The Acute Scrotum

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Introduction

Any male child, adolescent, or adult who presents with complaints of scrotal pain, tenderness, or swelling should be promptly evaluated. Although the differential diagnosis is extensive, testicular torsion and rupture should be considered based on a thorough history, physical examination, and appropriate radiological evaluation. Testicular salvage is only possible when the diagnosis is considered early in the evaluation of the patient with the acute scrotum. Timely and accurate diagnosis is required to prevent testicular loss. This chapter reviews testicular torsion and other causes of the acute scrotum in children, the latter disorders also being covered in detail for adult patients in Chapters 7 and 9.

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Testicular and Appendiceal Torsion

Torsion of the spermatic cord and testicular/epididymal appendages is one of the common causes of an acute scrotum. Torsion of the former is a true surgical emergency; that of the latter requires no surgical intervention. Although testicular torsion can occur at any age, there is a bimodal distribution in the age of presentation, during the neonatal period and during puberty. Extravaginal torsion is caused by the spermatic cord twisting on itself above the level of the tunica vaginalis and is seen in the neonatal period (Fig. 16.1). Several explanations, including multiparity, excessive uterine pressure, and a strong cremasteric contraction, have been suggested [1].

Intravaginal torsion involves torsion of the spermatic cord within the tunica vaginalis. This so-called bell clapper deformity (Fig. 16.2) is associated with an abnormal fixation of the testis and epididymis and is most commonly seen in adolescents who present with torsion. However, testicular torsion is not limited to children and may occur in young adults and the middle aged. Patients with the bell clapper deformity may also present with intermittent torsion, in which the cord can twist on itself and then spontaneously untwist (Fig. 16.3).

The appendix testis (Fig. 16.4a), a Müllerian remnant, and the appendix epididymis (Fig. 16.4b), a Wolffian remnant, are also susceptible to torsion. Torsion of these appendages occurs more commonly during adolescence. It has been sug-

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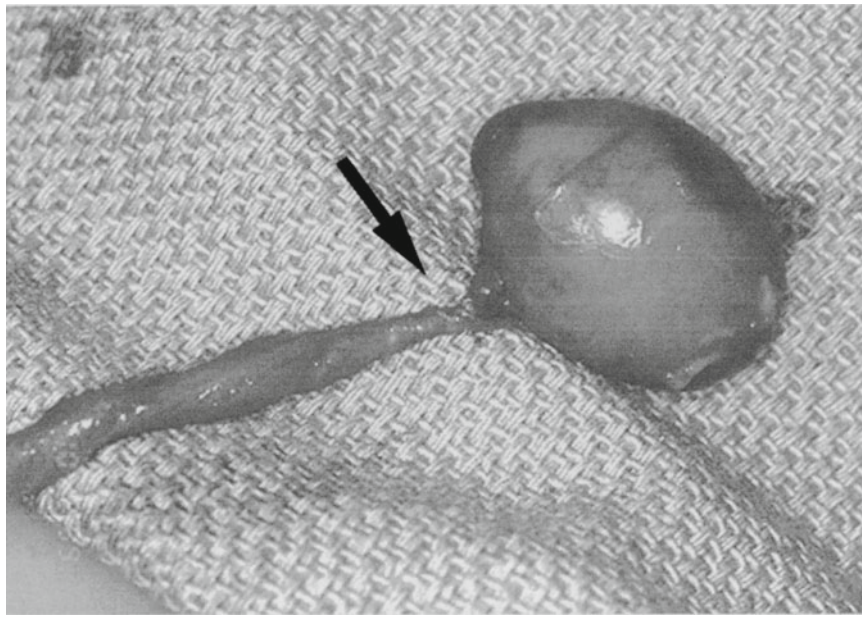

Fig. 16.1 The left testis of a 3-day-old infant with an extravaginal torsion. Note that the entire cord has twisted above the tunica vaginalis (*arrow*). The epididymis and testis are enclosed within the tunica; consequently, they are not visualized

