Ultrasonography Evaluation of Scrotal Masses

Daniel Sommers, MD*, Thomas Winter, MD

INTRODUCTION

This article reviews the anatomy and sonographic findings of scrotal masses. Normal anatomy, general imaging techniques, and assessment of intratesticular and extratesticular disorders will be discussed.

When a scrotal mass is palpated, the concern is for the presence of a testicular neoplasm. Ultrasonography (US) is an ideal modality for evaluating the scrotum in this scenario; it is readily available, inexpensive, and without ionizing radiation. US is nearly 100% sensitive for the detection of an intrascrotal mass.1 Delineation between intratesticular and extratesticular processes is 98% to 100% accurate.1–4

NORMAL ANATOMY

The normal scrotal wall consists of epidermis, superficial dartos muscle and fascia, external spermatic fascia, cremasteric muscle and fascia, and internal spermatic fascia. The scrotum is a fibromuscular sac divided by a midline septum into a right and left hemiscrotum. Each hemiscrotum contains a testis, epididymis, spermatic cord, vascular network, and lymphatic network.

Separating the testis from the scrotal wall are the 2 layers of the tunica vaginalis; these form an isolated mesothelium-lined sac.5,6 The parietal layer lines the scrotal wall and is separated from the visceral layer lining the tunica albuginea of the testis and covering the epididymis by a potential space that normally contains a small amount of fluid. The parietal and visceral layers of the tunica vaginalis join where the tunica attaches to the scrotal wall at the posterolateral aspect of the testis. The tunica albuginea covers the testis and epididymis with the exception of a small posterosomedical area.7

The fibrous tunica albuginea covers the testis, protecting it from injury. Posterosomedially, the tunica albuginea projects inward into the testes to form the mediastinum testis. Numerous fibrous septa extend from the mediastinum dividing the testis into 250 to 400 lobules. Each lobule consists of 1 to 3 seminiferous tubules that support the Sertoli cells and spermatocytes. The Leydig cells are adjacent to the tubules within the loose interstitial tissue and are responsible for testosterone secretion.

The seminiferous tubules converge to form larger tubuli recti, which open into the diluted...
spaces of the rete testis. The rete testis drains into the epididymal head (globus major) via 15 to 20 efferent ductules. The pyramid-shaped head of the epididymis is located at the superoposterior aspect of the testis and measures 5 to 12 mm in diameter. The narrow epididymal body (corpus) and tail (globus minor) are formed as the efferent ducts converge into a single duct. The curved tail of the epididymis courses inferolaterally and becomes the vas deferens, which continues superiorly into the spermatic cord.

The appendix testes and appendix epididymis are embryologic remnants of paramesonephric and mesonephric ducts, respectively, and consist of vascularized connective tissue.

Primary vascular supply to the testis is provided by the testicular artery, which arises from the aorta, just distal to the renal arteries. The testicular artery penetrates the tunica albuginea where it forms the capsular artery. The deferential artery, originating from the superior vesical artery, and the cremasteric artery, a branch of the inferior epigastric artery, both supply the epididymis, vas deferens, and peritesticular tissues. Venous drainage forms the pampiniform plexus around the upper half of the epididymis, which continues as the testicular vein through the deep inguinal ring. The spermatic cord contains the pampiniform plexus; vas deferens; testicular, cremasteric, and deferential arteries; genitofemoral nerve; and lymphatic vessels; and courses superior toward the superficial and deep inguinal rings.

**US TECHNIQUE**

Scrotal US examination is performed with the scrotum supported by a towel placed between the thighs with the patient in a supine position. Optimal results are obtained with a high-frequency (14–18 MHz) linear array transducer. The scrotum should be evaluated in both long and transverse axes. The size and appearance of each testis and epididymis should be documented and compared with the contralateral side. Color and pulsed Doppler parameters are adjusted to evaluate for low flow velocities to show blood flow in the testes and surrounding structures. Transverse images that include portions of both testes should be acquired in both gray-scale and color Doppler modes to show symmetry. The structures within the scrotum, including the scrotal wall, should be examined thoroughly to evaluate for extratesticular masses or processes. Additional techniques such as Valsalva maneuver or upright positioning of the patient may be used to evaluate venous vascularity or for inguinal hernia as dictated by clinical concern.

