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REVIEW ARTICLE

Acute scrotal ultrasound: a practical guide

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Abstract
Purpose The purpose of this article is to provide a practical review of common ultrasound (US) findings in patients presenting with acute scrotal pain.
Methods We performed a literature search and reviewed numerous US cases archived in the radiology department of a large university hospital to find examples that illustrate the common US findings encountered in acute scrotal pain.
Results We reviewed the literature and provided several practical examples of common US findings in patients presenting with acute scrotal pain.
Conclusion Scrotal US plays a pivotal role in the evaluation of acute scrotal pain and allows proper triage of patients for conservative, medical, or surgical management due to its ability to rapidly differentiate intra versus extratesticular pathology, determine extent of trauma, and assess parenchymal perfusion.

Keywords Ultrasound · Scrotum · Acute · Pain · Trauma

Introduction

The evaluation of acute scrotal pain can be challenging for the clinician initially examining and triaging the patient. Acute scrotal conditions due to traumatic, infectious, vascular, or neoplastic etiologies can all present with pain as the initial complaint. Additionally, the laboratory and physical examination findings in such conditions may overlap; this, coupled with potential patient guarding and lack of cooperativity, may result in a limited, non-specific physical examination. Therefore, scrotal ultrasound has emerged to play a pivotal role in the evaluation of the patient presenting with acute scrotal pain. Newer US platforms and linear-array transducers have evolved to allow high-resolution imaging of the scrotum and its contents. Additionally, a thorough US examination should also include evaluation of nearby structures in the proper clinical setting; examples include scanning of the perineum and base of the penis in cases of suspected infection/abscess resulting in referred pain to the scrotum, and scanning of the inguinal canal in cases of suspected hernia.

High-resolution imaging of the scrotum is especially important for evaluating small scrotal structures which were previously difficult to differentiate with earlier platforms; an example is the tunic albuginea, where early detection of a focal defect can allow diagnosis of testicular rupture and will facilitate prompt surgical intervention resulting in improved testis salvage rates [1]. The performance of scrotal US in the trauma setting is emphasized as the amount of soft tissue swelling, ecchymosis, and hematoma does not always correlate with the degree of testicular injury.

The use of color and duplex Doppler ultrasound is unsurpassed in differentiating several acute scrotal conditions, such as epididymo-orchitis, torsion, and infarction. The addition of gray scale ultrasound can be used to help determine if a testis has undergone necrosis and is no longer salvageable.

In addition to its ability to often allow a specific diagnosis, another strength of scrotal US is its speed and portability. Finally, the lack of ionizing radiation makes US a safe, effective means of examining the scrotum. In this

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article, we provide a pictorial summary of some of the more common etiologies resulting in acute scrotal pain.

Normal scrotal anatomy

The scrotum is the protuberance of skin, muscle, and connective tissue covering the testes and epididymes. The scrotum is divided centrally by the median raphe. Each hemiscrotum consists of a testis and its connective tissues, an epididymis, and a portion of the spermatic cord; on average, a normal adult testis measures approximately $5 \times 3 \times 2$ cm and shows a nearly homogenous, intermediate echogenicity at grayscale US evaluation [1]. The testicular parenchyma is composed of numerous lobules, each of which consists of numerous seminiferous tubules; the tubules transition into the tubuli recti and give rise to a series of dilated spaces called the rete testis. The rete testis traverses the center of the testis along a partial septum or mediastinum; in some patients, the rete testis can become dilated and appear as a cluster of tiny cysts. The mediastinum testis runs along the longitudinal axis of the testis and is shown at US as a thin echogenic band at the base of the testis (Fig. 1); the mediastinum testis is an inferior reflection of the surrounding protective fibrous covering known as the tunica albuginea. Appendages of the testis and epididymis are encountered variably at US and identified as subcentimeter outpouchings of tissue originating from the superior testis or epididymal head. The testicular artery supplies the testes, while the deferential, cremasteric, and pudendal arteries supply the vas deferens, paratesticular tissues, and scrotal wall. Venous drainage is via the pampiniform plexus.

Fig. 1 Normal scrotal US. Longitudinal US image of the right testis in an asymptomatic 23-year-old shows a normal-appearing testis. The central echogenic band (*arrow*) represents the mediastinum testis. Note a small, physiologic amount of peri-testicular fluid (*arrowhead*)

Scrotal US technique

Scrotal sonography is performed with the patient in the supine position with the scrotum supported by a folded towel placed between the thighs or a rolled towel draped over the thighs. The penis should be displaced superolaterally and covered with a towel. A high-frequency, linear-array transducer (8–15 MHz) is utilized to image the testes and scrotal contents in the longitudinal and transverse orientations. A higher frequency transducer is preferred to increase resolution and conspicuity of thin structures, such as the tunica albuginia although in the setting of acute swelling, scrotal edema, or large scrotal fluid collections a lower frequency transducer may be necessary to provide adequate depth of imaging. The testes and epididymides are compared for size and echogenicity and in the setting of unilateral symptoms, gray scale scan parameters should be optimized on the normal side. Scrotal skin thickness should also be assessed.

