Pediatric Testicular Torsion

Paul R. Bowlin, MD*, John M. Gatti, MD, J. Patrick Murphy, MD

KEYWORDS

• Testis • Torsion • Acute scrotum • Epididymitis/orchitis

KEY POINTS

- Testicular torsion is a surgical emergency and requires prompt surgical exploration and management.
- The diagnosis of testicular torsion can be made by history and physical examination alone. When suspected, surgical management should not be delayed in an effort to obtain imaging.
- When unilateral testicular torsion is discovered, a contralateral orchidopexy should be performed to reduce the risk of asynchronous testicular torsion.

OVERVIEW AND HISTORY

The pediatric patient presenting with acute scrotal pain requires prompt evaluation and management given the likelihood of testicular torsion as the underlying cause. Although other diagnoses can present with acute testicular pain, it is important to recognize the possibility of testicular torsion because the best chance of testicular preservation occurs with expeditious management.

The first published report of testicular torsion was by Delasiauve in 1840, and Taylor first described newborn torsion in 1897. Torsion of a testicular appendage was recognized in 1922 by Colt.

EPIDEMIOLOGY

Although torsion of the spermatic cord and torsion of the testicular appendages can occur at any age, it is more common to see the former in postpubertal boys and the latter in prepubertal boys.[1,2] Adolescent boys are most commonly affected, with a smaller increase in frequency seen in newborns as well.[3] There is evidence to suggest that the risk of torsion can be inherited, particularly in cases of bilateral torsion.[4] The annual incidence of torsion is estimated at 3.8 per 100,000 (0.004%) for boys age 18 years and under.[5]

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Section of Urology, Department of Surgery, Children's Mercy Hospital, University of Missouri–Kansas City, 2401 Gillham Road, Kansas City, MO 64108, USA
* Corresponding author.
E-mail address: prbowlin@cmh.edu

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DIFFERENTIAL DIAGNOSIS

- Spermatic cord torsion
- Torsion of appendix testis/epididymis
- Tumor
- Hernia/hydrocele
- Epididymitis/orchitis
- Trauma/abuse
- Cellulitis
- Vasculitis
- Varicocele

PERINATAL TORSION

Torsion can occur during the prenatal or postnatal period and is collectively referred to as perinatal torsion. Establishing the timing of the torsion can have implications on future management but is often difficult to determine. Classically, prenatal torsion involves a twisting of the spermatic cord that occurs proximal to the tunica vaginalis—extravaginal torsion. It typically is identified at birth with a firm, discolored, and nontender hemiscrotal mass. It is often difficult to palpate the testicle separate from the scrotal skin as the inflammation causes fixation of the skin to the inflamed testicular mass. Postnatal torsion, by comparison, appears with more classic signs of torsion: acute inflammation, erythema, and tenderness. The key clinical finding that suggests postnatal torsion is the report of a previously normal scrotum and testicle at birth. Understanding this, timing is critical given that postnatal torsion should be treated as a surgical emergency with immediate exploration, detorsion, and orchidopexy of the contralateral testicle to prevent later torsion.

The management of true prenatal torsion remains debated.[6] The decision about the need for exploration, timing of exploration, and management of the contralateral testicle varies widely among practitioners. Factors that influence the decision include the age at which the torsion is diagnosed and overall health of the child. The debate exists because salvage of a prenatally torsed testicle is extremely unlikely,[7] the risk of neonatal anesthesia is higher than in older children,[8] and there is a risk of iatrogenic injury to the contralateral testicle. The age of the child at diagnosis influences the decision primarily because the tunica vaginalis becomes adherent to the surrounding dartos around 4 to 6 weeks of life. When the torsion is discovered after this 4- to 6-week age period, there is theoretically no longer a risk of asynchronous torsion and thus no need for prophylactic orchidopexy on the contralateral side. A prenatal (extravaginal) torsion event does not predispose the child to a future postpubertal (intravaginal) torsion event. **Fig. 1** outlines the authors' preferred management algorithm for perinatal torsion.