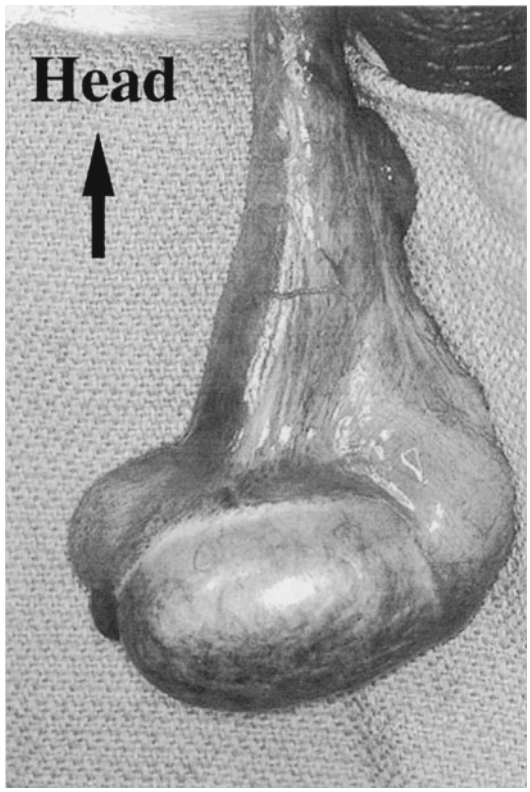

Fig. 16.2 The right testis of a 14-year-old boy who presents with intravaginal torsion has the bell clapper deformity, which may predispose to torsion of the spermatic cord

Fig. 16.3 This patient presented with five previous episodes of acute right testicular pain that spontaneously resolved after 10–15 min. On scrotal exploration, a bell clapper deformity was noted on the right side. Note the normal lie of the left testis

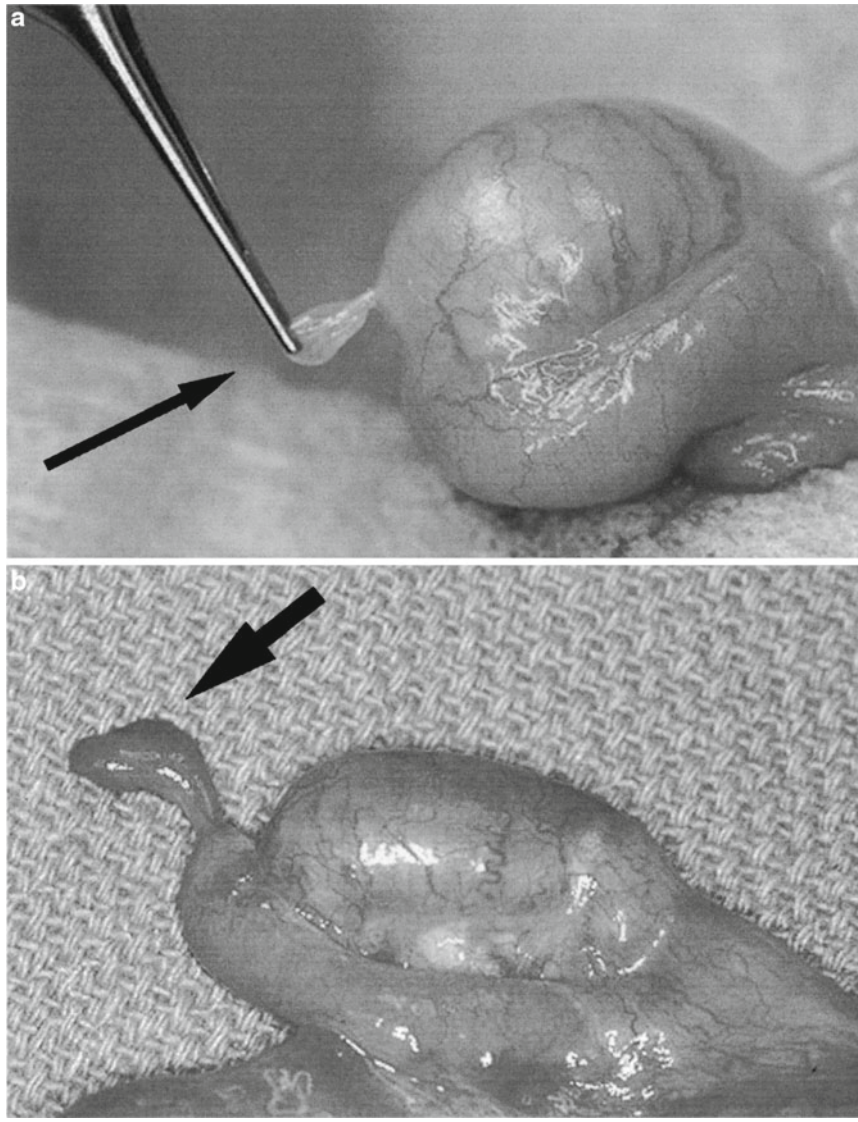

Fig. 16.4 (**a**) The appendix testis (*arrow*). (**b**) The appendix epididymitis (*arrow*). Both appendages are susceptible to twisting around their small vascular pedicle

gested that hormonal stimulation during puberty increases their size, making them more susceptible to twisting around their small blood supply.