Color Doppler is a critical component of scrotal sonography in the acute setting. Color Doppler parameters should be optimized for detection of low flow velocities. This includes utilizing an appropriately low pulse repetition frequency, increasing the Doppler gain to a level slightly below the point at which excessive flash artifact and noise is encountered, and using a low wall filter. As with gray scale images, Doppler parameters should be optimized on the asymptomatic side prior to a side-to-side comparison. A transverse image including simultaneous color Doppler interrogation of portions of both testes can facilitate this comparison. Spectral Doppler can be utilized to document intratesticular arterial flow, confirming that apparent color Doppler flow is not artifactual. Power Doppler increases the sensitivity for detection of slow flow though is more susceptible to patient motion which can be an issue when scanning the patient with an acute scrotum. The patient can perform a Valsalva maneuver, while interrogating with color Doppler to facilitate evaluation of venous structures within the spermatic cord including evaluation for varicoceles when necessary.

US findings in acute scrotal trauma

Trauma

Testicular trauma is a common cause of acute scrotal pain. Blunt trauma is the most common mechanism of injury, and is often due to physical assault, motor vehicle accidents, or athletic injuries. Penetrating scrotal injuries are less common, and are potentially due to stab wounds, projectile injuries or bites. Physical examination may be limited due to pain and often reveals varying degrees of

◄ **Fig. 2** Scrotal trauma. **a** Testicular rupture. Longitudinal US of the right testis in a 19-year-old male following jet ski accident. There is disruption of the tunica albuginea (*arrowheads*) and extrusion of a large amount of the inferior pole of the testis (annotated by letter *E*); the normal tunica albuginea is noted more superiorly (*arrow*). Also note surrounding hematocele (*asterisk*). The patient underwent debridement and repair with preservation of the superior aspect of the right testis. **b** Testicular fracture. Longitudinal US of the left testis in a 47-year-old who sustained a traumatic scrotal injury after being struck by a baseball traveling at high velocity. The thin hypoechoic band (*arrows*) corresponds to the testicular fracture line. Orchiectomy was performed due to extent of injury. **c** Penetrating testicular trauma with intrascrotal gas. Transverse US of the left testis in a 25-year-old who sustained a traumatic scrotal injury after a hand gun discharged while in the patient's pants pocket. A focal defect (*arrow*) along the lateral aspect of the left testis corresponds to a site of tunica albuginea rupture and tubule extrusion. A cluster of amorphous echogenic foci with mild posterior shadowing in the testicular parenchyma are due to intratesticular gas. The patient was treated with orchiectomy

edema and ecchymosis that may not correlate with the severity of injury [2]. US has become a pivotal tool in accurately assessing the extent of injury and vascular integrity thereby allowing prompt triage and management.

Blunt and penetrating scrotal trauma can result in testicular rupture and/or fracture, intra- and extra-testicular hematomas, hematoceles, hydroceles, and intratesticular pseudoaneurysms. Scrotal and epididymal hematomas, epididymal fracture and rupture, and traumatic epididymitis can also occur.

Testicular rupture and fracture

Testicular rupture refers to extrusion of scrotal contents into the scrotal sac via the disrupted tunica albuginea. The US finding of a tunica defect is diagnostic of testicular rupture. Extensive injury and surrounding hematoma may make it difficult to pinpoint the site of tunica disruption and associated US findings are used to support the diagnosis of testicular rupture; such supportive findings include a large testicular hematocele, contour abnormality of the testis, and heterogeneous echotexture of the testicular parenchyma (Fig. 2a). Rupture of the tunica albuginea is almost always associated with disruption of the tunica vasculosa which can result in a loss of vascularity to a portion of the testis [1, 3].

Guichard et al. [4] reported a sensitivity of 100% and specificity of 65% for US in the detection of testicular rupture when comparing US findings of testicular rupture with surgical findings. In their study, US criteria used to diagnose testicular rupture included a hypoechoic, heterogenous testicular parenchyma, a testicular contour abnormality, and localization of the breach in the tunica albuginea [4]. Another study reported a sensitivity of 100% and a specificity of 93.5% based on ultrasound findings of heterogeneous testicular echotexture and loss of contour definition only [5].

