

# SCROTAL ULTRASOUND

## When and what to look for

By Bruce R. Gilbert, MD, PhD

There are many indications for scrotal US (Table 1).<sup>1</sup> Scrotal US is often performed when the physical examination is inconclusive or difficult to complete (or both) because of patient discomfort or inability of the examiner to precisely identify the scrotal structures on palpation. The US examination is therefore an integral part of the physical examination of the male genitalia.

Investigation of a scrotal mass is the most common indication for scrotal US. All scrotal masses should be evaluated with US and the findings properly documented (including the location, echogenicity, size, color flow characteristics, and clinical impressions of any mass). A mass should be identified as being testicular, epididymal, paratesticular, or part of the scrotal wall. Echogenicity and color flow characteristics should help determine whether the mass is vascular, fluid, or solid. A scrotal mass can be either painful or nonpainful.

### PAINFUL SCROTAL ENLARGEMENT

This condition, which may occur in patients with epididymitis, orchitis, testicular abscess, and/or testicular torsion, often has a variable presentation. While US has the advantages of being a quick, noninvasive, and sensitive diagnostic test, it is not always specific. For example, in the acute scrotum, increased testicular blood flow can be noted on US in patients with orchitis and torsion-detorsion (Figure 1). US cannot differentiate the hyperemia often seen with reperfusion

(such as in cases of torsion-detorsion) from an inflammatory etiology. Overreliance on US findings can, therefore, be misleading at times. In my opinion, US cannot “rule out” torsion in the evaluation of the acute scrotum, since it can only define what exists at the time of the examination. The diagnosis of torsion should only be made clinically by the urologist based upon the history (for example, characteristics of onset and associated symptoms such as dysuria, fever, and chills), findings on physical examination (such as rubor, dolor, tumor, and tenderness), and diagnostic studies (including urinalysis and culture and WBC count).

**Epididymitis/orchitis.** The body of the normal epididymis has slightly decreased echogenicity as compared to its head. In patients with *acute epididymitis* (Figure 2), the epididymis may be involved focally (usually beginning in the cauda) or globally, with enlargement and thickening of the epididymis, decreased echogenicity, and an increased color Doppler flow. A high-flow, low-resistance pattern is seen. A reversal of flow during diastole occurs with venous infarction.<sup>2</sup> A reactive hydrocele is often present. Complications include infectious spread to the testis (epididymo-orchitis, Figure 3), abscess formation, testicular infarction (usually secondary to obstruction of venous flow followed by testicular atrophy), and chronic pain. Color Doppler is often diagnostic.

In patients with orchitis, the testis becomes enlarged, appears inhomoge-

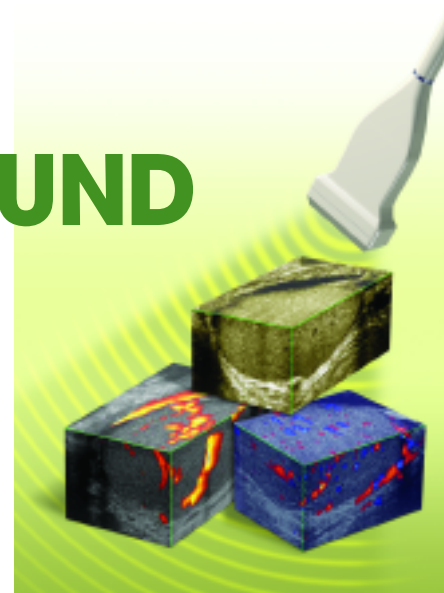


Photo illustration by George Baquero.

*Office scrotal ultrasound (US), when properly performed and documented, can provide indispensable information regarding males with scrotal symptoms. Part 1 of this article (June 2007, pages 10-22) included a primer on the underlying principles and terminology of scrotal US, explained why artifacts occur (and how to avoid them), and outlined the essential elements of an optimal scrotal exam.*

*Part 2 describes proper assessment of the various indications for scrotal US and offers tips on device selection.*



**Dr. Gilbert** is Associate Clinical Professor of Urology, and Associate Clinical Professor of Male Reproductive Medicine, Weill Cornell Medical College, New York, NY.

neous, and exhibits a decreased resistive index (RI). (See part 1 of this article for a refresher on terminology.) The RI of the epididymal and testicular artery have been shown to be significantly lower in patients with epididymo-orchitis than in control subjects.<sup>3</sup>

Patients with chronic epididymitis (Figure 4) often present with persistent pain. In these men, US examination reveals an enlarged epididymis with increased echogenicity and possible areas of calcification.

