Varicocele: A Review

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Abstract

Keywords

- varicocele
- infertility
- embolization
- orchalgia
- interventional radiology

Varicoceles are relatively common clinical problem that are associated with pain, testicular atrophy, and reduced fertility rates. After a brief historical perspective is presented, this article reviews the anatomy, indications, treatment options, and potential complications related to varicoceles.

Objectives: Upon completion of this article, the reader will be able to discuss the anatomy, indications, treatment options, and complications related to varicoceles.

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Historical Overview

Celsus provided a detailed description of varicocele and its operative treatment in the first century AD.^{1,2} Since that time, a wide range of conservative therapies have been recommended including suspension, compression, cold scrotal showers, astringents, and moderation of sexual activity.¹ Perhaps more interesting is the early evolution of surgical treatments, which involved a trans-scrotal approach and included cauterization, clamps, subcutaneous hoops, partial excision of the scrotum, ligation and resection of the dilated venous plexus, and even semicastration.^{1,3,4} This surgical approach remained in favor until 1898 when Narath first

performed an inguinal approach to treat a varicocele.¹ During several hernia operations in which varicoceles were identified, he resected the internal spermatic vein during a Bassini operation, resulting in a dramatic increase in the success rate for resolution of the varicocele. Since Narath published his results in 1900,¹ this surgical approach was further modified and developed by Ivanissevich and Gregorini⁵ and later by Bernardi,¹ both of whom practiced in Buenos Aires. Paloma proposed and refined a high retroperitoneal surgical approach, which involved ligation of both the artery and vein above the level of the deep inguinal ring.^{6,7} Reports by Tulloch in the 1950s first shed light on a relationship between varicocele and infertility, underscoring the concept that a varicocele is not an innocuous condition.^{1,8} More recently, laparoscopic approaches have been developed^{3,9} and imaging has improved dramatically. Spermatic venography was first used in 1977 to identify incompetent spermatic veins, with percutaneous embolization being initially described in 1978.³

Anatomy

Varicoceles are dilated tortuous veins of the pampiniform plexus—the venous sinuses that drain the testicles. These sinuses primarily drain into the internal spermatic vein (gonadal vein). The right internal spermatic vein normally drains obliquely into the anterolateral inferior vena cava (IVC), just inferior to the right renal vein, whereas the left spermatic vein normally drains perpendicularly into the left renal vein.

The perpendicular termination exposes the left spermatic vein to compromised flow in the setting of increased left renal venous pressures. This flow abnormality is augmented when there is compression of the left renal vein between the aorta and superior mesenteric vein (SMV; "nutcracker syndrome").^{10,11} Additionally, the increased length of the left-sided vein when compared with the right contributes to the increased prevalence of left-sided varicoceles.¹² This difference in incidence is such that an isolated right varicocele is rare, and some investigators advocate prompt evaluation for a retroperitoneal mass.¹³ Another factor that predisposes to formation of a left-sided varicocele is compression of the left spermatic vein by the left colon.¹⁴

Valvular absence or malfunction contributes to venous reflux, which is more common in the left internal spermatic vein. In a postmortem evaluation series, absence of valves in 40% of left spermatic veins and 23% of right spermatic veins was noted.¹²

In order of importance, other drainage pathways of the testicle in order of importance include the external pudendal vein that drains into the great saphenous vein; the vasal vein, which drains into the internal iliac vein; and the cremasteric vein (external spermatic vein), which drains into the inferior epigastric vein and the external iliac vein. Additional collateral pathways may exist to the retroperitoneal, peritoneal, ureteral, splenic, colonic, and adrenal veins, with possible communication between the bilateral internal spermatic veins at the L3 level.^{15,16}

Variant venous anatomy is not uncommon. Dissection of 150 cadavers revealed variant testicular vein anatomy in 21% of specimens, including duplication of spermatic veins and IVC termination of the left renal vein.¹⁷ Though uncommon, the right spermatic vein may drain directly into the right renal vein or duplicated right renal vein rather than the IVC.^{17,18} Another possible variant is drainage of the left spermatic vein into a branch of the left renal vein.¹⁹