**US ANATOMY**

The normal testis has a homogeneous, medium-level, granular echotexture (Fig. 1). Prepubertal testes are typically less echogenic than postpubertal testes secondary to incomplete maturation of the germ cell elements and tubules. Although better visualized when the testis is surrounded by fluid, the tunica (visceral layer of tunica vaginalis and tunica albuginea) can often be seen as an echogenic outline of the testis. Where the tunica invaginates to form the mediastinum testis, it is visualized as an echogenic band that extends along the long axis of the testis (Fig. 2). The normal rete testis can be identified in about 20% of patients as a hypoechoic area near the mediastinum. The space between the 2 leaves of the tunica vaginalis normally contains a small amount of anechoic fluid (see Fig. 1).

The epididymis is best visualized in a longitudinal view. The epididymal head is generally isoechoic or mildly hyperechoic to the testis, although its echotexture may be coarser. The narrow body of the epididymis measures 2 to 4 mm and is often indistinguishable from the surrounding peritesticular tissues. The tail may be seen as a curved 2-mm to 5-mm structure at the inferior pole of the testis where it becomes the proximal vas deferens.

Intratesticular flow can reliably be shown with color, power, and spectral Doppler. Power Doppler may result in increased sensitivity for low-flow states. The spectral waveforms of the intratesticular arteries, as well as the waveforms within the epididymis, typically have a low-resistance pattern.

![Fig. 1. Normal anatomy. The left testis (arrow) shows homogeneous, medium-level, granular echotexture. The epididymal head (arrowhead), well seen at the superior aspect of the testis, is generally isoechoic to mildly hyperechoic to the testis. A normal (physiologic) volume of fluid is present (curved arrow).](image-url)
US FINDINGS

When a palpable scrotal mass presents for US evaluation, the primary goals are localization of the mass (intratesticular vs extratesticular) and characterization of the mass. In general, intratesticular masses should be considered to be malignant.17 If the mass is extratesticular and cystic, it is almost certainly benign, with the generally accepted prevalence of malignancy of extratesticular lesions being approximately 3% to 6%.18–21

INTRATESTICULAR SCROTAL MASSES

Testicular cancer typically manifests as a painless scrotal mass and represents the most common nonhematologic malignancy in men aged 15 to 49 years.22,23 Other presenting symptoms include a sensation of heaviness or fullness in the pelvis or scrotum, testicular enlargement, and evidence of metastatic disease.24 Approximately 10% to 15% of patients present with pain and a scrotal mass, which may be misdiagnosed as epididymo-orchitis,25 or with pain and a scrotal mass following trauma to the scrotum.

Testicular tumors are subdivided into 2 major categories: germ cell tumors (GCTs) and stromal tumors. GCTs account for 90% to 95% of all testicular tumors. GCTs arise from primitive germ cells and are further subdivided into seminoma and nonseminomatosus GCTs (NSGCTs). These tumors are almost uniformly malignant. Non–germ cell primary tumors of the testis derive from the sex cords (Sertoli cells) and the stroma (Leydig cells) and are typically malignant in 10% of cases. Nonprimary tumors including lymphoma, leukemia, and metastases can also present as intratesticular masses. Color Doppler imaging has limited ability to distinguish malignant from benign solid intratesticular masses.24

GCTs

Intratubular germ cell neoplasia is thought to be the precursor of most GCTs and is the equivalent of carcinoma in situ. The prevailing theory is that these abnormal cells develop along a unipotential line and form seminoma, or develop along a totipotential line and form nonseminomatosus tumors.26,27 Seminomas are radiosensitive tumors, whereas NSGCTs respond better to surgery and chemotherapy.23

