The Acute Pediatric Scrotum: Presentation, Differential Diagnosis and Management

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\section*{Key Words}
Pediatric case • Scrotum • Testicular torsion

\section*{Abstract}
Both pediatric and adult urologists frequently evaluate pediatric patients with an acute scrotum. We present a detailed review on the acute pediatric scrotum highlighting the clinical presentation, differential diagnosis and management of this common clinical condition. It is important to highlight that a testicular torsion is the most important differential diagnosis and the main priority in each case is to diagnosis and treat a potential testicular torsion is of the essence. The aim of our extensive review is to update/review the appropriate evaluation and management of the acute scrotum and to guide the clinician in distinguishing testicular torsion from the other conditions that commonly mimic this surgical emergency. This review is useful for trainees in UK and Europe who plan to take the FRCS (Urol) examination.

\section*{Introduction}
Acute pediatric scrotal pain sometimes requires prompt surgical intervention and therefore accurate diagnosis of different etiologies of acute scrotal pain has great therapeutic and prognostic significance [1]. In clinical practice, acute testicular torsion (TT) accounts for 80–90\% of the acute pediatric scrotum at presentation [2]. We now review the different etiologies, differential diagnosis and management strategies of the acute pediatric scrotum.

\section*{Epidemiology}
The pediatric acute scrotum can present right from the new born patients to adolescent patients. The peak incidence of pediatric TT is bimodal with the main peak between 12 and 18 years and smaller peak in the first year of life. In a recent large study by Zhao et al. [3], looking at the incidence of TT confirmed that TT is uncommon but the rate of orchidectomy is high, especially in the youngest patients. Additional causes of the acute pediatric scrotum include torsion of a testicular appendage (hydatid of Morgagni), epididymo-orchitis, idiopathic scrotal edema, acute hydrocele and Henoch-Schönlein vasculitis.

\section*{Clinical Presentation}
The most difficult situation arising with the acute pediatric scrotum is the instant diagnosis. To date there is no single definitive test (clinical or radiological) available that can exclude a TT safely without the need for exploration. The diagnosis is largely based on the history at presentation and clinical findings that assist in the di-
agnosis. Only 50% of patients however have the complete ‘classic’ symptoms and findings of an etiology at presentation.

In most situations clinical examination detects the presence of a swollen, erythematous and tender scrotum. The symptom of ‘pain’ alone is not characteristic of any specific etiology and in younger patients such as infants may be completely absent at presentation. Some pediatric patients may present with a history of appendicitis or acute loin pain when the actual cause of the patients symptoms is secondary to an acute pediatric scrotum itself.

When a pediatric patient develops an acute scrotum it is important to urgently evaluate the patient to exclude a TT. At presentation it is common for patients to have tenderness, edema and erythema. When these signs are absent an urologist should not delay further assessment or surgical exploration. In patients presenting with a tor- red hydatid of Morgagni there is a classic ‘blue dot’ sign described that can be present in up to 20% of cases (fig. 1). In pediatric patients it is important to ask for a recent history of mumps or lower urinary tract symptoms to exclude epididymo-orchitis.

A further rare cause of the acute pediatric scrotum includes Henoch-Schönlein purpura, which is an IgA-mediated, autoimmune, hypersensitivity vasculitis of childhood. The main clinical features are skin purpura, arthritis, abdominal pain, gastrointestinal bleeding, orchitis and nephritis. The etiology remains unknown.

**Radiological Imaging**

The 3 main methodologies to investigate an acute pediatric scrotum include a colour Doppler ultrasound, radionuclide testicular scanning and magnetic resonance imaging (MRI).

An ultrasound Doppler will demonstrate simultaneous real-time anatomical imaging of the testis and will provide valuable information on vascular perfusion of the testis. Power Doppler and pulsed Doppler should be optimized to display low-flow velocities to demonstrate blood flow in the testes and adjacent structures (fig. 2). The colour gain should be adjusted carefully, as the artifactual appearance of flow may be created in a TT. Nussbaum et al. [4] demonstrated a sensitivity of the Doppler ultrasound of 78.6% in the diagnosis of TT. In current literature the sensitivity of an ultrasound Doppler in the diagnosis of TT is 85–90% and specificity is 75–95% [4]. The main issue with a Doppler ultrasound is that it is operator dependent and an increase flows may be demonstrated in TT.

