Pelvic Congestion Syndrome: A Review of the Treatment of Symptomatic Venous Insufficiency in the Ovarian and Internal Iliac Veins by Catheter-Directed Embolization

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INTRODUCTION
Pelvic venous insufficiency (PVI) is defined as venous reflux in the ovarian vein (OV), internal iliac vein (IIV), or parauterine veins. The reflux may or may not result in increased venous engorgement (i.e., congestion), and subsequently, the term PVI may be considered more appropriate than the older, more commonly used, term pelvic congestion syndrome (PCS). Chronic pelvic pain (CPP) is defined as noncyclic pain originating in the lower abdomen or pelvis for >6 months,[1] and up to 39.1% of women can be affected by it at some time in their lives.[2] Although first described as far back as in 1857,[3] it was not until the 1920s that ovarian varicosities were associated with CPP.[4] The fact that stress often aggravates the pain led many physicians to see this as a purely psychosomatic illness. The economic impact of CPP is huge, with the cost of loss of productivity estimated at $15 billion in the USA alone. While up to 31% of the patients with CPP are diagnosed with endometriosis, the majority are undiagnosed or misdiagnosed.[5] It was the seminal work of Beard et al. during the 1970s that has led to the greater acceptance of PCS as a cause of CPP.[6] However, there still remains skepticism from some.[7]

While commonly associated with CPP, PVI can also present as either atypical primary or recurrent leg varicose veins. In fact, the incidence of recurrence following surgical management of varicose veins ranges from 20% to 80%.[8-12] There is a high incidence of PVI in patients presenting with atypical recurrent varicose veins arising on the buttocks and upper postero-medial thigh and extending to the vulval and perivulval regions.[13]

CLINICAL PRESENTATION
CPP accounts for up to 20% of all laparoscopies; however, despite this, nearly 61% are found to have no explanation for their pain.[14] PVI typically, though not exclusively, presents in premenopausal multiparous women as recurrent/atypical leg varicose veins arising on the buttock or upper postero-medial thigh and extending to the vulval and perivulval region with or without concurrent CPP. The pelvic pain is nonspecific, though usually described as a deep, dull pelvic ache, dyspareunia, or postcoital pain centered around the lower pelvis, vulva, and upper thighs, exacerbated by prolonged standing or an increase in intra-abdominal pressure (straining or lifting). The pain is typically worse at the end of the day, immediately premenstrual, or during pregnancy. Some patients describe the pain worsening with each subsequent pregnancy. A comprehensive history is essential in helping to differentiate these combinations of symptoms from other possible gynecological/gastroenterological pathologies.

ETIOLOGY
There are numerous theories so as to the possible etiology of pelvic varicosities although none alone provide a satisfactory, comprehensive explanation for PCS.

Pelvic varicosities are thought to be the effect of gravity on an incompetent venous valvular system, with the resultant stasis producing venous congestion and the associated pain. The capacity of the OVs can increase by up to 60% in pregnancy with pelvic varicosities significantly more likely in multiparous women.[15] When combined with venous kinking of a malpositioned gravid uterus, it has...
been suggested that this leads to the venous stagnation, flow reversal, and varicosities that are seen. A relationship has been established between retroversion of the uterus with pelvic pain and dilated pelvic veins although it has yet to be proven whether this is an explanation for the presentation of PCS in nulliparous women. Other anatomical causes leading to increased venous pressure, damaged valves, and development of secondary PVI include renal “Nutcracker” syndrome, portal hypertension, iliac compression syndrome (May–Thurner syndrome), and inferior vena cava (IVC) syndrome.

El-Minawi postulated that when women affected by PCS are sexually stimulated up to, but not reaching, orgasm, pain caused by vasocongestion may be felt in the pelvic viscera. However, this theory does not explain why this leads to any permanent venous abnormality or why many of the presenting symptoms of PCS are unrelated to sexual intercourse.

One of the most commonly held opinions is that PCS is essentially a psychosomatic condition, rather than a physical one. Taylor commented that “psychiatric disturbances, usually of an emotional character, are a common accompaniment of pelvic congestion,” even suggesting that an important factor in the etiology of PCS was “the effect of a primary state of emotional tension” on the smooth muscle and secretory cells of the pelvis. While it appears true that women suffering from PCS tend to be more neurotic, there is, however, much evidence that a significant proportion of the emotional disturbance associated with chronic pain is a secondary effect.

