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Catherine Baud
Corinne Veyrac
Alain Couture
Jean Louis Ferran

Spiral twist of the spermatic cord: a reliable sign of testicular torsion

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C. Baud (✉) · C. Veyrac · A. Couture · J.L. Ferran
Service de Radiologie Pédiatrique, Hôpital Arnaud de Villeneuve, 371 av. du Doyen Gaston Giraud, F-34295 Montpellier Cedex 5, France

Abstract *Background.* Colour Doppler sonography (CDS) has become the procedure of choice in evaluating testicular perfusion but false negative findings have been reported.
Objective. To determine if direct visualisation of the twisted spermatic cord using high resolution US is a reliable sign to assess testicular torsion.
Material and methods. Thirty patients (aged 2–26 years) with equivocal diagnosis of testicular torsion prospectively underwent high resolution and CDS. The results were correlated with surgical findings. Serial transverse and longitudinal scans were performed to compare the scrotal contents on each side and study the complete spermatic cord course, from inguinal canal to testis, to detect a spiral twist.
Results. In 14 of the 23 cases of torsion, the diagnosis was based on the colour Doppler findings in the scrotum because blood flow was absent in the symptomatic testis and detectable without difficulty on the normal side. In nine cases, CDS was unreliable; in six cases intratesticular perfusion was present in a twisted testis and in three small boys, no colour signal was obtained in either testis. In all cases of torsion, the spiral twist of spermatic cord was detected at the external inguinal ring. The twist induced an abrupt change in spermatic cord course, size and shape below the point of torsion. It appeared in the scrotum as a round or oval, homogeneous or heterogeneous extratesticular mass with or without blood flow, that could be connected cephalad with the normal inguinal cord. In the other seven cases (three late torsions of the appendix testis, one epididymo-orchitis and three torsions with spontaneous reduction), no spiral twist was detectable.
Conclusion. The detection of spermatic cord spiral twist appears a reliable US sign of torsion whatever the testicular consequences.

Introduction

Acute scrotal pain and swelling is a potential emergency requiring accurate diagnosis. It is essential, but not always clinically possible, to differentiate testicular torsion from non-surgical causes such as epididymitis, epididymo-orchitis or torsion of the appendix testis. Scintigraphy is helpful but is often not immediately available at all times. Colour Doppler sonography (CDS) has become the procedure of choice in evaluating testicular perfusion but false negative findings have been reported. Our goal was to determine if direct visualisation of the twisted cord with high-resolution US is a reliable sign to assess testicular torsion.

Materials and methods

The study population consisted of thirty patients (2–26 years of age) who presented with acute scrotal pain and swelling between August 1993 and August 1996. High resolution and CDS were used prospectively to help in the diagnosis, considered to be equivocal by the clinician. The time loss caused by the examination was never greater than 30 min. Cases were diagnosed as either torsion or no torsion based on US findings prior to surgery. The results were correlated with final diagnoses established by surgery.

All US examinations were performed with an ATL UM9 DHI apparatus, sensitive to low flow rates (4–5 cm/s). A 10-MHz linear transducer with low wall filter (100 KHz), low pulse-repetition frequency (1–2 Hz) and 70–90 % colour gain output settings was used. A large amount of gel minimized pressure on the scrotal skin.

Transverse and longitudinal scans of scrotal contents on both sides permitted a comparison of testicular echogenicity and homogeneity, testicular size and vascularity. A transverse view with both testes on the same image was essential to appreciate subtle changes of echo texture. Testicular sizes were determined by objective measurements of their AP diameter on comparable transverse images of the left and right sides. A difference of 3 mm in AP diameter between both testes was considered as significant in the peripubertal period. The location of the head of the epididymis, its relationship with the testis and the spermatic cord, its size, echogenicity and perfusion were noted. Thickening of the scrotal skin and its vascularity were also noted.

In all cases, a high-resolution study of the spermatic cord was added to the CDS evaluation of the testes. The normal cord was identified in the inguinal canal and its complete course followed on serial scans.

Testicular torsion was diagnosed if there was an abrupt change in spermatic cord course, size, shape and echo texture below the point of torsion at the external inguinal ring.

Results

Surgical exploration defined the final diagnosis in the 30 children as follows – 23 testicular torsions, 3 torsions with spontaneous reduction, 3 torsions of the appendix testis and 1 epididymo-orchitis.

Three teenagers were considered to have transient torsion followed by spontaneous de-torsion. Grey scale sonography was normal. Colour Doppler sonography demonstrated increased cord and testis flow in one. In three children with late torsion of appendix testis and in one with epididymo-orchitis, CDS showed increase in cordonal, epididymal and testicular perfusion.

