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INTERVENTIONAL RADIOLOGY—ORIGINAL ARTICLE

Does Pelvic Congestion Cause Bladder Symptoms—Potential New Indication to Treat Pelvic Congestion

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ABSTRACT

Background: Pelvic Congestion Syndrome (PCS) is a condition characterised by chronic pelvic pain resulting from the dilation and reflux of veins within the pelvis. While pelvic pain is the primary symptom of PCS, other associated symptoms may vary among individuals. Bladder symptoms have been commonly observed in PCS, including increased urination frequency, urinary urgency, nocturia and rarely haematuria. This study aimed to investigate the prevalence of bladder symptoms in women with pelvic congestion syndrome and the effectiveness of Ovarian Vein Embolisation in alleviating these symptoms.

Methods: This was a retrospective cohort study on women diagnosed with PCS between January 1, 2017, and December 31, 2022. Inclusion criteria were defined as the presence of clinical symptoms and radiological evidence of PCS undergoing Ovarian Vein Embolisation (OVE). Participants were followed up at least 6 months post-procedure using a web-based survey to assess their bladder symptoms.

Results: One hundred and twenty-three women underwent OVE for PCS during the study period and consented to participate in the study, and 65% ($n = 80$) reported experiencing bladder symptoms. The most common bladder symptoms during pre-procedure consultations included daytime frequency, a sense of incomplete emptying, and nocturia. Among the individuals with bladder symptoms, 60/80 (75%) reported symptom improvement following OVE. Furthermore, 11/80 patients (13.8%) noted a complete resolution of their symptoms post-OVE, and 30/80 patients (37.5%) reported significant improvement. There were no reported major complications or mortality following OVE.

Conclusion: The findings of this study provided compelling evidence that bladder symptoms are common in women with PCS. Ovarian Vein Embolization emerges as a safe and effective intervention for alleviating concurrent bladder symptoms in these patients.

1 | Background

Pelvic congestion syndrome (PCS) is a condition characterised by chronic pelvic pain (CPP) resulting from the dilation and reflux of veins within the pelvis. This condition predominantly affects women of childbearing age and is often poorly understood and overlooked [1]. CPP is relatively common and affects 16% of women, and within this group, 10%–30% of cases are attributed to PCS [2–4].

The hallmark of PCS is the insufficiency of the venous system secondary to reflux from the ovarian or internal iliac veins,

Abbreviations: BPS, bladder pain syndrome; CPP, chronic pelvic pain; eMR, electronic medical record; IC, interstitial cystitis; OVE, ovarian vein embolisation; PCS, pelvic congestion syndrome.

resulting in pelvic venous congestion [1]. As these veins enlarge and become varicose, they may cause pain and discomfort and exert pressure on adjacent structures. Inflammatory mediators also play a role in exacerbating these symptoms. Hormonal fluctuations, especially during pregnancy and menstruation, further aggravate venous insufficiency [5].

Imaging findings supportive of the diagnosis of PCS rely on identifying dilated and refluxing pelvic veins. Initial diagnostic tools include non-invasive tests such as Doppler sonography, computed tomography, and MR venography [6–8]. Dilated gonadal veins (> 5 mm) and refluxing pelvic venous flow demonstrated on a venogram raise suspicion of underlying PCS [9, 10]. The gold-standard diagnostic test is catheter venography demonstrating venous reflux in the ovarian and/or internal iliac vein [2].

While pelvic pain is the primary symptom of PCS, other associated symptoms may vary among individuals. These include bladder symptoms, heavy or prolonged menstruation, superficial varicose veins in the pelvic region, and a sensation of pelvic fullness or pressure [2, 5–8].

Bladder symptoms have been commonly observed in PCS, including increased urination frequency, urinary urgency, nocturia and rarely haematuria [9]. Venous drainage from the bladder is via the visceral venous plexus and pelvic organs by the uterine and vaginal venous plexus [10, 11]. We hypothesised that increased blood flow and pressure within the pelvic veins in PCS patients may lead to venous congestion within the bladder, resulting in urinary tract symptoms.