It has long been reported that conservative management in cases of contusion or rupture of the testis has resulted in a high rate of delayed orchiectomy [6, 7]. Currently, early surgical exploration has now become the standard of care. Surgical exploration should not be delayed if the US findings are normal or equivocal, yet the physical examination findings are suggestive of testicular damage [2]. Early surgical repair of rupture is associated with testicular salvage rates higher than 80% [5]. Additional benefits include faster resolution of pain, hemostasis, and

preservation of spermatogenesis [8]. Delay in diagnosis and intervention may result in testicular atrophy, ischemia/infarction, abscess, delayed orchiectomy, and loss of spermatogenesis [2, 9].

A break or linear band of discontinuity within the testicular parenchyma is illustrative of a testicular fracture. Ultrasound will show a linear hypoechoic and avascular fracture line within the testis which may also coexist with rupture of the tunica albuginea (Fig. 2b) [1]. Management often consists of debridement along the avascular fracture line, while preserving the vascular parenchyma.

Hematomas, hematocele, and hydrocele

Scrotal trauma often results in hematomas which may be intratesticular or extratesticular, such as within the scrotal wall [3]. The US appearance of the hematoma depends on its age. Acute hematomas may appear hyperechoic and become hypoechoic to anechoic over time. Color Doppler signal within a suspected hematoma should raise concern for active hemorrhage or neoplasm [10]. Management of intratesticular hematomas largely depends on their size; small hematomas without evidence of rupture or fracture are treated conservatively, whereas large hematomas warrant surgical exploration and drainage due to elevated intratesticular pressure and the risk of progressive pressure necrosis and testicular atrophy [7].

Hematocele represents accumulation of blood between the tunica albuginea and tunica vaginalis, and is a common finding after blunt scrotal trauma (Fig. 2a). The US appearance varies with the age of the hematocele. Acute hematoceles are echogenic, while chronic hematoceles become anechoic over time and develop internal septa and loculations [11]. Chronic hematoceles may become calcified. Acute onset of large hematoceles may cause reduced blood flow to the testis and may mimic testicular torsion. Even in the setting of normal testicular blood flow, surgical exploration of an acute large hematocele is warranted to evaluate for occult testicular rupture. Small hematoceles without evidence of rupture may be managed conservatively.

Similar to hematoceles, hydroceles refer to fluid which accumulates between the tunica albuginea and tunica vaginalis. However, rupture of the bulbous portion of the urethra may cause extravasation of urine into the scrotum which will mimic a hydrocele [3].

Penetrating trauma

Bullet fragments, foreign bodies, and intrascrotal gas can be shown with US in the setting of penetrating injury. Most foreign projectiles are echogenic at US and will produce marked shadowing and distortion of the beam; gas is shown as multiple small echogenic foci with posterior reverberation or ‘dirty shadowing’ (Fig. 2c). Transection of the spermatic cord can be detected at US as hematoma and findings of testicular ischemia [3]. In a study by Cline et al. [12], 29 out of 30 patients underwent surgical exploration due to scrotal gunshot or stab wounds with evidence of deep scrotal injury, and the most common injuries were unilateral fractured testis and transection of the spermatic cord. Management of penetrating deep scrotal injuries generally includes immediate surgical exploration.

US findings in non-traumatic acute scrotal conditions

Epididymitis and epididymo-orchitis

Epididymitis and epididymo-orchitis are common causes for acute scrotal pain with approximately 600,000 cases per year in the United States. Occurring most commonly in adolescents and young adults, epididymitis has a prevalence of 14–28% [13]. Orchitis develops in 20–40% of epididymitis due to contiguous spread of infection [14]. Isolated orchitis is rare and most often associated with mumps. In adolescents, most cases of epididymitis are attributed to ascending sexually transmitted diseases, with *Chlamydia trachomatis* and *N. gonorrhoeae* the most common pathogens. In those younger than 14 and older than 35 the disease is generally caused by common urinary tract pathogens [15].

Clinically, epididymo-orchitis presents as acute scrotal pain localized to the posterior testis. Symptoms of lower urinary tract infection may be present, a finding that is common in epididymitis, but not torsion [16]. The Prehn sign, defined as relief of pain with elevation of the testes over the symphysis pubis, may be elicited in patients with epididymitis, further distinguishing it from torsion.

Typical gray scale US findings of epididymitis consist of an enlarged hypoechoic epididymis with parenchymal heterogeneity due to edema and hemorrhage [9]. Concomitant orchitis is characterized by an enlarged, heterogeneous testis, although findings may be focal or diffuse. When focal, orchitis is most often located adjacent to an inflamed epididymis. Associated findings of epididymo-orchitis may include skin thickening and reactive hydrocele [17].

