of FSH to luteinizing hormone (FSH/LH). The FSH, E2, AMH, and FSH/LH data were obtained by ELISA in the three groups of patients before surgery and between the 1st to 4th days of the 1st, 3rd, and 6th menstrual cycles after the surgery.

Diagnostic criteria for decreased ovarian reserve function included (I) 10 mIU/mL ≤ FSH ≤ 40 mIU/mL, (II) SH ≤ 10 mIU/mL, E2>50 pg/mL, (III) FSH/LH>3.0.[22] If one of them is met, it can be diagnosed as decreased ovarian reserve function.

Efficacy Evaluation

The curative effect was judged according to the VAS score reduction rate and the degree of symptom relief: efficacy index = (pre-treatment VAS score−post-treatment VAS score)/pre-treatment VAS score × 100%.

Cure: Symptoms such as lower abdominal pain, lumbosacral pain, sexual intercourse pain, and dysmenorrhea disappeared, and the amount of vaginal discharge decreased. The tortuous tubular dark area in the pelvic cavity disappeared after re-examination of color Doppler ultrasound showed that the curative effect index was more than 90%;

Remarkable effect: included relief of above symptoms and tenderness and reduction in the amount of band down. The scope of the tortuous tubular dark area in the pelvic cavity was re-assessed by color Doppler ultrasound or by measuring the inner diameter of the widest part, and the curative effect index was 60% to 89%.

Effective: The above symptoms were alleviated, one of which has not been alleviated, the other symptoms have disappeared, and the efficacy index is 30% - 59%;

Invalid: The symptoms were not alleviated, there was no change in color Doppler ultrasound re-examination, and the efficacy index was less than 30%.

Total effective rate = sum of cured, markedly effective, and effective cases/total cases × 100%.

Statistical Analysis

Data were statistically processed using the SPSS version 22 (SPSS Inc., Chicago, IL, USA), count data are expressed as a rate (%) and analyzed using the χ^2 test. The measured data are expressed as (x ±standard deviation [SD]), and comparisons among the three groups were analyzed using one-way analysis of variance (ANOVA). The comparisons before and after treatment within the groups were analyzed using the paired-samples *t*-test. $P < 0.05$ indicated a statistical difference.

Results

Comparison of General Conditions of Three Groups of Patients

This study included 132 patients with PCS. According to the therapeutic regimen, patients were divided into the following three groups: simple free coil embolization therapy (control group I), free coil combined with endocrine hormone therapy (control group II), and precise interventional embolization combined with endocrine hormone therapy (research group). Each group included 44 patients.

The analysis revealed no significant differences in age, body mass index (BMI), marital status, education level, pregnancy frequency, birth frequency, and disease course among the three groups of patients, with $p > 0.05$, indicating that the basic demographic data of the three groups of patients were comparable (Table 1).

Comparison of Pain Degree Between the Three Groups Before and After Treatment

For intragroup comparison, a paired sample *t*-test was used to compare the VAS of the three groups before and after treatment, and the difference was significant. The results revealed that the three treatment methods reduced the pain of patients to different degrees.

Table 1 Comparison of General Information of Three Groups of Patients (n, %)

Item	Control Group I (n=44)	Control Group II (n=44)	Study group (n=44)	F/χ2	P
Age(year)	36.20±3.98	36.75±3.44	35.68±3.59	0.929	0.398
BMI	23.52±2.01	23.07±2.31	22.82±2.38	1.120	0.329
Marital status				0.259	0.879
Unmarried	9(20.5)	11(25.0)	10(22.7)		
Married	35(79.5)	33(75.0)	34(77.3)		
Education level				5.582	0.233
Below technical secondary school	6(13.6)	8(18.2)	10(22.7)		
Technical secondary school and high school	36(81.8)	29(65.9)	27(61.4)		
High school and above	2(4.5)	7(15.9)	7(15.9)		
Number of pregnancies	4.45±1.34	4.27±1.4	4.14±1.21	0.643	0.527
Parity	1.57±0.55	1.52±0.59	1.52±0.59	0.091	0.913
Duration (months)	38.8±9.33	37.80±10.02	35.89±10.12	0.994	0.373