Ovarian vein embolisation has been demonstrated as a safe and effective treatment for alleviating chronic pain in women with PCS. Studies have shown a long-term clinical success rate of 75% to 85% in symptomatic relief [6, 12, 13].

While previous literature has described urinary symptoms in PCS [12], no dedicated study has specifically assessed the causal relationship between PCS and bladder symptoms. This retrospective study aims to investigate the prevalence of bladder symptoms in women with PCS and evaluate the effectiveness of OVE in improving these symptoms. We hypothesise that if bladder symptoms in women with PCS are due to venous congestion of the bladder, there will be a significant improvement in these symptoms once venous insufficiency resolves post-OVE.

2 | Methods

2.1 | Study Design and Ethics

This retrospective cohort study was conducted in a major private hospital in Sydney, Australia, from January 1, 2017, to December 31, 2022. The trial followed and adherence to the STROBE reporting guideline. The Adventist HealthCare Limited Human Research Ethics Committee approved the study, ensuring adherence to established ethical standards in medical research. Ethics approval AHCL reference ID: 2022–029.

2.2 | Patient Selection

All women referred to our facility with chronic pelvic pain were assessed for eligibility. Women exhibiting both clinical features consistent with Pelvic Congestion Syndrome (PCS) and radiological evidence of PCS would undergo catheter venography if they fulfilled both criteria. We defined typical symptoms of PCS as persistent, dull, aching pelvic discomfort and pain that worsens at the end of the day or following physical activity. In addition to the clinical symptoms, they also need to demonstrate radiological evidence of dilated or refluxing ovarian veins on ultrasound (US), computed tomography (CT), or magnetic resonance venogram (MR venogram).

One hundres and sixty-seven venogram procedures were performed during the study period and 15 patients did not demonstrated reflux and therefore excluded on current study. 144 patients exhibited dilatation and reflux in the ovarian vessels and subsequently received ovarian vein embolisation. The final study analysis included 123 patients (81%) with PCS symptoms who underwent OVE and given consent to participate in the study.

2.3 | Procedures

The same interventional radiologist performed OVE throughout the study to reduce inter-proceduralist variation. OVE was performed under local anaesthetic with light sedation (midazolam and fentanyl), using the right internal jugular approach under ultrasound guidance, via 5 Fr-sheath and 5 Fr diagnostic catheters such as MP A1 (Cordis).

The diagnostic catheter venography interrogating the left renal, bilateral ovarian, and bilateral internal iliac veins was checked. Valsalva manoeuvres were used to elicit reflux unless readily visualised at rest. The dilated and refluxing ovarian veins were embolised.

The "Sandwich" technique was typically used to embolise the ovarian vein. A nest of 2 pushable coils was deployed distally at the pelvic brim level, followed by 1 mL of sclerosing foam. The catheter was then positioned further proximally, and a second nest of 1–2 coils was deployed, followed by 1 mL of sclerosing foam. Any significant ovarian vein branches were either individually embolised or with their origins covered by coils and sclerosing foam.

2.4 | Data Collection

Data was extracted from the Genie (V11.04) electronic medical record system (eMR) [14]. Comprehensive patient data, including demographic information, pre-procedure investigation results, and detailed procedural notes, were collected. Data were recorded and managed by Microsoft Excel (V16.92) [15] with password protection, allowing only investigators to access the document to protect patient confidentiality.

The data collection process for this study commenced with written consent from participants and a secure web-based

questionnaire via email. Importantly, participants were informed of their right to withdraw from the study at any juncture, and their data would be kept confidential and anonymised. Participants were given an 8-week window to respond to the survey, and regular reminder emails were sent to increase response rates and ensure the completeness of collected data.