- Seminomas account for 35% to 50% of all primary testicular neoplasms.17,25 Seminoma is the most common primary neoplasm in cryptorchidism and the most common pure GCT. Seminomas are typically homogeneous, hypoechoic lesions that range from small, well-defined nodules to large, more heterogeneous masses that may replace and enlarge the testis (Fig. 3). Seminomas are usually confined by the tunica albuginea, rarely extending to peritesticular structures.7 Bilateral tumors are rare, occurring in 2% to 3% of patients, and are typically asynchronous.28,29
- NSGCT is considered the most common primary testicular malignancy, accounting for up to 60% of cases.17 Approximately 70% of NSGCTs produce hormonal markers: alphafetoprotein and human chorionic gonadotropin.30 Between 32% and 60% of GCTs are mixed GCTs composed of at least 2 different cell types.17,31 Pure NSGCTs are rare, but occur most often in the pediatric population.17 The sonographic appearance of these tumors

Fig. 2. Mediastinum testis. Long-axis view of the right testis shows the mediastinum testis (arrow), an invagination of the tunica albuginea, well seen as an echogenic band extending into the testis along its long axis.

Fig. 3. Seminoma. A homogeneous, lobular, hypoechoic mass (arrow) is present that is beginning to replace and enlarge the right testis, although confined by the tunica.
depends on the relative proportions of each component, although as a group these tumors are more heterogeneous, showing irregular or ill-defined margins, echogenic foci, and cystic components (Fig. 4). Tunica invasion is common. NSGCTs include embryonal carcinoma, yolk-sac (endodermal sinus) tumors, teratoma, and choriocarcinoma.\(^{17,32}\) Mixed GCTs that contain seminomatous components are treated as NSGCTs.\(^{23}\)

- Regressed or burned-out GCTs are thought to occur secondary to the high metabolic rate of the tumor, causing it to outgrow its blood supply with subsequent tumor regression. The patient may present with widespread metastatic disease with involution of the primary tumor. These primary tumors are generally small, and can be hypoechoic, hyperechoic, or seen as a focal calcification or clustered macrocalcifications (Fig. 5). Histologic analysis may show a minimal amount of residual tumor or only fibrosis and scar tissue.\(^{17}\)

**Non-GCTs**

Most non-GCTs are sex cord stromal tumors, accounting for 4% of testicular tumors, arising from cells that form the sex cords (Sertoli cells) and interstitial stroma (Leydig cells). Ninety percent of these tumors are benign. These tumors are typically small and discovered incidentally. Because there are no radiologic criteria allowing differentiation of these tumors from germ cell neoplasm, orchiectomy is typically performed.

- Leydig cell tumors are the most common sex cord stromal tumors and can occur in any age group (Fig. 6). Thirty percent of patients present with an endocrinopathy such as precocious puberty/virilization, gynecomastia, or decreased libido.
- Sertoli cell tumors are less common, and are less likely to be hormonally active. These tumors can be of 3 histologic types, including the subtype of large-cell calcifying Sertoli cell tumor (seen in the pediatric population), which can present with multiple and bilateral masses with large areas of calcification.\(^{33}\)
- Other sex cord stromal tumors are less common and include granulosa cell tumors, fibroma-thecomas, and mixed sex cord stromal tumors (including gonadoblastoma).\(^{28}\)