Clinical Presentation

Patients with intravaginal testicular torsion typically present with acute onset of severe scrotal pain, frequently making physical examination difficult. Some patients may present with pain referred to the ipsilateral lower abdomen. Torsion can occur following trauma or athletic activity; however, in most cases the patient is awakened from sleep. Nausea and vomiting may be associated with testicular torsion; urinary symptoms such as dysuria and urgency are usually absent. Important signs of torsion include a firm testicle riding high in the scrotum, an abnormal transverse orientation of the testis, and the absence of a cremasteric reflex [2]. In many cases, acute hydrocele or marked scrotal edema develops

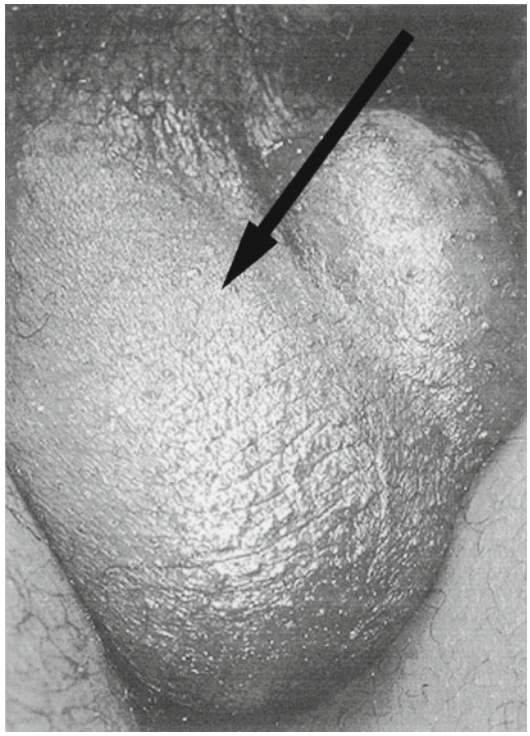

Fig. 16.5 The scrotum of a 14-year-old boy who presented with acute right testicular pain. The patient sought medical attention 12 h after the onset of pain. An acute hydrocele (*arrow*) has resulted, making palpation of the testis more difficult

when several hours have passed since the onset of the scrotal pain (Fig. 16.5). Fever and an elevated white blood cell count are not frequently associated with testicular torsion.

Intermittent testicular torsion has a similar presentation to that of intravaginal torsion, except that the episode is self-limited, with resolution of symptoms after the cord spontaneously untwists. Many who present with acute testicular torsion have a history of prior episodes consistent with intermittent testicular torsion. Those with intermittent torsion are likely to have normal physical exam at the time of evaluation, when the pain has resolved.

In contrast to intravaginal torsion, neonates with extravaginal torsion present with painless swelling and scrotal discoloration. It is often found incidentally on newborn examination, when a firm testis with an associated hydrocele is noted. Interestingly, associated scrotal erythema is not often present, but the overlying skin is discolored by the underlying hemorrhagic necrosis.

Table 16.1 Differential diagnosis for acute/subacute scrotum

Testicular torsion
Appendiceal torsion (testis or epididymis)
Epididymitis/epididymo-orchitis
Inguinal hernia (reducible or incarcerated)
Hydrocele
Trauma (mechanical, burns, or animal/insect bite)
Testicular neoplasms
Spermatocele
Varicocele
Dermatological lesions
Inflammatory vasculitis (Henoch–Schonlein purpura)
Idiopathic scrotal edema
Referred pain

Torsion of the appendix testis or epididymis can cause pain similar to that seen with intravaginal testicular torsion. However, the presentation for torsion of the appendix testis or epididymis can be quite variable, from an insidious onset of scrotal discomfort to acute severe scrotal pain. Consequently, it is often difficult to differentiate appendiceal torsion from other causes of acute scrotum (Table 16.1). At the earlier stages, the pain may be localized to the upper pole of the testis or epididymis, and a firm nodule can sometimes be palpated in this region of the scrotum. In some cases, the infarcted appendage can be seen through the scrotal skin as a blue dot, which is considered pathognomonic for appendiceal torsion. In the later stages, scrotal wall edema and erythema can develop, distorting the physical examination. The cremasteric reflex is usually preserved, and the testis should remain mobile.