2.5 | Outcome Assessment

The primary outcome of our study is improvement in bladder symptoms at least 6 months post-treatment. The follow-up survey specifically asked about urinary symptoms before and after undergoing the OVE procedure and the degree of change in their symptoms. Their later response was categorised into five groups:

- Complete Resolution
- Significant Improvement
- Some Improvement
- No Change
- Worsening

The secondary outcomes of this study were the impact of different demographic and clinical factors on the development of bladder symptoms within the PCS cohort. We performed subgroup analysis to investigate whether age group, parity, the maximal diameter of the ovarian vein, and unilateral or bilateral refluxing gonadal veins impact the risk of experiencing bladder symptoms. We have also evaluated whether a correlation exists between the diameter of the ovarian veins and the effectiveness of ovarian vein embolisation (OVE) in alleviating urinary bladder symptoms. Adverse outcomes of OVEs were also collected to assess the safety of this procedure.

2.6 | Statistical Analysis

Statistical analysis was conducted using Jamovi (V 2.3.19.0). Categorical variables such as the presence or absence of bladder symptoms, parity, and unilateral or bilateral vein involvement were analysed using the χ^2 test, and results were presented as counts and proportions. Continuous variables, such as age and maximum veinous diameter, were reported as mean with 95% confidential intervals. All tests were conducted with two-sided alternative hypotheses. The outcome was considered statistically significant if the p-value was less than 0.05.

3 | Results

3.1 | Study Participants

Catheter venography were conducted during the study period on 167 patients with both clinical symptoms and radiological evidence of PCS. Among these patients, 152 individuals had the presence of dilated and refluxing gonadal veins, subsequently undergoing Ovarian Vein Embolisation (OVE) and were deemed eligible for the study, of which 8 individuals declined to participate. Of those who provided informed consent, 21 patients were lost to follow-up, resulting in a 14% attrition rate. A total of 123 participants were included in the primary outcome analysis (Figure 1), ranging from 20 to 85 years old. 7.6% of them were nulliparous, and 92.4% were multiparous. 75% had

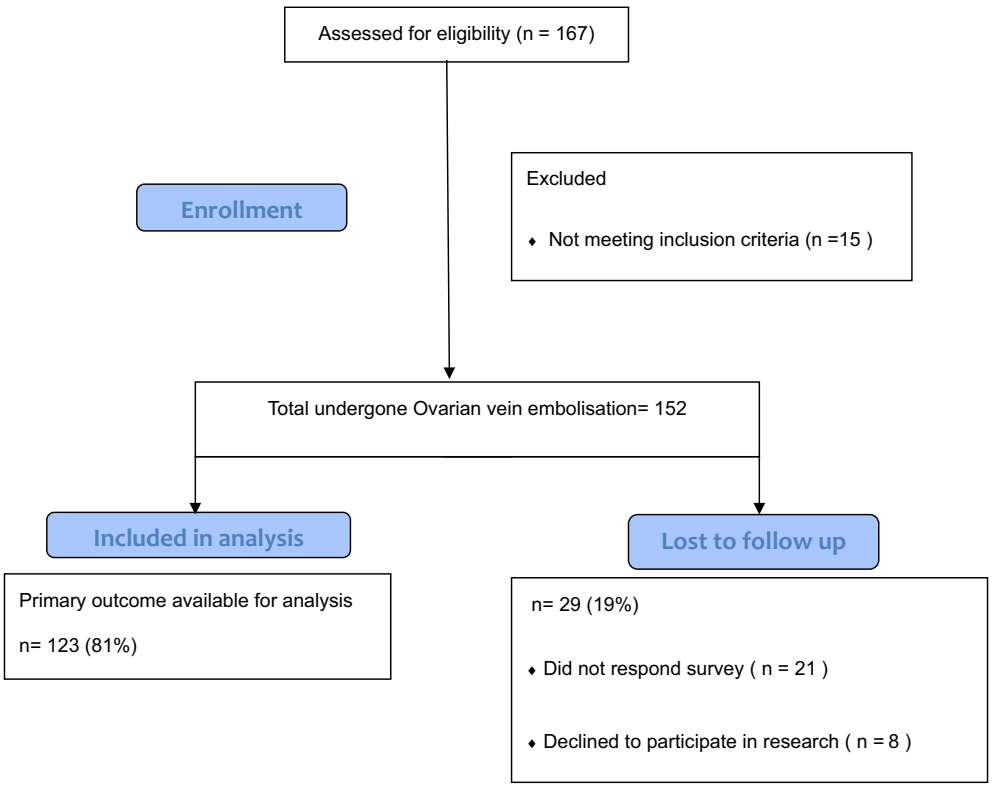

FIGURE 1 | Study flow chart.

