

REVIEW ARTICLE

TORSION OF THE TESTIS AND ITS APPENDAGES: DIAGNOSIS AND MANAGEMENT

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INTRODUCTION

Torsion of the testis was first described in 1840. It is interesting that a condition so acutely painful and so readily diagnosed clinically should have come to light so late in medical literature. Detorsion and suture fixation was first described in 1857. By 1901 there were only 32 cases reported in the world literature, and by 1930 this had increased to 250. Although many papers have been published on all aspects of torsion, some controversies still exist. In this review, which is based on a detailed analysis of 288 papers in the literature, we focus on the areas of consensus as well as the controversies. A full list of the articles used to compile this review can be obtained from the authors.

ANATOMY

Intravaginal torsion (IVT) (Fig. 1) is possible at three different levels: (1) most commonly the intravaginal spermatic cord rotates and causes infarction of the testis and epididymis; (2) in 9-25% of cases torsion occurs through the mesorchium between the testis and epididymis, causing infarction of the testis, but sparing the epididymis (mesorchial torsion); (3) rarely, torsion may occur through the mid-epididymis (epididymal torsion)¹.

Possible causes include a high investment of the tunica vaginalis on the spermatic cord (bell-clapper deformity) or loose attachments between the epididymis and testis (mesorchial torsion) (Fig. 1). The initiating force seems to be cremaster spasm, associated with low insertion and spiral arrangement of the cremaster fibres. The bell-clapper deformity is found in 12% of autopsies, and is bilateral in 66%². In testicular torsion the bell-clapper deformity is

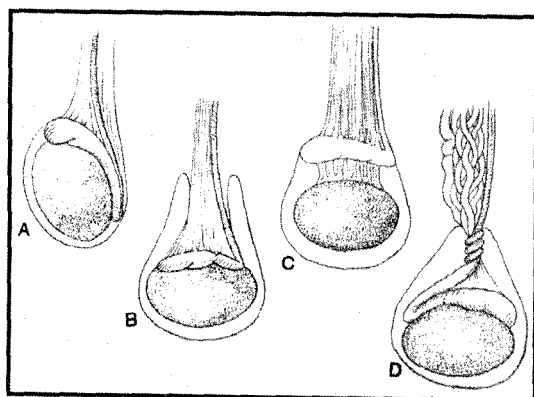


Fig. 1: The anatomy of (A) normal attachments, (B) bell-clapper deformity, (C) abnormal mesorchium and (D) intravaginal torsion (Modified from Stillwell and Kramer, 1986²²).

found in 71-75% of cases, and is present on the contralateral side in 55-100% of cases^{1,3}.

In extravaginal torsion (EVT) the entire testis complex, which has not yet fused to the scrotum, twists en bloc. Normally, fixation of the testis to the scrotum occurs 7-10 days after birth.

INCIDENCE

The estimated incidence of torsion ranges from 10.7 to 27.0 per 100 000 men per year. Torsion may occur at any age from the newborn to the late seventies, but about 60% of cases occur in boys 12-18 years old. Almost 90% of patients are below 25 years of age, and 5-9% are over 30. The peak age incidence is bimodal, being the highest at the age of 13, with a smaller peak in the first year^{3,4}.

The incidence of testicular torsion in the presence of an acute scrotum in children ranges from 12% to 40%. In the first year of life torsion of the testis is the most common cause of an acute scrotum, whereas in 3-13 year olds torsion of a testicular appendage, and in those over 17 years epididymitis is the most common diagnosis⁵.

The ratio of left versus right-sided involvement is 1.2:1, probably due to the slightly longer spermatic cord on the left³.

PREDISPOSING AND ASSOCIATED FACTORS

Cremaster spasm associated with sleep, trauma, vigorous exercise or cold weather may be the initiating force. The peripubertal growth spurt, which increases the testis/spermatic cord width ratio, may impart a greater moment to any twist.

Onset of torsion during sleep is reported in 11-40% of cases, and may result from a cremasteric reflex associated with nocturnal erections. A history of strenuous activity is reported in 7-60% of cases^{3,6}. A clear history of injury precedes torsion in 4-10% of cases^{3,7}.

Prior to the 1950s about 60% of cases of torsion were seen in undescended testes, but this figure declined with increasing use of early orchidopexy. Torsion of an intraabdominal testis has been reported in 45 cases, of which 65% had malignancy in the testis.

Several cases of torsion have been reported in patients on HCG therapy⁸. Torsion has been described in at least 11 families. Polyorchidism was associated with torsion in 9 of approximately 100 reported cases. There appears to be no racial predilection.

