Varicocele

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Pathophysiology

Male varicocele is defined as dilation of the pampiniform plexus, a network of normally tiny veins within the spermatic cord. Increased venous pressure is caused by incompetent gonadal venous valves or obstruction of venous return within the gonadal vein more centrally [1]. Varicoceles are relatively common, occurring in approximately 15% of young, healthy males, and have a natural predilection for the left side in 75–90% of patients [2–4]. The left gonadal vein is longer and inserts into the left renal vein, unlike the right gonadal vein, which inserts directly into the IVC. The resulting increased hydrostatic pressure in the left gonadal vein creates a favorable environment for formation of varicoceles [5]. Varicoceles occur bilaterally in up to 30–80% of cases [6]. Isolated right-sided varicoceles warrant further work-up as they may be the only sign of retroperitoneal pathology. Evaluation with cross-sectional imaging should be performed to exclude a potential neoplasm [7].

Key Point
The left gonadal vein inserts into the left renal vein. The right gonadal vein inserts directly into the IVC.

Key Point
Varicoceles are most common unilaterally on the left or bilaterally. An isolated right-sided varicocele warrants further work-up for retroperitoneal pathology.

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Varicoceles are present in 35% of primary infertility cases and in 80% of secondary infertility cases. Fortunately, they are the most common correctable cause of male infertility [4]. It is hypothesized that the pooling of blood within the pampiniform plexus raises scrotal temperature and negatively affects spermatogenesis resulting in decreased sperm counts, sperm deformity, and decreased motility [8].Varicoceles are associated with ipsilateral testicular atrophy, and early intervention can arrest that atrophy [8]. Nonsurgical and surgical treatment of varicoceles has been proven to arrest the decline of testicular function and improve the serum testosterone, sperm concentration, and sperm quality [4, 9].

Most varicoceles are asymptomatic; however, orchialgia, or testicular pain, is present in up to 10% of males with varicoceles [10]. Orchialgia is most often described as a dull, throbbing pain worsened by straining or prolonged standing [2]. Chronic orchialgia, defined as testicular pain for at least 3 months, is a rare presentation of varicoceles and is present in only 2–10% of males with varicocele [11, 12].

Varicocele is diagnosed clinically on physical exam and classically presents as a painless "bag of worms" upon palpation of the scrotum (Fig. 14.1). The Valsalva maneuver is performed with the patient in the upright position to increase distal venous pressure and accentuate the size of the varicocele. The size of the varicocele decreases in the supine position due to a decrease in the venous system hydrostatic pressure [5]. Grading of a varicocele is done on physical exam using the Dubin-Amelar grading system (Table 14.1).

Evaluation of testicular atrophy is an essential part of the physical examination. In some scenarios, such as pediatric varicocele, clinically occult varicocele, or male infertility, scrotal ultrasonography is the imaging modality of choice for varicocele diagnosis and further evaluation of the testes. Color-flow or Doppler imaging enables the clinician to confirm the diagnosis by visualizing venous dilation and reflux of blood into the pampiniform plexus, assess the size of the varicocele, and evaluate testicular blood flow [13]. Ultrasound findings to support a diagnosis of varicocele include visualizing the pampiniform plexus as multiple

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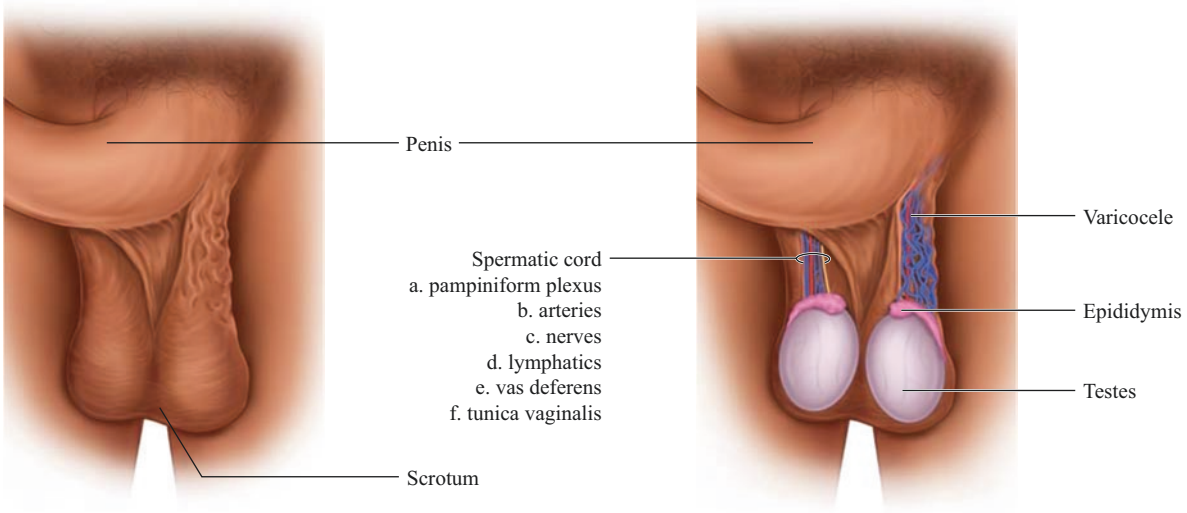