Table 2 Comparison of VAS Scores of the Three Groups Before and After Treatment

Item	Control Group I (n=44)	Control Group II (n=44)	Study group (n=44)	F	P
VAS before treatment	7.71±0.84	7.75±0.61	7.69±0.63	0.061	0.940
VAS after 24h	4.77±1.70●■	4.66±1.49●■	3.89±1.67▲*■	3.883	0.023
VAS after 1 month	4.07±1.5●■	3.64±1.26●■	3.07±1.85▲*■	4.927	0.009
VAS after 3 months	3.14±1.15●■	2.64±1.82■	2.05±1.64▲■	5.369	0.006
VAS after 6 months	2.93±1.19●■	2.39±1.56■	1.86±1.56▲■	5.988	0.003

Notes: ■ Compared with pre-treatment; P<0.05; * Compared with Control Group II, P<0.05; ●Compared with Study group, P<0.05; ▲Compared with Control Group I, P<0.05.

For a comparison between the groups, one-way analysis of variance (ANOVA) was used to analyze the degree of pain in the three groups at different time points after treatment. The degree of pain in the study group was significantly lower than that in the control group I and the control group II at 24 h and the first month after the surgery ($p < 0.05$). The degree of pain in the study group was significantly lower than that in the control group I in the third and sixth months after the treatment ($p < 0.05$). The use of interlock detachable coil interventional embolization was more rapid than free coil interventional embolization in relieving patients' pain, and the combination of endocrine hormone therapy exerted its long-term effect (Table 2).

Comparison of the Overall Efficacy of the Three Groups of Patients

The total effective rate of the study group was 90.91%. The total effective rate was 81.82% in the control group I and 86.36% in the control group II. The total effective rate of the three groups was significantly different ($P = 0.022$). The interventional embolization with interlock detachable coil exerted significant effects in reducing pain, relieving symptoms, and improving living and working abilities, and the clinical efficacy was more prominent (Table 3).

One case (2.27%) of ectopic embolism was reported in control group I, two cases (4.55%) in control group II, and no ectopic embolism occurred in the study group. However, the difference was not statistically significant due to the limited number of cases included in the study.

Comparison of Pelvic Venous Blood Flow Parameters Among the Three Groups

After treatment, the peak blood flow velocity of the ovarian artery increased, the resistance index decreased, the internal diameter of the pelvic vein decreased, and the area of varicose vein plexus around the ovary decreased in the three groups, with significant differences compared with those before the treatment ($p < 0.05$). Among them, patients treated with combined endocrine hormone therapy were better than those without endocrine hormone therapy ($p < 0.05$). Thus,

Table 3 Comparison of the Overall Efficacy of the Three Groups of Patients (n, %)

Item	Cure	Markedly effective	Effective	Ineffective	Total effective rate
Control Group I (n=44)	2(4.5%)	19(43.2%)	15(34.1%)	8(18.2%)	36(81.82%)
Control Group II (n=44)	4(9.1%)	24(54.5%)	10(22.7%)	6(13.6%)	38(86.36%)
Study group (n=44)	6(13.6%)	25(56.8%)	9(20.5%)	4(9.1%)	40(90.91%)
χ^2	5.213				
P	0.022				

Table 4 Comparison of Pelvic Venous Blood Flow Parameters Among the Three Groups Before and After Treatment

Item		Control Group I (n=44)	Control Group II (n=44)	Study Group (n=44)	F	P
Before treatment	PSV(cm/s)	24.30±4.70	25.48±5.07	24.52±5.01	0.712	0.493
	RI	0.84±0.12	0.81±0.11	0.81±0.1	1.214	0.300
	D(mm)	5.55±0.77	5.64±0.73	5.53±0.78	0.272	0.762
	S(cm2)	4.90±0.85	5.13±0.75	4.95±0.80	1.022	0.363
After 6 months	PSV(cm/s)	32.39±4.56*●	38.2±4.04▲	37.55±5.55▲	19.754	0.000
	RI	0.54±0.08*●	0.45±0.06▲	0.45±0.05▲	27.480	0.000
	D(mm)	3.48±0.33*●	2.99±0.33▲	3.02±0.28▲	34.599	0.000
	S(cm2)	3.00±0.48*●	2.65±0.32▲	2.77±0.29▲	9.911	0.000

Notes: ■ Compared with pre-treatment; P<0.05; * Compared with Control Group II, P<0.05; ●Compared with Study group, P<0.05; ▲Compared with Control Group I, P<0.05.