**Other Malignant Tumors**

- Lymphoma (almost exclusively non-Hodgkin B cell) accounts for 5% of testicular tumors. Testicular involvement occurs in only 1% to 3% of patients with lymphoma.\(^{34}\) Lymphoma is the most common bilateral intratesticular tumor, and synchronous or metachronous involvement occurs, involving the contralateral testis in 38% of cases.\(^{28}\) The epididymis and spermatic cord are often involved. Testicular lymphoma is the most common testicular neoplasm in men older than 60 years of age. Patients most commonly present with painless enlargement of the testis, although systemic symptoms such as weight loss, fever, and weakness have also been reported.\(^{17}\) Testicular lymphoma may appear sonographically as single or multiple discrete hypoechoic lesions indistinguishable from GCTs, or it may diffusely infiltrate the entire testis and mimic orchitis or epididymo-orchitis (Fig. 7).\(^{35-37}\)
- In acute leukemia the testes are a common site of infiltration. A blood-testis barrier limits the effect of chemotherapeutic agents in general, with this phenomenon commonly described in pediatric acute lymphoblastic leukemia, allowing persistence of leukemic cells in the testes after remission.\(^{37}\) The sonographic appearance of testicular leukemia is varied; tumors may be unilateral or bilateral, diffuse, focal, hypoechoic, or hyperechoic.\(^{37,38}\)
- Metastases to the testes are rare. The most common primary sources are prostate, lung, melanoma, colon, and renal, in descending prevalence (Fig. 8).\(^{39}\)

**Testicular Microlithiasis**

Testicular microlithiasis (TM) is usually an incidental finding on a scrotal US (if associated with

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**Fig. 4.** NSGCT. Large, intratesticular heterogeneous mass (arrow) with cystic and solid components proved to be a mixed GCT at orchiectomy. At the posterior margin (arrowhead), the mass is seen to expand the testis and invade the tunica.
a mass, the microcalcifications are irrelevant and management is driven by the mass). The small calcifications within the seminiferous tubules appear as punctate, nonshadowing, hyperechoic foci (greater than 5 in single field of view) (Fig. 9). The microcalcifications are typically bilateral and scattered throughout the testis. TM has been correlated with testicular carcinoma. The extent of the risk for subsequent development of neoplasm and the recommended surveillance in the setting of TM remain controversial with the most recent literature suggesting that there is no causal link and that follow-up should be determined by any other additional risk factors, not the microlithiasis.

Benign Intratesticular Conditions

Nonneoplastic conditions that can present as testicular masses include orchitis, cysts, adrenal rests, infarcts, hematomas, and benign vascular lesions.

- Orchitis most often represents an extension of epididymo-orchitis (Fig. 10) and may present as a focal hypoechoic, intratesticular mass, with diagnosis aided by clinical signs and symptoms. Orchitis may progress to a more serious infection that can lead to testicular ischemia, infarction, and intratesticular abscess (Figs. 11 and 12).
- Cysts of the tunica albuginea range from 2 to 5 mm in size and often present as palpable masses (Fig. 13).
- Simple intratesticular cysts can occur within the testicular parenchyma, and range in size from 2 to 20 mm. These cysts are typically solitary. Careful examination is required to exclude solid or mural components (eg, cystic teratomas) (Fig. 14).
- Testicular adrenal rest tissue is typically seen in patients with congenital adrenal hyperplasia, and rarely in the setting of Cushing syndrome. Aberrant adrenal rests that were trapped in the developing gonad during fetal development may present as bilateral, eccentrically located, predominantly hypoechoic masses (Fig. 15).
- Epidermoid cysts are rare, benign, keratin-filled intratesticular masses. One of the few benign intratesticular masses, they constitute 1% of testicular tumors and have no malignant potential. They are well circumscribed and may present as solid masses, have a target appearance, or have the classic appearance of a laminated or onion-skin pattern (Fig. 16). Doppler interrogation shows no flow within the cyst. Although the US appearance is characteristic, it is not pathognomonic because teratomas and other malignant tumors may have a similar appearance.
appearance. However, the combination of US appearance, lack of vascularity, and negative tumor markers may suggest testis-sparing enucleation rather than orchiectomy.\(^46,47\)