TABLE 1 | Baseline characteristics.

	Symptomatic ($n=80$)	Asymptomatic ($n=43$)	p
Age, *years*			
Mean (SD)	45 (11.4)	50 (14.8)	0.02
<40	23 (29%)	14 (33%)	
≥ 40	57 (71%)	29 (67%)	
Parity			
Nulliparous *n* (%)	6 (8%)	3 (8%)	0.97
Multiparous *n* (%)	72 (92%)	37 (92%)	
Missing (*n*)	2	3	
Maximum vein diameter, mm			
Mean (SD)	9.1 (2.4)	8.7 (2.6)	0.45
Reflux vessels			
Unilateral *n* (%)	60 (75%)	34 (79%)	0.61
Bilateral *n* (%)	20 (25%)	9 (21%)	

unilateral vein involvement, and 25% had bilateral vein involvement (Table 1). The baseline characteristics of the participants are given in Table 1.

3.2 | Primary Outcome—Bladder Symptoms

The prevalence of bladder symptoms in the study population pre-procedure was 65% ($n=80$). The remaining 43 (35%) patients reported no bladder-related symptoms (Figure 2). The most frequently described bladder symptoms during pre-procedure consultations were increased urinary frequency and sensations of irritation.

Among 80 patients who reported bladder symptoms, 11 of them (13.8%) had complete resolution of their symptoms following OVE, 30 patients (37.5%) experienced significant improvement, and 19 patients (23.8%) noted some degree of improvement. Nineteen patients (23.8%) reported no change in their symptoms, and one individual (1.3%) had worsening symptoms (Figure 3). This collective response showed that 75% of patients with pre-existing bladder symptoms ($n=60/80$) experienced complete resolution or improvement. There were no reported cases of patient who developed bladder symptoms post-procedure.

3.3 | Key Secondary Outcomes

When comparing those with or without bladder symptoms, we found the symptomatic group were significantly younger than those asymptomatic. The mean age of symptomatic women was 45, 5.5 years younger than the asymptomatic group (95% CI: 0.8–10.3, $p=0.023$). The rest of the baseline characteristics between the two groups were similar. There was no statistically significant difference between the two groups regarding parity, involvement of bilateral or unilateral veins, or the maximum diameter of the gonadal vein (Table 2).

Further subgroup analysis was performed to assess whether different factors impact the effectiveness of treatment for bladder symptoms. We found that a higher proportion of women with bilateral embolisation (85%) had improvement or resolution of symptoms than those with unilateral embolisation. However, the difference in proportion was not statistically significant ($p=0.41$). The mean maximum vein diameter between the group with improvement and those without improvement was the same (Table 2).

3.4 | Safety and Adverse Effects

There were no reported short-term severe adverse outcomes following OVE from our cohort, including re-admission, infection, coil migration or haemorrhage. No mortality was reported during the study. Ten patients (8%) had clinical symptoms of thrombophlebitis post-treatment.

4 | Discussion

Our data demonstrated that bladder symptoms are common in PCS and observed in 65% of women with both clinical and angiographic features of PCS. For those who had bladder symptoms with PCS, 75% reported symptom improvement following OVE, including 13.8% with complete resolution and 37.5% with significant improvement.

This study confirmed our clinical impression that a large proportion of women referred for treatment of PCS, also experience concurrent bladder symptoms. Clinicians and researchers involved with diagnosing and treating PCS should proactively enquire about and document bladder symptoms and post-treatment outcomes.

Interstitial cystitis (IC)/Bladder pain syndrome (BPS) is another condition that can resemble PCS due to the presence of both pelvic pain and bladder symptoms but with different underlying pathophysiology processes [16]. Distinguishing between the two can be difficult based on clinical symptoms and commonly mislabelled. Hence, the study aims to raise awareness of the presence of bladder symptoms and consider PCS as an important differential diagnosis in this cohort of patients. The prevalence of IC ranges from 0.01% to 2.3%, with a notable predominance among females, five times more common in women than men [17–19]. Dilated and congested pelvic veins characterise PCS, whilst IC/BPS is likely related to afferent hypersensitivity of the urinary bladder secondary to various contributing factors such as increased urothelial permeability, inflammation, and dysregulation of the spinal sensory pathway [19–22].