Abbreviations: PSV, peak blood flow velocity of ovarian artery; RI, resistance index; D, Internal diameter of pelvic vein; S, Area of periovarian varicose venous plexus.

the combined application of endocrine hormones effectively increased the vascular tension and reduced congestion (Table 4).

Comparison of Ovarian Reserve Parameters Among the Three Groups

After treatment, the levels of FSH, E2, and FSH/LH in the three groups decreased compared with those before treatment, with a significant difference ($p < 0.05$). Among them, patients treated with combined endocrine hormone therapy were better than those without endocrine hormone therapy ($p < 0.05$). In all, the combined application of endocrine hormones more effectively inhibited ovarian function, reduced pelvic congestion, and relieved the symptoms (Table 5).

Logistic Regression Analysis of Combined Endocrine Hormone Therapy on Ovarian Reserve Function

According to the diagnostic criteria of ovarian reserve function decline, 95 patients with ovarian reserve function declined before the treatment and were selected as the research objects. Next, improvement in the ovarian reserve function at different time points after treatment was analyzed. The groups were compared according to the combined application of endocrine hormones as the differentiation standard, considering age interference, age, and the improvement in the ovarian reserve function as dependent variables. Logistic regression analysis was used to evaluate the differences between the groups. The results demonstrated that at 3 and 6 months after treatment, the odds ratios between the total effective rate of the combined endocrine hormone group and the non-combined endocrine hormone group were 4.595 and 5.215, respectively, with statistically significant differences ($p < 0.05$, Table 6).

Discussion

The term "PCS" was first proposed by Taylor in 1949, and its etiology remains unclear. The most common pathophysiological mechanisms contributing to PCS include venous valve insufficiency leading to blood reflux, left common iliac vein compression, or left renal vein compression. The underlying cause of pelvic varicose veins is pelvic venous reflux.

Table 5 Comparison of Ovarian Reserve Parameters Among the Three Groups Before and After Treatment

Item		Control Group I (n=44)	Control Group II (n=44)	Study group (n=44)	F	P
Before treatment	FSH(mIU/mL)	12.18±3.52	10.84±3.72	11.97±4.39	1.521	0.222
	E2(pg/mL)	49.4±12.72	52.17±12.27	47.82±10.92	1.485	0.230
	AMH(ng/mL)	0.64±0.24	0.62±0.29	0.63±0.29	1.297	0.277
	FSH/LH	2.56±1.16	3±1.23	2.67±1.43	1.424	0.244
After 1 month	FSH(mIU/mL)	9.56±3.32■*●	8.12±3.08■▲	7.74±2.94■▲	4.201	0.017
	E2(pg/mL)	46.08±8.38*●	43.39±10.15■▲	43.65±9.44■▲	9.344	0.000
	AMH(ng/mL)	0.62±0.37	0.61±0.39	0.61±0.31	0.370	0.691
	FSH/LH	2.41±0.76*●	2.04±0.57■▲	1.86±0.63■▲	7.763	0.001
After 3 months	FSH(mIU/mL)	7.85±2.22■*●	6.74±2.18■▲	6.31±2.07■▲	5.983	0.003
	E2(pg/mL)	42.52±9.06■*●	39.97±8.77■	37.28±10.56■▲	3.352	0.038
	AMH(ng/mL)	0.60±0.38	0.59±0.32	0.61±0.3	0.942	0.392
	FSH/LH	2.23±0.73■*●	1.66±0.26■▲	1.73±0.25■▲	18.948	0.000
After 6 months	FSH(mIU/mL)	7.51±1.65■*●	6.43±2.12■▲	6.43±1.69■▲	5.096	0.007
	E2(pg/mL)	40.64±5.17■*●	35.59±5.42■▲	33.36±4.08■▲	25.241	0.000
	AMH(ng/mL)	0.65±0.32	0.68±0.32	0.65±0.35	1.717	0.184
	FSH/LH	1.82±0.31■*●	1.79±0.30■▲	1.78±0.31■▲	3.478	0.043

