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**Maria E. K. Sellars**
**Paul S. Sidhu**

# Ultrasound appearances of the testicular appendages: pictorial review

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M.E.K. Sellars · P.S. Sidhu (✉)
Department of Radiology,
King's College Hospital, Denmark Hill,
London SE5 9RS, UK
e-mail: paulsidhu@compuserve.com
Tel.: +44-20-73464164
Fax: +44-20-73463157

**Abstract** Five testicular appendages are formed during development of the male genito-urinary tract, which are the remnants of the degenerating mesonephric and paramesonephric ducts. The testicular and epididymal appendages, found at the upper pole of the testis and at the head of the epididymis respectively, are the most common and have a range of appearances on ultrasound. These appendages have the ability to undergo torsion, an important differential diagnosis in the child who presents with an acute scrotum. The varying ultrasound appearances of the testicular appendages are described and illustrated. Ultrasound features of appendiceal torsion are also demonstrated.

**Keywords** Testicular appendages · Anatomy · Ultrasound · Torsion

## Introduction

High-resolution ultrasound is the imaging modality of choice for the superficially located scrotal sac and its contents. A range of normal appearances on testicular ultrasound can make interpretation problematic, particularly in patients who present acutely, when decisions regarding clinical management may be influenced by ultrasound findings. Correct interpretation of the ultrasound appearances is dependent on an accurate anatomical knowledge of the scrotal contents. This applies to imaging the testicular appendages, which, although relatively small, are normally seen on modern high-frequency ultrasound imaging.

In this pictorial review, the embryology and anatomy of the testicular appendages is discussed and the variations in appearance are illustrated. Torsion of these testicular appendages, often a source of misleading clinical symptoms, is depicted.

## Embryology and anatomy

The ovoid testes develop from the genital ridge during the fifth week of gestation. Under the influence of testosterone produced from the eighth week of intra-uterine life the mesonephric ducts, which once drained urine from the mesonephric kidney, differentiate into the epididymis, vas and ejaculatory duct. The paramesonephric ducts, which develop lateral to the gonads, and the mesonephric ducts are suppressed by mullerian inhibiting factor produced by the fetal testes. A remnant of these ducts may remain to form the appendix testis (hydatid of Morgagni) and appendix epididymis, respectively [1, 2]. Three additional appendages, not seen on ultrasound, have been identified microscopically: the paradidymis (appendix of the cord or organ of Giraldés), arising from the spermatic cord, and the superior and inferior vas aberrans of Haler (Fig. 1) [3].

Vascular supply to the scrotal contents consists of the testicular artery (arising directly from the aorta), which runs through the inguinal canal within the spermatic cord. Capsular branches from the testicular artery enter the substance of the testis, the centripedal arteries. These in turn loop back on themselves forming recurrent rami branches [4, 5]. The cremasteric artery (a branch of the inferior epigastric artery) and the artery to the ductus deferens (arising from the superior vesical artery, a branch of the internal iliac artery) form anastomoses with the testiscular artery, with the blood supply to the appendages resulting from this plexus of supply [5].

