

**Abstract:**

Acute scrotal pain is frequently encountered within pediatric emergency medicine and requires thoughtful and timely evaluation. The differential diagnosis for scrotal pain is broad and includes conditions such as epididymitis, torsion of the appendix testis, testicular torsion, trauma, and incarcerated hernia. Some of these conditions represent surgical emergencies and thus need to be identified expeditiously. Obtaining a careful history and physical examination is essential to the evaluation of a child with acute scrotal pain. A good clinical history and examination in combination with appropriate diagnostic tests provide the best method for obtaining an accurate diagnosis. Using 2 case-based scenarios, we will discuss important conditions, components to the evaluation, and management of a child with acute scrotal pain.

**Keywords:**

testicular torsion; epididymitis; torsion of the appendix testes; scrotal pain; scrotal trauma

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1522-8401

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# Acute Scrotal Pain in Pediatric Emergency Medicine: Assessment, Diagnosis, Management, and Treatment

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**T**he acute scrotum is a condition of new onset pain, swelling, and/or tenderness of intrascrotal contents<sup>1</sup> and is commonly seen within pediatric emergency medicine. It is difficult to determine the incidence of acute scrotum within the population, as most studies within the literature are retrospective and are subject to selection bias. One study from a tertiary-level children's hospital in China reported 1228 cases of acute scrotum over the course of 18 years,<sup>2</sup> another series from a pediatric emergency department at a tertiary center in Israel identified 523 patients over 32 months,<sup>3</sup> and a series from an Australian tertiary-level children's hospital identified 204 patients over a 5-year period.<sup>4</sup> A prospective study regarding acute scrotal pain in the pediatric population was recently published from a

tertiary children's hospital in the United States with 85000 annual visits. The study accrued their study population over 32 months and a total of 552 patients were seen for scrotal pain. Excluding for patients with more than 72 hours of symptoms, history of genitourinary (GU) surgery, known diagnosis before emergency department visit, and presence of hernia/hydrocele, the total number of patients was 450.<sup>5</sup> The volumes reported within these series demonstrate that the incidence of acute scrotal pain is not trivial and should serve as a reminder that one should be prepared for this clinical situation.

The differential diagnosis for acute scrotal pain is broad, and there are studies that have looked at the frequency of specific etiologies. Table 1 provides a general differential diagnosis for acute scrotal pain. Most studies identify torsion of appendix testis, epididymitis, and testicular torsion as the most common etiologies for acute scrotum, and it is important to keep these 3 conditions in mind when evaluating acute scrotal pain. The incidence of these 3 diagnoses within the last 2 published prospective series from tertiary-level children's hospitals is summarized in Table 2. The objective of this review will be to discuss the evaluation, diagnosis, and management of the child presenting with acute scrotal pain.

## ACUTE SCROTAL PAIN

### Case 1

An 8-year-old boy complains of severe scrotal pain over the last 20 hours. The patient states that he first noticed the pain after eating dinner while watching television 4 days ago. The pain was dull and aching and has been gradually worsening over the last 2 days, and especially severe over the last 20 hours. He denies

**TABLE 1. Differential diagnosis for acute scrotal pain in the pediatric patient.**

Abscess
Cellulitis
Epididymitis
Hernia
Hydrocele
Intrascrotal mass
Orchitis
Referred pain
Testicular torsion
Torsion of appendix testis
Trauma
Varicocele

**TABLE 2. Incidence of testicular torsion, torsion of appendix testis, and epididymitis in pediatric acute scrotum.**

	Acute Epididymitis	Testicular Torsion	Torsion of Appendix Testis
Boettcher et al. <sup>6</sup>	16.3%	11.5%	68.3%
Shah et al. <sup>5</sup>	19.3%	9.2%	22.8%

trauma to the affected testicle and reports some increased swelling over the last 2 days. He denies nausea, vomiting, and fevers but reports having some dysuria over the last 2 days. There are no recent rashes or ear aches, and he is up to date with immunizations.

### History of Present Illness

Obtaining a good history is essential to the evaluation of acute scrotal pain. The first component of the history should characterize the pain. Onset of pain is important to document because longer duration of symptoms translate to longer periods of ischemia with testicular torsion, which have been shown to result in lower chances of testicular salvage.<sup>7,8</sup> Acute onset of pain, defined as being less than 24 hours has been correlated with testicular torsion, and acute onset of pain should alert the physician to the possibility of testicular torsion.<sup>6</sup> Prior episodes of similar pain may alert the clinician to intermittent testicular torsion or recurrent epididymitis from a GU anomaly. The location of the pain is also important and should be specific. Asking a patient to point with 1 finger at the area of greatest pain can sometimes localize pain to a single site. If this site is at the superior pole of the testicle, pain could be from torsion of the appendix testis, and if localized to the posterior aspect of the testicle, pain could be from an inflamed epididymis. During the initial history, it is also important to obtain any provocative and palliative factors. Did the child recently have trauma to the groin during play, or was the child awakened from sleep in severe pain? Does the pain improve with scrotal elevation or support, or is there nothing that makes the pain better? The quality and severity of the pain are also important. Severe pain that has gradually improved may represent progression of testicular torsion to testicular necrosis, especially if the patient presents many hours to days after onset. In addition to pain, it is important to discuss any other visible changes

such as enlargement of the scrotum or testicle, or any redness or swelling of the skin.