Color Doppler is highly sensitive in detecting scrotal inflammation, approaching sensitivity of 100% [18]. Color and power Doppler readily show hyperemia of the epididymis and/or testis (Fig. 3a). While echogenicity may be variable, Doppler flow is invariably increased. Demonstration of a normal spermatic cord and lack of an avascular nodule extending from the upper pole of the

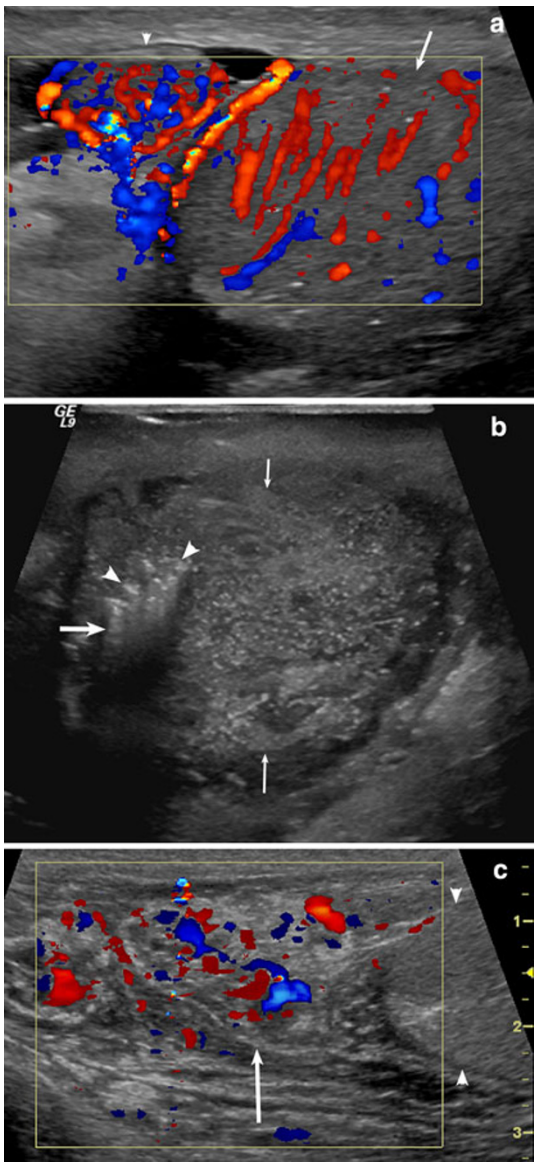

Fig. 3 Epididymo-orchitis and complications. **a** Epididymo-orchitis. Longitudinal color Doppler US in a 31-year-old with acute left scrotal pain and recent diagnosis of *Chlamydia trachomatis*. There is extensive hyperemia of the epididymal head (*arrowhead*) and testis (*arrow*) compared to the contralateral side (not shown). The patient's symptoms resolved after treatment with doxycycline. **b** Scrotal abscess. Transverse US image of the left testis in a 59-year-old paraplegic patient with recurrent epididymo-orchitis and scrotal abscesses. The left testis is nearly replaced by a heterogeneous fluid collection (*small arrows*). In the medial aspect, there is a cluster of echogenic foci (*arrowheads*) which result in reverberation artifact/'dirty shadowing' (*large arrow*) due to a gas component. Cultures following surgical drainage grew *Pseudomonas aeruginosa* and *Enterobacter cloacae*. **c** Vasitis. Longitudinal US image of the left inguinal canal in a 46-year-old with left scrotal and pelvic pain. There is hyperemia of the epididymal head and spermatic cord (*arrow*) as it traverses the inguinal canal. Note the normal-appearing superior aspect of the testis (*arrowheads*). **d** Vasitis. Axial CT image of the pelvis (same patient as in part **c**) shows an enlarged and inflamed left vas deferens (*arrows*). The right vas deferens is normal (*arrowheads*). The patient's symptoms resolved after treatment with Ciprofloxacin

testis are important findings to exclude torsion of the testis and appendix testis [13]. Epididymo-orchitis has been associated with decreased resistive indices (<0.5). In severe cases complicated by infarction, there can be reversal of arterial diastolic flow [19].

Abscess

If incompletely treated, epididymo-orchitis can lead to abscess formation. This may manifest clinically as persistent fevers, elevated white cell count, and development of a palpable scrotal abnormality. Whether intratesticular or paratesticular, US findings typically include a well-defined, ovoid, or rounded mass in the scrotum with variable internal echogenicity due to the ratio of fluid, purulent debris, and gas (Fig. 3b). Application of color Doppler will show an avascular mass with variable flow in the abscess rim and surrounding soft tissues. Follow-up US after incision and drainage or antibiotic therapy will allow assessment of resolution of any fluid collections.

