

Chapter 4

Varicocele Classification

In this chapter, we examine the several classification modes have been used to diagnose and grade varicocele, including physical exam, venographic examination, color Doppler study and thermographic tests. The diagnostic accuracy of the different methods for detecting varicocele is shown in Table 4.1.

Physical Examination

Physical examination with the patient standing in a warm room is currently the preferred method for varicocele diagnosis. This method has a sensitivity and specificity of around 70% compared with other diagnostic tools, such as venography and color Doppler studies [112, 184]. Based upon clinical examination, varicocele is generally classified according to Dubin et al. [185] into:

1. Impalpable or subclinical type or grade 0 when it is not palpable or visible at rest or during Valsalva maneuver, but demonstrable by scrotal ultrasound and color Doppler examination.
2. Palpable varicocele when it is clinically palpable at rest or with the aid of Valsalva maneuver. Such varicoceles are further divided into:
 - Grade 1: Palpable only during Valsalva maneuver
 - Grade 2: Palpable at rest, but not visible
 - Grade 3: Visible and palpable at rest

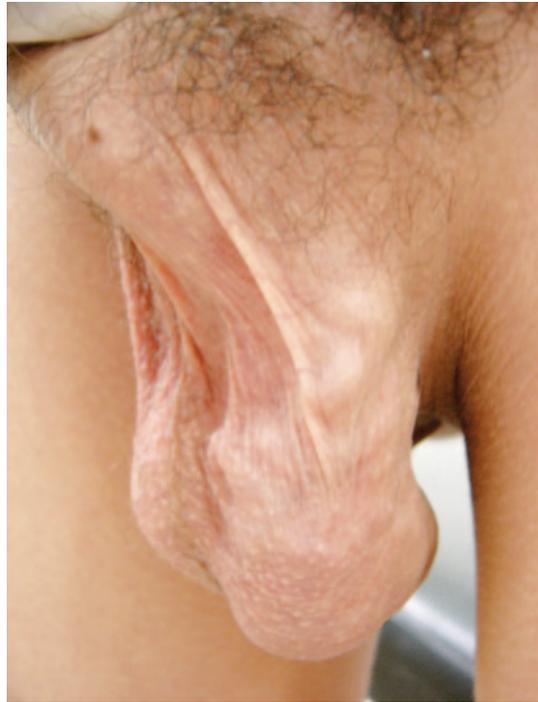
A grade III varicocele is easily identified, as shown in Fig. 4.1, while lower grade varicoceles may be difficult to recognize particularly in certain clinical situations such as prior scrotal surgeries, cryptorchidism, obesity and hydrocele [186].

Table 4.1 Diagnostic accuracy of methods to detect venous reflux to the pampiniform plexus

	Sensitivity (%)	Specificity (%)	Accuracy (%)
Physical exam	70	70	67
Color Doppler ultrasound	93	85	ND
Venography	100	60–70	ND
Thermography	84–98	81–100	ND

ND not defined

Fig. 4.1 Photograph of a grade 3 varicocele



Color Doppler Ultrasonography

Whenever physical examination is inconclusive or difficult to perform as in cases of low-grade varicocele, previous scrotal surgery, obesity, concomitant hydrocele, or scrotal tenderness/hypersensitivity, imaging studies are recommended. Among the non-invasive modalities, color Doppler ultrasound (CDU) has been shown to be the best non-invasive diagnostic tool.

The ultrasound study of the scrotum should be performed with high frequency linear probes and with devices able to evaluate blood flow. Blood vessels are first studied in a grey scale and then with the color Doppler and the pulse Doppler. For the correct detection of fluxes, CDU must be calibrated to detect a slow flow (7.5 kHz). The evaluation should be performed in the supine and then the upright

Table 4.2 Scoring system for color Doppler ultrasound (CDU) diagnosis of varicocele, as proposed by Chiou et al. [188]

CDU parameter	Score
<i>Maximum vein diameter (mm)</i>	
<2.5-0	0
2.5-2.9	1
3.0-3.9	2
>/=4.0	3
<i>Plexus/sum of diameter of veins</i>	
No plexus identified	0
Plexus (+) with sum diameter <3 mm	1
Plexus (+) with sum diameter 3-5.9 mm	2
Plexus (+) with sum diameter >/=6 mm	3
<i>Change of flow velocity on Valsalva maneuver</i>	
<2 cm/s or duration <1 s	0
2-4.9	1
5-9.9	2

positions, with and without a Valsalva maneuver, in order to obtain a complete evaluation of the fluxes in the seminal cord veins [187].