Spontaneous detorsion may occur at the time of anaesthesia or before in 10-25% of cases, probably due to cessation of the cremasteric spasm¹.

DIRECTION AND DEGREE OF ROTATION

Internal rotation ("double thumbs down") occurs in 71-100% of cases¹. In 91 reported cases where the degree of rotation was specified, we found that the average rotation was 480° (median 360°, range 180°-1080°).

MECHANISM OF INFARCTION

Arterial occlusion probably occurs with multiple twists, whereas arteriolar stasis develops secondary to venous occlusion with fewer twists. Experimentally, complete cessation of arterial inflow occurs at 300°-540° of torsion, and 3-4 complete turns (1080° to 1440°) produces irreversible damage after two hours. Torsion of 90° for periods as long as 7 days fails to cause necrosis, 180° causes necrosis in 50%, and 360° causes necrosis in all cases within 24 hours⁹. If the torsion is not reduced, there is gradual subsidence of pain over 2-5 days, but swelling and local tenderness may persist for 10-14 days.

INTERMITTENT OR SUBACUTE TORSION / SUBTORSION

Up to 50% of patients with acute torsion have experienced previous episodes of testicular pain. Intermittent torsion is often associated with various types of physical activity, a bell-clapper deformity, a horizontally lying testis or a long mesorchium. In a meta-analysis of 521 cases of torsion of the testis reported in 10 studies we found that intermittent subacute torsion accounted for 23% of all cases. Intermittent torsion must be considered in all patients who present with recurrent testicular pain, and fixation may cure up to 84% of their symptoms¹⁰.

TORSION OF APPENDICES

Torsion may involve the appendix testis, a Müllerian duct remnant located at the superior pole of the testis, or (more rarely) the epididymal appendix, a Wolffian duct remnant located on the head of the epididymis. Torsion of the testicular appendices has been reported in the first to the fifth decade. In a meta-analysis of 457 reported cases we found that 80% occurred in boys aged 6-13, with the peak incidence at 11 years. Torsion of the appendices is usually preceded by vigorous activity or trauma. Increased estrogen stimulation prior to puberty may cause the appendage to enlarge and strangulate.

The appendix testis is involved in 92% of cases, the appendix epididymidis in 7%, the vas aberrans in 0.3% and the paradidymis in 0.6%¹¹. In a meta-analysis of 629 cases from 9 studies we found bilateral metachronous tor-

sion of the appendices to occur in 2.5% of cases.

On examination a hard, tender nodule may be found in the upper pole region. A small bluish discolouration of the skin in the upper pole ("blue dot sign") is virtually pathognomonic, but these signs are present in only 21%.

NEONATAL / PERINATAL / EXTRAVAGINAL AND SUPRAVAGINAL TORSION

Neonatal or perinatal torsion can be divided into (1) prenatal (in-utero) and (2) postnatal torsion. In a meta-analysis of 211 reported cases from 48 studies of neonatal torsion we found that 85% were prenatal and 15% postnatal, with bilateral involvement in 18%. However, this figure may be too high, because bilateral cases may tend to be operated and reported on more often than unilateral cases, resulting in fewer reported cases of unilateral torsion. In the two largest single institution series of neonatal torsion, there was bilateral torsion in 9-11% of cases^{12,13}.

In a meta-analysis of 211 reported cases of neonatal torsion we found that 89% were EVT and 11% were IVT. The possible causes of EVT include extreme mobility of the neonatal tunica vaginalis inside the scrotum, an active cremasteric reflex, a high birth weight, maternal multiparity, and trauma during difficult delivery or breech presentation. EVT occurring in older boys, although rare, is often associated with severe scrotal trauma.

Prenatal torsion presents at birth with a hard, swollen, non-tender testis, and an oedematous, dusky hemi-scrotum that does not transilluminate. Prenatal torsion probably occurs around 32 weeks of gestation and is almost exclusively extravaginal¹².

Postnatal torsion presents within the first 30 days of life with symptomatic scrotal swelling and a documented normal scrotum at birth.

"VANISHING TESTIS"

The term "vanishing testis" or "testicular regression syndrome" is applied to testes that have become atrophic, presumably due to torsion late in gestation. Up to 95% of cases of absent testes may be due to antenatal torsion¹⁴.

EXAMINATION

In cases of acute scrotal swelling, time is of the essence. The history and physical examination are sufficient to make an accurate clinical diagnosis in 60-90% of cases, provided careful attention is paid to the following aspects.