After characterizing the pain, it is important to systematically go through all components of a medical history. Birth history is an important component in the evaluation of possible torsion in neonates (<1 month old) and infants (1-12 months). Certain risk factors such as high birth weight, late gestation, breech presentation, and trauma during delivery are associated with neonatal torsion.<sup>9</sup> During the medical history, it is important to elicit any history of undescended testicle, which places the child at higher risk for torsion. There are also congenital syndromes associated with an undescended testicle such as Down syndrome or prune belly syndrome. Immunization history is important, and attention should be paid to vaccination for mumps, which can cause orchitis. Immune deficiency should also be queried in cases of suspected cellulitis, abscess, or fasciitis. Medical conditions that require urethral catheterization such as neurogenic bladder from spina bifida or myelomeningocele should also be documented, as catheterization can be one potential source for infectious epididymitis. Surgical history should assess whether the child has had any recent urethral instrumentation or has previously undergone inguinal or scrotal surgery. Medication lists should also be evaluated. One rare cause of epididymitis is the use of amiodarone. This medication achieves high levels within testicular tissue and causes inflammation.<sup>10</sup> Allergies and recent exposures should also be determined. Social history should include living situation, sexual activity in older patients, and the presence of pets. In cases of scrotal trauma from dog bites, more history regarding the animal's vaccinations should be obtained. Sexual abuse or physical abuse should also be considered in the evaluation of a child presenting with acute scrotal pain. Family history of inguinal hernias or undescended testicle may also alert the clinician to the patient having one of these conditions. During the review of systems, it is important to look for systemic symptoms such as fever, weight loss, or rashes. Fevers can be secondary to tissue infection such as abscesses or in cases of epididymo-orchitis. In addition, attention should be paid to the gastrointestinal and GU systems. Disturbances such as nausea or vomiting are commonly seen in testicular torsion but can also be presenting symptoms for an incarcerated inguinal hernia. In any patient that may possibly require surgical intervention, it is also important to elicit timing of last oral intake and type of food consumed. Within the review of systems for the GU tract, it is important to ask whether there are any signs of possible urinary tract infection, nephrolithiasis, or sexually transmitted infection. Thus, one should ask

about urinary frequency, dysuria, hematuria, and urethral discharge.

Table 3 provides a summary of clinical variables that should be obtained during the history of present illness. Table 4 focuses specifically on the 3 most common etiologies for acute scrotal pain (epididymitis, testicular torsion, and torsion of the appendix testis) and provides information regarding pain and risk factors and then addresses specific symptoms such as voiding symptoms and fever. Recent studies have looked at specific clinical variables and symptoms that might help rule out testicular torsion, which is a surgical emergency.<sup>5,6</sup> Nausea and vomiting and the acute onset of symptoms have been identified as 2 variables that have been closely

**TABLE 3. Elements for a history of present illness for acute scrotal pain.**

History of Present Illness Element	Pertinent Points
Characterization of pain	Location Onset Palliating or provocative factors Quality Radiation Severity Timing
Birth history	Birth weight Gestational age at birth Birth complications
Past medical history	History of undescended testicle Immunizations Presence of immune deficiency Congenital syndromes (eg, Down syndrome) History of nephrolithiasis
Surgical history	History of GU surgery (eg, orchidopexy) Urethral catheterization
Medications	Amiodarone Steroids
Allergies	Environmental Medications
Social history	Sexually active History of sexually transmitted infections Pets Living situation
Family history	Undescended testicle Inguinal hernias
Review of systems	Trauma Rash Fever Dysuria Urinary frequency Hematuria

**TABLE 4. Clinical history in epididymitis, torsion of the appendix testis, and testicular torsion.**

Symptom/Characteristic	Epididymitis	Torsion of Appendix Testis	Testicular Torsion
Onset of scrotal pain	Acute or gradual	Acute or gradual	Acute
Presence of scrotal pain	76% <sup>4</sup> 58% <sup>11</sup> 61.2% <sup>12</sup>	92% <sup>4</sup> 94% <sup>11</sup> 100% <sup>12</sup>	88% <sup>4</sup> 68% <sup>11</sup> 100% <sup>12</sup>
Risk factors	Sexual activity History of STIs Congenital GU anomaly Urethral instrumentation (catheterization/surgery)	None known	History of undescended testicle  Down syndrome
Voiding symptoms	Dysuria Urinary frequency Urethral discharge	Uncommon	Uncommon
Presence of fever	Possible with infectious epididymitis or orchitis	Uncommon	Uncommon
Nausea/vomiting	14% <sup>4</sup> 12.5% <sup>11</sup> 12.9% <sup>12</sup>	n/a <sup>4</sup> 3% <sup>11</sup> n/a <sup>12</sup>	33% <sup>4</sup> 32% <sup>11</sup> 62.8% <sup>12</sup>

n/a, not applicable.

associated with testicular torsion (Table 4). It is important to note that although clinical history can suggest a diagnosis, once again, it must be taken together with physical examination and diagnostic testing to guide medical management.

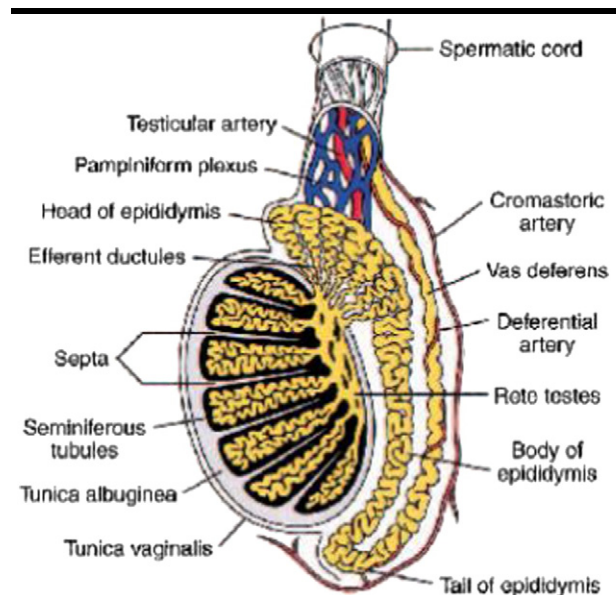
### Case 1, Continued

The patient's GU examination reveals Tanner Stage 1 with circumcised phallus without urethral discharge. The scrotal skin has intact rugations and is without significant edema. There is no redness. Both testicles are visibly descended within the scrotum. The right and left testicles have a normal lie. Palpation of the right testicle reveals no masses and is nontender. The epididymis is flat. The left testicle is mildly tender to palpation and more tender at the superior aspect, and the epididymis feels enlarged and is tender. The cremasteric reflex is intact bilaterally. No change in pain occurs with scrotal elevation. No inguinal hernias are appreciated. The abdomen is soft and nontender.

