Gonadal Vein Embolization: Treatment of Varicocele and Pelvic Congestion Syndrome

Mark A. Bittles, M.D.,¹ and Eric K. Hoffer, M.D.²

ABSTRACT

Therapeutic embolization of the gonadal veins is performed on male and female patients for different clinical situations using similar techniques. The testicular varicocele is a common clinical problem associated with pain and reduced fertility rates. In women, chronic pelvic pain can be attributed to pelvic congestion syndrome, which is said to result from retrograde flow in incompetent ovarian veins. Both of these clinical problems respond well to gonadal vein embolization. In this article, we review the clinical evaluation, diagnostic workup, and technical aspects of percutaneous intervention of gonadal vein embolization. The supporting literature is also reviewed.

KEYWORDS: Gonadal vein embolization, varicocele, pelvic congestion syndrome, interventional radiology

Objectives: On completion of this article, the reader should (1) be able to understand the clinical aspects of the male varicocele and of pelvic congestion syndrome, and (2) be familiar with treatment by gonadal vein embolization.

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Incompetence and retrograde flow in the gonadal veins can result in a varicocele in the male and pelvic congestion syndrome in the female. Venography and therapeutic embolization of incompetent gonadal veins are performed on male and female patients for different clinical situations using similar techniques. The testicular varicocele has been extensively studied because it is considered a treatable cause of infertility. The female equivalent, retrograde flow in incompetent ovarian veins associated with chronic pelvic pain, is pelvic congestion syndrome (PCS). This article is intended to describe the clinical situations associated with varicocele and PCS, review the literature supporting percutaneous treatment of these conditions, and de-

scribe the imaging findings and therapeutic interventional techniques.

MALE PATIENT

Clinical and Anatomic Considerations

A varicocele is an abnormal distension of the pampiniform venous plexus, the venous drainage from the testicle. The cause is usually retrograde flow in or impaired drainage of the testicular or internal spermatic vein (ISV) and may be associated with infertility or pain. Varicoceles are significant because they are the most common treatable cause of male factor infertility and

¹Vanderbilt University and Vanderbilt Children's Hospital, Nashville, Tennessee; ²Dartmouth-Hitchcock Medical Center, Radiology, Lebanon, New Hampshire.

Address for correspondence and reprint requests: Mark A. Bittles, M.D., Vanderbilt Children's Hospital, Radiology, 2200 Children's Way, Room 1418, Nashville, TN 37232-9700 (e-mail:

markbittles@vanderbilt.edu).

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present in 30 to 40% of infertile men.^{1,2} Controversy arises due to the 20% incidence of varicocele in the normal male population,³ the imprecision of noninvasive diagnosis, and the debated evidence that repair improves pregnancy rates.

Veins emerge from the mediastinum testis to create a loose network called the pampiniform plexus. The plexus begins in the scrotum and extends into the spermatic cord. The arteries supplying the testis course through the plexus, and the arterial blood is cooled from abdominal temperature to testicular temperature by counter-current heat exchange. The anterior portion of the plexus coalesces to form the ISV, which passes through the inguinal canal and ascends in the retroperitoneum alongside the spermatic artery. The spermatic vein commonly divides at the L4 level into medial and lateral divisions. The lateral is the most constant. On the left, it usually drains into the posterior-inferior aspect of the left renal vein; on the right, it drains into the anterolateral wall of the infrarenal inferior vena cava (IVC). The variable medial branch anastomoses with ureteral veins and may communicate across the midline.⁴ Alternative drainage pathways of the ISV include perirenal, retroperitoneal, and lumbar veins. Parallel collateral pathways are frequently seen on venography, particularly after a failed surgical ligation or sclerotherapy of the main ISV.

Varicoceles form due to absence or insufficiency of the valves in the ISV. The prevalence of left-sided varicocele suggests a relation to the more indirect path of the left ISV to the IVC via the renal vein. A majority of clinical varicoceles are on the left, and in most reports the incidence of right or bilateral varicocele ranges from 10 to 15%.^{5,6} When specifically sought, however, right-sided reflux can be identified in 50 to 83%.⁷ In the adult male, a unilateral right-sided varicocele warrants evaluation for obstructive retroperitoneal pathology, such as renal tumor, adenopathy, or situs inversus.