Using the commonly accepted CDU criterion of a 3 mm or greater vein diameter for varicocele, CDU was shown to have a sensitivity of about 50% and specificity of 90% compared to physical examination [188]. It means that CDU tests negative in approximately half of the patients with palpable varicocele (low sensitivity), while it is unlikely that a patient with a non-palpable varicocele will test positive by CDU (high specificity). To circumvent this matter, Chiou et al. [188] proposed a scoring system incorporating the maximal venous diameter (score 0-3), the presence of a venous plexus and the sum of the diameters of veins in the plexus (score 0-3), and the change of flow on Valsalva maneuver (score 0-3). Using a total score of 4 or more to define the presence of CDU-positive varicocele, the authors observed a sensitivity of 93% and a specificity of 85% when compared to physical examination. In their study evaluating 64 patients, all moderate to large varicoceles found on physical examination were positive by CDU diagnosis using the scoring system, but the same group had only a 68% positive rate by traditional CDU diagnostic criteria. The scoring system for CDU diagnosis of varicocele, as proposed by Chiou et al., is shown in Table 4.2.

Pilatz et al. [189] using a 7 MHz transducer determined that the optimal vein diameter cutoff points for discriminating testicles with or without clinical varicocele was 2.45 mm in the relaxed supine position (sensitivity 84%, specificity 81%) and 2.95 mm during Valsalva maneuver (sensitivity 84%, specificity 84%).

In accordance with Sarteschi et al. [190], varicocele can be divided into five grades according to the characteristics of the reflux and its length, and to changes during Valsalva's maneuver:

Fig. 4.2 Schematic illustration depicting the use of the 9MHz pencil-probe Doppler stethoscope for varicocele examination. The patient is examined in the upright position and the conducting gel is applied at the upper aspect of scrotum. A venous ‘rush’ may be heard during the Valsalva maneuver, indicating blood reflux



- Grade 1 is characterized by the detection of a prolonged reflux in vessels in the inguinal channel only during Valsalva’s maneuver, while scrotal varicosity is not evident in the previous grey-scale study.
- Grade 2 is characterized by a small posterior varicosity that reaches the superior pole of the testis and whose diameter increases after Valsalva’s maneuver. The CDU evaluation clearly demonstrates the presence of a venous reflux in the suprastesticular region only during Valsalva’s maneuver.
- Grade 3 is characterized by vessels that appear enlarged to the inferior pole of the testis when the patient is evaluated in a standing position, while no ectasia is detected if the examination is performed in a supine position. CDU demonstrates a clear reflux only under Valsalva’s maneuver.
- Grade 4 is diagnosed if vessels appear enlarged, even if the patient is studied in a supine position; dilatation increases in an upright position and during Valsalva’s maneuver. Enhancement of the venous reflux after Valsalva’s maneuver is the criterion that allows the distinction between this grade from the previous and the next one. Hypotrophy of the testis is common at this stage.
- Grade 5 is characterized by an evident venous ectasia even in an upright position. CDU demonstrates the presence of an important basal venous reflux that does not increase after Valsalva’s maneuver.