CLINICAL PRESENTATION

Testicular torsion classically presents with the sudden onset of severe unilateral scrotal pain. This pain is usually accompanied by nausea and vomiting. The pain is usually unrelenting and leads the child to immediately notify a caregiver, although very stoic children will often delay reporting the pain. Delays in recognition can also be seen in children who are unable to communicate with their caregivers.

Within hours of the torsion event, the scrotum will begin to show varying degrees of erythema, swelling, and induration. In cases where the evaluation occurs long after the

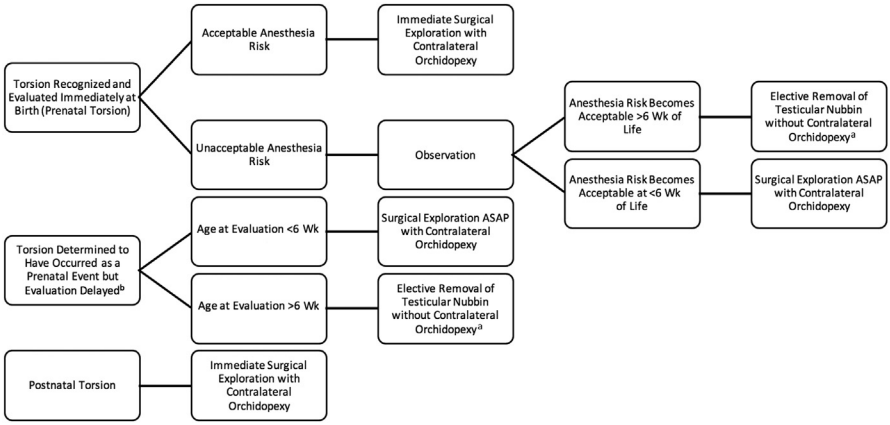

Fig. 1. Management algorithm for perinatal testicular torsion. [a]Observation is reasonable when the history and examination do not raise any concern for the presence of an intra-abdominal testicle. [b]When torsion timing is unclear, the decision of management needs to be based on a comprehensive discussion with the caregivers. ASAP, as soon as possible.

onset of symptoms, the severity of the scrotal edema can be quite severe and can make examination of the underlying testicle quite difficult.

INITIAL EVALUATION

The 2 most important components of the initial evaluation are the history and physical examination. These 2 elements alone are enough to establish the diagnosis and prompt treatment. It is important to recognize that any boy presenting with abdominal pain associated with nausea and vomiting requires a scrotal examination to evaluate for testicular torsion. Key components of the history that suggest acute testicular torsion include the following:

- Immediate onset of severe, unilateral scrotal pain
- Unrelenting pain
- Associated nausea/vomiting
- Described change in the position of the testicle

The physical examination should include a thorough investigation of the abdomen, inguinal region, penis, and scrotum. Key components of the physical examination include the following:

- Unilateral testicular tenderness
- Elevation (high-riding) of the testicle
- Transverse testicular orientation
- Palpation of the epididymis anteriorly
- Absent cremasteric reflex

The presence or absence of the cremasteric reflex is a classic teaching point in the evaluation of the acute scrotum. It is elicited by lightly stroking the inner thigh on the side of the suspected torsion. The resultant reflex occurs due to stimulation of the sensory fibers of the femoral branch of the genitofemoral nerve. This afferent input ascends to the brain, where there are superimposed cortical pathways that allow the signal to cross over and connect with motor centers that result in the efferent

stimulation of the genital branch of the genitofemoral nerve, which innervates the cremaster muscle.[9] Although the cremasteric reflex is frequently absent in cases of acute torsion, the presence of the reflex does not exclude torsion.[10] The reflex is more reliable when absent on the side of pain but present on the normal side. It is less reliable when absent on both sides.