### Physical Examination

Performing a good physical examination requires a basic knowledge of scrotal and testicular anatomy (Figure 1). The scrotum is a sac-like structure located between the perineum and penis of males. It is composed of many tissue layers, which include skin, dartos fascia, spermatic fascia, cremaster muscle, and tunica vaginalis. The contents normally present within the scrotum include a portion of the spermatic

cord, the testicle, and epididymis. See Figure 2 for a schematic diagram of tissue layers within the scrotum.<sup>3,8</sup> When evaluating acute scrotal pain, these intrascrotal contents form the basis for much of the differential diagnosis. The testicle is the male reproductive organ and is responsible for sperm production and maturation as well as endocrine

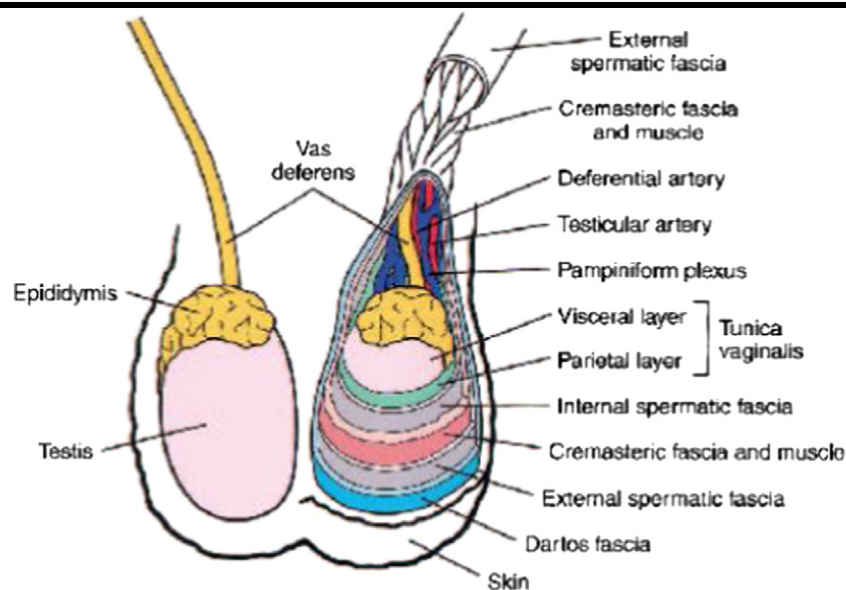


**Figure 1.** Schematic diagram of internal anatomy of testicle, epididymis, and spermatic cord. Reprinted with permission from Sudakoff et al.<sup>13</sup>

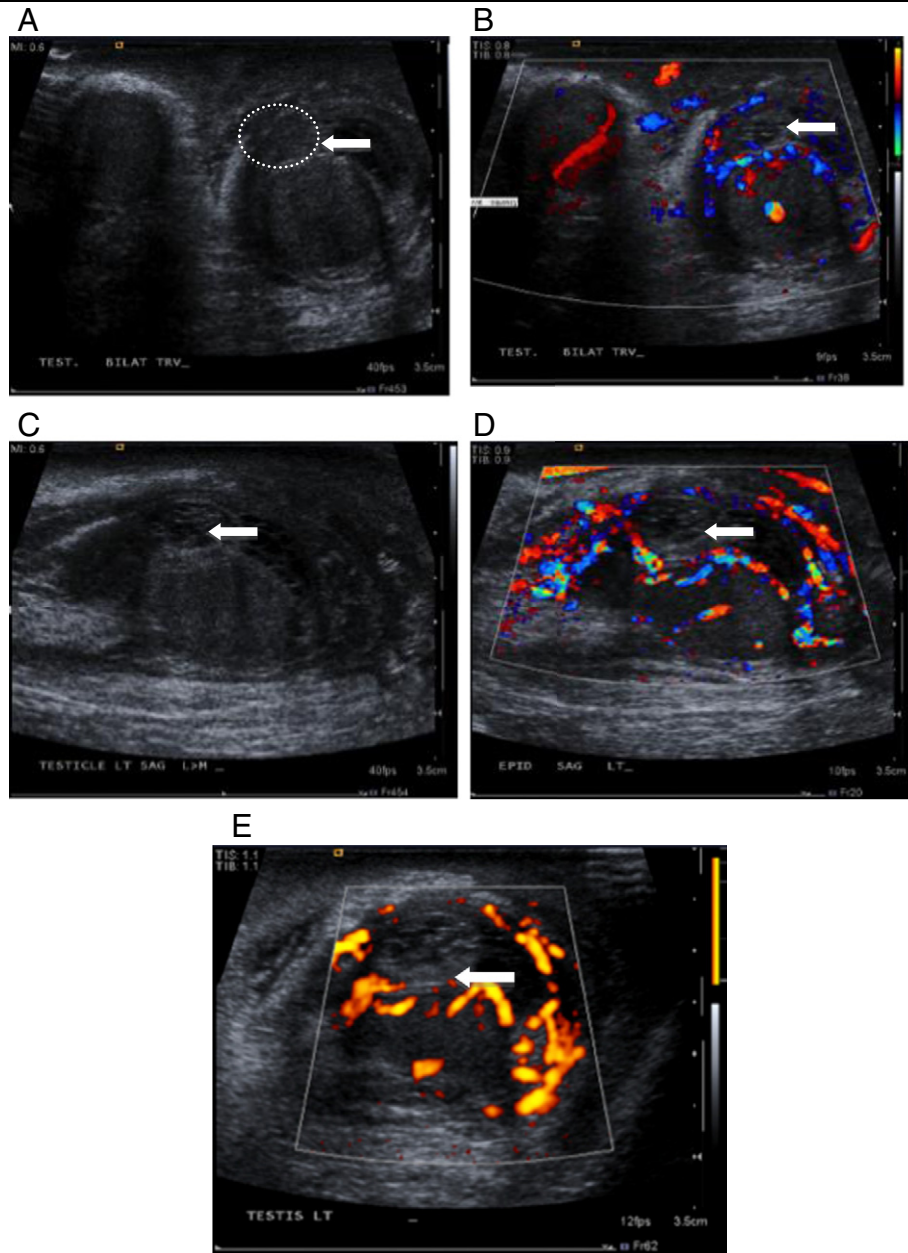
function through androgen production. The testicle descends from an intraabdominal location through a tunnel of peritoneum (processus vaginalis), which extends from the peritoneal cavity through the inguinal canal and into the scrotum during 20 to 28 weeks of gestation. Testicular descent is also accompanied by the extension of abdominal wall layers and the development of spermatic fascia and the cremaster muscle around the spermatic cord and testicle.<sup>1</sup> Once the testicle has completely descended into the scrotum, the processus vaginalis obliterates at the level of the testicle. This closure of the processus vaginalis prevents communication between the scrotum and peritoneal cavity. Defects in the closure of the processus vaginalis can result in conditions that can cause acute scrotal pain such as hernias and hydroceles. Testicles that also do not fully reach the scrotum have poorly developed tunica vaginalis and are predisposed to developing testicular torsion. Just posterior to the testicle is the epididymis. This is a structure primarily involved in the storage and maturation of sperm. The epididymis has continuity with the testicle through efferent ductuli and continues on through the spermatic cord as the vas deferens. See Figure 3 for a schematic diagram detailing the internal anatomy of the testicle and epididymis.<sup>3,8</sup> The vas deferens is a muscular tube that takes a retroperitoneal course and inserts into the urethra at the ejaculatory ducts. In infectious epididymitis, it is thought that the retrograde flow of urine through the ejaculatory ducts and vas deferens can cause infection within the epididymis. The other