Fig. 14.1 Varicocele

Table 14.1 The Dubin-Amelar grading system for varicocele

Grade	Physical exam finding
0	Non-palpable
1	Palpable with Valsalva only
2	Palpable at rest
3	Visible and palpable at rest

anechoic dilated tubular structures superolateral to the testis measuring greater than 2 mm in diameter [13] (Fig. 14.2).

Varicoceles that are non-palpable on physical exam and show no evidence of reduced testicular function or abnormal sperm parameters can be treated conservatively and should be offered regular clinical follow-up [14]. In adult males with clinically palpable varicoceles but otherwise asymptomatic, semen parameters can be obtained. If normal counts and motility, then 1- to 2-year follow-up is recommended to monitor for the development of symptoms, testicular atrophy, or semen dysfunction [14, 15]. In males with unilateral or bilateral varicoceles without evidence of decreased testicular size, annual clinical evaluation of semen analysis or testicular size should be performed to assess for early dysfunctional spermatogenesis. Invasive varicocele treatment can be considered in males with clinical varicocele and reduced testicular size or evidence of semen dysfunction (Table 14.2) [14].

Key Point
Varicocele treatment is indicated for males with clinical symptoms + testicular atrophy or semen dysfunction.

Conventional Therapy

There is no effective pharmacologic treatment; all available treatment options are surgical or image-guided [16]. Varicocele treatment was first described in the 1900s via an open surgical approach with removal of the pampiniform plexus. This approach has fallen out of favor due to the high risk of injury to the testicular artery [3]. The most common surgical approaches include open or laparoscopic spermatic vein ligation (the Palomo technique), inguinal varicocele ligation (the Ivanissevich technique), or microscopic inguinal or subinguinal varicocele ligation [7].

The Palomo technique involves high ligation of the testicular vein (and possibly the artery and lymphatics) above the internal inguinal ring. Some benefits to this technique include technical ease and reduced risk of injury to important vascular structures. However, this approach has high recurrence rates due to the formation of distal collateral vessels [7]. The Ivanissevich technique, or inguinal approach, ligates the cremasteric and gonadal veins within the inguinal canal. This approach allows for better access for collateral vessel ligation but has increased risk of arterial and lymphatic injury without the use of a microscope. Introduction of an operating microscope for dissection of the inguinal canal significantly reduces the risk of varicocele recurrence and the development of a hydrocele [17]. The subinguinal approach has been shown to reduce postoperative pain as it avoids incision of the external oblique aponeurosis.