Adverse effects on spermatogenesis are thought to be due to impaired heat dissipation in the pampiniform plexus,⁸ or reflux of adrenal or renal metabolites to the testes.² The pathophysiology is not well defined, but decreased testicular volumes are found in both fertile and infertile patients, with changes more pronounced in the infertile patients.⁹ Hypotrophy of the testicle and larger varicoceles correlate with decreased sperm counts and motility.¹⁰ Varicoceles are associated with a time-dependent decline in testicular function and size.¹¹

There is still debate about whether, when, and how to treat a varicocele. Pain and infertility are the most common clinical scenarios that present to the interventional radiologist. For the infertile adult, the American Society of Reproductive Medicine recommends that treatment be offered if the semen parameters are abnormal and the varicocele is palpable.¹² An important third group is the asymptomatic adolescent male with a varicocele. Prophylactic varicocele repair in the adoles-

cent is recommended if there is a reduction in testicular size (2-mL difference in volume compared with the other tests or two standard deviations with respect to normal testicular volume),¹³ bilateral varicoceles, or impaired spermatogenesis beyond age 18 years.¹⁴

Diagnostic evaluation for varicocele starts with a physical examination. The patient should be examined in a warm room in the standing position, preferably after standing 5 minutes. The scrotum is first visually inspected for obvious distensions around the spermatic cord. Palpation should be performed with the patient relaxed and during Valsalva maneuver. A palpable varicocele has been described as a bag of worms. More subtle varicoceles may feel like a thickened cord, with asymmetry compared with the opposite side. The classic grading system commonly used includes the following categories¹⁵:

Grade 1: Varicocele palpable only during Valsalva

Grade 2: Varicocele palpable in the standing position

Grade 3: Varicocele detectable by visual scrutiny alone

Limitations of physical the examination include the subjectivity of the examination and that it has only 50 to 71% sensitivity with respect to the gold standard demonstration of reflux on venography.^{16,17} Although magnetic resonance imaging (MRI), computed tomography (CT), and thermography have been used as diagnostic tests, the duplex ultrasound examination has a better result, with 97% sensitivity and 94% specificity with regard to venography; it is commonly performed to confirm physical findings before transcatheter therapy.^{1,18}

On ultrasound examination, a varicocele should have two prominent tortuous veins in the pampiniform plexus that are at least 2 mm in diameter and that increase in size with the Valsalva maneuver (Fig. 1A).¹⁹ Reflux that lasts at least 2 seconds correlates with positive venography.²⁰

Spermatic Venography

Venography remains the diagnostic gold standard, although it is now usually only performed before therapeutic intervention. Access may be from either a femoral or jugular approach. Authors who favor a jugular approach cite the ability to perform the entire procedure through a single catheter. The femoral approach frequently requires a sheath or guiding catheter (5F inner diameter) to stabilize the renal vein access and permit coaxial passage of a 4F or 5F Cobra-2 catheter into the ISV. A venogram from the midportion of the renal vein is performed during the Valsalva maneuver to document renal vein patency and to show left ISV incompetence (Fig. 1B). Rotation of the tip of the diagnostic catheter posterior and inferior is often enough to select the spermatic vein. Once selected, the catheter is advanced a few centimeters and a venogram is performed with

Figure 1 (A) Ultrasound shows dilated tortuous scrotal veins in a male patient. (B) Initial venogram image at the confluence of the left gonadal vein identifies its location. (C–D) Subsequent venograms through a sheath show reflux into the scrotum. A parallel vein is present. (E) Image shows coil embolization from just above the inguinal ligament to a few centimeters from the renal vein.

Valsalva (Fig. 1C). This injection confirms retrograde flow and identifies any parallel channels that may be present. A third injection is then performed in the mid-spermatic vein, at the mid-sacroiliac (SI) joint level, to clearly define the remainder of the ISV anatomy to the level of the pampiniform plexus, confirm retrograde flow, and identify any connections that may provide aberrant supply to the varicocele (Fig. 1D).