Incidence

Reported incidence of varicoceles in the general population ranges from 15 to 20%,^{12,20,21} and 30 to 40% in infertile men.^{12,22} This prevalence increases with age, approaching 42% in the elderly population.^{23,24} Due to the anatomic causes described earlier, left-sided varicoceles are 10 times more common than on the right and occur bilaterally in fewer than 10% of patients and isolated to the right in less than 1%.^{16,25}

In addition, genetics may add to the likelihood of developing a varicocele. A review of 62 first-degree relatives of patients with varicoceles found that 56.5% had palpable varicoceles, whereas the incidence in a control group of 263 was 6.8%.²⁶

Indications

Indications for the treatment of varicoceles include infertility, testicular atrophy in the pediatric/adolescent population, and orchalgia. When treating for infertility, American Urological Association/American Society for Reproductive Medicine criteria advocate that varicocele be palpable; the couple has infertility;

Table 1 Criteria for treating varicoceles for infertility

Palpable varicocele
The couple is infertile
Female member of the couple has normal fertility or a potentially treatable cause of infertility
Male member has abnormal semen parameters or abnormal sperm function

the female has normal fertility or a potentially treatable cause of infertility; and the male has abnormal semen parameters or abnormal results of sperm function tests (► **Table 1**). Additional indications include young men with a palpable varicocele, regardless of semen parameters, and adult men with varicoceles and altered semen parameters, regardless of whether they are currently attempting to conceive.²²

The treatment of subclinical varicoceles, those that cannot be diagnosed solely on clinical exam and instead rely on additional diagnostic exams,²⁷ is a controversial topic. Although many authors believe that there is little to no benefit in treating subclinical varicoceles for pain or fertility,^{28–32} several studies have found improvement in fertility following treatment.^{33–36}

Testicular Dysfunction

Approximately 40% of men being evaluated for infertility have a varicocele.²² The etiology of this infertility is complex and thought to be related to decreased sperm quality and quantity from increased temperature,^{37–39} reflux of the adrenal vein into the spermatic vein inducing a catecholamine effect,^{40,41} hypoxia from venous stasis, and elevated spermatozoal oxygen species.^{42,43}

Regardless of fertility status, varicoceles may result in testicular atrophy.⁴⁴ This loss in testicular mass is accompanied by dysfunctional testicular tissue, as evidenced by studies that have biopsied testicles with varicoceles.^{45,46}

Orchalgia is present in approximately 2 to 10% of men with varicoceles, and is described as dull, throbbing pain exacerbated by straining and prolonged standing.⁴⁷ This pain classically extends from the scrotum to the ipsilateral inguinal region following the path of the spermatic cord.⁴⁸ Varicoceles have been identified as the cause for chronic scrotal pain in 2 to 14% of men.^{49–51}

Evaluation

Evaluation should be performed in a warm room with the patient both recumbent and upright. If not obviously palpable but suspected, a Valsalva maneuver in the standing position may help engorge the dilated veins. Oftentimes, the varicocele reduces during the supine position.¹² A varicocele grading system based on physical exam was proposed by Dubin and Amelar (► **Table 2**).⁵²

Although not routinely used in diagnosing varicoceles, ultrasound is a valuable asset in the detection of subclinical

Table 2 Clinical grading of varicoceles

Physical exam grading of varicoceles	
Grade 1	Palpable when the patient is standing and performing a Valsalva maneuver
Grade 2	Palpable when the patient is standing, without performing a Valsalva maneuver
Grade 3	Visible through the scrotal skin and palpable while the patient is standing

varicoceles, and in the evaluation for a postsurgical recurrence of persistence.¹² On ultrasound, varicoceles will appear as tubular serpiginous hypoechoic structures along the superior lateral testis, generally measuring greater than 2 mm in diameter (►Fig. 1). Low-level echoes may be present, representing sluggish flow.⁵³ Color Doppler can be used for diagnosing and grading varicoceles by documenting reversal of flow with or without performing a Valsalva maneuver (►Fig. 2a, b). Additionally, the use of ultrasound increases the sensitivity of detecting subclinical varicoceles.⁵⁴ A proposed grading system for varicoceles according to color Doppler imaging stratifies patients into one of five grades (►Table 3).⁵⁵