- Testicular hemangiomas are rare and may present as a hypoechoic mass with focal calcifications.\(^48\)
- An intratesticular varicocele has a characteristic sonographic appearance of dilated tubular intratesticular veins near the mediastinum testis; Doppler examination should assist with the correct diagnosis (Fig. 17).\(^49\)
- Segmental testicular infarct may present as a focal, wedge-shaped, or rounded area within the testis (Figs. 18 and 19). Segmental infarct may result from epididymo-orchitis, autoimmune diseases, vasculitis, sickle cell disease, hypersensitivity angiitis, trauma, and pelvic surgery (especially herniorrhaphy).\(^30\)
- Intratesticular hematomas may occur as sequelae of scrotal trauma. They typically appear isoechoic or hyperechoic compared with the testis acutely, become smaller and more hypoechoic as they resolve, and lack vascularity on Doppler examination (Fig. 20). If surgical exploration is not performed, it is mandatory that these be followed to resolution to exclude the possibility of a testicular tumor mimicking a hematoma.
- Tubular ectasia of the rete testis may appear as a hypoechoic mass, although it represents

![Fig. 7. Testicular lymphoma in a 42-year-old man who presented with bilateral painful intratesticular masses. (A) The left testis showed several hypoechoic masses (arrows), whereas the right testis (not shown) had a single large mass replacing most of the testis. (B) The intratesticular masses were hypervascular. The right testis showed marked hyperemia (on power Doppler; top) and low-resistance flow (on pulsed Doppler; bottom). Diagnosis was made with a core biopsy of a supraclavicular mass, and the left testis was normal at US following 2 months of chemotherapy.](image1)

![Fig. 8. Metastatic disease to the testis. Solid, hypoechoic, slightly heterogeneous, vascular intratesticular mass (arrow) identified at sonographic examination in patient with a history of metastatic melanoma. Metastatic disease was pathologically proved at orchiectomy.](image2)

![Fig. 9. Testicular microlithiasis. Numerous microcalcifications are seen as punctate, nonshadowing, hyperechoic foci (greater than 5 in a single field of view) within the right testis. Incidental note was made of an epididymal head cyst (arrowhead).](image3)
dilated tubules near the mediastinum and is a benign variant, occurring secondary to obstruction in the epididymis or efferent ductules and often associated with a spermatocele (Fig. 21).

EXTRATESTICULAR SCROTAL MASSES Tunica Vaginalis

- Hydroceles are the most common cause of painless scrotal swelling.\(^{50}\) Congenital hydroceles occur when there is incomplete closure of the processus vaginalis and peritoneal fluid accumulates in the sac; these patients are at increased risk for developing an indirect inguinal hernia. Acquired hydroceles form as a reaction to infection, trauma, testicular torsion, or tumors. Although typically anechoic, occasionally there are low-level echoes within the fluid secondary to protein or cholesterol content (Fig. 22).\(^{51,52}\)

- Hematoceles are accumulations of blood within the tunica vaginalis, and may be acute or chronic. They typically have a more complex appearance than hydroceles, contain echogenic debris and septations, and may have mass effect on the adjacent testis (Fig. 23). Causes include trauma, surgery, and tumor. In the setting of an underlying

Fig. 10. Orchitis. Doppler image of the testes shows asymmetric hyperemia of the left testis (arrow) without a distinct intratesticular mass.

Fig. 11. Orchitis-related segmental infarct. Progression of orchitis to vascular compromise and intratesticular segmental infarct, presenting as an irregular, hypoechoic, nonvascular focus (arrow) within the testis. This focus was originally thought to represent a testicular tumor but intraoperative biopsy spared the patient an orchiectomy.

Fig. 12. Intratesticular abscess. Progression of epididymo-orchitis to the development of 2 separate hypodense avascular foci (arrows) not identified at initial scrotal sonogram, and consistent with intratesticular abscesses.
Fig. 13. Cyst of the tunica albuginea. Tunica cyst (arrow) is seen as a small peripheral, anechoic cystic lesion without internal features that involves the right tunica albuginea.

Fig. 14. Intratesticular cysts. Bilateral intratesticular cysts are shown (arrows) and seen as anechoic lesions without complicating features or internal vascularity.

Fig. 15. Adrenal rests. Aberrant adrenal rests (arrows) presenting as bilateral, eccentrically located, hypoechogenic masses in a patient with congenital adrenal hyperplasia.