main structure within the scrotum is the spermatic cord. Within the spermatic cord lies the blood supply to the testicle, vas deferens, nerves, and lymphatics.

During the physical examination for acute scrotal pain, there should be a focus on the GU and gastrointestinal examinations. Within the GU examination, one should visually inspect the scrotum and note any swelling, color changes, and skin changes. The patient can be supine or standing for the examination. An ideal position would have the child supine with knees propped up and to the side. From visual inspection, one may also determine whether both testicles are descended. Right after an initial inspection, one can test for the presence of the cremasteric reflex by lightly touching the inner thigh and looking for retraction of the testicle. Both sides should be tested, and symmetry of reflex, recorded. The urethra should be visually inspected, and any discharge should be noted. If discharge is present, one can send a urethral swab or can obtain testing of the urine. One should document the position of the urethral meatus and circumcision status of the patient. During palpation of any area with significant erythema and edema in the setting of a clinical history of immunosuppression, fever, and increasing groin erythema, one should assess for fluctuance and crepitus and mark the margins of redness. Examination of the nonpainful testicle should precede examination of the side with pathology. One should note the size, location of the testicle, and its lie (horizontal vs upright). The testicle should then be palpated for any masses,



**Figure 2.** Schematic diagram of structures and tissue layers within the scrotum. Reprinted with permission from Sudakoff et al.<sup>13</sup>



**Figure 3.** Color Doppler ultrasound of pediatric patient with acute scrotal pain. Arrow in each image points to necrotic appendix testis. A, Bilateral testes transverse view, B mode. Dashed oval surrounding appendix testis. B, Bilateral testes transverse view, color Doppler. C, Left testes sagittal view, B mode. D, Left testes sagittal view, color Doppler. E, Left testes sagittal view, power Doppler.

lesions, or tenderness. The epididymis is posterior to the testicle and can be palpated and should be flat and nontender. The spermatic cord can also be examined, and one should note any evidence of swelling, twisting, or mass at the spermatic cord. During examination of the painful testicle, once again, start with visual inspection and note the position (high or low) and lie of the testicle. Any skin changes over the testicle should also be noted. Before the examination, asking the child to point

with 1 finger where it hurts the most can be useful in localizing the pathology. The testicle and epididymis should be palpated for any masses, lesions, and areas of tenderness. Once again, the spermatic cord should also be evaluated for swelling or twisting. Elevating the testicle and evaluating whether this improves symptoms is known as Prehn's maneuver. Given the possibility for hernias and hydroceles, the inguinal canal should also be palpated. It is important to note that the vas deferens, which

**TABLE 5. Odds ratio of key physical examination findings in relation to etiology of scrotal pain.**

Physical Examination Finding	Testicular Torsion	Torsion of Appendix Testis Epididymitis	
Absence of cremasteric reflex	OR: 11 <sup>5</sup> OR: 27.8 <sup>3</sup>		
Prehn's sign	OR: 1.4 <sup>5</sup>		
Horizontal lie testicle	OR: 18 <sup>5</sup>		
High scrotal location	OR: 58.8 <sup>3</sup>		
Blue discoloration to scrotum (blue dot sign)	OR: 0.37 <sup>3</sup>	OR: 28.6 <sup>14</sup>	OR: 0.06 <sup>14</sup>
Tender nodule		OR: 2.9 <sup>14</sup>	OR: 0.5 <sup>14</sup>
Epididymal tenderness		OR: 0.06 <sup>14</sup>	OR: 17.8 <sup>14</sup>

OR, odds ratio.

travels with the spermatic cord through the inguinal canal, is directly connected to the epididymitis, and inflammation and irritation may radiate along the inguinal canal to the lower abdomen. The abdomen should be examined and palpated for any signs of peritonitis or bowel obstruction from an incarcerated hernia. A general examination should be performed looking at the status of the patient's cardiovascular system and whether they are suitable to undergo anesthesia for surgery if needed. The skin should also be examined for any rashes that might suggest the presence of vasculitis.

Physical examination findings have been correlated with certain etiologies (Table 5). Specifically for testicular torsion, there is an increased odds ratio for high location within the scrotum, transverse lie, and absence of the cremasteric reflex.<sup>2,5,6</sup> In a recent single-institution series of 241 boys with acute scrotal pain that underwent surgical exploration, in terms of physical examination findings, investigators found that acute torsion and epididymitis differed with regard to painful epididymis on palpation (epididymitis,  $P = .028$ ) and a positive blue dot sign (acute torsion,  $P < .001$ ).<sup>3,7</sup> Once again, these physical examination findings should be combined with clinical history and diagnostic tests to best determine management.