In patients suspected of having testicular torsion on a clinical basis, prompt surgical exploration is warranted. Adjunctive radiological tests should only be obtained when their purpose is to confirm the absence of testicular torsion so that surgical exploration can be avoided. In these cases, color or power Doppler ultrasound or scrotal scintigraphy may be obtained. In ruling out testicular torsion, there is no absolute gold

standard. False negatives can occur with any of these modalities. The choice of which modality to utilize varies with institution, depending on local experience, availability, and reliability of the tests.

Color Doppler ultrasound studies can assess the anatomy of the scrotum and its content while determining the presence or absence of testicular blood flow (as measured by velocity). The sensitivity of color Doppler ultrasonography is reported to be as high as 90 %, with a specificity of 99 % [3]. Caution must be used in the interpretation of these studies because almost 40 % of patients, especially those younger than 8 years, may fail to demonstrate flow on the asymptomatic side [4, 5]. Power Doppler ultrasonography measures blood flow by detecting the number of red blood cells as opposed to the velocity of flow. Although blood flow is more consistently detected in younger children with power Doppler [4], evidence from animal studies suggested that power Doppler and color Doppler are equally efficacious in the detection of torsion [6].

Radionuclide imaging was originally the study of choice for ruling out testicular torsion. However, it only allows for the assessment of blood flow. Nussbaum et al. carried out a study in 46 patients presenting with acute scrotal pain and showed scintigraphy for testicular torsion to have a sensitivity of 78.6 % and a specificity of 90.6 % [7]. Hyperemia of the scrotal wall can give false impressions of testicular blood flow. In addition, it is difficult to image children with small scrotal sacs or testis using this study.

Treatment

Faced with a suspected diagnosis of testicular torsion, the patient should be taken to surgery without delay. Manual detorsion may be attempted if surgical intervention cannot be done for a period of time. After performing a cord block with local anesthetic, the testis should be turned caudal to cranial and medial to lateral [8]. If the first attempt is unsuccessful, the testis should be turned in the opposite direction. If the detorsion is successful, the pain should resolve immediately. However, this process is often very painful, and manual detorsion may not completely correct the obstructed blood flow. Consequently, surgical intervention is still required following manual detorsion.

Upon entry into the scrotum, the tunica vaginalis is entered and the testis is examined. The spermatic cord should be detorsed to restore blood flow. The affected testis should then be placed in a warm sponge and observed for several minutes to determine viability. This can be done while exploring the contralateral testis. In all cases, the contralateral testis must be fixed through orchidopexy. Following this, the affected testis is reevaluated first by color, and if it is returning to its normal coloration, orchidopexy is done. If the testis remains dusky, further evaluation can be done by incising the tunica albuginea and looking for return of fresh blood. If the testis continues to appear dusky and tunica albuginea incision produces no fresh blood, the nonviable testis should be removed.

There are several options for surgical fixation of viable testes. Traditionally, the testis has been fixed by placing a suture through the tunica albuginea and into the wall of the scrotum. However, recurrent torsion has been reported with this technique. Fixation can be accomplished in a transseptal fashion through a median raphe incision. The testis is secured to the median septum with three to four fine, nonreactive, nonabsorbable sutures. These sutures can be brought through the septum, enabling the contralateral side to be fixed concurrently. Alternatively, a dartos pouch can be created where fixation relies on scarification of the testis. An incision is first made transversely in the scrotum following the natural skin creases. The tunica vaginalis is then everted, and the testicle is placed into the dartos pouch. A nonabsorbable suture is used to secure the dartos tissue around the cord. This technique is advantageous in that complications such as abscess formation and tubular atrophy are uncommon. Anecdotally, there have been no reported cases of recurrent torsion with this technique. Intermittent torsion is corrected using either of the above techniques on a semi-elective basis.

Recent data suggests the existence of a compartment syndrome effect taking place in the

setting of testicular torsion. Kutikov et al. reported on three cases where incision of the tunica albuginea led to increased perfusion of a testicle that was not reperfusing following detorsion. Subsequent reapproximation of the tunica albuginea in these patients led to a return of testicular ischemia. In all cases, a tunica vaginalis flap or graft was used to cover the exposed seminiferous tubules and to keep intratesticular pressure low and maintain perfusion [9]. A study carried out by Figueroa et al. showed similar findings with regard to increased testicular compartment pressures in testes that had been detorsed intraoperatively. Perfusion was successfully increased when performing the tunica albuginea incision with tunica vaginalis flap. Their preliminary study included 65 patients, 11 of who underwent the tunica albuginea incision with tunica vaginalis flap. Their results suggest that 6 out of those 11 patients would have otherwise undergone orchidopexy [10].