INITIAL MANAGEMENT

When the history and examination suggest testicular torsion, surgical exploration should immediately follow. If surgical care is not immediately available, an attempt at manual detorsion can be performed. Classically, this maneuver is instructed to be done in a fashion that rotates the testicle from medial to lateral, colloquially referred to as the "open book" rotation. From the perspective of the provider standing face to face with the patient, this means rotating the right testicle counterclockwise and rotating the left testicle clockwise. The success of this technique is hampered by patient discomfort, incomplete (or partial) detorsion, as well as the possibility of rotating the testicle in the wrong direction. Around one-third of testicles will be found to have rotated from medial to lateral, a situation that is only worsened when a classic "open book" detorsion maneuver is attempted.[11] In addition, the number of testicular rotations can range from 180° to 1080°, leaving open the possibility of only partial untwisting the testicle with a manual detorsion maneuver.

If manual detorsion is successful, the patient will typically have immediate relief of their pain. Although this relief may result in a longer window for testicular salvage, it should not delay prompt surgical management and fixation.

IMAGING AND LABORATORY TESTS

As stated throughout this article, clinical suspicion for acute testicular torsion mandates immediate surgical exploration. The acquisition of confirmatory imaging is generally unnecessary and typically only results in a delay in definitive management.[1] Although currently this principle remains unchanged, the advent of point-of-care ultrasound in the emergency department may ultimately lead to an environment where bedside imaging may almost be considered an extension of the physical examination with almost no delay in further management.[12]

Imaging is generally recommended only in cases where the cause of the acute scrotum is not thought to be due to acute torsion. Ultrasound with color-flow Doppler and radionuclide imaging are the 2 most commonly used imaging modalities. Although radionuclide imaging has been the historical examination of choice, the use of ultrasound with Doppler is now widely favored because of its excellent visual resolution, ability to detect the presence or absence of blood flow, availability, and lack of ionizing radiation. Ultrasound has a sensitivity and specificity of 89.9% and 98.8%, respectively, with a false-positive rate of 1% when performed by experienced providers.[13] The integration of any radiologic study, however, still needs to include the other aspects of the evaluation because false negatives can occur.[14]

Laboratory investigation in cases of suspected torsion is rarely necessary. In cases where the individual's medical history of presentation raises concern for a serious abnormality that can be demonstrated with laboratory data (anemia, coagulopathy, severe electrolyte disturbance, and so forth), laboratory investigation can be pursued. As a general principle, however, this should not delay progression to the operating room unless the risk of anesthesia is thought to be much greater than the likelihood of testicular salvage. In this unusual scenario, accepting the risk of testicular loss and theoretic risk of contralateral torsion may warrant consideration. Once the

anesthetic risk is deemed acceptable, however, urgent surgical management should be undertaken.

OPERATIVE MANAGEMENT

Once surgical management is decided on, it should occur as quickly as possible. Testicular salvage rates are associated with the duration of ischemia with a "golden" window of 4 to 8 hours from the time of torsion to time of detorsion. Although an inguinal or hemiscrotal approach is reasonable, most surgeons use a midline raphe incision. Access via the midline allows each hemiscrotum to be independently explored and, once healed, the surgical scar is typically imperceptible. The general steps in the operative management of torsion are as follows:

- Midline scrotal incision
- Cautery dissection through the dartos layers of the symptomatic hemiscrotum to expose the underlying testicle
- Delivery of the testicle through the dartos
- Inspection of the tunica vaginalis and spermatic cord for extravaginal torsion (unlikely outside of newborn period)
- Incision and eversion of the tunica vaginalis to allow inspection of the testicle and epididymis
- Detorsion of the testicle noting direction and degrees of torsion
- Placement of detorsed testicle in a warm gauze sponge
- Cautery dissection through the dartos layers of the contralateral hemiscrotum to expose the underlying testicle
- Delivery of the testicle through the dartos
- Incision and eversion of the tunica vaginalis to allow inspection of the testicle and epididymis
- Fixation of the contralateral testicle
- Repeat inspection of the symptomatic testicle
  - Obviously nonviable → orchiectomy
  - Obviously viable → orchidopexy
  - Questionably viable → orchiectomy or ochidopexy

The assessment of testicular viability is a relatively subjective aspect of the surgical management. When viability is questionable, additional investigation can be performed, including incision of the tunica albuginea to inspect for active bleeding and to assess the viability of the seminiferous tubules. When no bleeding is observed and/or the tubules appear densely ischemic, orchiectomy is generally favored. In the presence of active bleeding and/or viable-appearing tubules, however, orchidopexy should be considered.