### Case 1, Continued

Urinalysis was performed and showed no evidence of pyuria or hematuria. A color Doppler ultrasound was performed (Figure 3). No intratesticular masses were seen on either side, and there was good bilateral intratesticular blood flow, although increased in the left testis with higher velocity and decreased resis-

tance, suggesting reactive hyperemia. A complex heterogeneously hypoechoic and septated structure in between the L epididymal head and L testis measuring 7 mm in greatest diameter was seen. This structure did not have any blood flow within the center or within the wall. There was also extensive surrounding hyperemia in this region. The epididymal head was prominent with increased blood flow. These findings were concerning for a previously torsed and now necrotic appendix with reactive epididymitis and hyperemia of the testis due to significant inflammatory response. The right epididymal head was normal in size. There was no hydrocele on the right side, and there was no varicocele.

## Diagnostic Tests and Consultation

### Surgical Consultation

In cases where the clinical history and physical examination are highly suspicious for testicular torsion, there is no need to obtain any other diagnostic tests, and surgical consultation should be initiated promptly and the patient readied for the operating room. Testicular torsion is a vascular emergency that requires reestablishment of blood flow to testicular parenchyma. Confirmatory color Doppler ultrasound can be performed during the time of patient preparation for surgery but should not delay surgical treatment. When testicular torsion is not highly suspected, other diagnostic tests should be pursued to elucidate the etiology for scrotal pain. If during this workup there is evidence of testicular torsion or another surgical emergency such as testicular rupture/fracture, prompt surgical consultation should be obtained.

Fournier gangrene is a necrotizing fasciitis of the perineum and genitalia more commonly caused by polymicrobial bacteria but, in some cases, can be caused by 1 species of bacteria. This is another etiology that requires prompt surgical consultation. Given the connection of the scrotal fascial layers with the abdominal wall layers, this infection can spread quickly from the scrotum to affect a large portion of the body and become life threatening without prompt initiation of parenteral antibiotics and surgical debridement. Clinical history of immune suppression or deficiency from steroids, chemotherapy, diabetes mellitus, or transplant medications with a history of systemic symptoms such as fever and malaise with physical examination findings of crepitus, necrosis, or rapidly spreading erythema all suggest this diagnosis.

The presence of an incarcerated or strangulated inguinal hernia also warrants surgical consultation. A

strangulated hernia is a true surgical emergency, as the blood flow to the herniated segment of bowel is diminished and can lead to bowel ischemia and necrosis. An incarcerated hernia is one in which the bowel segment cannot be manually reduced, but there is no clinical evidence of strangulation. The overlying skin appears normal, and bowel sounds can still be heard through the herniated segment. Incarcerated hernias pose a problem because of the possibility of progressing to a strangulated hernia and because they can also serve as a point of bowel obstruction.

Cases of scrotal trauma also require prompt surgical consultation, as testicular rupture or avulsions are emergencies that require scrotal exploration and repair. This will be discussed in a later portion of this article. Remaining etiologies for nontraumatic acute scrotal pain, such as torsion of appendix testis, epididymitis, hydrocele, and varicocele, can be managed conservatively and usually do not require emergent surgical exploration.

### **Color Doppler Ultrasound**

Color Doppler ultrasound has been frequently used to complement physical examination findings and clinical history in diagnosing testicular torsion. In 2000, Baker et al<sup>15</sup> retrospectively looked at the accuracy of color Doppler ultrasound in patients with a low suspicion of torsion based on clinical and physical examination findings. They found that Doppler ultrasound demonstrated a 1% false-positive rate, sensitivity of 88.9%, and specificity of 98.8% in this population.<sup>15</sup> In a large retrospective series, Yang et al<sup>2</sup> found that among the 103 patients with testicular torsion, 4.9% demonstrated normal flow, 1.9% increased flow, and 93.2% had decreased flow on Doppler ultrasound. More recently, a prospective trial looking at the accuracy of color Doppler in patients suspected or referred for testicular torsion found sensitivity, specificity, positive predictive value, and negative predictive value of 100%, 75.2%, 80.4%, and 100%, respectively.<sup>16</sup> The authors of the article go on to conclude that routine scrotal exploration in the setting of a negative ultrasound is unnecessary. The drawback to this study is that their study population was a group referred for testicular torsion or those who had a high clinical suspicion for torsion. Thus, a sensitivity of 100% may be an overestimation of color Doppler ultrasound's ability to detect testicular torsion in a population with equivocal history and examination. Once again, ultrasound does provide a noninvasive method of evaluation and, if readily available, should be used. With regard to ultrasound reports and images, it is advised to personally look

over ultrasound images with or without a radiologist in cases of acute scrotum.

In cases with an ultrasound diagnosis of torsion of the appendix testis, it is important to ensure that the testicular parenchyma has both venous and arterial blood flow and that the area of poor perfusion is in the area of an expected appendix testis. Radiologists have looked at criteria to diagnose torsion of the appendix testis and found that size greater than 5.6 mm provides 100% specificity.<sup>17</sup> Thus, one should also look at the size of the appendix testis. It is appropriate to pursue conservative management in patients with clinical symptoms and physical findings that do not suggest testicular torsion with an appendix testis greater than 5.6 mm in size. It is important to note that most reported cases of torsion of the appendix testis in the literature were primarily diagnosed on scrotal explorations and that there are no large published series looking at patient outcomes with children conservatively managed based on a sonographic diagnosis of torsed appendix testis.