Vasitis

Infection from epididymo-orchitis can spread retrograde via the vas deferens, resulting in deferentitis or vasitis. As the vas deferens extend from the seminal vesicles to the epididymes via the inguinal canal, infection can extend into the peritoneum and be a cause of pelvic pain or referred pain to the scrotum. Therefore, a thorough scrotal US examination should include evaluation of the inguinal region to evaluate the spermatic cord and to assess for indirect inguinal hernia. Physical examination findings in the setting of vasitis can include a firm, tender structure lateral to the testis with extension to an indurated, tender inguinal region due to inflammation, and infiltration along the spermatic cord. US findings mimic those on physical examination and include a thickened hypoechoic, hyperemic spermatic cord with inflammation and phlegmon lateral to the testis (Fig. 3c). Vasitis is commonly unilateral, but can be bilateral. Treatment is similar to epididymitis, and includes antibiotics and analgesia.

Scrotal cellulitis/edema

Scrotal cellulitis is usually evident clinically, manifested by erythematous, indurated scrotal wall skin. Compared to the general population, these findings are more commonly encountered in obese patients and in patients with altered immune function, such as in diabetes, malnutrition, and immunosuppression. However, the physical examination may be limited by pain and differentiation of cellulitis from

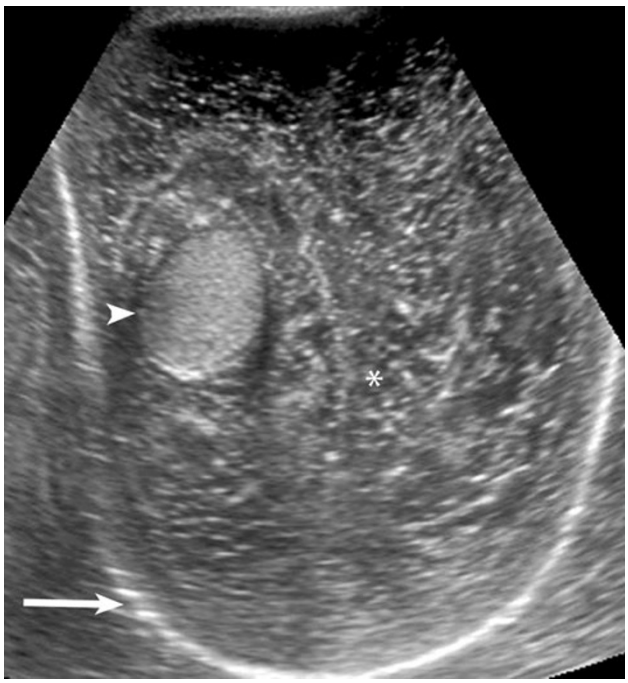

Fig. 4 Massive scrotal edema. Longitudinal US in a 55-year-old with cirrhosis and anasarca shows extensive thickening of the scrotal wall (*asterisk*). The testis is normal-appearing (*arrowhead*). The scrotal wall is noted (*arrow*). The patient was treated conservatively and edema eventually resolved

abscess may not be possible clinically. Therefore, evaluation with ultrasound can quickly evaluate the scrotal soft tissues. Typical US findings of cellulitis include scrotal wall thickening, edema, and hyperemia; ill-defined hypoechoic regions which lack color Doppler flow represent regions of phlegmon. Generalized scrotal edema is associated with third spacing of fluid and anasarca and has many etiologies (Fig. 4).

Miscellaneous conditions

Lesions in the inguinal canal

In addition to diagnosing vasitis, US may also be used to assess other etiologies involving the spermatic cord and inguinal region which result in pain. Differential considerations for inguinal tenderness include spermatic cord hematoma, hernia, and rarely neoplasms. Lipoma and sarcoma are the most common spermatic cord tumors, but usually present as a painless mass [20]. Spermatic cord hematomas are usually post-traumatic or post-operative. US findings can vary due to age of the hematoma; findings commonly include a heterogeneous mass-like lesion with lack of color Doppler flow. As the hematoma liquefies, a more cystic component will evolve and may contain low-level internal echoes; in this setting, differentiation from abscess may be difficult, but correlation to patient history and laboratory analysis will usually allow correct diagnosis. An indirect inguinal hernia can be a cause of inguinal and scrotal pain, as herniated bowel, fat and vessels can extend into the scrotum. US findings can include an elongated heterogeneous lesion filling the inguinal canal; if peristalsis is shown, the finding is pathognomonic. However, peristalsis may be absent if bowel obstruction has occurred or if only fat and vessels have herniated (Fig. 5a, b). Additional findings can include incomplete or