More recently there has been emerging evidence to support a third approach to the questionably viable testicle. Decompression of the tunica albuginea via a wide longitudinal incision along its surface (fasciotomy) followed by coverage of the defect with a tunica vaginalis flap has shown encouraging results as an option for testicular salvage.[15] This approach still mandates testicular fixation but theoretically allows for relief and recovery of the testicular "compartment syndrome." Although the long-term success of this option is difficult to definitively assess, it is a potentially useful option for the questionably viable testicle. The surgical technique itself has been described by Kutikov and colleagues.[16]

In cases where a torsed gonad is preserved, there has been concern raised about the possibility of damage to the contralateral testicle because of antisperm antibodies.

This debate includes cases of testicular salvage using a tunica vaginalis flap. These concerns generally arise from animal studies with the physiologic significance in humans remaining a source of debate.[17] In cases of torsion of a solitary testicle however, it is obviously recommended to make every attempt to preserve the testicle regardless of its likelihood of future atrophy. Adjuvant procedures, such as the aforementioned tunica vaginalis flap, should also be considered as a means to potentially save a gonad that would otherwise be unlikely to survive.

The techniques used to perform orchidopexy vary widely among surgeons, including debate about the following:

- Number of points of testicular fixation (typically between 1 and 3)
- Use of permanent or dissolvable suture
- Use of suture fixation versus placement of testicle within a dartos pouch alone
- Placement of fixation sutures within scrotum (medial, lateral, inferior, or a combination of all 3)

At the authors' institution, orchidopexy, in the setting of testicular torsion, is typically done in 1 of 2 ways. The first technique is to place the testicle partially back within the tunica vaginalis, leaving the anterior one-third of the surface of the testicle exposed. The edges of the tunica vaginalis are then tacked to the testicle in several places with an absorbable suture (polydioxanone or polyglactin). The second technique uses polypropylene suture to tack the tunica albuginea to the interior surface of the scrotum. This tacking is typically done inferiorly, laterally, and either anteriorly or medially for 3 total points of fixation.

FOLLOW-UP

In general, children recover well after surgery and can typically be discharged to home from the recovery room regardless of the surgical outcome (orchidopexy or orchiectomy). Outpatient follow-up several weeks after the procedure allows for evaluation of delayed atrophy. In cases where orchiectomy was performed, it also allows for discussion about future placement of a testicular prosthesis, should one be desired. Recommendations to avoid specific activities or sports are generally not given, but emphasis is given regarding the utilization of appropriate protection. Finally, it allows an opportunity to discuss the importance of testicular self-examination, a valuable topic for all male adolescents regardless of the outcome of their torsed testicle.

When counseling patients and families about torsion, it is important to remind them that the fixation of the testicle does not rule out the potential for future torsion. Recurrent torsion has been reported and requires urgent evaluation identical to an initial torsion event.[18] Similarly, studies have shown that there may be a component of heritability with testicular torsion[4] as well as a lower likelihood of testicular salvage in boys who experience an acute torsion event after having a sibling with torsion.[19] The latter phenomenon is difficult to explain but thought to potentially be related to a form of "desensitization" regarding testicular pain from the perspective of the caregiver.

INTERMITTENT TESTICULAR PAIN

Intermittent testicular pain is a frequent complaint, particularly among male adolescents. Although a history of testicular pain with spontaneous resolution should raise concern for the possibility of intermittent testicular torsion, a detailed history and examination can often elicit an alternate cause, as described in the differential diagnosis section. Anecdotally, people frequently associate testicular pain with puberty and the

testicular growth that accompanies the early stages of puberty. These so-called growing pains, however, are not well described in the literature.