In these seven cases without testicular torsion, there was no abrupt change in spermatic cord course, size and shape. On longitudinal views, cord course was almost straight from the inguinal canal to the posterior border of the testis (Fig. la). On serial transverse scans, each vessel kept the same position in the cord and appeared on CDS as a colour spot and not as a loop (Fig. 1 b). The spermatic cord never measured more than 10 mm in AP diameter. The head of the epididymis was always identified at the cranial pole of testis.

In the 23 patients with torsion, intratesticular blood flow was visualized without difficulty on the normal side in 20 patients (aged 11–26 years). The diagnosis was established with CDS in 14 of these patients because of no detectable flow in the symptomatic testis and easily detectable flow in the contralateral testis. The involved testis was enlarged in all cases. Testicular enlargement was mild (difference of 3–4 mm in the AP diameters) in the ten testes which were viable. It was marked (difference of 7–23 mm in the AP diameters) in all four necrotic testes. In 12 patients, the affected testis was homogeneous with normal echogenicity in 3 and showed a change of echogenicity in 9. Two patients had a heterogeneous testis due to infarction and necrosis with thickening and hyperaemia of adjacent scrotal tissue.

In six cases, CDS was normal or mildly abnormal. Intratesticular perfusion was still present. The affected testis showed normal echogenicity and was of normal size ($n = 3$) or mildly enlarged ($n = 3$). At surgery, all six testes were viable.

In three small boys (2–4 years of age), no colour signal was obtained in either testis. Two boys had markedly enlarged testes due to necrosis. The third had a homogeneous slightly enlarged testis which was viable.

In all cases of torsion, the spiral twist was detected on high-resolution sonography. The cord twisted at the external inguinal ring (Fig. 2). This produced an abrupt change in spermatic cord course, size, shape and echo texture below the point of torsion. The twisted cord appeared in the scrotum as a round or ovoid mass in an extratesticular location. It was homogeneous (Fig. 3) or heterogeneous without any specific internal architecture. Often some tiny ducts could be seen in the twist, probably due to lymphatic obstruction (Fig. 4). The scrotal portion of the cord was in a supratesticular, paratesticular or even infratesticular location. The twisted cord diameter varied from 12 to 33 mm. In missed torsion, the twisted cord could be markedly enlarged with hyperechoic thickening of intervascular tissues due to haemorrhagic infarction of the epididymis and cord (Fig. 5). The normal epididymal head was never visualized at the cranial pole of the testis. It was sometimes recognized as a cup-shaped area wrapped around the cord. Blood flow was present within the cord during its complete spiral course in the six patients with intratesticular perfusion. The vessels performed one or several loops on the cord circumference (Fig. 2 b). In the 16 other cases, the twisted cord was completely avascular or a disruption of the colour signal within the spiral was noted.

Discussion

Intravaginal torsion of the spermatic cord is a surgical emergency and treatment delay often results in loss of

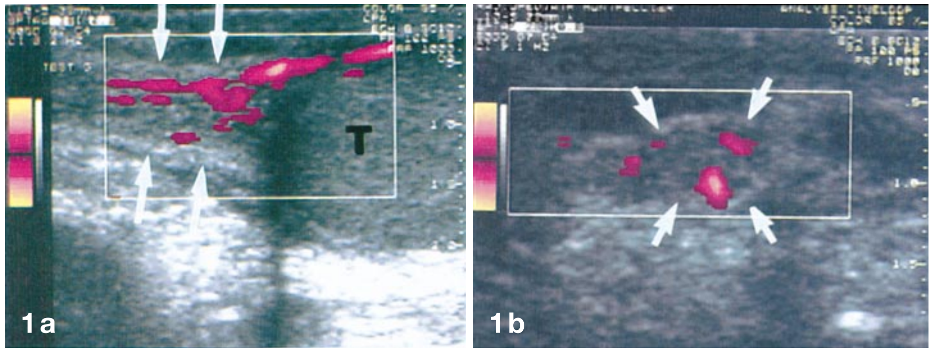


Fig. 1 a, b Normal spermatic cord. **a** Longitudinal scan of the cord at the external inguinal ring shows the course of the spermatic cord (*arrows*) to be straight to the posterior border of the testis. The vessels are slightly tortuous within it. **b** Transverse scan of the normal inguinal cord (*arrows*). Its AP diameter is less than 5 mm. Several spots are present but there are no spirals on the cord circumference