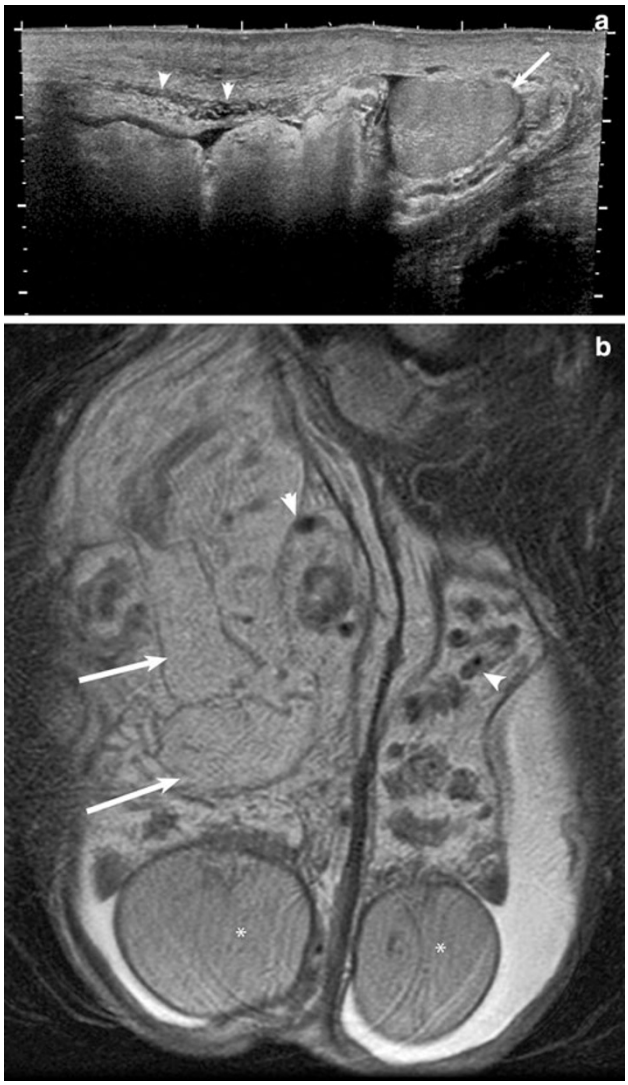

Fig. 5 Inguinal hernia resulting in acute scrotal pain. **a** Longitudinal US image of the right inguinal canal in a 39-year-old with right scrotal pain shows an elongated heterogeneous structure in the right inguinal canal (*arrowheads*); hyperechoic regions corresponded to fat while hypoechoic, serpiginous structures corresponded to vessels. The right testis (*arrow*) was normal. **b** Corresponding coronal T2 weighted MR image shows bilateral inguinal hernias containing fat (*arrows*) and vessels (*arrowheads*), but no bowel. Note normal-appearing testes (*asterisks*). The patient underwent herniorrhaphy

'dirty' shadowing induced from intraluminal air and identification of the stratified layers of the bowel wall. If findings are inconclusive, correlation to CT can be made.

Perineal infection

Scrotal US may include evaluation of the perineum in a patient presenting with pain and infectious symptoms; additionally, obtunded patients should also undergo imaging evaluation of the perineum, especially those who have been incapacitated for an indeterminate length of time and those in whom there is clinical suspicion for diabetic coma. A scrotal US examination which includes only the scrotum may miss life-threatening infection or perineal abscess. To properly scan for perineal infection, the US technologist may have to reposition the patient so that the perineum is exposed; it may be necessary for the technologist or patient to retract the scrotum from the field of view.

Imaging findings of perineal abscess include a well-defined collection with variable internal echogenicity due to its contents (Fig. 6a, b); the fluid collection will be avascular with variable peripheral flow and surrounding hyperemia. More diffuse infection raises concern for Fournier's gangrene, a urologic emergency due to polymicrobial necrotizing fasciitis with mortality rates approaching 75% [21]. Diagnosis may be made on clinical grounds and can include findings of crepitus. Fournier's gangrene is associated with immunocompromised states, such as chronic diabetes, alcoholism, and advanced age. With US, the key finding is intrascrotal gas manifested by numerous echogenic foci with ring-down or reverberation artifact. This must be differentiated from air in a bowel containing inguinal hernia by showing gas peristalsing in the bowel lumen.

Vascular etiologies of acute scrotal pain

US plays a pivotal role in differentiating acute torsion from epididymo-orchitis. While loss of the cremasteric reflex and absence of Prehn's are physical examination findings of torsion, there can be overlap on physical examination as both entities present with scrotal tenderness and swelling [22, 23]. Additionally, while most cases of torsion involve younger males, torsion can occur at any age. The degree of venous engorgement, edema, hemorrhage, and arterial compromise depends on the degree of torsion; studies have shown that there must be at least 720 torsions for occlusion of the testicular artery [24]. The degree of testicular ischemia depends on the degree and length of torsion. If diagnosed in the first 6 h, torsion can be successfully treated surgically in nearly 100% of cases; the salvage rate drops to approximately 20% between 12 and 24 h after diagnosis [25]. In adolescents and adults, torsion occurs within the tunica vaginalis due to lack of attachment of the tunica to the posterolateral aspect of the testis; this results in the so-called "Bell-clapper" deformity and allows the testis to be mobile and rotate freely. Torsion can also be iatrogenic in the setting of spermatic cord manipulation or post-herniorrhaphy. Approximately, 8% of cases of testicular torsion are post-traumatic, presumably due to forceful contraction of the cremasteric muscle and testicular rotation [11, 26, 27]. Extravaginal torsion occurs outside of the tunica vaginalis due to non-fixation of the testes and gubernacula; this type of torsion occurs exclusively in newborns and the testis is typically infracted at birth. US findings will include lack of color flow, parenchymal heterogeneity, and hydrocele.