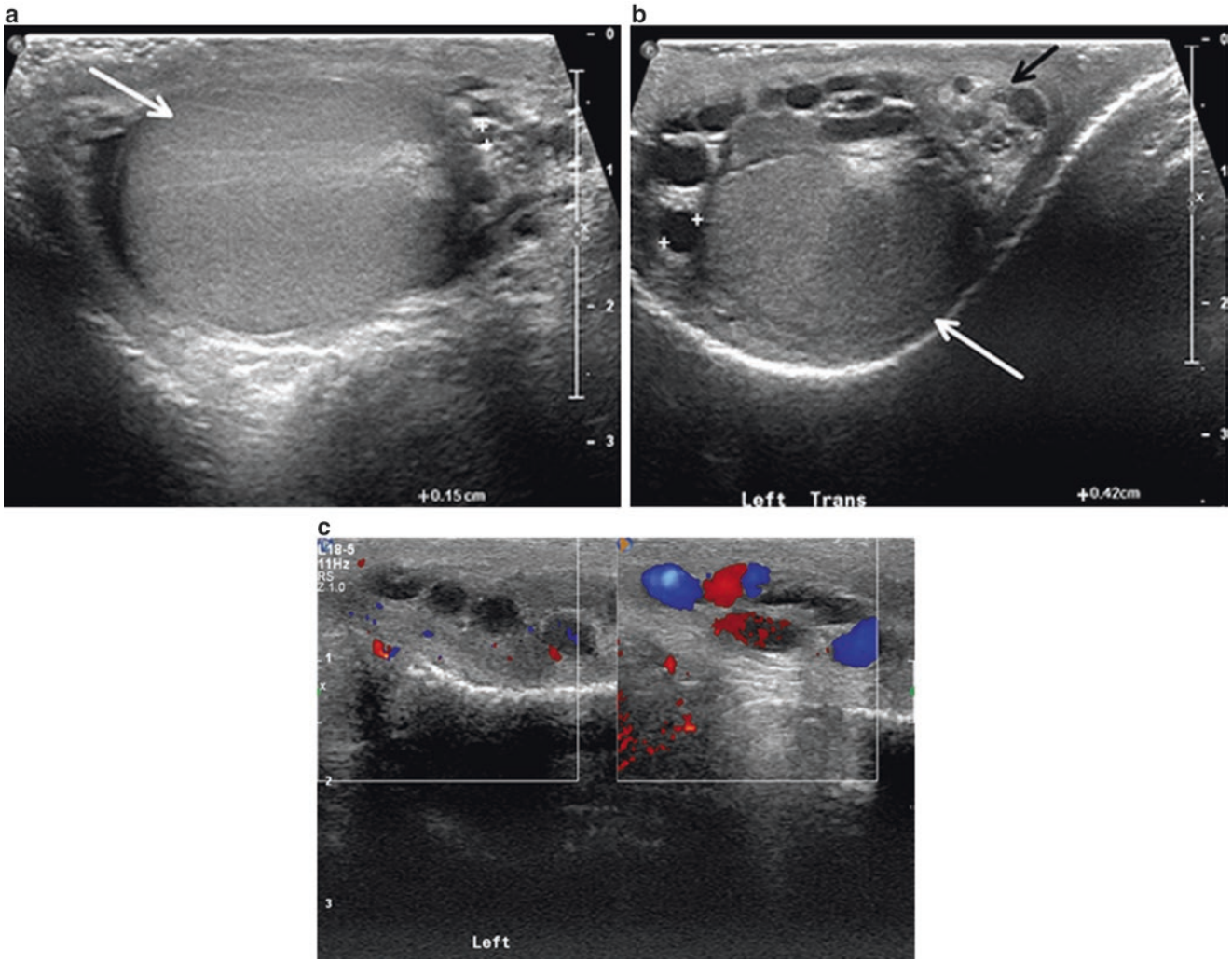

Fig. 14.2 Left-sided varicocele in a 31 year-old male. (**a**) Grayscale ultrasound image of the right scrotum showing a normal testis (*white arrow*) and normal size of a pampiniform plexus vein (*cursors*) in the transverse view. (**b**) Transverse view of the left scrotum shows multiple dilated veins of the pampiniform plexus, all measuring greater than 2 mm in diameter (*cursors*), surrounding the normal testis (*white arrow*). The normal epididymis is also seen in this image (*black arrow*). (**c**) Doppler flow confirms that the dilated veins are patent and increase in size with Valsalva (image right)

Table 14.2 Clinical indications for varicocele embolization according to the 2014 committee of the American society for reproductive medicine and society for male reproduction and urology

Patient population	Symptoms
Male partner of an infertile couple	Palpable varicocele on exam Abnormal semen parameters Female partner has normal fertility or a treatable cause of infertility
Adult male	Palpable varicocele Abnormal semen analysis Desire for future fertility Associated testicular pain
Adolescent male	Unilateral or bilateral varicocele Reduced testicular size

Surgical varicocele ligation is currently more common but not superior to percutaneous treatment in many clinical scenarios (i.e., painful varicocele without infertility or testicular atrophy) [18, 19]. Research has shown similar rates of success when comparing surgical and percutaneous techniques in clinical outcome for men with infertility [20, 21]. A retrospective study performed by Shlansky-Goldberg showed a similar increase in semen parameters after surgical intervention (34%) versus percutaneous intervention (39%) [22]. Some of the benefits of minimally invasive percutaneous interventions include the elimination of large surgical incisions resulting in less pain for the patient, moderate conscious sedation anesthesia instead of general anesthesia, shortened

hospitalization, and decreased risk of unintentional injury to the testicular artery or lymphatic system that would be possible during traditional surgical approaches [17].

Interventional Therapy

One of the first successful attempts at percutaneous therapeutic intervention for varicocele occurred in 1978 with the injection of hypertonic glucose and a sclerosant into the left gonadal vein via the transfemoral approach [23, 24]. Since then, embolization techniques have evolved considerably with the introduction of the microcatheter, improved sclerosing agents, micro-coils, and vascular plugs. The most commonly used embolic agents in treatment of varicoceles include coils and sclerosants, although Gelfoam and cyanoacrylate are used as well [25]. The mechanism of gonadal vein thrombosis with coils is a mechanical reduction in flow, with platelet aggregation on the coils, which often contain thrombogenic fibers [26]. Liquid sclerosant embolic agents cause vessel occlusion by inducing a thrombogenic and inflammatory reaction and endothelial damage. Cyanoacrylate glue precipitates into a solid when in contact with ionic solutions and thus fills the vessel lumen inducing thrombosis. In general, coils are easier to control than liquid embolics, which require more operator experience to administer safely and effectively.