Our study is the first to examine bladder symptom improvement as a potential outcome for venous embolisation in PCS patients.

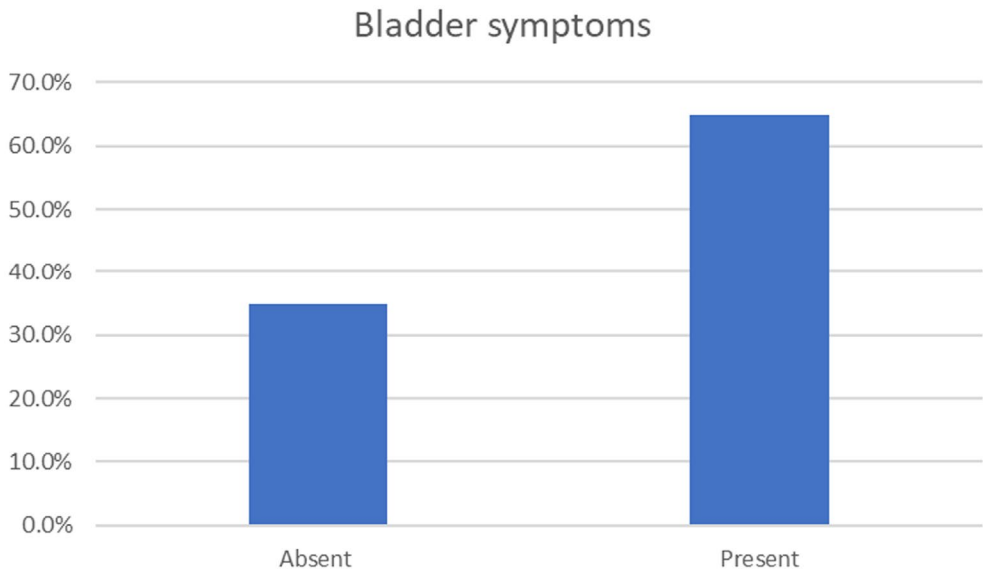

FIGURE 2 | Primary outcome—prevalence of bladder symptoms in PCS.

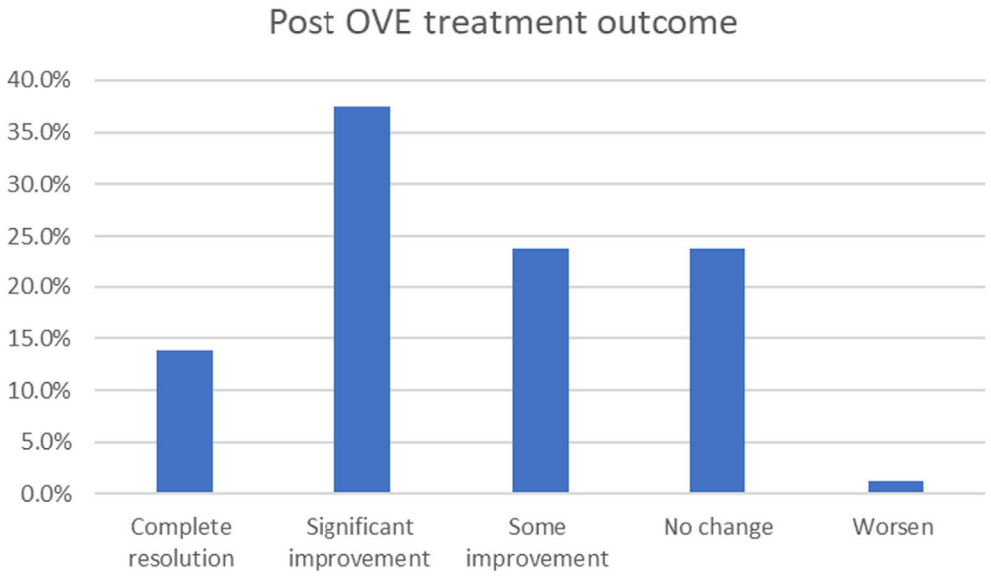

FIGURE 3 | Changes in bladder symptoms post-OVE.