Absent valves are significant in the development of retrograde flow in the development of PVI although, in addition, the OVs are exposed to a 100-fold increased concentration of estrogens compared to the peripheral venous circulation. This leads to the belief that hormonal factors play a part in the development of ovarian varicosities, which in some way may explain why PVI, primarily, although not exclusively, affects premenopausal women.

Smaller studies have suggested tubal ligation and use of intrauterine contraceptive devices, such as the Lippes loop, as possible causes for PCS although larger studies would be needed to validate this theory.

**Anatomy**

Pelvic venous drainage is through three main “collecting” veins: the IIVs, the OVs, and the superior rectal veins.

The IIV drains four groups of afferent tributaries as follows:
1. Anterior visceral veins (uterine, vaginal, vesical, and rectal)
2. Parietal veins (inferior gluteal, obturator, and pudendal)
3. Posterior pelvic parietal veins (ileolumbar and sacral)
4. Extrapelvic veins (superior gluteal).

There is considerable variability in the drainage of the parietal veins that drain into the anterior branch of the IIV [Figure 1], with 50% draining as a single vein, 36% as a double vein, and 14% as a plexiform. The IIV joins the external iliac vein (EIV) to form the common iliac vein (CIV) that combines with the contralateral side to form the IVC. On the left, the OV drains (as a single vein in 79%) into the left renal vein (in 99%) or the IVC directly (in 1%). On the right, the OV drains (as a single vein in 78%) into the IVC directly (in 98%) or into the right renal vein (in 2%).

There are intra/extra-pelvic anastomoses with the lower limb venous drainage [Figure 2]. These can be described as two interconnecting networks: the gluteal-ischiatric venous plexus and the internal pudendal venous plexus.

The gluteal vein, draining through the sacral plexus, anastomoses with collateral from the great saphenous vein (the external circumflex iliac vein), while the ischiatic vein, draining the posterior compartment of the thigh, drains into the internal pudendal vein, which itself anastomoses with the femoral vein and great saphenous vein.

The internal pudendal vein anastomoses indirectly with the great saphenous vein through the superficial and deep veins of the clitoris or directly with the external pudendal vein in the labia majora. It is these veins that form vulval varicosities. The internal pudendal vein also forms anastomoses with the perineal tributaries of the anterior visceral veins and the obturator vein.

Many of these channels are relatively valveless and are gravity and vascular tone dependent for their circulation. Anatomic studies have shown that 13%–15% of women lack valves in the left OV while the corresponding figure for the right vein is 6%. When present, 43% of the valves on the left and 35%–41% on the right are incompetent.

**Anatomical Variations**

The vasculature of the female pelvis is complex, particularly with regard to the various venous plexuses surrounding genital organs, and can exhibit wide variation among individuals. The most commonly encountered variations by the authors include as follows:
Internal iliac vein draining into contralateral common iliac vein
Not an uncommon presentation and knowledge of its presence will aid in prompt catheterization of the gonadal branches of the IIVs [Figure 3].

Duplicated inferior vena cava
Duplicated IVC with azygous and hemiazygous communication has been described. Fluoroscopy may reveal a duplicated IVC, with each trunk draining its own CIV. Further variants in which opacification of the right iliac system fills the right IVC with cross-filling of the left iliac system may be seen. This may be associated with disconnection of the left internal iliac system from the left EIV/CIV. Connection of the left IIV to the right iliac system by venous collaterals means that access to the left pudendal and obturator may need to be achieved from the contralateral side. Contralateral coil embolization is frequently achievable [Figure 4].

Reverse-angle renal veins with alternative left ovarian vein drainage
During some attempts to access the renal veins, it can be noted that they acutely joined to the IVC. Under these circumstances, a transfemoral approach may be required when attempts with a reverse curve catheter fail. In two patients presenting with this anatomical variation to the author, it was found that the left OV did not connect directly to the underside of the left renal vein but rather drained into the segmental veins of the kidney when associated with this pattern. Due to vascular tortuosity, a microcatheter (PROGREAT® microcatheter; Terumo Interventional Systems, Leuven, Belgium) was used to access the left OV. Inadvertent perforation of the segmental renal vein was seen in one case, and the catheter was seen to enter the ureter. The catheter was promptly withdrawn with no complications or sequelae. Interlock-18 microcoils (Boston Scientific, MA, USA) were used to embolize the left OV [Figure 5].