Notes: ■ Compared with pre-treatment; P<0.05; * Compared with Control Group II, P<0.05; ●Compared with Study group, P<0.05; ▲Compared with Control Group I, P<0.05.

Abbreviations: FSH, Follicle-stimulating hormone; E2, Estrogenic; AMH, Anti-mullerian hormone; FSH/LH, The ratio of FSH to luteinizing hormone.

Table 6 Logistic Regression Analysis of Combined Endocrine Hormone Therapy on Ovarian Reserve Function

Point of Time	Parameters	B	SE	Wald	P	OR	95% CI	
							Lower	Upper
One month	Age	1.267	0.522	5.885	0.015	3.550	1.276	9.882
	Group	0.887	0.470	3.562	0.059	2.428	0.164	1.035
Three months	Age	2.332	1.080	4.661	0.031	10.294	1.240	85.479
	Group	−1.525	0.562	7.361	0.007	4.595	0.072	0.655
Six months	Age	1.268	1.108	1.309	0.253	3.552	0.405	31.154
	Group	−1.651	0.754	4.793	0.029	5.215	0.044	0.841

Abbreviations: SE, standard error; OR, odds ratio; CI, confidence interval.

The diagnosis and differentiation of PCS is a comprehensive process involving considerations from multiple dimensions. In terms of symptom assessment, patients with PCS usually experience pelvic pain symptoms lasting for 3–6 months.[7] The pain is dull, accompanied by a sensation of bearing-down or heaviness, and is mostly unilateral, but it can also be bilateral or shift from one side to the other. Some patients also have a history of varicose veins in the vulva, buttocks, perineum, or lower extremities, as well as symptoms such as dysuria, frequent and urgent urination, and changes in vaginal discharge. During bimanual examination, there are often cervical motion tenderness, uterine body tenderness, and tenderness in specific ovarian areas. Ultrasonography is the preferred imaging method. Transabdominal or transvaginal examination can rule out pelvic masses and other lesions, and can indicate the dilation of uterine and ovarian veins and changes in their volume. Under Doppler ultrasonography, PCS is characterized by the dilation of the left ovarian vein (diameter > 4 mm), reversed blood flow at the tail or in the reverse direction, and slow blood flow (< 3 cm/s).[23] CT and MRI examinations can provide cross - sectional images of the pelvic vasculature and surrounding tissues,[24] but they have the problems of low specificity and high cost. Venography is the gold standard for diagnosing PCS and can evaluate venous dilation and reflux. Laparoscopy can directly observe the condition of pelvic veins, but it is not used as the first - line diagnostic method. PCS mainly needs to be differentiated from other diseases that cause chronic pelvic pain (CPP). Compared with endometriosis, the latter mostly presents as secondary and gradually worsening dysmenorrhea. In