TABLE 2 | Subgroup analysis of post-OVE patients with different factors.

	Improvement ($n = 60$)	No improvement or worsen ($n = 20$)	p
Maximum vein diameter, mm			
Mean (SD)	9.1 (2.5)	9.1 (2.0)	0.08
Reflux vessels			
Unilateral	43 (72%)	17 (85%)	0.41
Bilateral	17 (28%)	3 (15%)	

The positive outcome of this small cohort suggest pelvic venous congestion might be the underlying treatable cause of undiagnosed bladder symptoms, in women who might otherwise be labelled interstitial cystitis/bladder pain syndrome (IC/BPS). Correct identification of PCS in a patient previously mislabelled as IC/BPS is essential as there is effective treatment for PCS. For IC/PBS patients, no currently available treatment option has been shown to provide long-term symptom control, and many remain refractory to treatment [18, 19]. Our study demonstrated that our current protocol of performing an angiogram

for diagnosis and subsequent embolisation for treatment is an effective and pragmatic approach to diagnosing and treating PCS women, leading to an improvement in 75% of women in bladder symptoms.

The high prevalence of bladder symptoms in women with PCS suggests a potential underlying association between PCS and bladder symptoms. An animal study on rats with pelvic congestion showed a higher urinary frequency and lower locomotor activity than the control group [23]. We propose a plausible pathogenic mechanism of bladder symptoms in PCS, possibly due to the interconnected venous drainage system of the urinary bladder and other pelvic organs. We hypothesised that elevated venous pressure within this system could contribute to increased pressure in the visceral venous plexus, potentially leading to venous congestion within the bladder wall. This theory was supported by the animal study showing bladder ischemia and increases bladder vessel permeability, resulting in detrusor overactivity that increases the frequency of voiding [23].

In the present study, only one patient reported worsening bladder symptoms after OVE, and none experienced severe postoperative complications, including re-admissions, infections, coil migrations, or haemorrhage. The thrombophlebitis rate was 8%, comparable or lower in incidence than prior studies on OVE-related outcomes [12, 13]. This suggests that OVE has a good safety profile if conducted with a standardised approach.

It is important to acknowledge several limitations of our study. Its main limitation is the retrospective nature of the study. The causality between PCS and bladder symptoms cannot be established. The sample size in our study is limited, and it is based on data from a single centre; hence, its generalisability in other centres needs further assessment. Prospective, multi-centred controlled studies are required to strengthen the evidence further.

Our study's attrition rate was 14%, which could result in potential selective bias. However, the baseline characteristics between lost to follow-up and included in the final analysis were similar.

Lastly, the survey was conducted at least 6 months post-procedure, which could result in potential recall bias. Based on prior studies, we have chosen this minimum follow-up timeframe as most of the symptom improvements were observed in the first 6 months post-OVE [6]. Outcome measures are subjective and may vary based on individual patient experiences. Developing a validated tool to assess bladder symptom severity could be helpful for future studies to reduce measurement bias.

5 | Conclusion

Our study demonstrated bladder symptoms are commonly associated with PCS, potentially attributed to the interlinked venous drainage system. Based on the data, OVE is a safe and effective approach to alleviate bladder symptoms in PCS patients. To validate the findings of this study and demonstrate a causal relationship between PCS and bladder symptoms, further prospective, controlled trials should be conducted. Future studies could focus on examining macroscopic findings on cystoscopy and microscopic features of PCS patients' bladder symptoms to provide a more comprehensive understanding of the manifestation of bladder symptoms and the underlying pathophysiological process of PCS.

Author Contributions

All authors read and approved the final manuscript and contributed significantly to the study design, data collection, management, and interpretation of data, manuscript writing and submission for publication. As the chief investigator, W.Y.T.W. has had authority over these activities.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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