Surgical Treatment

The Palomo technique, a retroperitoneal high ligation above the internal inguinal ring, was introduced in 1949.⁶ However, this technique had a high rate of recurrence because the superior point of ligation did not address collaterals. It also resulted in a lengthy patient recovery because it required dissection of the abdominal musculature.⁵⁶ There have been modifications to this approach; however, treatment has shifted toward microsurgical inguinal or subinguinal varicocelectomy.⁵⁷ Subinguinal varicocelectomy (with or without microsurgery) offers the advantage of avoiding the external oblique fascia and therefore minimizes postoperative pain.¹² Laparoscopic varicocelectomy may also be performed. It is technically similar to the open retroperitoneal approach, as it involves high ligation of the spermatic vein without identification of the external spermatic vessels. Consequently, the

incidence of postoperative hydrocele and recurrence is higher when compared with a microsurgical varicocelectomy. However, laparoscopic approaches do offer the advantage of treating bilateral varicoceles easily, as well as a quick recovery time.¹²

Endovenous Treatment

Percutaneous varicocele embolization is routinely performed as an outpatient procedure using moderate sedation and with the patient in the supine position. The approach used and the catheters selected are operator dependent. A right common femoral vein approach is often used, especially when treating an isolated left varicocele.^{58–62} However, some operators may prefer a right internal jugular vein approach⁶⁰; a transbrachial approach may offer similar advantages.^{63,64} Following venous access, a 7F sheath is placed. If using femoral access, a C2 or C1 angiographic diagnostic catheter (Cook Medical, Bloomington, IN) can be used to access the left renal vein and left internal spermatic vein (►Fig. 3a–c), whereas a reverse-curve catheter such as a Simmons-1 (Cook Medical, Bloomington, IN) is preferred for the right internal spermatic vein. A superior approach offers the advantage of using the same catheter for both the right and left internal spermatic vein, such as a JB1, H1H (Cook Medical, Bloomington, IN), or Bentson-Hanafee-Wilson 1 catheter (Terumo Medical Corporation, Somerset, NJ). Retrograde venography is performed once the catheter has engaged the internal spermatic vein. This should be repeated while the patient either performs the Valsalva maneuver or is placed in reverse Trendelenburg. This latter venogram

Fig. 1 Gray-scale ultrasound in a 14-year-old boy being evaluated for a left varicocele. There are multiple serpiginous anechoic vessels associated with the left scrotum, measuring up to 2.3 mm in diameter (calipers).

Fig. 2 Color Doppler ultrasound in a 14-year-old boy being evaluated for a left varicocele. Imaging was performed before (a) and during (b) Valsalva. During Valsalva, blood flow is increased.

documents the presence of reflux, checks for the presence of venous collaterals, and aids in planning for embolization (► **Fig. 4a, b**). Some operators may opt to use a microcatheter at this point to gain access to the inferior internal spermatic vein.

Successful varicocele embolization has been described using a variety of embolic agents and sclerosants, with operator preference dictating embolic choice. Authors have reported using sclerosing agents,^{63,65} coils,⁵⁸ liquid embolics,^{60,66} detachable balloons,⁵⁸ and hot contrast.⁶¹ Earlier literature described the use of an “air-block” technique in which a small amount of air was injected prior to injecting the

sclerosant. However, this has been shown to often be ineffective and is no longer used.^{67–69}