Radionuclide testicular scanning performed using technetium-99m (99mTc) is injected intravenously but this test is time consuming. The technique involves a bolus injection of from 10 to 15 mCi of 99mTc sodium pertechnetate is injected intravenously in the antecubital fossa. Eight serial five-second frame images are collected during the angiogram or ‘perfusion phase’. Subsequently, a
static image of 500 K counts is obtained at 3 to 5 minutes post-injection and this represents the ‘tissue phase’. Holder et al. [5] actually found no diagnostic difference between a static image obtained immediately after the angiogram (or the so called ‘blood pool’ image) and the ‘tissue phase’ image obtained 3 to 5 minutes post-injection. This test is now not routinely performed.

Information about the role of MRI in the diagnosis of torsion is limited, although MRI is likely to be highly sensitive [6, 7]. However, with its limited availability, particularly at night, and its cost, MRI is unlikely to become a front-line examination for the patient presenting with acute scrotal pain.

**Etiologies**

The following etiologies are commonly associated with the acute pediatric scrotum.

**TT**

TT continues to be the most urgent etiology to diagnose and manage in the entire cohort of pediatric acute scrotum as misdiagnosing and mismanagement of TT can result not only in clinical consequences for the patient but also legal consequences for the surgeon. Torsion of the testis is a surgical emergency, as ischemic injury of > 4 hours seriously threatens the continued viability of the ipsilateral testis [8].

There are 2 main types of TT. The first type is ‘intravaginal torsion’ which is the commonest form of TT seen in adolescents and adults. This form of TT is caused due to congenital high insertion of the tunica vaginalis resulting in the classically described ‘bell clapper deformity’. In view of the high insertion of the tunica vaginalis the testis can tort more easily in comparison to a normal testis.

The second type of TT is ‘extravaginal torsion’ which is commonly seen with the first year of birth. This form of TT occurs both within the pre- and post-natal period. In extravaginal torsion the pathogenesis involves the incomplete fixation of the tunica vaginalis to the scrotal wall resulting in the entire testis torting in a vertical axis to the spermatic cord [2, 8].

The 2 most important factors determining testicular damage are the time from the onset of symptoms to the reduction of torsion, and the degree of twisting in the cord. Manual detorsion is successful in > 80% of attempts, usually when the duration was < 12 hours, and in such cases > 90% of the testes are salvaged [9].

It is extremely important to surgically explore a patient with a suspicion of a TT as experimental studies [10] have demonstrated that a testis can only be salvaged by restoring blood supply within 4–6 hours from the time of onset of ischemia. Testicular atrophy occurs when acute surgical exploration is delayed by 6–8 hours and necrosis occurs by 8–10 hours.

The management of acute TT involves an emergency scrotal exploration. On exploration the viability of the testis is assessed. The factors that determine the decision whether should be conserved or whether an immediate orchidectomy to conserve or remove the testis include the duration of the history, the appearance of the testis and arterial bleeding on incising the tunica albuginea. The last step is not routinely performed in view of the theoretical risk of the long-term formation of anti-sperm antibodies.

If the testis is thought to be viable a three-point fixation should be performed not only on the affected side but also the contralateral side. The testis is fixed (orchiopexy) via a scrotal incision following an incision in the tunica vaginalis is opened. The testis is then anchored to the scrotal wall using 2 or 3 non-absorbable sutures, e.g. 4/0 or 5/0 Prolene (polypropylene) or Ethibond (Polyester) sutures to the upper pole, lower pole and midzone of the testis (three-point fixation). Sutureless fixation is experimental and should not be recommenced. Despite a thorough fixation there is still a previous orchidopexy. The chance of a re-torsion has been found in patients undergoing a sutureless fixation and the placement of a testis within a dartos pouch only.

In pediatric patients following TT the semen analysis confirms that semen quality is significantly reduced following unilateral torsion in adolescence. Unilateral TT seriously interferes with subsequent spermiogenesis in about half the patients and produces borderline impairment in another 20% [11]. Sperm antibodies occur in 0–11% of patients at the time of torsion or at a later follow-up [12]. Current research continues to be performed to evaluate the long-term prognosis of fertility in prepubertal males with TT. Hormonal function is relatively well preserved, with elevated levels of luteinizing hormone and follicle-stimulating hormone only in patients with torsion of > 8 hours or testicular atrophy [13]. The 2 most important factors determining testicular salvage after torsion are the duration and the degree of testicular rotation. Saving the ipsilateral testis requires prompt presentation by the patient, prompt diagnosis and immediate surgery [8].
Torsion of Testicular Appendage (Hydatid of Morgagni)

The appendix testis (or hydatid of Morgagni) is a vestigial remnant of the Müllerian duct, present on the upper pole of the testis and attached to the tunica vaginalis. It is present about 90% of the time. Pediatric patients presenting with torsion of testicular appendage have a peak incidence between 10 and 12 years. The classical clinical presentation is less pain intense as seen in TT. On examination a ‘blue dot’ sign may be seen on the side of the effected testis (fig. 2). This is caused due to hemorrhagic infarction of the hydatid of Morgagni. Diagnosis is clinically and an ultrasound Doppler may provide additional information.