The treatment of neonatal torsion is controversial. Some suggest that surgical exploration is unnecessary; others advocate immediate surgical exploration and fixation of the contralateral side. It is rare to salvage the affected testis in a patient with unilateral neonatal torsion. In addition, of more than 30 cases of bilateral neonatal torsion reported in the literature, only two testicles have been successfully salvaged [11]. The most important reason for exploration in our opinion is to prevent possible unilateral torsion from becoming bilateral anorchia. In the rare case of bilateral neonatal torsion, a more conservative approach can be taken. The newborn's general condition and anesthetic considerations should be evaluated to determine whether to proceed with surgical intervention.

The treatment of twisted testicular appendages is nonsurgical. If the diagnosis is certain, conservative therapy with limitation of activity and administration of nonsteroidal analgesics can be instituted. Most of the symptoms will dissipate once the acute changes of acute necrosis resolve. In rare instances, surgical exploration may be undertaken if conservative management fails. Simple excision of the torsed appendage is curative.

Epididymitis/Epididymo-Orchitis

Another common cause of an acute scrotum is inflammation/infection of the epididymis. The infection may also involve the testis (epididymo-orchitis). An uncommon diagnosis in children [12], several different etiologies are responsible, including infection, trauma, and anatomical abnormalities.

Bacterial infection is common in patients who are sexually active. However, viral agents such as mumps, coxsackie, echovirus, and adenoviruses have been identified in children with epididymitis [13, 14]. Traumatic causes include straining or lifting, for which a sudden increase in abdominal pressure causes reflux of sterile urine, leading to epididymal inflammation. Torsion of a testicular appendage can also lead to a reactive epididymitis.

Anatomical abnormalities and dysfunctional voiding are further causes of epididymitis. Other causes of epididymitis in children include insertion of an ectopic ureter into the seminal vesicle and bladder outlet obstruction such as posterior urethral valves or urethral stricture. Detrusor-sphincter dyssynergia, secondary to neurogenic and nonneurogenic bladder dysfunction, will lead to increased bladder pressures, with the possibility of sterile reflux. Finally, epididymitis may be associated with systemic diseases, including sarcoidosis, Kawasaki's disease, and Henoch–Schonlein purpura [15].

Clinical Presentation

The most common presenting symptoms include scrotal swelling, erythema, and pain. Epididymitis is usually an indolent process, but may present in a fashion similar to testicular torsion. Epididymitis is more likely in a patient with a past history of urinary tract infection, urethral catheterization, or urinary tract surgery. Although fever and urinary symptoms such as dysuria, urethral discharge, and hematuria are more common in patients with epididymitis than with testicular torsion, many patients with epididymitis may not have any of these symptoms.

On physical examination, localized epididymal or generalized scrotal tenderness may be found. The cremasteric reflex is usually preserved. Evaluation of the urine often demonstrates pyuria and bacteriuria; however, urine cultures may be sterile in 40 % of the cases [12, 15] because virus can also be an etiological agent.

Scrotal imaging can be used to help distinguish between epididymitis and torsion. In the cases of epididymitis, Doppler ultrasonography or radionuclide imaging demonstrates increased blood flow. On ultrasonography, the testis is often enlarged and has a reactive hydrocele.

Treatment

Epididymitis is treated with a combination of scrotal elevation, nonsteroidal anti-inflammatory agents, and antibiotics when appropriate. Limitation of activity, scrotal elevation, and application of heat or cold will help alleviate scrotal pain. Urethral instrumentation should be avoided.

In children with suspected epididymitis, a urinalysis and urine culture should be performed. In addition, a voiding cystourethrogram and a renal bladder ultrasound should be obtained to look for anatomical abnormalities such as ectopic ureter if a urinary tract infection is documented. If the above studies are normal, the child should be worked up for unrecognized dysfunctional voiding as a cause for reflux of urine into the epididymis. Treatment of epididymitis in adults is reviewed in detail in Chap. 9.

Testicular Trauma

Testicular trauma is an infrequent occurrence because of the mobility and position of the testicle within the tunica albuginea. The etiology is most often caused by a direct blow that compresses the testicle against the pubic bone [16] as a result of a sports injury or motor vehicle accident [17]. Blunt trauma accounts for 85 % of the cases; the remainder result from penetrating injuries [18]. There is a slight preponderance of injuries on the right side, possibly because of the higher riding position of the testicle [17]. The majority of patients are between 10 and 30 years of age.