**Testicular abscess.** Persistent fever and scrotal pain and swelling can be seen in approximately 5% of patients with orchitis. These are the clinical hallmarks of a testicular abscess. The characteristic US appearance of a testicular abscess usually appears within 1 to 7 weeks.<sup>4</sup> Ineffective treatment of epididymo-orchitis may result in a pyelocele (an abscess around the testicle), a testicular or scrotal abscess, or testicular infarction, and possibly fasciitis. While a scrotal abscess may resemble a tumor, the historical presentation (that is, preceding epididymo-orchitis) together with US evidence of inflammation, as described above, will often differentiate the 2.

**Torsion.** While torsion of a testicular or epididymal appendage is thought to be more common than torsion of the spermatic chord, the latter represents a true urologic emergency. While irreversible testicular damage is presumed after 4 hours of spermatic cord torsion,<sup>5-9</sup> only 50% of men who were detorsed less than 4 hours after their symptoms began were noted to have normal semen quality.<sup>10</sup>

Torsion is a clinical diagnosis proven at surgery. US does not diagnose torsion—only the urologist (or pathologist) can. US should only be used to document findings. Many conditions (such as torsion-detorsion,

TABLE 1  
Indications for scrotal US

#### ASSESSMENT OF SCROTAL MASS

##### **Painful enlargement**

Epididymitis/orchitis  
Testicular abscess  
Torsion

##### **Nonpainful enlargement**

Testicular tumor  
Hydrocele  
Varicocele  
Spermatocele/epididymal cyst  
Scrotal hernia  
Cyst

#### EVALUATION OF SCROTAL TRAUMA

Testicular rupture  
Hematocele

#### INVESTIGATION OF EMPTY OR ABNORMAL SCROTAL SAC

Undescended testis  
Thickened scrotal skin

#### EVALUATION OF FERTILITY AND RELATED ISSUES

Varicocele  
Atrophic testis  
Measure size and intratesticular lesions  
Microlithiasis  
Impaired semen quality  
Azoospermia  
Antisperm antibody

#### FOLLOW-UP AFTER SCROTAL SURGERY

Varicocele  
Testis biopsy  
Hydrocelectomy

#### FOLLOW-UP OF PATIENTS WITH INDETERMINATE SCROTAL MASSES

Source: American Urological Association Consensus Statement on Urologic Ultrasound Utilization.<sup>1</sup>

intermittent torsion, persistent capsular flow, and color flow artifacts) can suggest apparent flow in cases where none exists.

On US, the affected testis usually appears hypoechoic. Testicular size

can vary from hypertrophic to atrophic. The sonographer should always compare the affected testis with the contralateral side using longitudinal, transverse, and coronal views (Figure 5). Apical views can be particularly informative when the sonographer attempts to align the transducer parallel to flow. Spectral waveform analysis with calculation of the RI is also helpful, but as stated previously, is not diagnostic. In patients with acute torsion, the epididymis may appear hypoechoic and enlarged, similar to epididymitis.

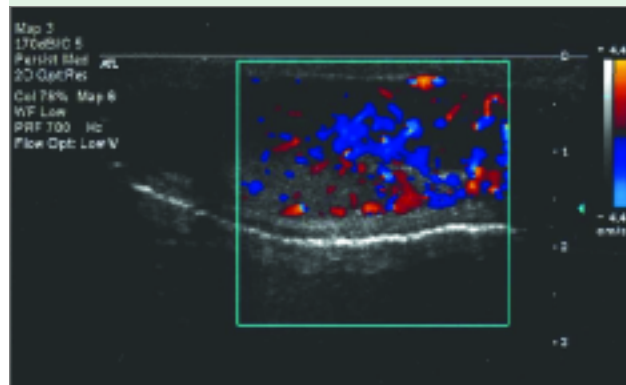
**Nonpainful scrotal enlargement.** A variety of conditions can result in a nonpainful scrotal mass or enlargement. US is an excellent modality for identifying the etiology and has also been used intraoperatively to localize nonpalpable lesions.<sup>11</sup>

• **Testicular tumor.** The most common US appearance of a testicular malignancy—whether a germ cell tumor, a non-germ cell tumor, or a metastatic lesion from a nontesticular source—is one of homogeneous echogenicity that is hypoechoic to the surrounding testicular parenchyma with intralesional vascularity (Figure 6).<sup>12</sup> However, a wide range of presentations exist, including nonpalpable lesions<sup>13</sup> and hyperechoic lesions that are heterogeneous with areas of calcification, cystic changes,<sup>14</sup> and/or variable vascularity. Patients with widespread metastasis may present with only a scar or an area of calcification in the testis that represents a “burned-out” testicular tumor, in which involution occurred due to its high metabolic rate outstripping its blood supply (Figure 7).