Clinical management depends on the patients’ symptoms and surgical intervention is warranted to exclude a TT if the patients’ symptoms are severe or if the surgeon suspects a TT. On scrotal exploration a further excision of the contralateral testicular appendage is not necessary. In patients where clinical signs are unequivocal to make a definitive diagnosis and where the pain is mild or resolving, conservative management is appropriate.

Epididymo-Orchitis

An acute bacterial infection of the epididymis progressing to involve the testis occurs as a result of retrograde bacterial colonisation via the ejaculatory ducts and vas deferens. Pediatric patients may not have the classical lower urinary tract symptoms of dysuria as seen in adults. When a pediatric patient is diagnoses with epididymo-orchitis it is prudent to exclude an additional anatomical or functional urinary tract abnormality such as neuropathic bladder, persistent Müllerian remnant or ectopic ureter. In infants with urinary infection may be associated with low-grade vesicoureteric reflux.

On clinical examination the pediatric patient may be very tender on clinical examination of the testis. A urine dipstick analysis may show the presence of leukocytes or nitrates and additionally urine microscopy – pyuria, bacteriuria and positive urine culture.

It is important to highlight that surgeons should organize an emergency scrotal exploration if there is a strong clinical suspicion of TT. In pediatric patients with recurrent epididymo-orchitis it may be necessary to consider a vasectomy if the underlying anatomical urological abnormality is not suitable to a definitive surgical correction although performing a pediatric vasectomy is extremely rare.

In pediatric patients with epididymo-orchitis should be followed-up and managed as complicated urinary tract infection. The initial management involves a non-operative management comprising of regular analgesia and antibiotic therapy based on regional guidelines.

Idiopathic Scrotal Edema

Acute idiopathic scrotal edema, a self-limiting acute scrotal edema and erythema that resolves without sequela, was first reported by Qvist in 1956. The highest incidence is seen in prepubertal males between the ages of 5–6 years. The condition is thought to be idiopathic but the pathogenesis is related to possible reactive edema secondary to localised lymphangitis.

On presentation pediatric patients have significant edema of the scrotum associated with a unilateral distribution in certain cases. In most cases the condition is self resolving within 24–48 hours. Patients can be prescribed antihistamines but antibiotics should only be prescribed if there is evidence of infection.

Incarcerated Hernia

An additional surgical emergency is an incarcerated hernia. Pediatric patients manifest with a gross swelling of the inguinoscrotal hernia. On clinical examination it is important to exclude this as an inguinoscrotal hernia from a primary true scrotal pathology as the surgical management if completely different.

Acute Hydrocele

A hydrocele is a collection of fluid within the processus vaginalis that produces swelling in the inguinal region or scrotum. Pediatric patients may present with a tense hydrocele noticed by the parents for the first time and present as an emergency. Clinical examination confirms a painless swelling that transilluminates. The diagnosis can be confirmed with an ultrasound. Clinical management involves reassurance and a definitive hydrocelectomy at the 2 years.

Henoch–Schönlein Purpura

Henoch–Schönlein purpura, a systemic vasculitic syndrome of uncertain etiology, is characterized by non-thrombocytopenic purpura, arthralgia, renal disease, abdominal pain, gastrointestinal bleeding and, occasionally, scrotal pain. The onset can be acute or insidious. Hematuria may be present. The syndrome has no specific treatment.

Testicular Trauma

Testicular trauma may present following either on as a direct blow to the scrotum or a straddle injury. Damage
occurs when the testis is forcefully compressed against the pubic bones. A spectrum of injuries may occur. Following a thorough clinical assessment, pediatric patients should undergo urgent ultrasound scan to exclude any breach to the tunica albuginea and assess vascularity on Doppler ultrasound. Surgical referral is required because testicular rupture requires immediate drainage and repair. Hematomas and hematoceles are managed on an individual basis.

**Conclusion**

The testicular salvage rates in TT are 85–97% if operated within 6 hours of onset of symptoms. Pediatric patients with an acute scrotum have several different etiologies, symptoms and pathology. All patients must be evaluated urgently and surgeons should have a low threshold to organize an emergency testicular exploration when a TT is suspected.