With regard to epididymitis, ultrasonography usually reveals increased blood flow to the epididymis and epididymal enlargement. These findings, however, can also be present secondary to torsion of an appendix testis, and thus, torsion of the appendix testis should also be assessed. One study helped convey some slight differences in ultrasound findings between torsion of the appendix testis and epididymitis. These findings were increased epididymal echogenicity in epididymitis,  $P = .043$ , and augmented peritesticular perfusion in epididymitis,  $P = .05$ .<sup>14</sup> In a series of children with and without urinary tract anomalies, 1 group found enlargement of the epididymis to be more commonly seen in children with urinary tract anomalies.<sup>18</sup> In a recent large retrospective study, ultrasound findings of increased blood flow and epididymal enlargement were seen in 87% of patients seen in the outpatient urology clinic setting.<sup>19</sup>

### **Urinalysis and Urethral Swab**

Urinalysis is a test usually sent during episodes of acute scrotal pain to determine whether there is pyuria. Pyuria is defined by the presence of white blood cells within the urine and can be manually assessed by looking at a urine specimen under the microscope. Pyuria on urinalysis has been extensively used in the detection of urinary tract infection within the pediatric population. In a recent prospective trial, pyuria in uncentrifuged urine, defined as greater than 5 white blood cells per high-power field, had a sensitivity of 84%, specificity of 94%, positive predictive value of 53%, and negative predictive value of 99% in detecting urine cultures that would ultimately grow greater than 50 000 colony-forming



units per milliliter of bacteria.<sup>20</sup> The pathophysiology of infectious epididymitis is thought to be due to retrograde flow of infected urine from the urethra through the ejaculatory ducts through the vas deferens and into the epididymis, and it has been clinical practice to assume that pyuria would be a good marker for infectious epididymitis because it has been used as a marker for urinary tract infections. Two retrospective studies have looked at patients diagnosed with epididymitis and the correlation with pyuria on urinalysis or a positive urine culture. Unlike urinary tract infections, the 2 studies found that most patients diagnosed with epididymitis did not have pyuria or positive urine culture. In a study from Korea, 73 (96.1%) of 76 cases had negative pyuria in urinalysis. In a US study, among 140 cases of epididymitis, only 9 had pyuria or a positive urine.<sup>21</sup> These results may reflect clinicians overusing or incorrectly using the diagnosis of epididymitis but, more importantly, convey that most patients with epididymitis do not have bacterial infection.

Urinalysis can also convey the presence of hematuria, which may suggest the presence of urinary tract calculi. Calculi in the distal ureter can occasionally cause pain to radiate down the ipsilateral groin and present as acute scrotal pain. In postpubertal children who are sexually active with urethral discharge, it is appropriate to culture the urethral discharge or send a urine culture for sexually transmitted disease testing.

### Case 1, Continued

The patient was diagnosed with torsion of the appendix testis with reactive epididymitis. A urine culture was sent. He was managed with scrotal support, no strenuous activity for 2 weeks, oral nonsteroidal anti-inflammatory drugs (NSAIDs), and a 14-day course of Bactrim. Pediatric urology follow-up 3 weeks later revealed a normal urinalysis with resolution of pain and no evidence of testicular atrophy.

### Management

Testicular torsion requires prompt scrotal exploration with detorsion and orchidopexy with or without contralateral orchidopexy. Institutions that do not have a urologist available can transfer the patient to another hospital with these services. Two studies have looked at the impact of hospital transfers on patient outcomes in torsion and found that transfer between hospitals did not affect testicular salvage in torsion.<sup>22,23</sup> In cases where the testicle is not salvageable, the patient may undergo orchiectomy with or without placement of a prosthesis. Testicular atrophy and necrosis strongly correlate with length of ischemia time in torsion.<sup>8</sup> Despite high rates of testicular

salvage in patients with pain duration less than 6 hours, patients must be informed that there is still potential for permanent damage. Conversely, although prolonged ischemia times of 12 to 48 hours are associated with higher incidence of death and atrophy, one should not delay any attempt for salvage, as there have been cases of successful salvage at these time points. Before surgical intervention, patients should avoid the use of NSAIDs for pain, as these have been shown to increase bleeding times. The patient should be kept NPO, and parents and the child should be informed of the possible need for orchiectomy.

Patients diagnosed with testicular torsion should have manual detorsion attempted at the bedside to restore blood flow to the ischemic testicle, especially if surgical intervention may be delayed. Manual detorsion is a maneuver performed at the bedside and entails spinning the testicle in a lateral direction, as most of spermatic cord twisting occurs medially. The biggest difficulty in performing manual detorsion is the pain associated with manipulating the torsed testicle. In testicular torsion, there is also a 33% chance<sup>24</sup> that the spermatic cord has twisted in a lateral fashion, and by twisting the cord laterally, one may introduce more coiling of the cord and worsen ischemia. With the advent and increasing bedside use of portable ultrasound machines, successful manual detorsion can be confirmed with Doppler color flow. It is important to note that a spermatic cord can twist multiple times, and thus, a single rotation in one direction may not alleviate symptoms. In this situation, if the pain worsens or if there is no improvement in flow by color Doppler, one can attempt twisting the testicle in the opposite direction. During this manipulation, clinicians have used conscious sedation and local anesthetic blocks, which may make it difficult to assess success of detorsion by symptoms. This is when color Doppler becomes important. Other temporizing measures such as inducing cold ischemia with ice<sup>25</sup> and hyperbaric oxygen<sup>26</sup> have been studied in an animal model that showed improved histologic outcomes for ischemia/reperfusion. However, these measures have not been looked at during clinical practice.

Epididymitis and torsion of the appendix testis usually do not require surgical intervention. Mainstays of therapy for torsion of the appendix testis include NSAIDs, bed rest, scrotal elevation, and close urologic follow-up. Pediatric epididymitis management in the emergency department setting usually involves sending a urine culture and empirically treating children with a course of antibiotics. Most retrospective studies looking at children with epididymitis diagnosed in the emergency department have found a low incidence of positive urinalysis and

positive urine cultures,<sup>21</sup> thus suggesting overtreatment with antibiotics in this condition. Current management suggests that epididymitis can be conservatively managed with NSAIDs and scrotal elevation. Urine cultures should be sent, and the need for antibiotic therapy can be tailored from these results. In 1 study, managing children without antibiotics revealed similar outcomes for pain resolution.