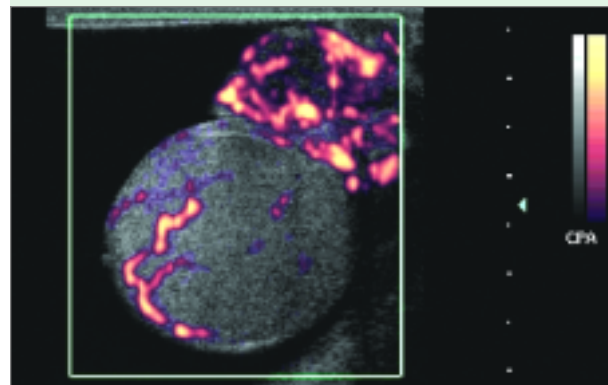
The tumor tissue type cannot be reliably differentiated solely by its appearance on US.

• **Hydrocele.** Patients with a hydrocele (caused by a collection of serous fluid between the parietal and visceral layers

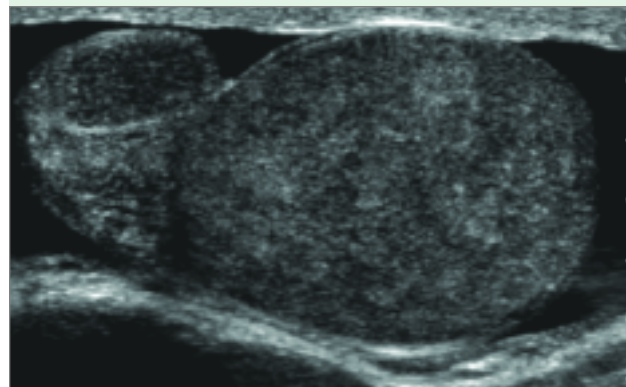
**FIGURE 1**  
Increased blood flow after manual testicular detorsion



**FIGURE 2**  
Epididymitis as demonstrated by power Doppler

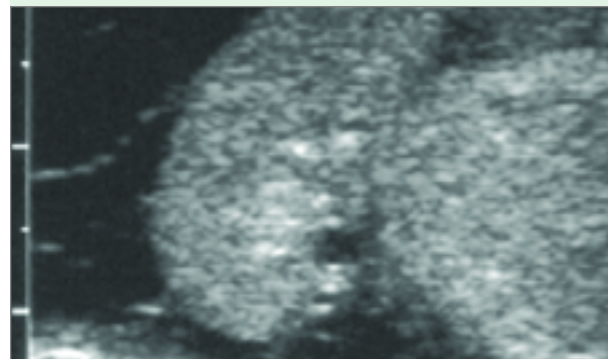


**FIGURE 3**  
Epididymo-orchitis



This 2D gray scale image demonstrates an enlarged and heterogeneous epididymis and testis.

**FIGURE 4**  
Chronic epididymitis



In this patient with chronic epididymitis, US examination demonstrates increased echogenicity and microcalcifications in the caput epididymis.

of the tunica vaginalis) present with a painless scrotal swelling. While hydroceles are usually anechoic, they may contain echogenic cholesterol crystals. The presence of septations (Figure 8) is often associated with infection, trauma, or metastatic disease. While the etiology may be idiopathic, hydroceles may develop secondary to infection, trauma, torsion, or tumor, or may result from a patent process vaginalis. The testis is often posteriorly displaced by the hydrocele.

• **Scrotal hernia.** Patients with a scrotal hernia (Figure 9) usually present with mesenteric fat and/or bowel loops seen superior to the testis. Characteristic US findings include peristalsis,

fluid-filled bowel loops, and highly echogenic omental fat.