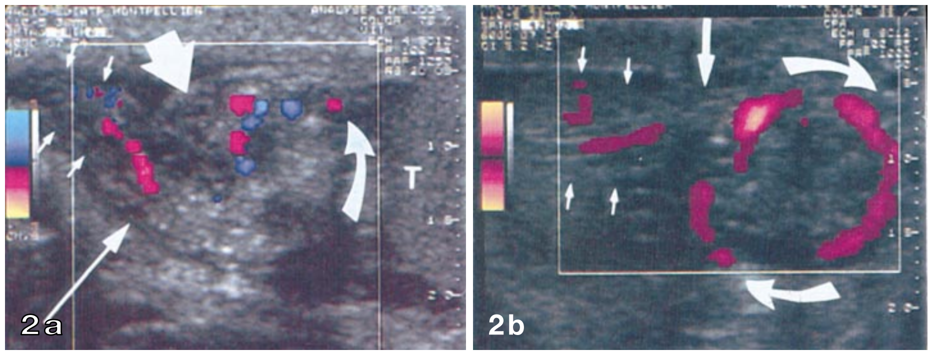


Fig. 2 a, b Incomplete torsion. **a** Longitudinal view of the left external inguinal ring shows the cord (*curved arrow*) and the epididymis (*large arrow*) rolling up. There is an abrupt change in spermatic cord size which is normal in the inguinal canal (*small arrows*) and enlarged below the point of torsion (*long arrow*). **b** Transverse scan at the same level in a different patient shows a sudden change in the course of the vessels, being straight in the inguinal canal (*small arrows*) and spiralled below the point of torsion (*straight arrow*). There are vascular loops (*curved arrows*) on the cord circumference. Both testes were viable at surgery

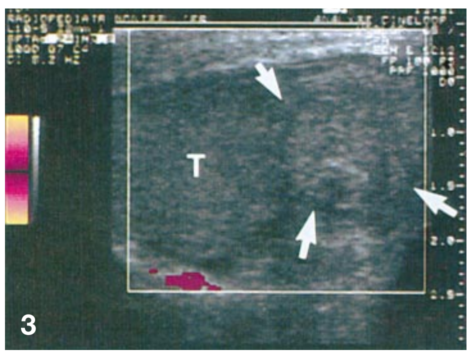


Fig. 3 Complete torsion. Transverse scan through the left scrotum shows a round homogeneous paratesticular mass (*arrows*). No signal could be detected in the testis (*T*) or twisted cord (*arrows*). There was 180° torsion at surgery and the testis was viable

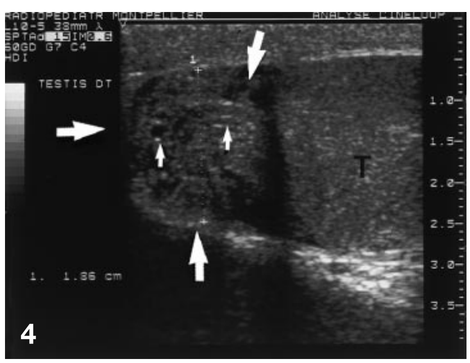


Fig. 4 Spiral twist. Longitudinal view of the right testis shows a round supratesticular mass curled around itself like a snail shell (*arrows*). There are some tiny ducts (*small arrows*) within the twist, probably due to the lymphatic obstruction. At operation, there was 360° torsion and the testis was viable

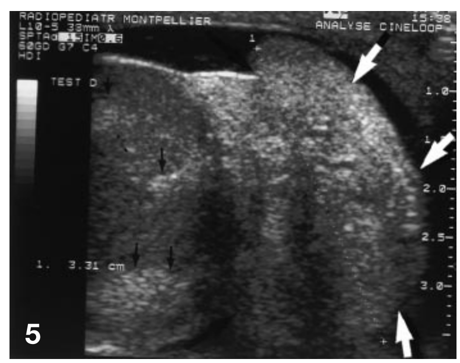
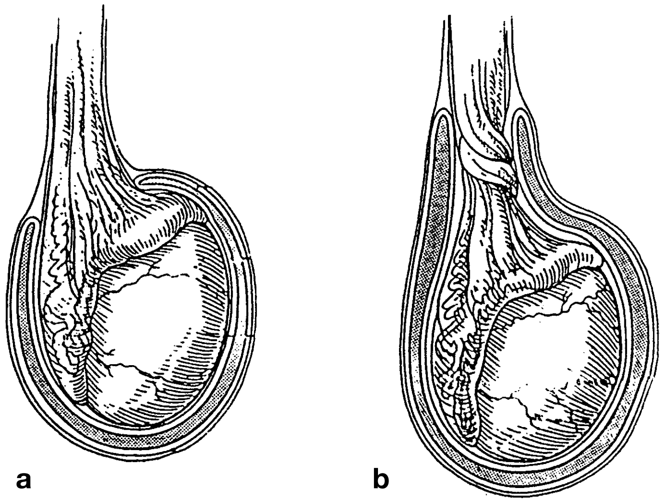