addition to CPP symptoms, patients with PCOS often have endocrine disorders such as abnormal menstruation, hirsutism, and obesity. Patients with chronic pelvic inflammatory disease have signs of pelvic inflammation and a history of acute attacks.[25] The treatment of PCS is based on clinical symptoms and related venous abnormalities. Compared with non-invasive examination, the sensitivity of transcatheter venography is higher, and the diagnosis and treatment can be completed simultaneously. Compared with other treatment methods, vascular interventional therapy can directly eliminate the diseased vessels, improve patients' symptoms, and has fewer postoperative complications, shorter hospital stay, and faster recovery. Therefore, intravascular intervention is the safest and most effective treatment for PCS.[26] Tu et al[27] analyzed the results of 12 studies on the treatment of PCS using embolization techniques and found that after treatment, the VAS scores of patients decreased from the range of 7.2–7.9 to 2.5–5.6. The efficacy was superior to that of drug and surgical treatments. Another research group[28] used embolization of the ovarian vein and internal iliac vein to treat PCS. After 45 months of follow-up after embolization, the clinical symptoms of 83% of patients significantly improved. The complication rate of interventional embolization was around 3.4% to 9%,[19] and commonly included coil displacement, ectopic embolization, and vascular perforation. The interlocking arm design of the interlock detachable coil is advantageous. The spring coil remains locked before release, allowing the spring coil to withdraw before full release. It is safe and controllable, with an accurate release, rich cilia winding, and a good precise embolization effect, and can effectively prevent risks such as ectopic embolization.[29] This study found that the total effective rate of using an interlock detachable coil for precise embolization was 90.91%; the cure rate was 13.6%, the markedly effective rate was 56.8%, and the effective rate was 20.5%, which was significantly higher than that of the control group treated with free coil embolization alone. A total of three cases (3.41%) of ectopic embolism occurred in the control group treated with free coil embolization, whereas no ectopic embolism occurred in the study group. However, the difference was not statistically significant due to the limited number of cases included in the study.

PCS is also an estrogen-dependent disease. The increase in the levels of estrogen and progesterone in patients with PCS during pregnancy could be related to pelvic vascular dilatation, whereas the symptoms are significantly reduced after menopause. Ovarian endocrine dysfunction could be a major contributor to pelvic vascular lesions in patients.[30] Estrogen reduces venous vascular resistance and induces venous dilatation by releasing nitric oxide, whereas progesterone antagonizes estrogen, increases vascular tension, and induces vascular smooth muscle contraction. Secretion of estrogen and progesterone causes venous dilatation and congestion, which further destroy the function of venous valves and function together to cause ovarian and pelvic venous insufficiency and reflux.[23] During pregnancy or multiple pregnancies, the corpus luteum and placenta produce high levels of estrogen and progesterone. In addition, the compression of the enlarged uterus and the increase in the maternal blood volume cause extreme dilatation and congestion of pelvic veins and severe elevation of venous pressure, resulting in PCS.[30] Endocrine hormone therapy primarily reduces the levels of estrogen in the body by inhibiting ovarian function and blocking the release of estrogen to inhibit the vasodilation of estrogen, subsequently reducing the vasodilation of ovarian and pelvic veins, and reducing pelvic ovarian venous congestion. However, the effect of endocrine hormone treatment alone is not good due to ineffective embolization of varicose veins.[31] We found that the venous blood flow parameters and ovarian reserve parameters of patients in the experimental group who underwent combined interventional embolization and endocrine therapy were significantly better than those without endocrine hormone therapy ($p < 0.05$). The combined effect of interventional precise embolization and endocrine hormone therapy on PCS varicose veins reduced the secretion of estrogen by inhibiting ovarian function and decreased the level of estrogen in the body to inhibit the vasodilator effect of estrogen, subsequently reducing pelvic vein dilatation and inhibiting vascular inflammatory reaction.

Compared with simple free coil embolization therapy, the detachable interlock design of Interlock Detachable Coil in precision interventional embolization combined with endocrine hormone therapy enables doctors to more accurately place the coil at the diseased blood vessel site during the operation, achieving tight embolization of the blood vessel, effectively reducing abnormal blood perfusion, and thus significantly alleviating pelvic congestion. Compared with the treatment plan of simple free coil embolization combined with endocrine hormones, the precision of Interlock Detachable Coil interventional embolization ensures the effective treatment of diseased blood vessels, reduces the risk of damage to normal tissues, and decreases the incidence of complications. When combined with endocrine hormone therapy, it can better exert a synergistic effect and improve the overall treatment outcome.

Ethical Statement

The study was approved by Ethics Committee of Affiliated Hospital of Jiangnan University (No.293812) and informed consent was taken from all the patients.

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Disclosure

The authors have no conflicts of interest to declare.

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