Direct connection of anterior left internal iliac vein to the inferior vena cava
Further cases in which the anterior branch of the internal iliac cannot be visualized directly may be seen by indirect opacification of pelvic collaterals. Contrast injection into one of the other pelvic tributaries such as the left OV has been shown to opacify other tributaries such as the right OVs/left or right IIVs. This has allowed visualization in cases in which the anterior division of the internal iliac has been seen to arise directly off the IVC [Figure 6].

The embryological background to these variations is beyond this article but has been described elsewhere.

In summary, anatomical abnormalities may arise within the venous system during development. It is important that these variants are recognized and that alternative surgical techniques can be administered to ensure successful intervention in all patients with PVR.

Diagnostic Studies
The transvaginal duplex ultrasound (TVUS) scan performed preoperatively is the authors’ preferred method of identifying evidence of flow reversal in the IIV and OV trunks. However, it is often difficult to specify exactly which afferent is specifically affected. In considering which veins require embolization, and subsequently, how many coils will be required, it is important to interpret the TVUS scan findings in the context of the anatomical clinical presentation of vulval/perivulval, buttock, or posteromedial thigh varicosities with or without pelvic pain.
The internal pudendal and obturator veins are most closely associated with vulval and posteromedial thigh varicosities. Rich anastomoses are often present between the OVs and these IIV tributaries. The most common pattern of reflux involves both IIV tributaries and the left OV [Figure 7].[26]

There has been an increasing interest in PVI and underlying venous compression. Venous compression has been implicated in the cause for PVI in a minority of patients, while forming only a small cohort, missing potential venous compression can lead to both increasing pain and an increased thrombotic tendency. In the case of iliac vein compression (May–Thurner syndrome), this may present with increasing left leg swelling in conjunction with worsening PCS following embolization. In the case of left renal vein compression (Nutcracker syndrome), the increased thrombotic tendency within the renal vein may lead to renal vein thrombosis. Typically, both can see worsening of the underlying PVI and associated symptoms. At the authors’ institution, diagnostic workup, therefore, includes transabdominal ultrasound. This includes visualization of the iliac venous bifurcation and documentation of venous velocities and waveforms within these segments to exclude significant venous compression. In addition, diameters and ratios of the hilar renal vein and mesoaortic segments are recorded in conjunction with velocities through the mesoaortic segment of the left renal. While it is not infrequent to see narrowing of the mesoaortic segment with ratios and velocities suggestive of nutcracker, it is important not to overdiagnose this condition. The ratio and velocities should be subsequently repeated in the Trendelenburg position allowing the sonographer to differentiate between a true nutcracker and pseudonutcracker appearance. Data from the authors’ institute strongly confirm that those patients with significant OV reflux demonstrate underfilling of the mesoaortic segment due to a siphon effect into the left OV.[27] Reversal of this flow-related phenomenon in the Trendelenburg position should see normalization of the mesoaortic velocities and also hilar-to-mesoaortic ratio [Figure 8].

Contrast-enhanced computed tomography (CT) and magnetic resonance venography typically show dilated pelvic veins and OVs and have been used by some to diagnose PVI. The supine position during scanning may, however, underestimate the size of venous dilatation. While previous research into pelvic venous reflux has suggested that the size of the OVs indicates the presence or absence of reflux, research from the authors institute has shown no significant difference between the diameters of competent and refluxing OVs, and as such, techniques that measure vein diameter may not be suitable for the diagnosis of venous reflux in the OVs.[28] At best, early portal phase CT may show reflux within the left OV. Given the most common pattern of reflux which includes left ovarian and bilateral internal iliac branches, the authors believe that cross-sectional imaging is largely limited to investigation of underlying venous compression rather than confirmation and location of PVI.