Individuals thought to be most at risk for intermittent testicular torsion include those with a "bell-clapper" deformity. Normally the tunica vaginalis invests upon the length of the posterior side of the testicle and epididymis, effectively fixing the testicle within the scrotum and limiting the risk of testicular torsion. When the tunical investments attach more proximally on the spermatic cord, the testicle and epididymis are allowed to hang more freely and take on a horizontal lie (**Fig. 2**), creating a narrow point of rotation that may predispose one to developing testicular torsion. The incidence of the "bell-clapper" deformity has been reported to be as high as 12% and can frequently be a bilateral process.[20] Considering that testicular torsion occurs at an incidence far lower than 12%, it is clearly not an isolated risk factor for testicular torsion. When evaluating the child with intermittent testicular pain and a "bell-clapper" deformity, it is important to counsel the patient and family about its association with testicular torsion. The risk of torsion must be weighed against the risks of anesthesia, persistent or worsened pain, and iatrogenic testicular injury or loss.

MIMICKERS OF TESTICULAR PAIN

Inflammation of the testicle and/or epididymis can occur in response to infection (viral or bacterial), trauma, torsion of the appendages, and urinary reflux into the ejaculatory duct/vas deferens, which is commonly referred to as "chemical" epididymitis/orchitis. True bacterial infections in children are generally rare. When suspected, a urine analysis and culture can be obtained. Investigation of sexually active adolescents for Gonococcus and Chlamydia is often warranted. If a true bacterial infection is diagnosed, consideration should be given to obtaining imaging of the urinary tract (renal/bladder ultrasound and/or voiding cystourethrogram) once the infection has been treated. Other anatomic abnormalities such as ectopic ureter (to the vas, ejaculatory duct, or seminal vesicle), ejaculatory duct obstruction, or posterior urethral valves may need to be considered and ruled out. Viral infections are also a rare source of testicular/epididymal inflammation. Historically, mumps orchitis, in postpubertal boys, was a common cause, which is rare today because of immunization.

Fig. 2. Bilateral "bell-clapper" configuration of the testicles. Note the transverse testicular lie of the testicle relative to the spermatic cord. This patient underwent bilateral orchidopexy with complete resolution of his previously intermittent bilateral testicular pain.

Adenovirus, enterovirus, influenza, and parainfluenza viruses have all been implicated as infectious causes. Although viral culture and serology can be obtained, it is generally unnecessary because supportive treatment is typically all that is required.

When evaluating the child with testicular pain thought not due to acute torsion or infection, it is important to take a detailed voiding and stooling history. Children with significant constipation and/or voiding dysfunction are thought to be at an elevated risk of developing epididymitis/orchitis because of high urinary pressure that can develop in the posterior urethra. This pressure can lead to reflux of urine into the ejaculatory ducts and vasa and subsequent inflammation of the epididymis/testicle, commonly referred to as "chemical epididymitis."[21,22] Occasionally, this urinary reflux will be seen during the voiding phase of a voiding cystourethrogram.

Torsion of the appendix testis/epididymis is a common cause of acute scrotal pain and is often referred to as "the great mimicker." Embryologically, the appendages differ in origin with the appendix testicle being a Müllerian remnant and the appendix epididymis being a Wolffian remnant. It is more common to see an appendage torsion in the prepubertal boy.[23] Given the shared ischemic cause, torsion of an appendage can very closely mimic the symptoms of acute testicular torsion. Close physical inspection will occasionally reveal the ischemic and inflamed appendage to be visible through the skin. This so-called blue-dot sign is highly suggestive of a torsed appendix and is often accompanied by focal tenderness of the appendage itself (**Fig. 3**). This inflammation and tenderness can spread to the epididymis and testicle, however, depending on the duration of the appendiceal torsion. Ultrasonography can often demonstrate an enlarged and heterogenous appendage adjacent to the testicle, often with no demonstrable blood flow (**Fig. 4**). When being evaluated many hours after the onset of pain, it can be very difficult to distinguish between a torsed appendix and a

Fig. 3. Physical examination of the scrotum demonstrating a classic "blue-dot" sign.