Types of injuries include testicular contusions with hematoceles and hematoma, testicular rupture, and traumatic dislocation. Hematoceles result from bleeding into the tunica vaginalis; a hematoma develops from intratesticular bleeding. Patients who sustain testicular injury may also present with torsion. Hydroceles and pyoceles may present as delayed sequelae of an acute injury.

Clinical Presentation

In patients with testicular injury, the scrotum may be tense, edematous, ecchymotic, or fail to transilluminate. In these patients, there are often associated findings, such as nausea, emesis, and urinary retention. Because of the nature of the injury and the force required to compress the testicle, other abdominal or pelvic injuries, in particular pelvic fractures, should be ruled out. This is especially true for testicular dislocation, for which the scrotum will be well developed, but no testicle is palpable within the scrotum. In many cases, the diagnosis is delayed; however, palpation of the inguinal area will reveal a normal testicle.

Urethral injuries are also commonly associated with scrotal trauma. Bleeding at the urethral meatus in association with a pelvic fracture or perineal ecchymosis is an indication for obtaining a retrograde urethrogram. Traumatic torsion will present as a painful high-riding testicle, which may have a transverse lie. Scrotal pain and swelling in the presence of a fever and elevated white blood cell count several days after a traumatic event suggest the presence of a pyocele.

The most useful diagnostic tool in the evaluation of closed testicular trauma is ultrasonography of the scrotum. Guichard et al. carried out a study of 33 patients presenting with blunt scrotal trauma where they compared ultrasonographic findings to surgical findings. Rupture was suspected in patients whose scrotal ultrasound showed heterogeneous parenchyma and a loss of testicular contour. Sensitivity and specificity of ultrasound for testicular rupture were found to be 100 % and 65 %,

respectively [19]. Buckley and McAninch performed a study in 65 patients presenting with blunt scrotal trauma and reported a sensitivity of 100 % and specificity of 93.5 % for ultrasound diagnosis of testicular rupture [20]. Absence of testicular blood flow is indicative of traumatic torsion.

Treatment

Patients with penetrating trauma or ultrasound evidence of testicular rupture require immediate surgical exploration. If the diagnosis is uncertain and there is any possibility of an underlying testicular tumor, an inguinal approach is best; otherwise, a transverse scrotal incision is made. In the case of testicular rupture, the devitalized tissue is excised, and the capsule is repaired (Fig. 16.6a, b). Failure to repair these injuries can lead to persistent pain, abscess formation, and testicular atrophy.

Orchiectomy should be avoided when there is remnant functioning tissue. In the rare occurrence of complete traumatic amputation without scrotal avulsion, prompt microsurgical repair of the vessels can be performed. If this is not an option, orchiectomy should be considered. Autotransplantation into a subcutaneous thigh pocket can be attempted; however, the results to date have been disappointing, with atrophy and necrosis more common outcomes [21].

Dog bites to the scrotum are occasionally encountered. These wounds should be debrided, and the patient should be given broad-spectrum antibiotics and tetanus and rabies vaccinations. These wounds should only be closed in the absence of infection [22]. Traumatic torsion is corrected by surgical detorsion of the testicle, followed by the placement of the testicle in a dartos pouch. The testicle may be secured in place with a nonabsorbable suture. Testicular dislocation requires immediate surgical reduction. Although closed reduction may be attempted, it is associated with a high failure rate [23]. In addition, there is the possibility of torsion or testicular rupture associated with dislocation, which is best managed in an open fashion.

Evacuation of a scrotal or tunical hematoma is controversial. Open evacuation may lead to infection. However, failure to relieve the hematocele can lead to pressure-induced atrophy of the testicle. It is our policy when confronted with a tense subcapsular hematoma to open the tunica albuginea and drain the blood. Patients diagnosed with a mild contusion and no changes in testicular architecture are best managed with bed rest, scrotal elevation, and nonsteroidal anti-inflammatory agents.

Scrotal and Perineal Burns

Burns to the scrotum and perineum occur infrequently. Anatomically, the scrotum is protected by the thighs. In combination with the looseness of the scrotal skin and the retraction of the cord by the cremasteric muscles, these features help to protect the testicles. Isolated scrotal burns are uncommon, and most are seen in patients with more extensive burns [24]. Scald burns are more common in very young children, whereas flame or electrical burns affect older children.