## SCROTAL TRAUMA/INJURY

In addition to nontraumatic etiologies for acute scrotal pain, direct injury to the scrotum from blunt force, penetrating injury, or burns are obvious reasons for acute scrotal pain. Trauma is an important factor when evaluating a child with acute scrotal pain, as conditions such as testicular avulsion or testicular rupture, which can result from blunt force or penetrating scrotal trauma, warrant timely surgical evaluation and intervention. Evaluation of the patient with trauma has some similarities to patients with nontraumatic scrotal pain, but there are some slight differences. In the setting of trauma, there is an immediate need to assess the integrity of structures and diagnose any conditions that require surgical intervention. In addition, clinical history may be more difficult to obtain from the patient, and information may need to come from a second-hand observer or family member. Some traumatic injuries result in gross distortion of the genitalia that makes physical examination difficult. Other specific injuries to the scrotum that can be seen in the emergency department setting include animal bites and skin avulsion.

### Case 2

A 17-year-old adolescent male presents to the emergency department after being kicked in the groin while fighting at school. He said the fight was 1 hour ago and that the other kid was wearing “work boots.” He reports no other injuries to the genitalia and states that he has had no difficulty urinating. He has had severe pain in his left scrotum and noticed some bruising.

### History of Present Illness

During evaluation of any trauma patient, it is important to define the mechanism of injury. One should determine when the trauma occurred, characterize whether the injury was from blunt force or from a penetrating injury, and get an idea as to the general amount of force delivered to the injured area and whether other adjacent structures

**TABLE 6. Injuries seen with blunt and penetrating scrotal trauma.**

#### Blunt Scrotal Trauma

Testicular fracture with or without rupture  
 Testicular dislocation  
 Testicular avulsion  
 Testicular torsion  
 Hematocele  
 Scrotal hematoma  
 Epididymal injury  
 Urethral injury

#### Penetrating Scrotal Trauma

Testicular fracture  
 Hematocele  
 Epididymal injury  
 Rectal injury  
 Urethral injury

may have been injured. The testicle, epididymis, penis, urethra, and rectum are structures within the vicinity or located in the scrotum, and thus, are susceptible to injury. The testicle, in particular, is subject to avulsion, fracture, or dislocation. Table 6 provides a list of potential injuries seen during scrotal blunt force or penetrating trauma. Any changes in the size or coloration of the scrotum should be elicited, and if possible, the pain should be characterized by its location, palliative factors, timing, quality, and radiation. During the history, one should also keep in mind to look for any data that may suggest abuse. A good review of systems will provide insight into the health of major organ systems. One should also question any history of blood per rectum or per urethra once again to delve into whether the rectum or urethra may be compromised. In burn injuries, it is necessary to determine whether the injury was thermal, chemical, or electrical, as the amount of tissue destruction differs for each source. The source of the flame and any force from an explosion should be elicited, type of chemical (acid, base) and source for electrocution (electrical outlet, fallen electrical line). When dealing with animal bites, it is important to elicit what type of animal was involved in the attack and, if possible, whether the animal has been domesticated and received its appropriate vaccines. Skin avulsion injuries should prompt a history as to how the scrotal skin was injured. This injury is most commonly seen in motorcycle or bicycle accidents, and before this,

was commonly seen in agricultural accidents.<sup>27</sup> It is also important to assess the extent of damage to other organ systems after significant trauma.

### Case 2, Continued

On physical examination, the left testicle was visibly descended within the scrotum and was nontender to palpation. The skin of the right hemiscrotum had decreased rugations from edema and was purple/ecchymotic. The testicle was unable to be palpated through the edema and hematoma. There was significant tenderness to testicular manipulation.

### Physical Examination

In episodes of scrotal trauma, one should begin with visual inspection. One should note whether both testicles are visibly descended and whether there is any significant asymmetry in appearance. In cases of testicular dislocation, the force of trauma can cause the testicle to ascend into the inguinal canal or abdomen and leave the hemiscrotum empty. Scrotal skin should be inspected for color, edema, rugation, any visible wounds, bleeding, or drainage. The penis should be inspected for urethral blood or discharge. The tunica of the corporal bodies should be palpated for any areas of defect, and the skin inspected for any ecchymosis or wounds. The testicles should also be examined, and the tunica albuginea should be felt for

any disruptions. The epididymis should also be inspected and palpated, and the cord can also be palpated for any swelling or twisting. The external ring and inguinal canal should be inspected for any masses or hernias. In cases of burns, one should document areas affected, specifically the percentage of scrotum involved, presence of eschar, and any involvement of the penis or glans. The physical examination should also include assessment of other possible sites of injury, palpating the abdomen, and performing a digital rectal examination.

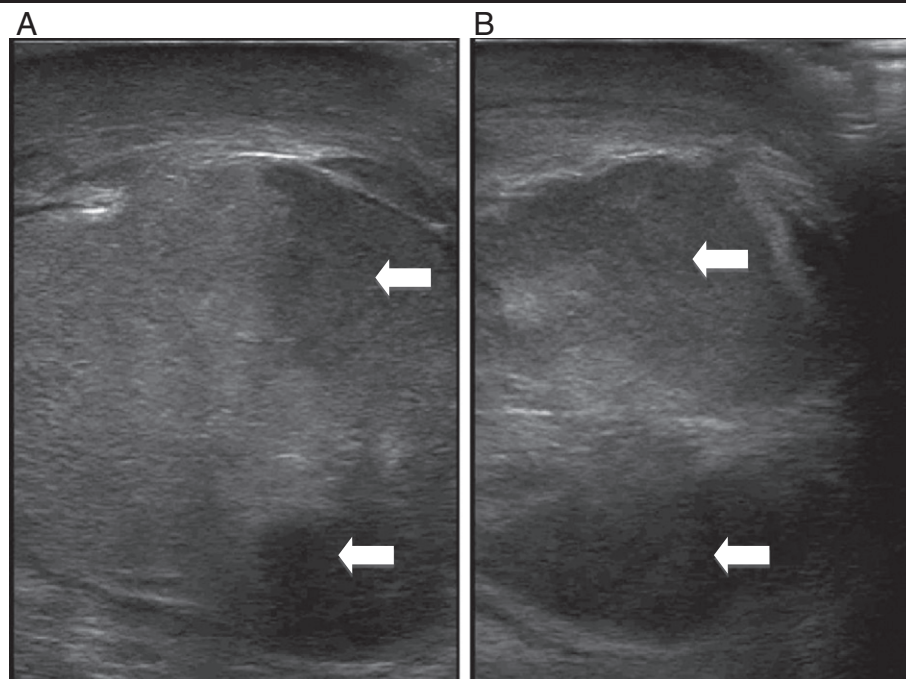
### Case 2, Continued

A scrotal ultrasound was performed (Figure 4) and demonstrated heterogeneous echotexture of the parenchyma with some distortion of the testicular contour. Rupture of the tunica was not identified. A scrotal hematoma was also detected. Doppler revealed diminished flow to hypoechoic areas.