The presence of vascular flow in the testis can be readily depicted at US. When using only color Doppler, the sensitivity, specificity, and accuracy has been reported to be 86, 100, and 97%, respectively [28]. The use of both color and power Doppler further increases sensitivity [29].

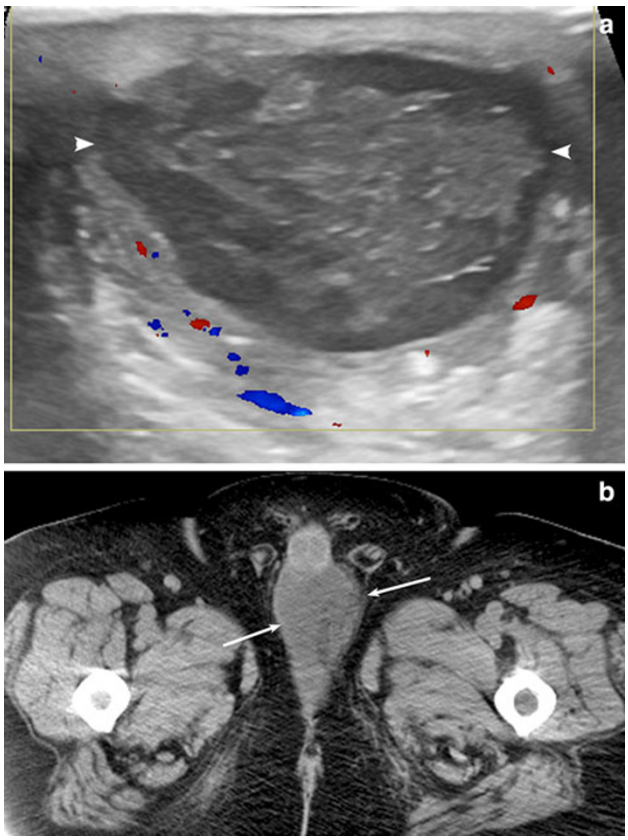

Fig. 6 Perineal abscess presenting as scrotal pain. **a** Transverse color Doppler US image in a 33-year-old patient with scrotal pain and history of suppurativa hidradenitis shows an encapsulated heterogeneous fluid collection (*arrowheads*) in the perineum. **b** Corresponding CT image (same patient as in part **a**) shows the low attenuation fluid collection posterior to the base of the penis. The patient was treated with incision and drainage. Cultures were consistent with a polymicrobial infection, mostly due to *Staphylococcus aureus*

However, the presence of color or Doppler flow in the proper clinical setting does not exclude torsion, as cases of incomplete or transient torsion may have flow at the time of US examination. The ability of color, power, and spectral Doppler in diagnosing incomplete torsion remains undetermined as no studies have yet validated their role. Gray scale findings of torsion are also variable and depend on the extent and duration of torsion. In the early phases, the parenchyma will often appear normal; at 4–6 h, the parenchyma may be edematous and slightly hypoechoic [30]. After approximately 24 h, the parenchyma will be heterogeneous due to congestion, infarction, and hemorrhage. Despite the variable gray scale findings in torsion, recognition of a homogeneous testicular parenchyma indicates that a testis has not yet undergone irreversible ischemia or infarction and is a good predictor of viability [31, 32]. Testicular torsion can lead to infarction if left untreated. Similar to torsion, US findings of infarction include lack of Doppler; at gray scale, the parenchyma is usually hypoechoic or heterogeneous (Fig. 7). Infarction may also be segmental if due to an embolic phenomenon, manifesting as a well-demarcated region of hypoechogenicity with lack of flow (Fig. 8a, b).

Torsion can also affect the appendages of the testis and epididymis. Patients typically present with gradual pain and may manifest with a firm bluish nodule at the superior aspect of the testis referred to as the "blue dot" sign. US will show a circular mass adjacent to the testis or epididymis which may show peripheral increased flow on color Doppler examination; reactive hydrocele and skin thickening may also be shown [28].