• **Epididymal cyst/spermatocle.** An epididymal cyst (Figure 10) is a non-painful scrotal structure that, when large, displaces the testis inferiorly. A spermatocle is a benign, anechoic epididymal cyst that contains sperm, is usually located in the head of the epididymis, and often has septations.

**TRAUMA**

Traumatic injury to the testis has many etiologies.<sup>15-17</sup> Sporting injuries account for 50% of cases, and motor vehicle accidents account for 9% to 17%. US is thought to have 100% sensitivity and 80% specificity for testicu-

lar trauma.<sup>18</sup> Traumatic injury to the testis should be considered a surgical emergency when testicular rupture (discontinuity of the tunica albuginea) is identified. US characteristics of testicular rupture include scrotal wall thickening, discontinuity of the tunica albuginea (in 17% of patients), irregular testicular margins, hematocele or testicular hematoma, and decreased blood flow (Doppler color flow) to the affected area (Figure 11).<sup>19</sup>

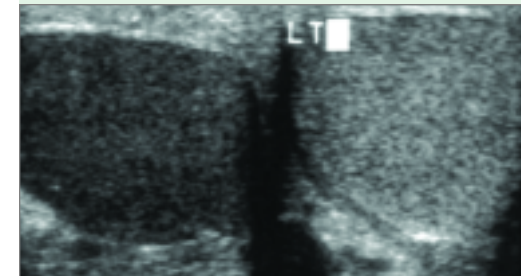
**ABNORMAL SCROTUM**

In patients with cryptorchidism or abnormally thick scrotal skin, US can facilitate treatment by identifying and characterizing the abnormality.

**Undescended testis.** When the absence of a testis in the scrotum is noted, a search is initiated to confirm its presence or absence. US is usually the initial diagnostic imaging modality because of its sensitivity in the inguinal canal (where most undescended testes are found), its ready availability, its safety profile, and its lack of need for anesthesia in the infant or young child. If the absent testis is not identified within the inguinal canal, CT or MRI is often used in an attempt to locate an intra-abdominal testis. Surgical exploration, however, remains the gold standard for identifying an intra-abdominal testis.

A cryptorchid testis in the inguinal canal, identified by the presence of the mediastinum testis, is usually small in

**FIGURE 5**  
Right testicular torsion



Examination of the contralateral (normal) left testis allows for comparison of the echogenicity.

size (hypotrophic). It can be differentiated from an inguinal hernia by the absence of peristalsis, the presence or absence of highly reflective omental fat, or both.<sup>17</sup>

**Thickened scrotal skin.** Palpation of the scrotal contents can be difficult in patients with a thickened scrotal wall

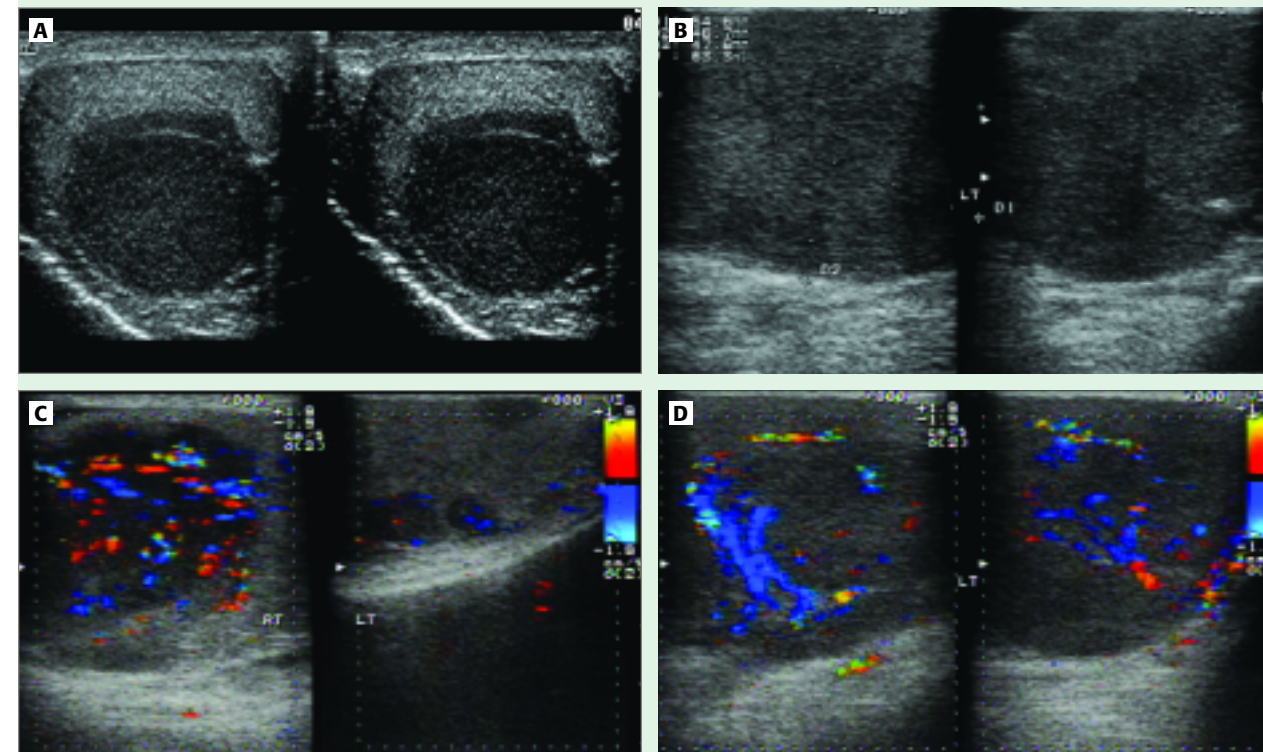
or a retracted scrotum (Figure 12). Scrotal US is particularly useful in the testicular evaluation of patients who exhibit scrotal wall changes secondary to heart failure, lymphatic or venous obstruction, an infectious etiology (such as filariasis), or an inflammatory etiology (such as cellulite or Fournier's gangrene).<sup>20-23</sup>