Fig. 16. Epidermoid cyst. Well-circumscribed, avascular intratesticular mass (arrow) with a classic laminated or onion-skin appearance.

Fig. 17. Intratesticular varicocele. Dilated tubular intratesticular veins are present throughout the testis. Intratesticular varicoceles are often in close proximity to the mediastinum testis.

Fig. 18. Segmental testicular infarct. Large, hypoechogenic area within the mid and superior aspect of the testis (arrow), without internal vascularity on Doppler interrogation. Segmental infarcts are more common in the superior and mid aspect of the testis.
varicocele, minor trauma may result in rupture of a dilated vein and development of a hematocoele.

- A scrotal abscess (pyocele) most often results as a complication of epididymo-orchitis. An abscess appears heterogeneously echogenic, possibly containing gas manifesting as bright echogenic foci and shadowing (Fig. 24).
- Because the tunica vaginalis is lined by mesothelial cells, it can rarely become involved by mesothelioma. A history of asbestos exposure is present in less than half of these patients.\(^45\)

**Paratesticular Masses**

This category includes lesions that are extratesticular but within the tunica vaginalis, although they are not easily classified as arising from a particular paratesticular tissue.

- An indirect inguinal hernia can present as a scrotal mass, exiting the abdominal cavity via the inguinal ring and continuing along the inguinal canal into the scrotum. Sonographic

![Fig. 19. Central testicular infarct. Central hypoechoic, avascular focus (arrow) following indirect inguinal herniorrhaphy initially suggesting a focal testicular infarct. Follow-up US showed a gradual reduction in size of the avascular focus consistent with progression of infarct.](image)

![Fig. 20. Intratesticular hematoma. Posttraumatic hematoma (arrow) is seen as a peripheral, hypoechoic, intratesticular focus without internal vascularity. In the rare situation in which these are not immediately surgically explored, follow-up US is mandatory to ensure that the mass does not represent an occult tumor.](image)

![Fig. 21. Tubular ectasia. Dilatation of the rete testes (arrowheads) appears as hypoechoic masses within the mediastinum testis bilaterally in this patient with a history of prior vasectomy.](image)

![Fig. 22. Hydrocele. Simple hydrocele (arrow) presents as an anechoic collection within the space between the parietal and visceral layers of the tunica vaginalis.](image)
appearance of the hernia depends on its contents; typically omentum and/or bowel. Bowel is usually easy to identify (Fig. 25). Omento-only hernias may be difficult to diagnose because the echogenic appearance of the fat can overlap with lipomas and fat in the spermatic cord (Fig. 26). Following the spermatic cord in both directions and imaging during Valsalva may be helpful in making the diagnosis.

- Fibrous pseudotumor has many names, including fibroma, nodular fibropseudotumor, and scrotal mouse; it describes a benign fibroinflammatory reaction resulting in 1 or more nodules most commonly involving the tunica. US evaluation typically shows 1 or more solid, variably echogenic masses, attached to or closely associated with the testicular tunica (Fig. 27).

- Polyorchidism (supernumerary testis) is a rare condition, with 3 testes representing the most common form, although as many as 5 have been reported. The cause is an abnormal embryologic division of the genital ridge. Supernumerary testes are intrascrotal in approximately 75% of cases, with inguinal or retroperitoneal testes occurring progressively more infrequently (Fig. 28).

- Scrotoliths, scrotal calculi, or scrotal pearls are free-floating calcified bodies within the tunica vaginalis. They may result from torsion of the appendix testes or appendix epididymis, or may represent inflammatory deposits that have formed along and separated from the tunica vaginalis. On sonography they appear as mobile, echogenic foci with posterior acoustic shadowing (Fig. 29).