The pain of torsion is of rapid onset in 55-91% of cases and is usually severe, but may begin to diminish after 6 hours. Patients with testicular torsion tend to present earlier (median 6 hours) than those with torsion of the appendix testis (median 29-48 hours), but up to 20% present after 24 hours^{4,8}.

Torsion may result in abdominal pain, nausea and vomiting through reflex stimulation of the celiac ganglion. In 5-25% of cases the main complaint is abdominal pain. Nausea and vomiting are present in 26-60% of cases. Nausea has a positive predictive value of 96% and vomiting 98% for torsion^{6,7}.

Many patients (11-47%) with torsion describe previous episodes of similar pain that resolved spontaneously ("prophetic pain"), suggesting intermittent torsion with spontaneous detorsion⁶.

The cremasteric reflex, mediated by the L1-2 (ilioinguinal and genitofemoral) nerve roots, is elicited by stroking the medial upper thigh, which results in elevation of the ipsilateral testis. It normally occurs in 48% of newborns, 45% of boys aged 1-30 months, and 100% of boys between 30 months and 12 years of age¹⁵. It is absent in 40-100% of patients with testicular torsion, but is usually present in torsion of a testicular appendix. The absence of the cremaster reflex has a positive predictive value of 43% and a negative predictive value of 96% for torsion of the testis⁸.

A drawn-up ("high-riding") testis, due to shortening of the spermatic cord (in the same way that twisting a length of towel leads to shortening) is present in 26-80% of cases^{6,8}.

About 25-90% of patients with torsion will have a horizontal lie of the contralateral testis ("Angell's sign") when the patient is examined in the upright position. An abnormal (anterior) position of the epididymis within the scrotum strongly indicates torsion³.

Pyrexia is present in 8-41% of cases. It is an ominous sign for testicular viability, since 50-100% of patients with torsion and pyrexia have an infarcted testis³.

Scrotal erythema and oedema are associated with a duration of torsion >12 hours. If scrotal induration is present, up to 78% of testes will be infarcted⁶.

Prehn's sign suggests that elevation of the testis relieves the pain in cases of acute epididymitis but not torsion. Theoretically, this is analogous to elevation causing pain relief in an acutely inflamed but not in an ischaemic limb. However, Prehn's sign is notoriously unreliable.

Urinalysis is absolutely essential. Abnormal findings on urinalysis occur in 0-10% of cases of torsion, whereas pyuria occurs in approximately 50% of patients with epididymitis^{7,6}.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of the acute scrotum includes epididymitis, orchitis, torsion of testicular appendices, scrotal trauma, idiopathic scrotal oedema, scrotal abscess, inguinal hernia, hydrocele, Henoch-Schönlein purpura, familial Mediterranean fever, idiopathic infarction of the testis, testis tumor and acute appendicitis. With neonatal torsion the differential diagnosis includes syphilitic orchitis, ectopic splenic or adrenal rests, and meconium peritonitis with a patent processus vaginalis.

SPECIAL INVESTIGATIONS

A fourfold increase in C-reactive protein (CRP) suggests epididymitis, since it is usually normal in torsion. The white blood cell count is not helpful in distinguishing between torsion and epididymitis.

When pain has been present for more than 12 hours or the diagnosis is unclear, imaging can be helpful.

Colour Doppler Ultrasound (Angiodynography)

This is currently the modality of choice, since it is fast, cost effective, easy to perform, available at all hours and provides anatomical information. The drawbacks are that it is opera-

tor dependent, unreliable in small testes (< 1 cm³), and the detection of flow does not rule out torsion, since blood flow is not always cut off instantaneously or completely. Reduced flow and equivocal studies require surgical exploration¹⁶.

In a meta-analysis of 1585 Doppler studies from 18 series, the sensitivity for torsion was 92% with a specificity of 99%. If the sensitivity and specificity were calculated including the indeterminate studies (3% of cases) the true sensitivity was 89% and the true specificity 98%. The positive predictive value of Doppler for torsion was 96% and the negative predictive value 98%.

Scintigraphy

Scintigraphy using Technetium-99^m sodium pertechnetate is a quick and safe determinant of testicular bloodflow. The "halo sign" (a central "cold" spot with a "hot" perimeter of increased uptake) usually represents late torsion, tumour, hydrocoele, abscess or haematoma. Increased uptake may be due to epididymo-orchitis, torsion of the testicular appendices, tumor, mild trauma or resolved torsion. However, scintigraphy is not always available after hours, and is unreliable in young children and when there is an abnormal or undescended contralateral testis or bilateral disease¹⁷.