**FERTILITY AND RELATED ISSUES**

In male patients with the following scrotal conditions, which have the potential to affect fertility, US can provide beneficial diagnostic information prior to and after intervention.

**Varicocele.** The most common presentation of a varicocele is due to an investigation of male subfertility and

**FIGURE 6**  
Testicular tumors



**A and B:** On 2D gray scale US, tumors may appear hypoechoic and well circumscribed (A) or not well circumscribed and multifocal (B). **C and D:** 2D color flow Doppler clearly demonstrates increased tumor blood flow.

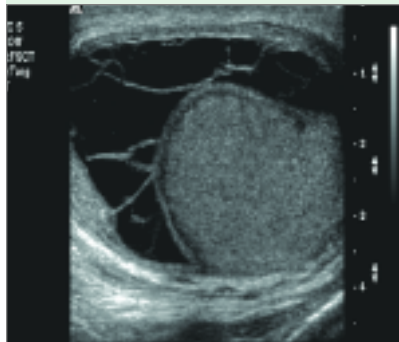
**FIGURE 7**  
“Burned out” testicular tumor



infrequently due to scrotal pain. A varicocele is present in about 15% of normally fertile men, in 30% to 40% of men with primary subfertility, and in as many as 80% of men with secondary subfertility. Clinically significant varicoceles are associated with a couples' subfertility and impairments in semen quality that can include a decrease in sperm count, sperm motility, and the number of morphologically normal sperm. In particular, an increased number of tapered (elongated) heads are usually present with an increase in the number of immature (round) germinal forms appearing in the ejaculate.

Varicoceles are more often identified on the left side, most likely related to the angle of insertion and the length of the left testicular vein. However, it has been found to be a bilateral condition in more than 80% of some series.<sup>24</sup> US characteristics include the findings of multiple, low-reflective serpiginous tubular structures of varying diameters best visualized superior and posteriolateral to the testis.<sup>25</sup> In patients with a large varicocele, these dilated veins can fill a good portion of the scrotum (Figure 13). Color flow Doppler is important in documenting the presence and size of a varicocele

**FIGURE 8**  
Septated hydrocele

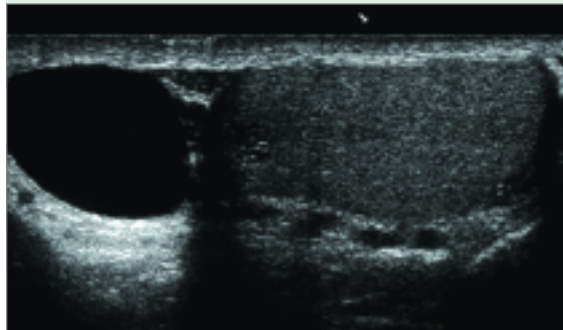


The presence of septations within a hydrocele is frequently associated with infection, trauma, or metastasis.