![Figure 5: Reverse-angle left renal vein, marked with an asterisk, and the left ovarian vein coming off the segmental veins of the kidney, as seen on fluoroscopy (a). The tortuous nature of the segmental vessels necessitated the use of a microcatheter to navigate the vasculature (b). Accidental perforation of the left ovarian vein and entry into the ureter, marked with an asterisk, during the embolization procedure (c)](image)

![Figure 6: (a) Hard injection of contrast from within the left ovarian vein filled the left iliac system into the anterior division of the left internal iliac vein. (b) Contrast traveled through this internal iliac division up to the level of the third lumbar vertebra where a connection to the inferior vena cava was demonstrated](image)

![Figure 7: Pattern of reflux in pelvic veins](image)

**ENDOVENOUS EMBOLIZATION**

**Equipment**

There are two mainstay 5-French guide catheters that are recommended: an angled end-hole catheter, such as a multipurpose-angled (MPA) catheter and a Simmonds 2 catheter (SIM 2 catheter). A long, stiff hydrophilic guidewire (180/260 cm in length) is recommended for use with the guide catheters. The MPA catheter is used to select the IIV afferent tributaries and the SIM2 is used to select the the
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OV/gonadal vein. The catheters are introduced through 5-French vascular access sheaths placed in the jugular vein. Iodinated contrast is used to perform the venograms. The procedure can be easily performed with most modern fluoroscopic X-ray C-arms.

**Approach**

There are two approaches that are possible, the femoral or jugular approach. The choice is operator dependent although the jugular approach has clear advantages in terms of ease of access of the pelvic tributaries and hemostasis postoperatively. Ultrasound-guided venous puncture is performed using the Seldinger technique.

Conscious sedation is mostly not required, and the procedure may be carried out following local anesthetic infiltration around the jugular vein puncture alone.

By adopting this approach, the authors were able to demonstrate that pelvic vein embolization (PVE) under local anesthetic is safe and technically effective in a remote outpatient facility outside of a hospital.[39]

Once a 5-French vascular sheath has been placed in the jugular vein, an angled catheter, such as a 5-French MPA catheter and 0.035-inch hydrophilic wire, is used to negotiate along the superior vena cava, through the diaphragmatic caval opening and into the IVC, under fluoroscopic X-ray guidance. In some cases, it may be helpful to ask the patient to hold their breath to aid passage of the catheter across the right side of the heart.

At the IVC/iliac confluence, the angled catheter and wire are passed into the common and then IIV. If both IIV tributaries require intervention, then it is entirely operator choice as to which side is selected first. Once the catheter is placed in the anterior branch of the IIV, venography is used to delineate the afferent tributaries of the IIV.

As previously mentioned, there is considerable variability to the pelvic venous anatomy, and the venogram simply provides a “roadmap” by which the relevant afferents can be super-selected. The venogram should not be used as an indicator of the presence (or absence) of venous reflux as, unlike the TVUS, the venogram is generally performed in a nonphysiological supine position. Neither should a lack of dilated veins give false reassurance of a lack of venous reflux.
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It is extremely important that, in particular, the internal pudendal and obturator veins and their relevant collaterals are super-selected, given the rich network of intra-extra-pelvic anastomoses with the lower limb venous drainage and vulval veins. Venograms performed in the oblique plane may be helpful in identifying some of these anastomoses and may reduce the risk of subsequent inadvertent malposition of embolization material. Despite the variability in appearances of the pelvic venous drainage, the internal pudendal vein and obturator vein can be easily identified and super-selected as the vulval venous drainage is through the internal pudendal vein and the perineal and the leg venous drainage is through the superficial and deep external pudendal vein into the obturator vein branches.

Embolization material

Once super-selected, it is these authors’ preference to inject 4–8 ml of 3% sodium tetradecyl sulfate foam (Fibrovein) into the internal pudendal and obturator venous tributaries while the patient performs the Valsalva maneuver. Intraprocedural transvaginal duplex scanning has demonstrated that the Valsalva maneuver ensures that foam is drawn into the smaller afferent venous tributaries. This ensures that the smaller afferents inaccessible to the guide catheter are adequately treated. It is unwise to place coils very distally in the vulval veins as patients subsequently have reported that they can often “feel” the coils when placed as such. Without foam sclerotherapy, there is a greater risk of incomplete obliteration of reflux, leading to a potential increased risk of clinical recurrence. The use of foam sclerotherapy, in this setting, also theoretically reduces the risk of pelvic thrombophlebitis. The target afferents are opacified on venography and the foam, made using the Whiteley and Patel method, is injected until the contrast is cleared from the afferents, thus ensuring that the target tributaries are satisfactorily filled with foam sclerosant.