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**Epididymis**

- Epididymitis is the most common cause of an acutely painful scrotum. It may be acute or chronic depending on the duration of disease and inciting organism. Infection usually occurs from direct extension of urinary tract pathogens in a retrograde fashion via the vas deferens from a lower urinary tract source of infection. In 20% to 40% of cases there is extension to the testis (epididymo-orchitis) that may lead to vascular compromise, ischemia, infarction, and intratesticular abscess. Gray-scale findings of acute epididymitis include an enlarged, heterogeneous, often hypoechoic epididymis with hyperemia shown during color or power Doppler imaging (Fig. 30). Reactive hydrocele or pyocele with associated scrotal wall thickening may be present. Testicular involvement is suggested by testicular enlargement with heterogeneous echogenicity of the testicular parenchyma. Primary orchitis in isolation without epididymitis is rare and most commonly secondary to infection with the paramyxovirus causing mumps. Chronic epididymitis is characterized at US by an enlarged epididymis with
increased heterogeneous echogenicity. Granulomatous epididymitis and granulomatous orchitis can be seen with tuberculosis, brucellosis, sarcoidosis, syphilis, and parasitic and fungal infections.\(^{45}\) Associated findings in chronic epididymitis include calcifications, hydroceles, scrotal wall thickening, and fistulae.\(^{55-57}\) Testicular involvement is less common with these processes.

- The most common epididymal mass is a cyst, which is multiple in approximately 30% of men.\(^{58}\) Spermatoceles and epididymal cysts are indistinguishable from one another; both appear as anechoic, well-defined masses (see Fig. 9).\(^{59}\) A spermatocele represents cystic dilatation of efferent ductules in the epididymal head.\(^{59}\) Epididymal cysts contain clear serous fluid and can arise throughout the epididymis. Epididymal cysts were reported to be more common in the general population in a series by Holden and List,\(^{60}\) although spermatoceles were more common in patients after vasectomy.\(^{60,61}\)

- Sperm granulomas can also occur in patients after vasectomy and represent a foreign body giant cell reaction to extravasated sperm. They typically present as well-defined, solid, subcentimeter, hypoechoic masses at US, although they range up to 4 cm and become more heterogeneous. Sperm granulomas most often occur at the transected ends of the vas deferens, can be multiple, and can be painful, although they are often asymptomatic.\(^{60}\)

- Adenomatoid tumor is the most common epididymal tumor, accounting for 30% of paratesticular neoplasms. They are of mesothelial origin, may present as painless scrotal masses, and are universally benign, with no reports of recurrence or metastatic disease.

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**Fig. 25.** Indirect inguinal hernia. (A) Abdominal radiograph shows bowel gas superimposed over the expected course of the left inguinal canal and left hemiscrotum (arrow). (B) US examination of the left spermatic cord and left hemiscrotum in the same patient shows a small bowel loop extending into the superior left hemiscrotum with bowel wall (arrow), bowel contents (arrowhead) and shadowing from bowel gas present superior to the left testis.

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**Fig. 26.** Indirect inguinal hernia. US examination of the left spermatic cord shows a large heterogeneous mass (arrows) within the inguinal canal without bowel signature or bowel contents, consistent with a fat-containing indirect inguinal hernia.

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**Fig. 27.** Fibrous pseudotumor. Solid, heterogeneous mass (arrow) separate from the right testis and epididymis (arrowhead), but closely associated with the testicular tunica.
following excision. These tumors are round, well-circumscribed masses ranging from a few millimeters up to 5 cm, and are more frequently found in the epididymal tail. On sonography, they typically appear hyperechoic and homogeneous, although great variability has been reported (Fig. 32).

- Papillary cystadenoma of the epididymis is a rare tumor with a strong association with von Hippel-Lindau disease. Up to 40% of papillary cystadenomas are bilateral, an appearance that is virtually pathognomonic. A solid, palpable mass ranging from 1 to 5 cm (typically 1.5–2 cm) is the most frequent finding. At US, they typically present as echogenic, solid masses, although they may have distinct, small cystic spaces (Fig. 33).