### Diagnostic Tests and Consultation

#### Surgical Consultation

There should be a low threshold for surgical consultation in patients with trauma or direct injury to the scrotum. Consultation can be initiated without diagnostic imaging or in parallel in cases with a clinical history of high-energy transfer, deep



**Figure 4.** Ultrasound image in case of blunt scrotal trauma. Right testicle: A, sagittal view; B, transverse view. Arrows denote areas of hematoma.

penetrating injury, or burn and/or concerning physical findings such as a palpable tunical defect with loss of normal testicular volume and contour or an expanding pulsatile hematoma. It is important to remember that testicular torsion is within the differential and is a surgical emergency that requires immediate surgical intervention. There have been multiple cases of trauma-induced testicular torsion.<sup>28-30</sup> Patients who have deep penetrating injuries to the scrotum where there is concern for testicular rupture should also have prompt surgical evaluation. Surgical consultation should also be obtained for burns to the perineum and genitals. Assessment and any need for debridement or urinary diversion can be performed.

### **Doppler Ultrasound**

Color Doppler ultrasound should ideally be performed in all cases of direct trauma or injury to the scrotum in the setting of acute scrotal pain. There are no studies evaluating outcomes of cases managed without ultrasound evaluation or studies looking at a nomogram/score, which would allow one to safely omit color Doppler ultrasound in the evaluation of traumatic scrotal pain. Thus, omission should be a decision made after a good clinical history and physical examination, one which allows thorough examination of the genitalia. Imaging of the testicle during episodes of trauma can provide important information that can be sometimes difficult to obtain from a physical examination. Color Doppler ultrasound can assess the presence and location of fluid collections, identify masses and foreign objects, and assess blood flow to the testicle. The accuracy of color Doppler ultrasound in detecting testicular rupture has been studied through retrospective cohorts. Results have been variable and depend on what radiologic criteria are used to define testis rupture. When rupture is radiographically defined as the presence of a detectable defect in the tunica albuginea, the sensitivity of ultrasound is 50%. However, when using a radiographic definition of rupture as being when there is heterogeneous echo texture of the testicle with loss of contour, the sensitivity increases to 100%.<sup>31</sup> The ability to get a good ultrasound examination and images can be difficult in cases with large hematomas. This once again harkens to the necessity of weighing the results of diagnostic imaging with clinical history and physical examination. With regard to characterizing fluid collections, ultrasound can also help determine whether a hematoma is intratesticular or extratesticular. This is important because some large intratesticular hematomas may need to be surgically drained. The utility of ultrasound in detecting

epididymal injury has not been extensively studied. However, findings that may suggest epididymal injury are similar to those of epididymitis and include enlargement and hyperemia.

### **Case 2, Continued**

Because of clinical history, physical examination and ultrasound findings, the patient was taken to the operating room for scrotal exploration. During exploration, a rupture of the tunica was identified and primarily repaired. The hematoma was evacuated, and testicle appeared viable. Follow-up 6 months later revealed no atrophy of the testicle.

### **Management and Outcomes**

Rupture of the testicle is seen in both blunt and penetrating traumas, and the standard of care is prompt surgical exploration with repair. Outcomes with regard to infection, testicular loss, and atrophy are improved with early (<72 hours) vs late (>72 hours) surgical intervention.<sup>32</sup> There is 1 report of using conservative management in select cases of rupture. This study looked at delayed presentation of rupture (1-5 days) in a small cohort of adolescent boys (n = 7) and assessed the potential using conservative management.<sup>33</sup> The small size of the cohort, retrospective nature of the study, and short-term follow-up, however, does not justify this form of management in acute presentation or rupture and even within the studied presentation time. This approach should be seen purely as investigational. The presence of a large hematocele on ultrasound should alert the clinician of possible rupture and is also a condition in which scrotal exploration should be considered. Testicular fracture without blood flow or any ultrasound with diminished flow to the testicle should be managed with surgical exploration. Most penetrating injuries from ballistic trauma, such as gunshot wounds, require surgical exploration for potential testicular salvage. Superficial penetrating trauma from dog bites without evidence of testicular injury on examination and ultrasound can be managed by irrigation, antibiotics (Augmentin, second-generation cephalosporin, or clindamycin with a fluoroquinolone) and primary closure.<sup>34,35</sup> Human bites, however, should not be primarily closed and should be irrigated, packed, and treated with antibiotics (augmentin or moxifloxacin).<sup>36</sup> Burns to the scrotum and genitalia should be referred to burn centers where surgical evaluation and intervention can be pursued. Scrotal skin avulsion injuries that result in exposure of the testicle should prompt surgical consultation where reconstruction can be evaluated and performed if necessary.

## SUMMARY

Obtaining an accurate diagnosis and correct treatment plan in pediatric acute scrotal pain requires good clinical judgment based on clinical history, physical examination, and diagnostic tests. Outcomes for these children strongly rely on the interaction and collaboration between medical and surgical specialists. Future directions in this field include developing scores or nomograms integrating patient characteristics to guide diagnostic testing and treatment. The delayed presentation of children with scrotal pain to health care providers evident within published studies points to poor awareness of conditions, such as testicular torsion, with children and parents. Thus, another area of future research is looking at factors that may affect time to treatment in this condition and educational programs that might improve outcomes.



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