Treatment depends on the type of burn incurred. Most first-degree and superficial second-degree burns respond to conservative treatment. Michielsen et al. [25] reported an 81 % success rate in treating these patients with physiological dressings and topical antimicrobials. Of these children, 14 % were treated with allografts, for an overall 95 % rate of wound healing. Patients with deep second- or third-degree burns will require more surgical procedures; however, those with deep flame or electrical burns suffer a dramatically high incidence of partial penile loss, testicular loss, and groin contractures [24]. The outcome of these patients is dictated by the severity of the initial injury.

Miscellaneous Causes of Acute Scrotum

Included in the differential diagnosis for the acute/subacute scrotum are hernias/hydroceles (Table 16.1). In children, a persistent processus vaginalis allows fluid or omentum/bowel to descend into the scrotum, resulting in a commu-

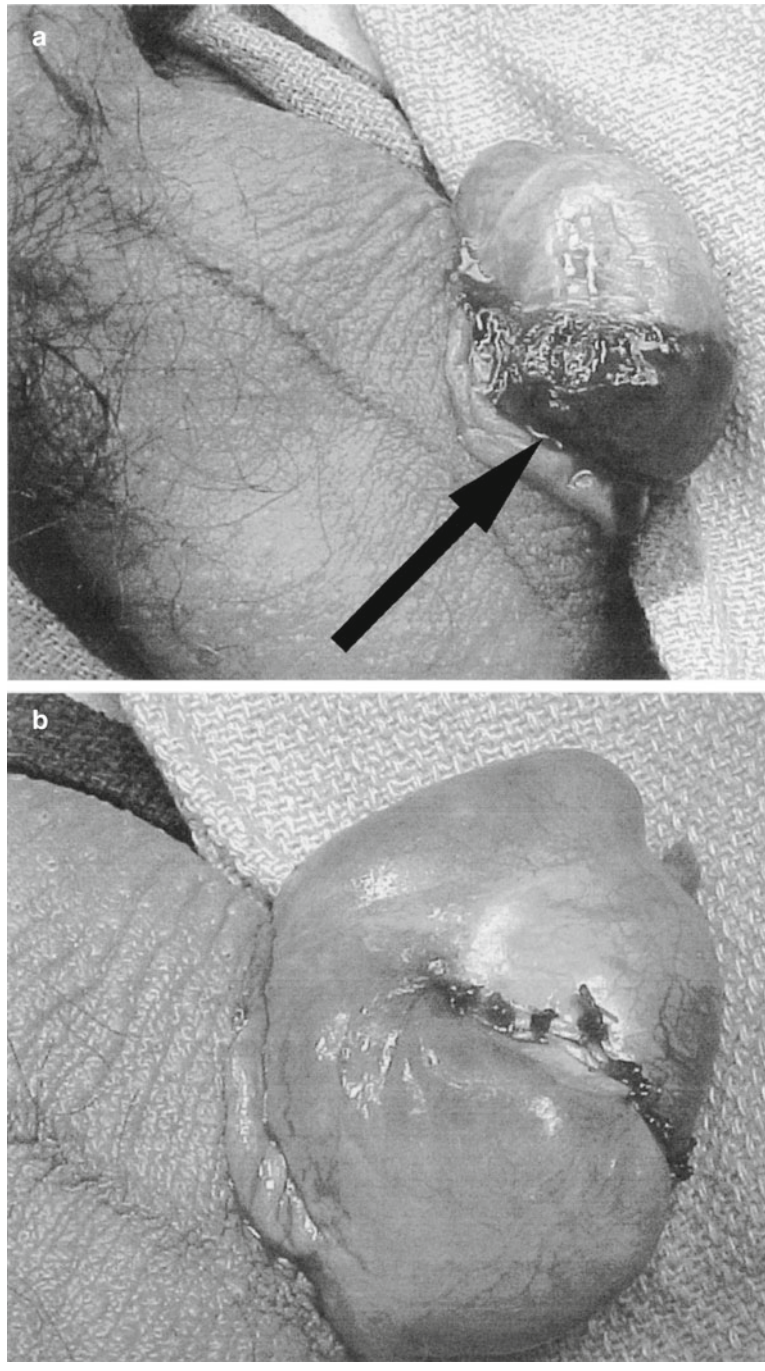

Fig. 16.6 (**a**) Traumatic rupture of the testicle with devitalized tissue (*arrow*). (**b**) The devitalized tissue has been excised and the capsule approximated

nicating hydrocele or hernia, respectively. In adults, hernia results from a weakness in the abdominal wall that allows its content to descend into the scrotum. When pain is present, bowel incarceration in a hernia sac should be considered. Prompt surgical exploration should be