Patients often describe a “stinging” or “heavy dragging” sensation on injection of foam into the IIV afferents. Specifically, they complain of discomfort in the vulva/vagina when the internal pudendal veins are injected and buttock/hip discomfort when the obturator veins are injected. The sensation generally lasts between 5 and 10 min.

Foam sclerosant is often not required in the OVs, particularly if satisfactory embolization is achieved of the IIV afferents. Sclerotherapy in the gonadal veins is associated with deep pelvic discomfort on injection. The exception to this is when the IIV afferents are richly anastomosed with a duplex or plexiform ovarian venous drainage. The “sandwich” technique has also been described in treating gonadal vein, where a combination of coils and sclerosant is used.

The use of foam sclerosant is supplemented by the use of fibred endovascular embolization coils. It is advisable, though not mandatory, to use detachable coils, as these can be repositioned.
where necessary to ensure accurate placement and retrieved easily if malpositioned. It is difficult to predict exactly how many coils are required to achieve satisfactory embolization. It is important to size the coil diameter to the average size of the target vein. In general, the minimum size coil selected is 10 mm in diameter, with the most common size 12 mm. For megalic veins, a 15-mm coil may be required. The first coil deployed should be “packed” tightly to form a “plug.” Subsequent coils can then be deployed while withdrawing the guide catheter gradually to ensure the length of the target vein is covered. It is wise to have a selection of coil lengths (200–400 mm) to allow for some flexibility during embolization. Care must be taken to avoid placement of coils within the IIV trunk and to restrict placement of coils to the anterior branch of the IIV at the most.

**Completion of procedure**

Unless intraoperative transvaginal duplex is employed, occlusion of the target vein and subsequent nonopacification of the distal vessel are the most reliable endpoints for embolization before termination of the procedure [Figures 9-14]. Once the guide catheter and wire have been withdrawn, the vascular sheath can be removed with the patient sat upright at 45° while applying manual compression on the puncture site.

Patients are usually recovered in a reclining chair for at least 30 min postprocedure before being discharged home the same day. On discharge, it is advisable that the patient is provided with written and verbal postoperative instructions and advised to return to the clinic in 6–8 weeks for a follow-up transvaginal duplex scan to assess the efficacy of the embolization and to exclude any new reflux.

**Complications of Embolization**

Complications of embolization of the pelvic veins are rare. Coil embolization to the pulmonary circulation with successful retrieval has been reported in the literature although these cases were generally reported in the early experience of the procedure and related to placement of the coils within the main IIV trunk, rather than restricting coil placement to refluxing tributaries. When embolization to the pulmonary artery occurs, it may be present as shortness of breath and chest pain immediately after the procedure or in some cases may be asymptomatic. When symptomatic, it is advisable to remove the coil with the use of an endovascular snare, which can be negotiated into the pulmonary artery through the femoral vein under fluoroscopic guidance.

Inadvertent migration of the coils into the deep common femoral vein has also been reported although, with careful deployment at the time of the procedure and use of detachable coils, this can be avoided.

There have been reported cases of symptomatic perineal thrombophlebitis although the use of intraoperative foam sclerotherapy in the IIV afferents avoids this.

The most common complication following PVE is postembolization syndrome. This is described as transient pyrexia, general aching, and gluteal and lumbar pain. The occurrence of this is highly unpredictable and variable. It is self-limiting and is largely controlled by oral paracetamol and nonsteroidal anti-inflammatory medication, such as ibuprofen.

The majority of patients are fit, are healthy, and have often never had any medical or surgical of note previously. Understandably, many have intense procedural-related anxiety before the procedure. Postoperatively, many of these patients complain of feeling extremely tired and fatigued. In all cases, these symptoms are self-limiting and have resolved by 5–7-day postprocedure.

It is rare for patients to have an allergic reaction to the intravenous X-ray contrast dye used during the procedure, but it is advisable to have steroids, adrenaline, and antihistamines available. There has also been a reported case of symptomatic bradycardia resolved by administration of atropine.