A pencil probe Doppler (9 MHz) is an inexpensive alternative to assess men with varicocele, as shown in Fig. 4.2. Examination should be carried out with the patient standing and a venous “rush” produced by blood reflux should be heard under Valsalva maneuver [4]. Although simple, this method was shown to be positive in men harboring subclinical varicocele [17]. The use of pencil probe Doppler has been

advocated as an useful tool to assess subclinical varicocele on the contralateral side in a patient who already has a palpable varicocele to decide whether or not bilateral surgical repair is to be performed [191]. At present, the clinical significance of a positive result for venous reflux as shown by adjuvant diagnostic modalities such as the CDU and pencil probe Doppler in infertile men is uncertain. It is our routine, however, to examine the contralateral cord with a pencil-probe Doppler (9 MHz) stethoscope to determine if a subclinical varicocele exists when a clinically palpable varicocele is identified at one side only. Whenever present, the subclinical varicocele is treated at the same time as the coexistent clinical varicocele. This is based on the observation that altered blood flow after varicocelectomy may unmask an underlying venous anomaly and result in clinical varicocele formation [23].

Spermatic Venography

The technique of spermatic venography for varicocele diagnosis was first described by Ahlberg in 1966 [192]. It is performed using the Seldinger technique via the right femoral vein or right internal jugular vein with minor variations. Venography is often conducted in conjunction with therapeutic occlusion or in research purposes.

Briefly, the technique is performed through a transfemoral approach, the angiographer places a catheter with a single curved tip into the left or right gonadal vein to a point just beyond the valve most proximal to the left renal vein or inferior vena cava, respectively. The examiner then administers 5–10 mL of 60% iodinated contrast material by hand injection and obtains two radiographs that document the caliber of the abdominal and pelvic portions of the internal spermatic vein and show the presence of venous collateral and anastomotic channels. It is possible to look for left internal spermatic vein valvular incompetence by placing the catheter tip in the left renal vein and injecting contrast material while the patient performs a Valsalva maneuver. It is usually not necessary to image the scrotum, and gonadal shielding is both feasible and desirable.

In patients with varicoceles the internal spermatic vein diameter will be enlarged (4–12 mm), and reflux of contrast material may extend to the abdominal, pelvic, inguinal, or scrotal portions of the spermatic vein. When venography is performed in subfertile patients with palpable varicoceles, reflux is seen in nearly 100% of patients [193]. However, in subfertile patients without a palpable varicocele, left testicular reflux has been reported in 60–70% of patients [194].

Although venography is highly sensitive for detecting reflux of blood to the pampiniform plexus, its significance with reference to the presence of a clinical varicocele is unclear. Technical factors, including placement of the catheter beyond the most caudal venous valves that artificially bypasses the valves, and high injection pressure that does not reflect normal physiologic conditions are responsible for false-positives, thus lowering specificity of venographic studies [195, 196].

Marsman reported venographic findings in patients with clinical and subclinical varicoceles using nonselective and selective left spermatic vein catheterization and

selective right spermatic vein cannulation [197]. A major difference between the two groups was the degree of reflux. The authors classified the degree of reflux into grades 0–5, in which grade 0 represented absence of reflux and grades 1–5 represented reflux into the upper lumbar, lower lumbar, upper pelvic, lower pelvic, or inguinal portions of the spermatic veins, respectively [197]. Sigmund and associates described two different types of varicoceles based on findings at Doppler evaluation and venography; these were the stop-type and shunt-type varicoceles [198]. In patients with stop-type varicoceles, retrograde venous reflux documented by contrast injection or by bidirectional Doppler flow signal stagnates in the internal spermatic vein. In patients with shunt-type varicoceles, retrograde venous reflux is followed by detectable increase in antegrade venous outflow through the cremasteric and deferential veins into the external pudendal, internal iliac, external iliac, and femoral veins. These authors found that in a group of 44 patients, 6 had subclinical, small, stop-type varicoceles, and 38 had clinically apparent, medium or large, shunt-type lesions [198].

Thermography

Thermography is a diagnostic method that measures temperature differences across the skin surface using non-contact telethermography utilizing infrared camera or contact thermography utilizing liquid crystals varicoscreen. Thermography was first used in medicine as early as 1957 [199], and it was applied to varicocele in the 70s. However, thermographic equipment was expensive, large in size, had poor resolution with potentially high thermal drift and there was a lack of software support for image interpretation.