The spermatic vein may spasm when cannulated. Often the guidewire and catheter will still advance into the vein and the procedure can continue. If the catheter will not easily advance, then waiting for 5 to 10 minutes can often allow the vein to reopen. Injection of 50 to

100 μ g of nitroglycerin may help. The best approach is to minimize the manipulation and trauma to the vein through the use of hydrophilic or 3F catheters.

The procedure on the right is similar. A cavogram is rarely required to identify the origin of the right spermatic vein. A recurved catheter such as Simmons 1 works well from a femoral approach. The tip usually first finds the renal vein, then is retracted, rotated slightly anteriorly, and brought inferiorly until it enters the origin. The right ISV will rarely enter at the inferior aspect of the right renal vein. A venogram is performed during a gentle Valsalva so as not to dislodge the catheter. Care is taken not to pull the catheter tip too

far into the vein, as the only valve may be near the origin, and incorrect diagnosis of incompetence is made if the valve is crossed.

If injection at the orifices of the spermatic veins does not demonstrate reflux, a renal venogram with Valsalva is performed to identify aberrant incompetent collateral supply to the more caudal spermatic vein. If negative, an internal iliac study with an occlusion balloon may identify a source.

Anatomic variations that are pertinent to transcatheter embolization or sclerosis of the ISV were described by Sigmund and colleagues.²¹ Type 0 is normal; there is no reflux on venography. Type I is a single testicular vein without valves. Type II has afferent collateral medial retroperitoneal vessels to the ascending lumbar or retroperitoneal veins. There are two subtypes: IIa is without and IIb is with a competent valve at the ISV entry to the renal vein. Type III is a duplicated ISV. In type IV, there is collateral flow from the more lateral renal and perirenal veins to the ISV. This is also divided into subtypes: IVa is without and IVb is with a competent valve that is bypassed by an insufficient collateral. Type V is a bifurcated renal vein with a retroaortic component.

The classifications carry prognostic significance because technical success for transcatheter treatment is reduced in types IIb and IVb due to a frequent inability to pass the competent upper valve²²; in types IIa and IVa uncontrolled runoff through collaterals limit the effect of sclerotherapy.^{21,23}

Treatment

There are many methods to occlude the spermatic vein. The first use of metal coils for embolization was described in 1978 by Lima et al.²⁴ Since that time, additional materials have been reported including detachable balloons,²⁵ boiling contrast,²⁶ sclerosing agents (e.g., sodium tetradecyl sulfate [Sotradecol], polidocanol,²⁷ alcohol),²⁸ and liquid adhesives (e.g., cyanoacrylate).²⁹ Tungsten coils were used due to their improved visibility. However, they have been discontinued because they were found to be biodegradable leading to increased tungsten levels in the blood.^{30–32} Stainless steel, platinum microcoils, and/or sclerosants are now the most frequently used embolics.^{7,27,33–36}

The main goal of treatment is to interrupt retrograde flow into the pampiniform plexus from the ISV or any collateral vessel. This entails occlusion of the ISV low in the pelvis from just above the inguinal ligament to ~5 cm from the confluence of the spermatic vein with the renal vein (Fig. 1E). This way, not only is the main ISV occluded, but collaterals and side branches are blocked. Parallel or collateral venous channels that extend below the inguinal ligament must be individually selected and occluded separately. Aberrant vessels or

small collaterals that may be difficult to coil can be treated with injection of a liquid sclerosing agent. Embolization with coils has the advantages of being relatively painless and easily controlled, as long as coils are sized correctly. The 0.035-inch coils that range from 5 mm to 8 mm are commonly used,⁶ although larger diameters may be needed. The size of the coil should be at least 10% larger than the diameter of the spermatic vein at the level of deployment. If undersized, deployment can result in pulmonary embolization. Coil removal from the pulmonary artery can usually be performed with a snare; however, this requires a second procedure. The risk of significant morbidity is low from this complication.