**Effectiveness and Durability of Pelvic Vein Embolization**

Kwon et al. evaluated the therapeutic effectiveness of coil embolization of the OV for PCS by reviewing the medical records and telephone interviews of 67 patients who were diagnosed with PCS and underwent OV coil embolization. They assessed the pre- and postembolization pain levels up to 6 years after the procedure and found that 82% (55/67) experienced pain reduction after coil embolization, were satisfied with the procedure, and did not pursue any further treatment. Twelve patients (18%, 12/67) responded that their pain level had not changed or had become more severe. Nine patients were treated surgically, and the remaining three patients remained under continuous drug therapy. Although certainly demonstrative of the clinical effectiveness of coil embolization for PCS, one possible explanation for why the number of patients who experienced a reduction in pain was not higher could be that only the OV was reported to have been treated. It is, therefore, possible that many of the remaining 12 patients who reported either no change or worsening pain, may have had residual, untreated PVI in the afferent venous tributaries of the IIVs.

Santos et al. reported the Whiteley Clinic’s specialist vein center 6–8-year results of transjugular coil embolization for pelvic vein reflux. Patients who had undergone OVE in 2005–2007 were invited back to the clinic for transvaginal duplex ultrasonography in summer of 2013. A total of 110 women were contacted. Preembolization transvaginal duplex ultrasonography results were compared to those obtained 6-week postprocedure and at long-term follow-up. Twenty-eight female patients aged 40–75 years (mean 53.5) attended (response rate 25.5%), with parity before embolization ranging from 1 to 5 children (mean 2.8). Mean follow-up time was 7.5 years. Six-week postprocedure, 25 women had complete
or virtual elimination of all reflux and three had persistent reflux in at least one vein. At long-term follow-up, 11 women had complete elimination of all reflux, seven had elimination of all truncal reflux but minor reflux in vulval veins, six had minor reflux in one truncal vein, and four had significant reflux in one or more truncal veins (one of these gave birth 1-year post-PVE and another had coils removed during gynecological surgery). They concluded that transjugular PVE was a durable technique for the abolition of reflux in the pelvic veins and was particularly adept at treating reflux in the OVs.

Although these studies are relatively small, they do suggest that PVE can produce quantifiably durable and clinically effective results long term. Larger comparative studies are needed though to validate these findings and counter any skepticism of the condition and treatment.

**TIPS AND TRICKS AND COMPLEX CASES**

It is highly recommended that those considering performing PVE familiarizes themselves with the wide anatomical variability of pelvic venous drainage. Most of the challenges faced during PVE are due to this wide variation.

Complex cases can include apparent absence of the left IIV with a duplicated IVC, anomalous origin of the anterior division of the IIV arising from the IVC with the posterior division arising from the CIV and the right IIV arising from the left CIV.

Care should be taken to carefully interrogate the CIV for accessory afferents from the internal pudendal or obturator veins draining directly into the EIV or CIV or in some cases the IVC directly.

It is not uncommon for the afferent veins to go into spasm during cannulation. This can be mostly avoided if care is taken when probing the afferent veins and avoiding advancing the catheter without first leading with the guide wire. If, however, spasm does occur, then it is best to leave that vein territory and leave at least 15 min before attempting again. In some cases, the draining afferents may have a scarred and atrophic drainage into the IIV trunk. In these cases and in other cases where cannulation may be challenging, it may possible to access the contralateral afferents through the ipsilateral afferents across the midline. Where this is not possible, the use of a coaxial microcatheter may be required. Another possible solution to challenging cannulation would be to increase the volume of foam sclerosant with the aim of injecting sclerosant across the midline into the contralateral afferents.

**KEY LEARNING POINTS**

- It has a high index of suspicion of PVI in patients who present with atypical superficial venous reflux and varicose veins, recurrent varicose veins, or pelvic pain with no other cause
- Transvaginal duplex scanning is the gold standard for the diagnosis as it can provide
- Anatomical information of which vein territories are affected
- Dynamic demonstrable evidence of reflux
- A detailed understanding of the variability of pelvic venous drainage and the rich anastomoses that exist between the afferent veins is vital to correlate the transvagal duplex scan results with the venogram findings
- A right jugular approach under local anesthetic is recommended, using an MPA and SIM 2 catheters over a stiff hydrophilic wire to select the refluxing pelvic and gonadal veins
- In the deep IIV afferents, it is advisable to inject sclerosant foam before deploying platinum embolization coils to ensure effective obliteration of reflux in the small afferent veins
- Complications are rare and can be mostly avoided by a careful approach
- Postembolization syndrome and postprocedural fatigue are common and unpredictable but self-limiting
- Although smaller studies have demonstrated the clinical effectiveness and durability of PVE, larger comparative studies are needed to validate the procedure as a treatment for PCS.
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