Fig. 5 Late torsion. Longitudinal view of the lower pole of the testis shows a hugely enlarged, hyperechoic, inhomogeneous infratesticular mass (*arrows*). Hyperechoic foci (*small arrows*) are visualized in the heterogeneous testis. At surgery, there was haemorrhagic infarction of the testis, epididymis and cord

the testis [1]. It is most common in teenagers and young adults but may occur at any age. It results from an underlying abnormality which is either high investment of the tunica vaginalis (Fig. 6) or a long mesorchium [2–5].

Patients typically present with sudden onset of an extremely painful scrotal swelling associated with nausea or vomiting and abdominal pain [2, 6–10]. The testicle is fixed in a transverse or high position due to shortening of the twisted cord [2]. Surgery must be performed immediately, without imaging studies, in these typical cases.

In some cases, the physical examination may be limited because of tenderness and swelling [2, 4–7, 9–13].



a b

Fig. 6 a, b (Reproduced from Cilento et al. [10]) **a** Normal attachment of the tunica vaginalis which only partially envelops the gonad. **b** Intravaginal torsion. Complete testicular envelopment within the tunica vaginalis permits the gonad to twist upon its vascular pedicle

Symptoms can disappear completely [14–16] with partial de-torsion and clinical signs are not always reliable in young children [15].

When diagnosis is uncertain, CDS has become the examination of choice to assist the clinician in establishing a definitive need for emergency surgery [4, 14–18]. The diagnosis of testicular torsion is made when intratesticular blood flow is visualized without difficulty on the normal side but is absent or dramatically reduced on the affected side. In our series, CDS evaluation was reliable in 14 cases of testicular torsion, but unreliable in 9. There were three technical failures because in small boys (2–4 years of age) no colour signal was obtained in either testis. In six cases, intratesticular perfusion was normal or only mildly abnormal. In the literature, there are several reports of CDS identifying blood flow in a testis subsequently shown at surgery to be twisted [1, 4, 15, 16, 19]. These cases underscore the unreliability of CDS in the assessment of testicular torsion.

Direct visualization of the twisted cord allows these diagnostic difficulties to be overcome and was the only reliable finding in 9 of our 23 cases of testicular torsion. Sonographic evaluation of the spermatic cord is, therefore, an essential part of the examination. The normal cord can be identified in the inguinal canal and followed more inferiorly into the scrotum to the postero-superior border of the testis. On longitudinal scanning (Fig. 1 a), the normal cord appears as a smooth linear structure limited by a highly echogenic stripe [20]. It contains slightly sinuous testicular, deferential and cremasteric arteries and the pampiniform plexus of veins. On transverse scans (Fig. 1 b), the cord appears as an ovoid structure with a hyperechoic edge containing several spots. Its AP diameter, based on a study of twenty normal controls, is always less than 10 mm. On serial transverse scans, each vessel keeps nearly the same place in the cord and no loop can be seen.

The twisted cord looks quite different. The spiral twist corresponds to the clockwise or counter-clockwise rotation of cord vessels and epididymal structures. The cord rolls up at the external inguinal ring. The twist induces an abrupt change in spermatic cord course, size and shape below the point of torsion. It appears in the scrotum as a round or ovoid, homogeneous or heterogeneous extratesticular mass. When the cord is still vascularized, vascular 1oops are clearly seen on the cord circumference.

The major difficulty is distinguishing the twisted cord with a swollen epididymis. Many authors have described an extratesticular mass in patients with testicular torsion and presumed that epididymal enlargement was its only cause [3, 4, 6, 11, 19]. In our experience the mass can be easily connected cephalad to the normal inguinal cord and not to the body and tail of the epididymis. The epididymal head is never in its normal location. It is sometimes recognized as a cup-shaped area wrapped around the cord.

The cord and epididymis may be hugely swollen in epididymitis, epididymo-orchitis or twisted appendix testis, but in these situations there is no abrupt cord change. The relationship of the epididymis with the testis and cord is normal. The head is adjacent to the superior pole of the testis and the body is often also enlarged and wrapped around its posterolateral aspect. Colour Doppler sonography shows hypervascularity of the cord vessels, epididymis and sometimes the testis.