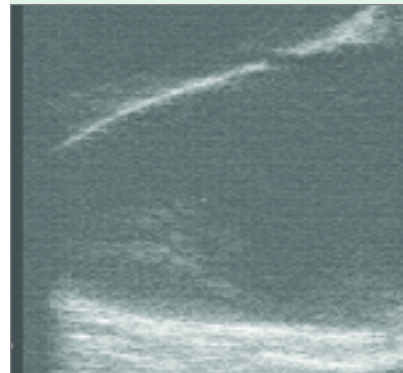
as well as differentiating an intratesticular varicocele (Figure 14) from a dilated rete testis.<sup>26,27</sup> The presence of bilateral varicoceles is often best identified by scrotal US.

No standards have been set for measurement of a varicocele. Clinical evaluation of scrotal contents is subjective and influenced by several factors such as patient compliance, scrotal wall thickness, and contraction of the scrotum. One group's criterion for a varicocele is measurement in the supine position of the largest vein posterior to the testis of greater than 2.5 mm and documentation of reversal of flow after a Valsalva maneuver.<sup>28</sup> A color flow image of the dilated varicocele vein(s) should be archived for documentation.

**FIGURE 10**  
Epididymal cyst



**FIGURE 9**  
Scrotal hernia



In patients who experience sudden onset of a varicocele or whose varicocele persists in the supine position, further imaging of the retroperitoneum is warranted to identify etiologic factors.

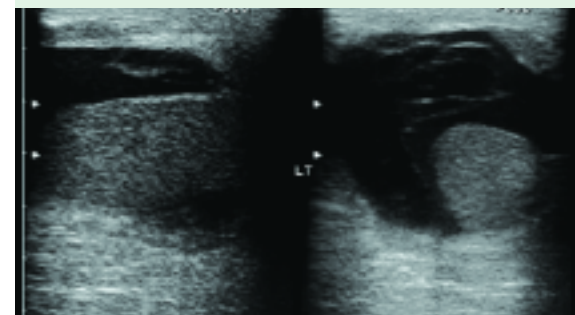
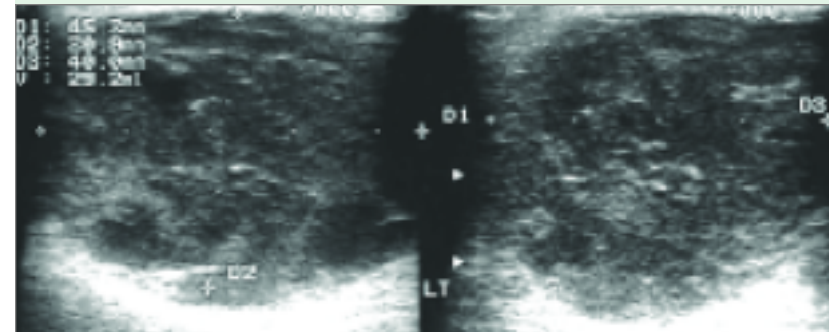
**Testicular atrophy.** This condition may be related to age, trauma, torsion, infection, or inflammation, or may occur secondary to hypothyroidism, drug therapy, or chronic disease. The appearance on US is variable, and while related to the underlying cause, is usually characterized by decreased echogenicity with a normal appearing epididymis.

Imaging for patients presenting with subfertility provides documentation prior to treatment and intratesticular evaluation for conditions such as tumor (Figure 15) or testicular microlithiasis (TM).

**Testicular microlithiasis.** Defined as 5 or more microcalcifications within a testicle, TM is thought to be caused by the calcification of degenerating cells in the seminiferous tubule. This condition, which occurs in 1% to 5% of asymptomatic men, is usually symmetrical (occurring unilaterally 20% of the time). Acoustic shadowing is often absent, likely due to the small size of the calcifications (Figure 16).