Coil embolization is performed by advancing the catheter to the distal internal spermatic vein and embolizing the length of the vein from the approximate location (► **Fig. 4c, d**) of the inguinal canal to its confluence with the left renal vein or inferior vena cava. If collaterals are large, they too are selectively embolized. Distal protection during embolization with sclerosant has been described several ways, including creating a nest of coils, using balloon occlusion,¹⁶ or with manual compression of the spermatic cord.⁶³

Table 3 Ultrasound grading of varicoceles

Grade 1	Reflux in the spermatic cord veins in the inguinal region while performing a Valsalva maneuver. No appreciable scrotal varicocele
Grade 2	Nondilated veins while supine. When standing dilated veins reach the upper pole of the testicle. Reflux to upper pole veins only while performing a Valsalva maneuver
Grade 3	Nondilated veins while supine. When standing dilated veins reach the lower pole of the testicle. Reflux to lower pole veins only while performing a Valsalva maneuver
Grade 4	Dilated veins while supine with reflux while performing a Valsalva maneuver
Grade 5	Dilated veins that reflux without performing a Valsalva maneuver

Fig. 3 A 17-year-old male undergoing left varicocele embolization with access via the right common femoral vein. (a) Selective catheterization of the left renal vein; (b) Left renal venogram; (c) A 6F sheath was advanced into the left renal vein (arrow) for additional support.

Outcomes

As the initial treatment for varicoceles, percutaneous embolization is technically successful in 90 to 97%, with recurrence rates ranging from 2 to 24%; both of these ranges are comparable to surgery.^{16,70–72} Additionally, when comparing improvement in seminal parameters and pregnancy rates following percutaneous embolization versus surgery, there was no reported statistical difference between the two interventions.⁷⁰

Percutaneous varicocele embolization is an excellent treatment option for patients with persistent or recurrent varicocele following varicocelectomy. Because this is often secondary to a persistent draining vein not treated during surgery, retrograde venography allows for visualization of the culprit vein. A 2011 review of persistent/recurrent varicoceles treated with percutaneous embolization demonstrated complete resolution in 80% and partial resolution in an additional 16% of cases.⁷¹

Fig. 4 A 17-year-old male requiring left varicocele embolization. (a) A 5F catheter was positioned in the distal left internal spermatic vein and venogram was performed. Duplication of the distal internal spermatic vein is present; (b) venogram of the left internal spermatic vein after partial coil embolization, again showing partial duplication; (c, d) coil embolization with subsequent venogram demonstrating satisfactory occlusion.

Treatment of varicoceles has been demonstrated to improve fertility. A Cochrane review of 10 studies including 894 participants demonstrated an increase in pregnancy rates following varicocele treatment compared with no treatment.⁷³

Complications

The most common complaint following embolization is testicular pain that may last for up to 10 days.^{3,63} Such pain has been reported in up to 17% of patients.^{60,67,74} Other minor immediate complications include inguinal hematoma,⁶⁷ temporary venotomy site pain,⁷⁵ and contrast allergy.⁶³ Multiple studies demonstrated no risk of hydrocele formation following embolization, likely due to sparing of the lymphatic system.^{29,62} However, a single study reported a hydrocele incidence of 4.5% of patients.⁴⁸ It is uncertain if this was reactive to thrombophlebitis rather than being lymphatic in nature.

During venography, perforation of the internal spermatic vein and dissection of the IVC/renal vein may occur, reported in up to 4.6 and 4.1% of cases, respectively. This complication is usually without clinical consequence.⁶⁷ Though rare, more serious complications from varicocele embolization have been described, including coil migration to the right atrium⁷⁵ and pulmonary arteries,⁷⁶ as well as bowel necrosis following sclerotherapy.⁷⁷

Summary

Percutaneous embolization is a safe and effective treatment option in the management of varicoceles, with comparable results to surgical varicocelectomy. Interventional treatment has the additional benefit of limiting surgical complications such as the development of a hydrocele, as well as being far less invasive. Additionally, the ability to visualize variant anatomy makes percutaneous embolization an important tool in the setting of failed surgical varicocelectomy.

Disclosure

None.

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