In a meta-analysis of 527 scintigraphy studies from 12 series, the sensitivity for torsion was 97% and the specificity 99%. Including the indeterminate studies (2% of cases) the true sensitivity for torsion was 96% and the true specificity 99%. Scintigraphy had a positive predictive value of 99% and a negative predictive value of 99%.

Magnetic Resonance Imaging (MRI)

MRI with intravenous contrast enhancement combines excellent structural imaging with functional information. However, MRI is more expensive than colour Doppler and less likely to be available after hours. Its use is limited by the need for sedation in young patients¹⁸.

MANAGEMENT

The management protocol for the acute scrotum is illustrated in Fig. 2. When clinical

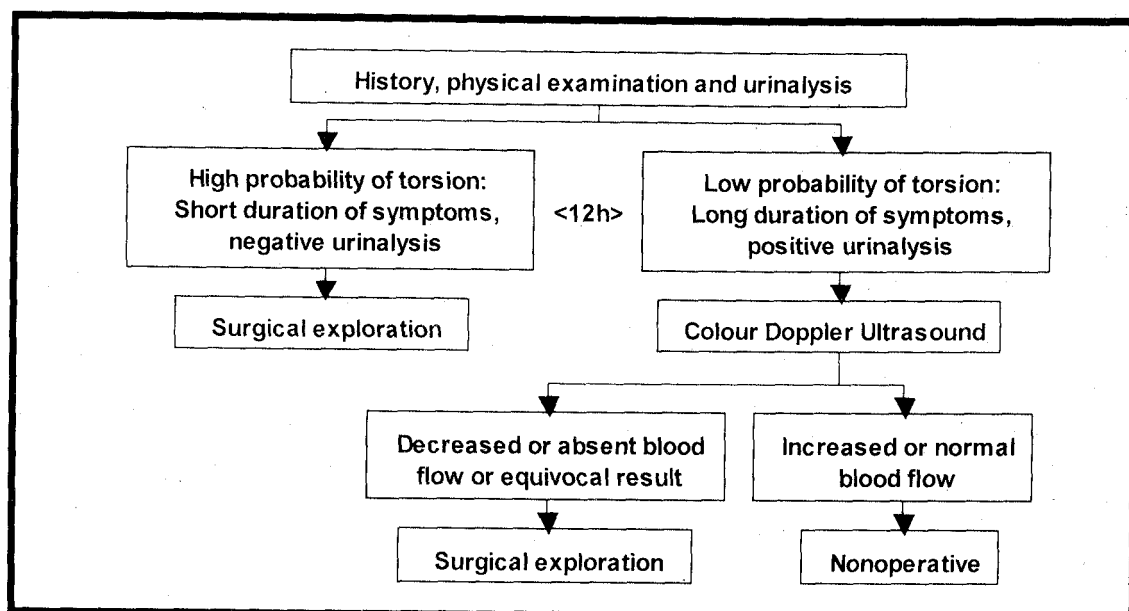


Fig. 2: Management protocol for the acute scrotum (Modified from Galejs and Kass, 1999²³)

examination suggests testicular torsion and the duration of pain is less than 12 hours, urgent surgical intervention is indicated. Immediate surgery is indicated in all cases of acute solitary testis.

Manual Detorsion

Because torsion is usually by internal rotation, manual detorsion (without analgesia) should first be attempted in external rotation – “like opening a book”. If this fails, internal rotation should be attempted. Immediate pain relief signifies success. Manual detorsion can be performed under sedation or with a spermatic cord block, but success is then more difficult to judge. Detorsion is successful in over 80% of attempts, but residual torsion is still present in up to 28% of cases, therefore surgical repair should not be delayed⁷.

External Cooling

Placing an ice pack on the affected testis (with a towel to protect the skin from hypothermic injury) significantly preserves testicular function in animal studies. Although this has not been validated in human studies, it is routinely used in some centers⁵.

Management of Intravaginal Torsion

Exploration of both scrotal compartments can be performed through a single incision in the median raphe. When the testis is obviously necrotic, orchidectomy is indicated, since up to 45% of necrotic testes may extrude through the wound or form a draining sinus when left in situ³. Consideration should be given to simultaneous placement of a silastic prosthesis.

If the testis fails to regain any pink colour after detorsion and only black blood oozes from an incision in the tunica albuginea, orchidectomy is indicated. If the testis regains some mottled colour with red bleeding from an incision in the tunica, it should probably be preserved. Equivocal testes should be wrapped in warm saline gauze for 5-10 minutes and then re-examined.