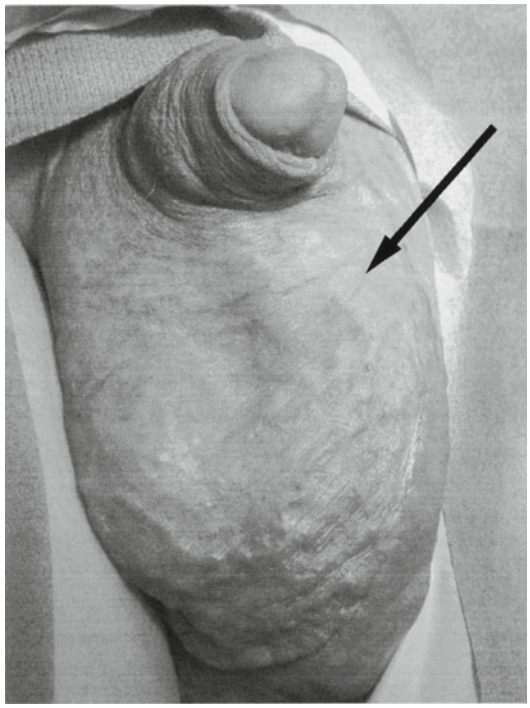

Fig. 16.7 A varicocele is noted above the left testis (*arrow*). Note the "wormlike" appearance of the varicocele that often dissipates on recumbence

undertaken. If the diagnosis is uncertain, Doppler ultrasonography may demonstrate bowel in the inguinal canal or scrotal sac. However, the ultrasonographic findings may be inconclusive. Given the serious, potential complication of ischemic bowel, inguinal exploration should be undertaken when an incarcerated hernia is suspected.

Varicocele results from dilation of veins of the pampiniform plexus of the spermatic cord. It is estimated that approx. 4.4–22.6 % of men have varicocele [26]. Its formation is partly caused by increased venous pressure in the left renal vein, collateral venous anastomoses, and incompetent valves of the internal spermatic vein. Occasionally, thrombosis of the varicocele results in inguinal or scrotal pain that is often relieved by assuming the supine position. In most cases, varicocele presents as a painless, compressible mass above or surrounding the testis (Fig. 16.7).

When symptomatic, treatment of varicocele is indicated. Ligation of the varicocele can be performed using a retroperitoneal, inguinal, or subinguinal approach. Alternatively, angiographic embolization can be performed to occlude the dilated veins. The choice of surgical technique is dependent on the surgeon's familiarity and consideration of potential complications, such as hydrocele formation, varicocele recurrence, and testicular atrophy.

Henoch–Schonlein purpura is a systemic vasculitis that can cause scrotal swelling and pain similar to that of torsion or epididymitis. The cause of the vasculitis is not known, but can involve the testis and/or epididymis [27]. Patients with Henoch–Schonlein purpura may have concurrent abdominal or joint pain, nephritis, hematuria, and purpura skin lesions. Scrotal involvement occurs in 35 % of patients with Henoch–Schonlein purpura. Typically, the scrotum is diffusely tender with generalized erythema. Urinalysis often demonstrates hematuria and occasionally proteinuria. Color Doppler ultrasonography or radionuclide scintigraphy shows increased blood flow. Scrotal involvement by Henoch–Schonlein purpura is self-limiting, and observation is usually indicated.

Like Henoch–Schonlein purpura, acute idiopathic scrotal edema is a self-limiting process that results in acute/subacute scrotal swelling [28]. Etiological factors include allergic or chemical dermatitis, insect bites, and trauma. Acute idiopathic scrotal edema is usually not associated with erythema, fever, urinary symptoms, hematuria, or pyuria. Pain is likely to be minimal, but pruritus may be significant. The normal testes can be palpated through the thickened scrotal wall. Examination of the perineum should be performed to rule out a contiguous process, such as a perineal abscess, which can also result in scrotal edema. When the diagnosis is unclear, Doppler ultrasonography should be done to evaluate testicular anatomy and blood flow. Acute idiopathic scrotal edema is self-limited and does not require any surgical intervention or antibiotic treatment.

Summary

The acute onset of scrotal pain should immediately raise the possibility of testicular torsion and requires immediate evaluation. History, physical

examination and selected laboratory studies generally allow a clinical decision for scrotal exploration for presumed torsion. High resolution scrotal ultrasonography allows confirmation of other diagnoses, but should not delay care for most cases of torsion. Torsion of the scrotal appendages, epididymitis, trauma, and a variety of other non surgical conditions may thus be identified and appropriately managed.

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