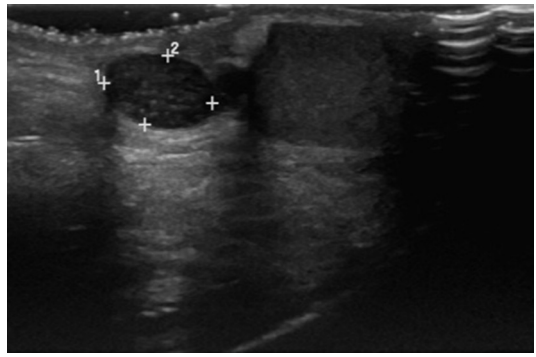

Fig. 4. Ultrasound image demonstrating torsion of the testicular appendage. Note the heterogenous appearance of the appendage relative to the normal-appearing testicle. This patient was found to have a classic "blue-dot" sign on physical examination.

torsed testicle. As with the physical examination, ultrasound can often identify a torsed appendage early on but has difficulty making this distinction later on when adjacent scrotal inflammation has progressed. Although the testis and epididymis are the most common places to find an appendage, there are potentially 5 anatomic sites where an appendage can exist (**Fig. 5**).[24,25] Surgical removal of a torsed appendage is not required because the appendage will ultimately necrose with relief of the pain. Surgical removal can occur, however, when exploration is undertaken because of concern about testicular torsion. If the torsed appendage is not removed, it may calcify

Fig. 5. Testicle with 3 distinct appendages. Normal appendix testis (held by hemostat on left side of image), torsed appendix epididymis (*black arrow*), and normal superior vas aberrans of Haller (held by hemostat at top of image).

and later be felt as a small "mass" within the scrotum. It can also end up free floating within the tunica vaginalis. When a testicular appendage is encountered incidentally in an otherwise normal testicle, most surgeons advocate for removal of all appendages to prevent the risk of future appendiceal torsion.

When counseling patients and families about a torsed appendage (or any other cause of scrotal pain), it is important to emphasize the potential of future torsion of the spermatic cord. It is critical that the patient and family understand that the diagnosis of scrotal pain due to appendiceal torsion or minor trauma may increase the risk of spermatic cord torsion during the recovery period.[26]

The appropriate management of epididymal/testicular inflammation and pain needs to include treatment of the acute inflammation as well as treatment of the underlying factors (if any) that led to development of the inflammation. Once testicular torsion and infection have been ruled out, children are often given little guidance as to how to manage their ongoing testicular pain. Repeat medical evaluation is frequently sought because of persistence of the pain. Antibiotics are frequently prescribed but rarely indicated in children in the absence of an abnormal urine analysis/culture. Similarly, narcotics can be used but are generally not required. Clinical improvement depends on relieving the inflammation. The key aspects of the management of the epididymal/testicular inflammation include the following:

- 48 to 72 hours of an age-/weight-appropriate dose of anti-inflammatory medication
- Corresponding 48- to 72-hour period of modified bed rest
- Aggressive oral hydration
- Timed voiding
- Management of constipation (if present)

The goal of the above recommendations is to help break the inflammatory cycle. Patients are recommended to limit all activities aside from normal activities of daily life (bathroom, meals, and so forth). Limiting activity has the benefit of reducing the physical movement of the scrotum and contents, which in turn allows the inflammation to subside, akin to elevating a sprained ankle. Hydration, timed voiding, and constipation management help to begin addressing any underlying issues that may have predisposed development of the inflammation. Long term, these issues may require additional directed management to fully address the problem.

Although most pediatric scrotal pain cases will be caused by one of the above issues, other less common causes exist. Vasculitic syndromes, such as Henoch-Schönlein purpura (HSP), can lead to pain, erythema, and swelling of the scrotum in up to two-thirds of patients.[27] Although rare, cases of HSP have been associated with acute testicular torsion, which reinforces the importance of always keeping torsion in mind when evaluating the acute scrotum.[28] Scrotal pain due to hernia, hydrocele, trauma, or neoplasia can also occur. Typically, a thorough history and physical examination are sufficient to differentiate these issues from acute testicular torsion.

SUMMARY

Despite being a common issue, acute scrotal pain in a child should be considered a surgical emergency until proven otherwise. History and physical examination are sufficient to confirm the diagnosis and prompt surgical exploration. When torsion is ruled out, aggressive management of the underlying cause or causes is important to provide relief of discomfort and limit the chance of recurrence.

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