Many groups, particularly those in Europe, use sclerosants exclusively. The most frequently used are sodium tetradecyl sulfate (Sotradecol) and polidocanol (Aetoxisclerol). A catheter placed into the refluxing segment of the spermatic vein is injected with 3 to 4 cc of sclerosant during Valsalva. Deposition of sclerosant in the pelvic segment of the vein is more effective than at a lumbar level.^{21,37} Care must be taken to avoid reflux below the inguinal ligament because this may produce the complication of chemical phlebitis. Methods to avoid reflux include coil occlusion at the level of the inguinal ligament, test injection with contrast to assess the volume of sclerosant needed, control of the degree of Valsalva during injection, and external compression just above the superior pubic ramus during the injection. The catheter is then left at the orifice of the ISV for 2 to 3 minutes to minimize egress of sclerosant.

If the right side does not demonstrate reflux, we do not routinely embolize it. This helps keep radiation exposure to a minimum. However, for recurrent cases, the threshold for treating the right gonadal vein is much lower.

The procedure typically is performed with conscious sedation and is not particularly painful. Vein ablation with alcohol or cyanoacrylate incites a rapid inflammatory effect and may cause more immediate discomfort and require more analgesia during the procedure. Extra sedation is also required if hot contrast is used as the sclerosant. Patients are ambulated after 2 hours of recovery and are advised to avoid heavy lifting for a week, but they may resume normal activity the following day. Discharge pain medication other than a nonsteroidal anti-inflammatory is rarely necessary.

Complications

Complications of spasm, dissection, perforation, and unselectable anatomy are the leading causes of failure to complete the procedure in 2 to 26% of patients.^{22,27,35,38,39} In patients with intact valves at the confluence with the IVC or renal vein (type IIb or IVb, with aberrant or collateral retrograde flow to a more

caudal incompetent segment of the ISV), spasm or perforation may occur due to difficulty in passage of the catheter and guidewire.^{21,22} Perforation risk is diminished with the use of hydrophilic wires and micro-catheters.²¹ In the presence of a perforation, the use of sclerosant is not recommended because retroperitoneal injection poses a risk of ureteral stricture. The presence of collateral channels has also been cited as a contraindication to sclerosant injection due to dilution or communication with systemic circulation.^{27,38} In these cases, as with perforation, the use of coils may permit successful embolization.

Other major complications of transcatheter embolization or sclerotherapy that require prolonged hospital admission or additional procedures are quite rare. The venous puncture-associated complications of an arterial puncture, false aneurysm, and large hematoma are very infrequent (less than 0.4% incidence). Pain can occur with injection of sclerosants; however, this is usually short lived and well controlled with moderate sedation (typically midazolam and fentanyl). Epididymo-orchitis occurs in 0 to 4%.³⁹

Pampiniform plexus phlebothrombosis and phlebitis are the most common complication specific to spermatic vein embolization; it is reported in 0.5 to 3% of procedures.^{27,34,35} This usually occurs due to passage of sclerosant into the scrotal portion of the varicocele. Symptoms of scrotal pain and swelling begin 24 to 48 hours after the procedure, and the patient may develop a low-grade fever. This should be evaluated with immediate and follow-up duplex ultrasound (6 weeks) to assure there is no sign of testicular necrosis, a very rare complication. Often, the varicocele itself thromboses. Phlebitis will resolve with a short course of oral corticosteroids and ibuprofen. Stronger prescription pain medicine may be required for a few days. Because it is difficult to differentiate phlebitis from infection, antibiotics are also often given.⁴⁰

Radiation exposure is a common concern when discussing this procedure with urologists and with patients. This is of particular importance when treatment is for fertility issues and in the treatment of the adolescent varicocele. Techniques to limit gonadal radiation exposure include: gonadal shielding, careful beam collimation, use of last image hold for image documentation, and minimization of fluoroscopy dose through the use of low-dose settings. Typically, the procedure can be performed using less than 10 minutes of fluoroscopy time. In a study of 223 patients, measured doses were within range of other diagnostic radiographic procedures, such as CT and nuclear medicine examinations. The mean exposure time was 6.3 minutes, and the mean gonadal dose was 0.49 mSv. This compares with an annual background dose of 2.4 mSv, an abdominal CT dose of 10 mSv, and the threshold associated with the deterministic effect of temporary sterility of 150 mSv.²⁷