Prognosis can be suggested from the CDS and greyscale findings. In our experience, the presence of testicular perfusion, even after 48 hours torsion, always indicates a viable testis at surgery. Normal echogenicity with mild testicular enlargement is a good sign of viability. Marked testicular enlargement is a bad prognostic feature. Heterogeneous testicular echo texture with hypervascular scrotal wall thickening is always the sign of infarction and necrosis. In the missed torsion, identification of a spiral twist provides the diagnosis and excludes post-infectious testicular ischaemia.

US distinction between reactive testicular hyperaemia following spontaneous de-torsion, epididymis or epididymo-orchitis and local inflammatory reaction due to a necrotic appendix testis is not possible. Visualization of a normal cord course excludes torsion at the time of the examination but the differential diagnosis is based on clinical history and physical findings.

Conclusion

Sonographic evaluation of the spermatic cord in addition to CDS of the scrotal contents is essential. Spiral twist of the spermatic cord is a reliable sign of testicular torsion whatever the consequences for the testis. In patients with acute scrotal pain and swelling, any unexplained extratesticular mass must be considered a twisted cord until proved otherwise.

References

1. Witherington R, Jarell TS (1990) Torsion of the spermatic cord in adults. J Urol 143: 62–63
2. Klauber GT, Sant GR (1985) Disorders of the male external genitalia. In: Kelalis PP, King LR, Belman AR (eds) Clinical pediatric urology, 32nd edn. Saunders, Philadelphia, pp 825–863
3. Hricak H, Jeffrey RB (1983) Sonography of acute scrotal abnormalities. Radiol Clin North Am 21: 595–603
4. Middleton WD, Siegel BA, Melson GL, et al (1990) Acute scrotal disorders: prospective comparison of color Doppler US and testicular scintigraphy. Radiology 177: 177–181
5. Krone KD, Carroll BA (1985) Scrotal ultrasound. Radiol Clin North Am 23: 121–139
6. Pryor JL, Watson LR, Day DL, et al (1994) Scrotal ultrasound for evaluation of subacute testicular torsion sonographic findings and adverse clinical implications. J Urol 151: 693–697
7. Pedersen JF, Holm HH, Hald T (1975) Torsion of the testis diagnosed by ultrasound. J Urol 113: 66–68
8. MacCombe AW, Scobie WG (1988) Torsion of scrotal contents in children. Br J Urol 61: 148–150
9. Bird K, Rosenfield AT, Taylor KJ (1983) Ultrasonography in testicular torsion. Radiology 147: 527–534
10. Cilento BG, Najjar SS, Atala A (1993) Cryptorchidism and testicular torsion. Pediatr Clin North Am 40: 1133–1149
11. Arger PH, Mulhern CR, Coleman BG, et al (1981) Prospective analysis of the value of scrotal ultrasound. Radiology 141: 763–766
12. Riley TW, Mosbaugh PG, Coles JL, et al (1976) Use of radioisotope scan in evaluation of intrascrotal lesions. J Urol 116: 472–475
13. Sample WF, Gottesman JE, Skinner DG, Ehrlich RM (1978) Gray scale ultrasound of the scrotum. Radiology 127: 225–228
14. Lerner RM, Mevorach RA, Hulbert WC, Rabtnowitz R (1990) Color Doppler US in evaluation of acute scrotal disease. Radiology 176: 355–358
15. Patriquin HB, Yazbeck S, Trinh B, et al (1993) Testicular torsion in infants and children: diagnosis with Doppler sonography. Radiology 188: 781–785
16. Burks DD, Markey BJ, Burkhardt TK, et al (1990) Suspected testicular torsion and ischemia: evaluation with color Doppler sonography. Radiology 175: 815–821
17. Wilbert DM, Schaerfe CW, Stern WD (1993) Evaluation of the acute scrotum by color-coded Doppler ultrasonography. J Urol 149: 1475–1477
18. Atkinson GO, Patrick LE, Ball T (1992) The normal and abnormal scrotum in children : evaluation with color Doppler sonography. AJR 158: 613–617
19. Steinhardt GF, Boyarsky S, Mackey R (1993) Testicular torsion: pitfalls of color Doppler sonography. J Urol 150: 461–462
20. Feld R, Middleton WD (1992) Recent advances in sonography of the testis and scrotum. Radiol Clin North Am 30: 1033–1051