Both benign and malignant tumors of the testis may

**FIGURE 11**  
Testicular trauma



Longitudinal view (top) and transverse view (bottom) of a postoperative hematoma.

contain microliths, and the associated risk of malignancy has not been well defined. Bennett and colleagues demonstrated a direct relationship between the number of microliths and the incidence of testicular tumor at initial presentation.<sup>29</sup> Only 1 (2%) of 65 patients who had fewer than 5 microliths had a concomitant testicular tumor, compared with 7 (18%) of 39 patients who had 5 or more microliths. In a study by Bach and associates, 48 (9%) of the 528 pa-

tients referred for scrotal US had microlithiasis, with 13 (27%) of the 48 having testicular cancer.<sup>30</sup> Only 38 (8%) of 480 patients without TM had testicular cancer. However, results from a prospective analysis demonstrated only a 5% to 10% risk of coexisting tumors when TM was present.<sup>31</sup>

The risk of subsequent development of testicular tumor in patients presenting with TM is less clear.<sup>32,33</sup> Data from several investigators sug-

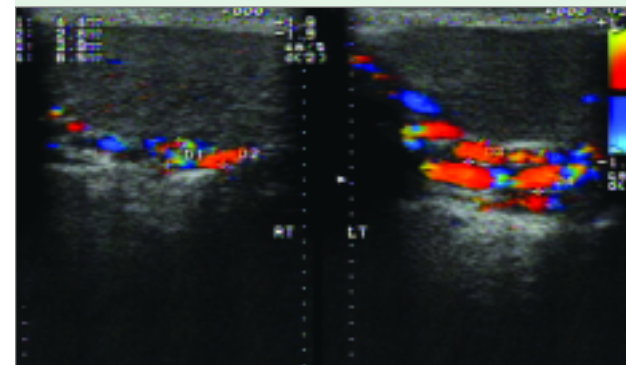
**FIGURE 12**  
Thickened scrotal wall secondary to scrotal edema



gest that TM is a benign, nonprogressive condition, at least when followed for up to 45 months.<sup>29,34,35</sup> However, several recent case reports have documented the development of testicular tumors in patients with TM when follow-up extended for several years, suggesting the need for close follow-up in these patients.<sup>36-40</sup> The frequency and type of exam required on follow-up is not well defined by the present literature, and the suggested duration of follow-up is even less clear.

Many urologists teach patients how to perform monthly testicular self-exam, then follow them with physical exam and scrotal US every 6 to 12 months. Conditions associated with an increased incidence of germ cell tumors (such as testicular atrophy, infertility, cryptorchidism, presence of intratubular germ cell neo-

**FIGURE 13**  
Large bilateral varicocele



**FIGURE 14**  
Intratesticular varicocele

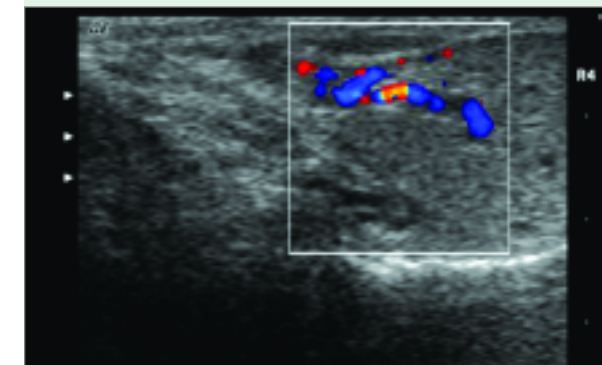
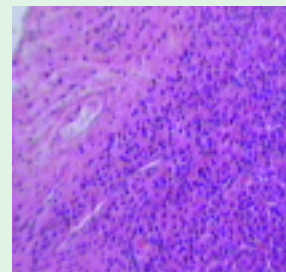
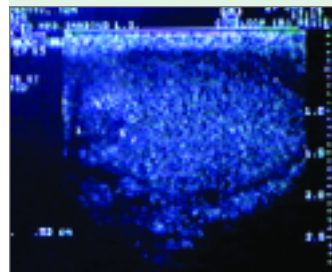
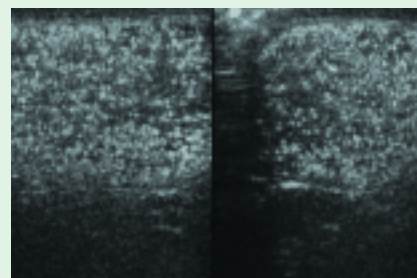
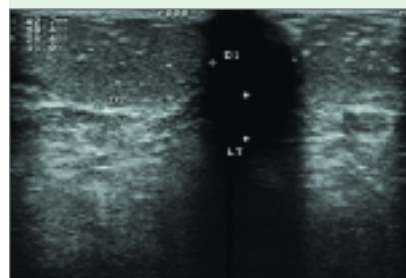


FIGURE 15

**Atrophic testis with nonpalpable Leydig cell tumor**

This patient with an atrophic testis (left) had a nonpalpable Leydig cell tumor identified on pathologic exam (right).