Scrotal thermography was shown to be a useful diagnostic method for varicocele, because testicles have lower temperature than core body temperature in normal conditions [200]. Heat clearance by venous flow through pampiniform plexus is important to maintain this lower temperature. Given that overlaying skin temperature depends on the complex relationships of heat exchange between skin tissue, inner tissue, local vasculature and metabolic activity, venous stasis in varicocele may lead to elevated temperature of affected pampiniform plexus and/or testicle that may be detected by thermography.

Contact thermography involves the application of a flexible film containing heat-sensitive liquid crystals. This is applied to the scrotum once the patient has been undressed and upright for 5 min in a room at normal temperature. The phallus is taped to the abdominal wall to prevent interference. The thermostrips of different colors correlate with different temperatures, allowing for easy interpretation by the operator [184].

In contrast, infrared thermography allows imaging of the surface thermal distribution. Recent development of focal plane array thermovision cameras and accompanying software rendered digital thermography both less expensive and easier to standardize. The equipment consists of an E-25 digital infrared video camera (Flir Systems, Boston, MA), which has a sensitivity for temperature variance of 0.2 °C.

It is used in combination with QuickView2 software (Flir Systems) for analyzing data [201]. To perform the examination, the patients should stand in a temperature-controlled room (air temperature approximately 24 °C) with the scrotum exposed for 5 min before examination. The device records maximum and minimum temperatures of a selected area, along with average and standard deviation. The penis should be held against the abdominal wall. In healthy men the average temperature of the scrotum is symmetric and should not exceed 32 °C, corresponding to the colors blue or green. In varicocele the temperature is higher, usually between 32.5 and 35.3 °C, represented by a reddish color. Furthermore, a right–left average temperature variation of >0.8 °C that involves more than 25 % of the hemiscrotum indicates a varicocele [202].

The discriminative value of the technique is enhanced when used in combination with the Valsalva maneuver, which further enhances the asymmetrical pattern or elevated temperature, making it particularly attractive to diagnose low-grade varicoceles. It can be also used as a follow-up method to evaluate success of varicocele treatment [202–204].

Using contact scrotal thermography, Hirsh et al. [205] reported similar accuracy for detecting varicocele compared with Doppler flow studies. Comhaire et al. [16], Lewis and Harrison [201], Kormanó et al. [206], and Pochaczewsky et al. [207] have also advocated the use of scrotal thermography in evaluating patients with suspected varicoceles. However, Miesusset et al. [208] reported that increased scrotal temperatures were also observed in infertile men with abnormal spermatogenesis without varicoceles. Although scrotal thermography may also be used as an adjunctive test to confirm the clinical impression, it has not been widely employed. Further studies are needed to verify the sensitivity and specificity of non-contact thermography in diagnosis compared to CDU and venography.

Key Points

- Varicocele can be diagnosed and graded using different methods including physical examination, venography, color Doppler ultrasonography, and thermography.
- Based upon clinical examination varicocele is classified into impalpable and palpable varicocele. Palpable varicoceles are graded in: (i) Palpable only during Valsalva maneuver (grade 1); (ii) Palpable at rest, but not visible (grade 2); Visible and palpable at rest (grade 3).
- Whenever physical examination is inconclusive or difficult to perform as in cases of low-grade varicocele, previous scrotal surgery, obesity, concomitant hydrocele, or scrotal tenderness/hypersensitivity, imaging studies are recommended.
- Although venography is considered the gold standard method for diagnosing reflux of blood to the pampiniform plexus, it is rarely used except when conducted in conjunction with therapeutic occlusion.
- Among the non-invasive modalities, color Doppler ultrasound (CDU) has been considered the best diagnostic tool.
- Thermography is a diagnostic method that measures temperature differences across the skin surface using a highly sensitive non-contact telethermography utilizing infrared camera or contact thermography utilizing liquid crystals varicoscreen.