Outcomes

TECHNICAL SUCCESS

The methods of varicocele repair continue to evolve as outcomes are variable and variably reported. Despite lower technical success as compared with surgical repair, many favor the percutaneous transcatheter technique as a first-line treatment because it is a minimally invasive outpatient procedure and has minimal complication rates.⁴¹ The targeted overall reported technical success rate, as cited by the *Journal of Vascular and Interventional Radiology* quality improvements guidelines, is 83 to 96%, with a clinical or imaging detected recurrence rate at 6 weeks of 7 to 16%.⁴² These numbers reflect the range of reported results.^{33–35,37,39} Reattempts succeed in 50 to 75%, but many proceed to a surgical procedure.

CLINICAL SUCCESS

When technically successful, the clinical outcomes of percutaneous ISV embolization or sclerotherapy are similar to surgical procedures. Semen parameters such as sperm concentration and motility improve in 70 to 82% of patients, and morphology infrequently improves.^{38,43–46} Clinical, imaging, and laboratory findings that are associated with higher success, as measured by significant improvement in serum parameters or pregnancy rates, include grade III or bilateral varicoceles, persistent reflux on Valsalva, lack of testicular atrophy, varices greater than 3 mm in diameter, normal follicle-stimulating hormone (FSH) level, positive gonadotropin-releasing hormone stimulation test, and total mobile sperm count > 5 million with motility > 60%.^{47–49} There may be benefits even in the azoospermic male, where a 35% improvement in sperm count and motility has been shown, such that half of the in vitro fertilization patients did not require a testicular biopsy to obtain adequate sperm for intracytoplasmic sperm injection.^{50–52}

The efficacy of either surgical or percutaneous varicocele repair to achieve pregnancy is less clear. Pregnancy rates of 32 to 57% are reported after retrograde sclerotherapy or embolization.^{7,53} Madgar and colleagues reported a randomized controlled trial of high spermatic ligation in men with varicocele as the only demonstrable factor of infertility. They found a significant difference in pregnancy rate of 44% in those treated versus 10% in those not treated.⁵⁴ Schlegel reviewed 13 controlled studies and found pregnancy rates after varicocele treatment averaged 33%, whereas those in the control arms averaged 16%.⁵⁵ Marmar and colleagues performed a meta-analysis of five controlled surgical repair studies and found 2.63-fold increased odds of spontaneous pregnancy after varicolectomy versus no repair.⁵⁶

On the other side of the argument, Nieschlag and colleagues reported a randomized controlled trial of surgical repair, percutaneous embolotherapy, and

counseling.⁵⁷ Although repair resulted in a significant increase in testicular size and improved semen parameters versus the untreated patients, pregnancy rates were similar. A Cochrane meta-analysis of eight studies found no effect of repair on pregnancy; however, this study has been criticized for including men with normal semen parameters or subclinical varicoceles.⁵⁸

Surgical Options

The minimal complication and rapid recovery rate associated with the percutaneous approach led many to prefer it over open surgery. The traditional surgical approaches are the retroperitoneal ISV ligation (Palomo procedure), now modified to spare the testicular artery; and the inguinal (Ivanissevich) approach where access is through the external oblique to the inguinal canal. The technical success rates are 99%. Recurrence rates and the risk of developing a hydrocele are 5 to 20%.⁵⁹ These open repairs entail general anesthesia, 2 to 3 days hospitalization, and multiple days to weeks for recovery. The surgical method has become more competitive with the percutaneous approach in recent years; intraoperative microscopy permits the lymphatic channels to be spared to decrease the hydrocele rate, and the subinguinal approach exposes the spermatic cord below the external inguinal ring without traversing fascia or muscle. The technical success is 99%, recurrence and hydrocele rates are 0 to 2%, and these procedures may be performed on an outpatient basis.^{60,61}