Fixation Techniques

The techniques recommended for orchidopexy include suture fixation, a dartos pouch, and the window operation (Fig. 3). There are at least 22 reports of recurrence after previous fixation for torsion. Absorbable sutures were used in 19, and non-absorbable sutures in 3 cases.

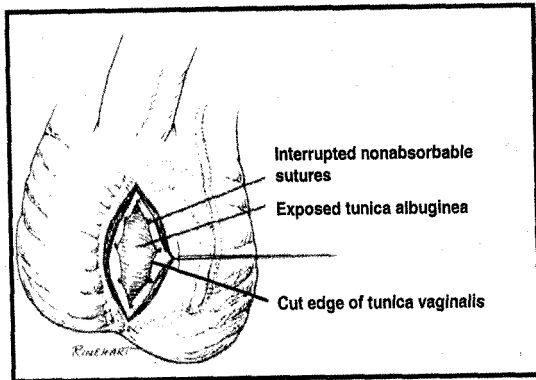


Fig. 3: Surgical technique for the "window orchidopexy" (modified from Knight and Vassy, 1984²⁴)

The reasoning behind using absorbable sutures was that they cause more fibrosis. Non-absorbable sutures cause little fibrosis, but their permanent nature sustains fixation. However, they may tear out, therefore at least 3 sutures should be used. Silk may cause abscess formation and is more likely to extrude. Nylon or prolene is the suture of choice.

Eversion of the tunica vaginalis with dartos pouch fixation produces excellent fixation¹⁹.

In the window orchidopexy a midline scrotal incision is made and the edge of the tunica vaginalis is sutured to the tunica albuginea with 6 interrupted 4-0 sutures, creating a window of 1.5 cm x 2.0 cm. The other hemiscrotum is opened via the same skin incision and fixed in the same way. The incision is then closed over these two windows leaving a broad area of the testes exposed to subcutaneous tissue²⁰ (Fig. 3).

Postoperative Complications

Minor complications after scrotal exploration for torsion, such as postoperative fever, minor wound infection, haemorrhage and haematoma, occur in 2-27% of cases.

Recurrence after Fixation

The reported incidence of subsequent torsion in the unfixed testis varies from 5% to 43%⁶. In the 22 cases of recurrent torsion after previous fixation, the median time to recurrence was 21 months, and 80% occurred in the

contralateral testis. Recurrent torsion despite using non-absorbable sutures can occur because the sutures tore out, or a single suture allows the testis to twist like a pirouetting ballerina, or a percutaneously placed suture was removed.

Management of Extravaginal Torsion

In postnatal torsion immediate surgery and contralateral fixation is required in an all-out attempt to retain some testicular function.

In cases of unilateral prenatal torsion, there is controversy about whether exploration or contralateral orchidopexy is indicated. The arguments against exploration include the low rate of testicular salvage (5%), the low risk of contralateral torsion, and the increased anaesthetic risk in neonates. The arguments in favor of surgery are that up to 11% of cases are IVT (with a high risk of contralateral torsion), there is a 5% possibility of testicular salvage, other conditions (e.g. tumor, hernia) can be excluded, and leaving an infarcted testis in place may have adverse effects on the contralateral testis. Considering these arguments it is hard to justify conservative management if the neonate is fit for anesthesia¹³.

An anterolateral or midline scrotal approach is appropriate if the testis is in the scrotum, but an inguinal approach may be preferred where the testis is lying in the inguinal canal, when the diagnosis is uncertain or where a patent processus vaginalis is suspected.

Management of Torsion of Appendices

If the diagnosis is certain, management entails bed rest and scrotal elevation. Nonsteroidal anti-inflammatory drugs and analgesics are generally not helpful. The inflammation usually resolves within 2-7 days. About 13% may need surgery for pain persisting after two days. If a twisted appendage is found at exploration it can simply be excised without ligation.

In a meta-analysis of 629 cases of torsion of the appendices from 9 studies, we noted metachronous bilateral torsion in 2.5% of cases. Therefore, exploring the contralateral side with the intention of removing the appendices is not justified.

Management of Solitary Testes

Congenital monorchia may be due to perinatal or silent torsion, therefore the contralateral testis should be fixed. Unilateral testicular atrophy may be due to missed torsion, which necessitates contralateral orchidopexy²¹.

CONCLUSION

Torsion remains a relatively common surgical emergency, and requires prompt diagnosis and urgent management. The following also remains true: the diagnosis is primarily clinical; an attempt at manual detorsion prior to surgical exploration is worthwhile; and bilateral fixation of the testes with non-absorbable sutures is essential to prevent possible recurrence of torsion.

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