FIGURE 16

**Microlithiasis**

Patients with TM may present with few (left) or many (right) microcalcifications.

plasm on biopsy) in the presence of TM support long-term follow-up.

**Impaired semen quality and azoospermia.** Poor semen quality can be a harbinger of underlying disease. Varicocele, ductal obstruction, and testicular tumors are examples of pathology easily demonstrated by US that may or may not be identified by physical exam. US, being a noninvasive, real-time imaging modality, is often used in the comprehensive evaluation of men with impaired semen quality to document the presence or absence of pathology, especially when the physical exam is inconclusive or suggestive of intrascrotal pathology. In men with azoospermia, US can often define the underlying etiology (for example, congenital bilateral absence of the vas deferens or microlithiasis).<sup>41-43</sup>

**Antisperm antibodies.** About 10% of men presenting with subfertility are found to have antisperm antibodies, compared with 2% or fewer of fertile men.<sup>44-46</sup> Several common causes

of antisperm antibodies, including obstructive azoospermia, congenital bilateral absence of the vas deferens, epididymitis, genital trauma, and cryptorchidism, can be evaluated with scrotal US.<sup>47-51</sup>

**POSTOPERATIVE FOLLOW-UP**

While rarely considered, office US is a superb modality for following patients postoperatively. Changes in semen quality following varicocelectomy can be correlated to US documentation indicating the absence, persistence, or recurrence of the varicocele. US is also a sensitive modality for evaluating the testicular parenchyma following testis biopsy, testicular sperm extraction, or hydrocele repair.<sup>52,53</sup>

**WHAT TO LOOK FOR IN AN US SYSTEM**

The choice of an US system is unique to each practice. No matter what system your practice considers, be sure to try it “on site” before making a pur-

chase. Equipment manufacturers are extremely accommodating, and will likely agree to bring the equipment to your facility along with a trained technician for a trial use of a day or more.

Here are some of the most important issues to consider before making a purchase:

- What is your budget?
- Which features are required, and which are optional? In my opinion, color capabilities can provide essential information and therefore should be seriously considered.
- What is the intended purpose of the device? Will it be the only US machine for the practice or is it being purchased for a particular type of exam? If it is being purchased for a specific purpose (such as for the determination of bladder volume or for prostate biopsy), you might consider a specifically designed system. The intended functions will help determine which transducers are necessary.
- Will the machine be used at a single site or at multiple locations? If portability is important, you might consider purchasing one of several available self-contained systems.
- What archival system does your practice employ for images? If you have specific requirements, make sure the equipment you intend to purchase can do what you want. Better yet, try it out in your office!

**Transducer selection.** In my opinion, urologists should consider obtaining 3 transducers at the time of initial purchase. A curved array transducer with a broad bandwidth (3.5 to 5 MHz) is useful for both bladder and renal examination. The same transducer can be used to evaluate the testes in patients with a thickened scrotal wall and to compare the echogenicity of the 2 testes.

Also consider a linear array (small parts) transducer with a bandwidth of at least 7.5 MHz and a “footprint” that can accommodate a large size testis. If the equipment has color capabilities,

this probe can also be used for penile Doppler studies. An intracavitary transducer (5 to 7.5 MHz) is used for transrectal prostate studies.

Broad bandwidth or multifrequency probes are standard on most equipment. You might also ask to try a biplane probe, which is valuable for prostate examination. This type of probe provides simultaneous sagittal and transverse images and is very useful for prostate biopsies. With these transducers, renal, scrotal, penile, and transrectal US examinations and diagnostic procedures can be appropriately performed.

## CONCLUSION

When armed with a comprehensive understanding of the testicular anatomy, the fundamental principles of US, and the proper equipment, urologists can perform, interpret, and document the results of office scrotal US in a way that provides invaluable information regarding the diagnosis and treatment of many urologic conditions. Urologists, uniquely qualified by training and experience to perform these studies, should maintain a high degree of proficiency in these. CU

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