- Malignant epididymal masses. Most solid epididymal masses are benign. Malignant tumors of the epididymis are rare, and include sarcomas, metastases, and adenocarcinoma, with most representing metastases from a primary tumor at another site. Genital tract lymphoma generally involves the testis, but can involve the epididymis in 60% of cases and the spermatocord in 40%. US features that increase the risk of malignancy in a well-defined epididymal mass include size greater than 1.5 cm and Doppler-detected vascularity.

**SPERMATIC CORD**

The spermatic cord should be evaluated as part of every scrotal US examination.

- Hematomas, edema, and inflammation can present as diffuse cord abnormality. Hematomas of the cord can result from trauma or surgery, and can appear as elongated, echogenic masses involving the soft tissues of the cord (Fig. 34). Thickening of the cord...
may be present in epididymitis. Rotation or spiral twist of the spermatic cord, real-time whirlpool sign, has been reported to be a sensitive and specific sign for testicular torsion. Varicoceles are present in approximately 15% of men, and up to 40% of men with infertility. They are the most common mass of the spermatic cord, and represent abnormal dilatation of the veins of the pampiniform plexus, usually caused by incompetent valves of the internal spermatic vein. Normal vessels within the pampiniform plexus typically range up to 1.5 mm and may not be visualized. On gray-scale US, varicoceles present as multiple, anechoic, serpiginous, tubular structures of various sizes larger than 2 to 3 mm about the superior and lateral aspect of the testis. Color Doppler optimized for low flow velocities confirms venous pattern, with phasic variation and flow reversal during performance of the Valsalva maneuver. Lipomas are the most common extratesticular neoplasm, and most often originate from the spermatic cord. Lipomas are typically hypechoic at US, although they contain varying amounts of fibrous, myxoid, or vascular tissue, making them more or less echogenic (Fig. 35). Additional less common benign tumors include leiomyomas, dermoid cysts, lymphangiomas, and adrenal rests. If lipomas are
excluded, then 56% of spermatic cord masses are malignant, and most malignant masses are sarcomas, including rhabdomyosarcoma and liposarcoma. The sonographic appearance of these tumors is variable, and therefore nonspecific (Fig. 36). 

**SCROTAL WALL MASSES**

- Noninflammatory causes of scrotal wall thickening include lymphedema, heart failure, liver failure, and venous obstruction. The thickened scrotal wall may appear hypoechoic, or alternating hypoechoic and hyperechoic. 
- Scrotal trauma may cause a scrotal wall hematoma, which may appear isoechoic to hyperechoic acutely, and become hypoechoic with maturation. Hematomas show no internal flow on Doppler interrogation and tend to decrease in size as they resolve.
- Cellulitis of the scrotal wall is most common in patients who are obese, diabetic, or immunocompromised. At US, the thickened scrotal wall is typically hypoechoic with increased blood flow at color Doppler US. Scrotal wall abscesses can develop in the setting of cellulitis.
- Fournier gangrene is a rare, polymicrobial necrotizing fasciitis of the scrotum that often extends to involve the perineum and lower abdominal wall. This condition constitutes a urologic emergency because of the high mortality. Although the diagnosis is based primarily on the clinical examination, imaging may have a role if clinical findings are ambiguous.

Crepitus has been reported in 18% to 62% of cases, with gas at US appearing as numerous, hyperechoic foci with reverberation artifact (Fig. 37). Diffuse scrotal wall thickening is usually associated with a normal appearance of the testes and epididymides.

- Primary solid neoplasms of the scrotal wall are rare. Sporadic cases of metastatic disease have been reported, including melanoma, anal carcinoma, and lung carcinoma. These lesions are typically hypoechoic at US examination, although they have variable echogenicity.
SUMMARY

Sonography is the ideal modality for evaluation and characterization of a scrotal mass. Extratesticular masses are usually benign, while intratesticular masses are generally malignant until proved otherwise. However, it is important to recognize the benign intratesticular conditions, thus possibly preventing orchiectomy when unwarranted, while appreciating the more significant findings of extratesticular masses that may warrant further intervention.

REFERENCES