The How To

Laboratory work-up is not necessary in the young, healthy adult male. When appropriate, typical labs obtained include a CBC, PT, PTT, and creatinine. After appropriate pre-procedural assessment, the three key components of interventional management of varicoceles are obtaining venous access, renal, and then gonadal catheterization, venography, and embolization.

1. Access is usually obtained through the right internal jugular or common femoral veins using the Seldinger technique.
2. The venogram is performed through a 4F or 5F catheter, positioned in the left renal vein, during Valsalva, with a hand injection of contrast. Reverse Trendelenburg positioning is also helpful to demonstrating reflux. If gonadal reflux is seen, this will allow the identification of the gonadal vein junction with the left renal vein (Fig. 14.3).
3. The gonadal vein is then catheterized and another venogram is performed (Fig. 14.4). This venogram allows the identification of collaterals that put the varicocele at risk for recanalization. Embolization is then carried out from the inguinal ring proximally, typically with coils and sclerosants, with care not to embolize into the scrotum (Fig. 14.5).
4. Embolization is carried out up to the confluence of the gonadal vein with the renal vein, to prevent recanalization and collateral formation (Fig. 14.6).
5. Occlusion of collateral veins should also be performed. Embolization technique for right-sided varicocele is the same as for left varicocele up to the confluence of the left gonadal vein and IVC [15].
6. The patient is monitored for 1–2 h in the recovery room prior to discharge home. Patients should not engage in heavy lifting (>20 lb) for the following 48 h but are able to return to work the day following the procedure.

A small percentage (~10%) of patients may have back pain or testicular swelling and pain after the procedure. This may be a sign of pampiniform plexus thrombophlebitis. This is usually self-limiting and can be treated with nonsteroidal anti-inflammatory drugs (NSAIDs) and limited activity until symptoms resolve. Patients should have a 3-month follow-up ultrasound to evaluate for treatment response and evidence of recanalization.

The risks associated with the use of coils include vessel perforation, coil migration to the heart or pulmonary arteries, and gonadal vein recanalization. The risks associated with liquid embolics include too distal occlusion causing testicular venous infarcts, nontarget embolization through reflux, and vessel rupture due to pressurization during injection.

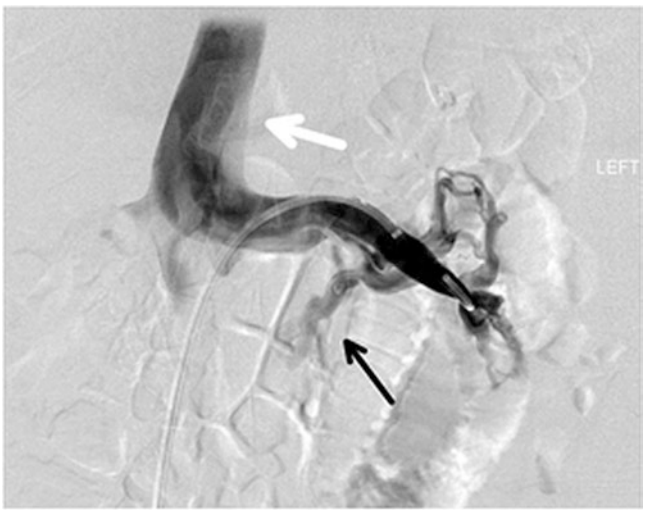

Fig. 14.3 Venogram shows an endovascular sheath within the left renal vein. Contrast material is injected through the sheath into the renal vein and is seen refluxing into the left gonadal vein (*black arrow*) and antegrade flow to the IVC (*thick white arrow*)

Fig. 14.4 Contrast injection in the left gonadal vein (*white arrows*) shows a dilated pampiniform plexus within the scrotum (*black arrow*). In most cases, direct fluoroscopy over the testes can be avoided

Fig. 14.5 Embolization treatment of varicocele. Embolization coils extend from internal ring (*white line*) of the inguinal canal up near the left renal vein

Fig. 14.6 Venogram taken after gonadal vein coil embolization with the sheath still in the origin of the gonadal vein demonstrates no filling of the gonadal vein (*black arrow*) and reflux into the renal vein. No further collateral vessels are identified

Key Point

Procedural complications:

- Vessel perforation
- Coil migration
- Nontarget embolization
- Gonadal vein recanalization
- Pampiniform plexus thrombophlebitis

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