FEMALE PATIENT

Clinical and Anatomic Considerations

Chronic pelvic pain (CPP) is a common problem and a major challenge to healthcare providers. It is defined as continuous or intermittent noncyclic pain of 6 or more months' duration that localizes to the pelvis and is of sufficient severity as to cause functional disability.⁶² The community prevalence of CPP is 14.7%, with as many as 9.2 million American women sufferers.⁶³ Common causes of CPP include endometriosis, pelvic adhesions (sequelae of pelvic inflammatory disease), atypical menstrual pain, and nongynecological causes such as urologic disorders and inflammatory bowel disease.⁶² In 13 to 31% of patients, the cause is PCS, which is characterized by dilation of pelvic veins in the setting of chronic pelvic pain.^{64,65} Pelvic venous congestion was first described by Taylor in 1949.⁶⁶ Pelvic congestion syndrome usually presents in premenopausal women in their 20s and 30s with unilateral pelvic pain, which is made worse by standing, lifting, and coitus, and it is improved by lying supine.⁶⁷ On examination, varicosities may be seen at the sides of the vulva and can extend to the medial aspect of the upper thigh. The combination of ovarian point

tenderness and postcoital pain have been found 94% sensitive and 77% specific for PCS.⁶⁷

The etiology of PCS is poorly understood, although it is primarily a consequence of ovarian vein reflux and pelvic varicoceles.⁶⁸ Venous plexuses surround the uterus, ovaries, vagina, bladder, and rectum with a rich network of anastomoses. As in men, the left ovarian vein drains to the left renal vein and the right ovarian vein drains to the IVC in most individuals. It has been suggested that up to 15% of women lack valves in the left ovarian vein and 6% lack valves in the right.⁶⁹ Despite the presence of valves, the ovarian vein dilation that occurs with pregnancy can result in valvular incompetence and retrograde blood flow, and PCS has been shown to be more frequent in multigravid women.⁷⁰ The fact that PCS occurs mostly in premenopausal women and that pain may be reduced after hormonal therapy suggests a hormonal influence.⁷¹ Venous outflow obstruction due to extrinsic compression, IVC syndrome, or nutcracker syndrome (superior mesenteric artery [SMA] compression of the left renal vein) can also cause PCS.^{72,73}

The connection between the venous congestion and pain has been demonstrated based on medical and surgical therapies. In a trial of medroxyprogesterone acetate (MPA) therapy, a reduction in venous congestion was significantly associated with a diminished pain score.⁷¹ Further, in a study of preoperative female kidney donors, 10% had ovarian varices and 59% of those had CPP. Three quarters of those with both CPP and varices improved after ovarian vein ligation.⁷⁴

Pelvic ultrasound is commonly used to noninvasively diagnose PCS. The normal pelvic venous drainage is via a few straight channels that are less than 4 mm in diameter. Diagnostic Doppler US findings include multiple tortuous, dilated (> 6 mm) veins around the ovary and the uterus, with slow (< 3 cm/s) or retrograde flow, and dilated arcuate veins across the myometrium. Reversed flow with the Valsalva maneuver corresponds to reflux demonstrated by venography.⁷⁵ Polycystic changes of the ovaries, either diffuse or focal clusters of 4 to 6 cysts, are found in half of women with pelvic congestion, although usually without the clinical findings associated with abnormal ovarian endocrine function.⁷⁵ Findings of dilated tortuous veins on CT and MRI have also been described.^{76,77} Whether discovered on abdominal imaging or suspected by superficial pelvic varices, phlebography remains the gold standard for diagnosis of ovarian or internal iliac venous reflux.

Ovarian Venography

The procedure for the contrast study of the female gonadal veins is similar to that in the male. It can be performed from either a femoral or jugular approach. Methods to improve demonstration of varices include

injection during Valsalva or using a tilt table to place the patient in a semiupright position. Selective catheterization of the left renal and then the ovarian vein is performed, and a venogram is obtained during Valsalva, to assess venous distension and reflux (Fig. 2). In contrast to the male, the right ovarian vein is routinely studied.³⁶ In addition to providing a roadmap for embolization, venography is valuable in that it identifies reflux or valvular incompetence, demonstrates filling of contralateral veins, and can identify reflux in tributaries of the internal iliac veins. Incompetent iliac veins, when dilated, are also thought to contribute to symptoms and may reduce the effectiveness of ovarian vein embolization. Presence of one or more of the following venographic appearances suggests PCS^{78,79}:

1. Dilation of the ovarian vein (diameter > 6 mm)
2. Ovarian vein reflux
3. Uterine vein engorgement

4. Congestion of the ovarian venous plexus
5. Filling of pelvic veins across midline
6. Filling of vulvovaginal or thigh varicosities

Treatment

In 1993, Edwards et al⁸⁰ reported transcatheter embolization of bilateral ovarian vein varices in a woman with PCS that resulted in prolonged symptomatic relief. Similar to spermatic vein embolization, multiple variations on the technique have been described including coil embolization,⁷⁹ foamed sodium tetradecyl sulfate with coils,⁸¹ sodium morrhuate and Gelfoam,⁸² liquid glue agent,⁸³ and Amplatzer plug⁸⁴ occlusion. Each has been described with favorable results.

After diagnostic venography, and coaxially through the diagnostic catheter or sheath, a 3F microcatheter or a 4F angled or Cobra catheter can be advanced into the caudal ovarian vein. Placement of

Figure 2 (A) Injection at the confluence of the left gonadal vein and the renal vein demonstrates spontaneous flow peripherally and valvular incompetence. (B) There are two visible parallel channels in the middle left gonadal vein. (C) Injection more caudally identifies dilated pelvic veins crossing midline. (D) Postembolization image shows occlusion of the gonadal vein. Note that coils have been placed peripherally as well as across the ostia of the parallel channels.

embolic coils should start at the level of the sciatic notch and progress upward to within several centimeters of the renal vein (Fig. 2D). There is some operator variation in which vessels are embolized. Unlike their for their male counterparts, most authors routinely embolize female patients' bilateral ovarian veins.^{33,36,73,83} In addition, some authors have described evaluation and embolization of internal iliac tributaries during the initial therapy or as a routine second procedure;³⁶ however, we reserve internal iliac embolization for clinical (as opposed to radiographic) treatment failures and perform this as a separate procedure if needed 1 to 2 months later. Postprocedure care is similar to that for the male procedure, and same-day discharge is expected.

Complications

Complications of ovarian vein embolization include thrombophlebitis, recurrence of varices in up to 10%, nontarget embolization in 1 to 2%, and potential effects of radiation exposure to the ovaries. There are data showing no effects on menstrual cycle or fertility.⁸¹

Outcomes

Current literature suggests high technical and clinical success rates with low rates of complications. Kwon and colleagues reported unilateral coil embolization treatment of 67 patients, and 82% had either a complete absence of pain or significant improvement.⁷⁹ In that study, there was a 3% initial complication rate and 3% reported worsening of symptoms. Kim and colleagues reported 127 patients treated with bilateral ovarian and internal iliac vein embolization. Despite the more extensive treatment, they had a similar 83% clinical success at 45 months.³⁶ Improvement was significant with regard to pain perception, dyspareunia, urinary frequency, and number of pain medicines required. A recurrence rate of 5% was noted in this study among patients who showed initial improvement.

Other Treatment Options

Open surgical and laparoscopic ligation of pelvic varices has been performed with excellent clinical success rates of 97 to 100%.^{83,85,86} These methods are more invasive than percutaneous therapy and they require general anesthesia, at least 2 days of hospitalization, and 2 days to weeks of recovery time. Medical management with MPA has a reported clinical success rate of 75%.⁸⁷ A recent comparison of MPA and goserelin, a gonadotropin-releasing hormone agonist, found the latter superior in both reduction of clinical pain symptoms and venographic abnormalities.⁶⁵

CONCLUSION

Gonadal vein embolization is a minimally invasive, safe, and effective outpatient treatment option in both male and female patients. Treatment of the male varicocele is overshadowed by uncertainty as to its overall utility in improving pregnancy rates. Preference for the transcatheter method is challenged by new minimally invasive surgical techniques. In women with chronic pain attributable to PCS, embolization can reduce or eliminate pain with minimal recovery time and side effects.

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