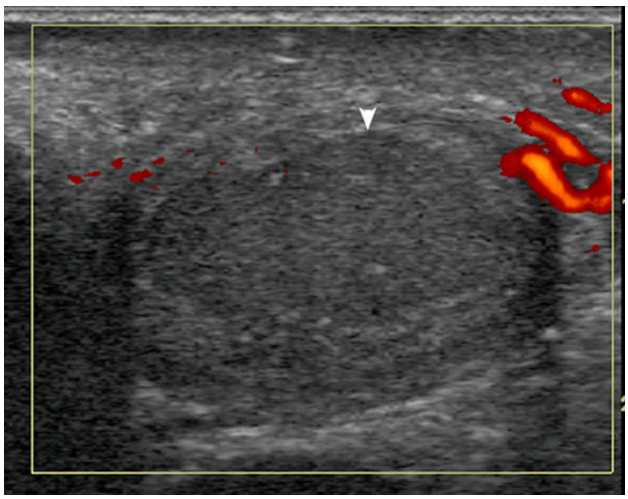

Fig. 7 Testicular infarction due to torsion. Longitudinal US image in an 18-year-old presenting with pain approximately 30 h after onset of symptoms. Despite use of power Doppler and technique optimization, there is no flow in the testis. The testis is hypoechoic centrally (*arrowhead*) consistent with infarction. Orchiectomy yielded an infracted testis

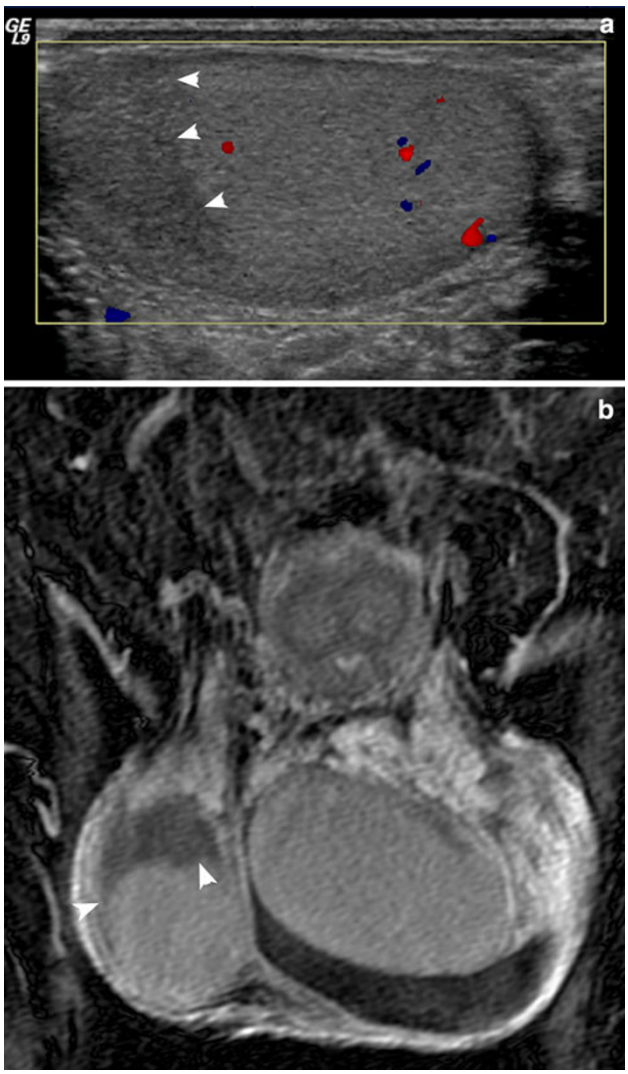

Fig. 8 Acute scrotal pain due to segmental testicular infarction following aortic graft placement. **a** Longitudinal US image of the testis with shows a geographic region of decreased echogenicity at the superior aspect of the right testis. There was no color Doppler flow shown in this segment. **b** Corresponding (same patient as in part **a**) post-contrast T1 weighted image with fat saturation shows lack of enhancement at in a geographic region at the superior pole of the right testis. The findings were presumably due to an embolic event in the peri-procedural period. The patient was treated conservatively and symptoms resolved

Miscellaneous

Testicular tumors rarely present with acute pain; rather, patients may describe a vague discomfort or palpable abnormality. US findings are variable due to tumor type, but typically include a solid parenchymal mass with internal flow. Similarly, most varicoceles do not cause acute pain. Most varicoceles can be diagnosed clinically and are idiopathic. Typical color Doppler US findings include dilated veins which are accentuated with Valsalva maneuver. While most varicoceles are idiopathic, evaluation

of the retroperitoneum should be performed if a varicocele is new, right sided or non-decompressible due to the potential of a retroperitoneal mass.

Summary

Thorough evaluation of the acute scrotum requires obtaining a detailed history and performing a careful physical examination. As the physical examination can be non-specific and potentially limited, US has emerged to play a pivotal role in the evaluation of the acute scrotum. The speed, portability, and lack of radiation make US the imaging modality of choice in this setting. A properly performed US examination can allow a specific diagnosis in most cases and facilitate triage and management of patients with acute scrotal pain.

Conflict of interest None.

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