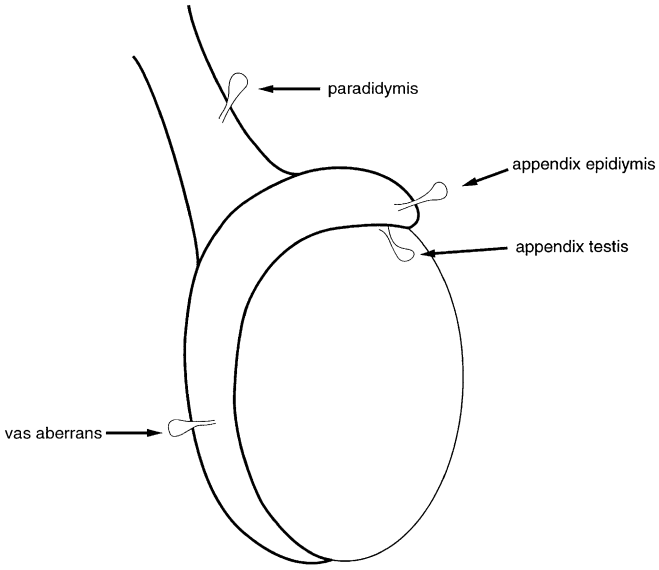



**Fig. 1** The position of the testicular appendages. (From [5])

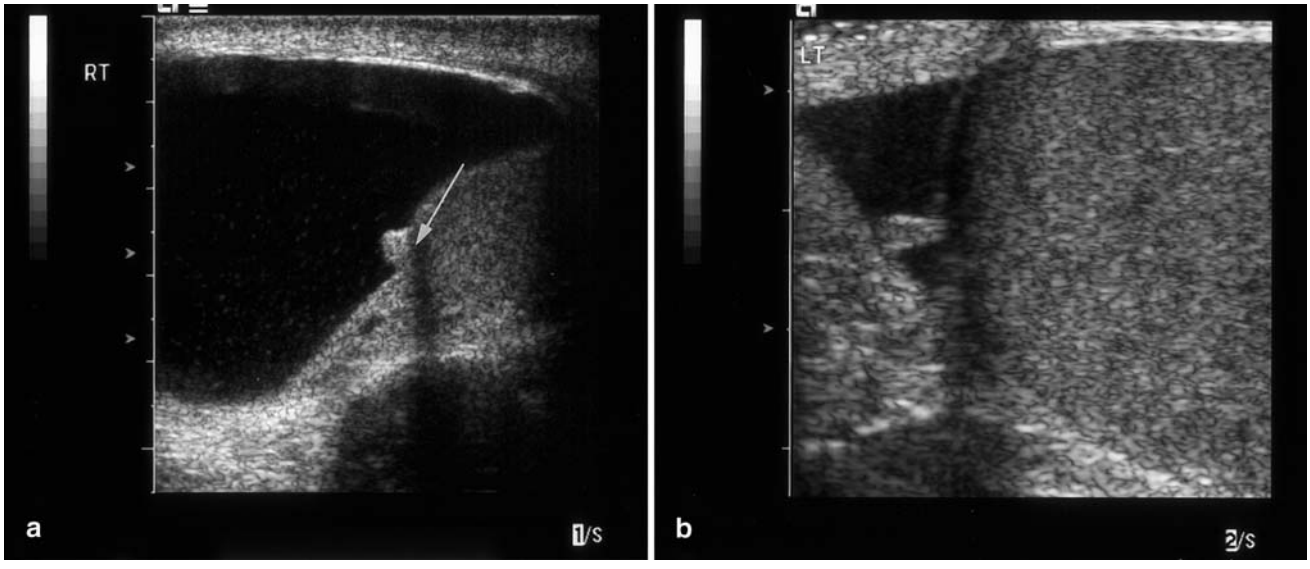
## Ultrasound appearances

The appendix testis is found at the upper pole of the testis in the groove between the testis and the laterally situated head of the epididymis. The appendix testis can measure between 1 and 7 mm in length, and may be present in up to 92% of patients, bilateral in 69% [2, 3, 6]. The appendix testis is usually of similar reflectivity to the head of the epididymis and is best seen in the presence of a hydrocoele (Fig. 2) [7]. The appendix testis has a variable morphology: most commonly being oval shaped and sessile (Fig. 3) but it may appear "stalk like" and pedunculated (Fig. 4), cystic (Fig. 5) or even calcified (Fig. 6). The stalk-like and cystic appendices are associated with an increased likelihood of appendiceal torsion, once thought to be an unusual occurrence but now recognized as a cause of acute scrotal pain [3].

The epididymal appendix seen projecting from the head of the epididymis has been reported to be present in up to 34% of autopsy specimens but is less frequently seen on ultrasound (6% in the series of Johnson and Dewbury; Fig. 7) [2, 3]. The epididymal appendix has a length of between 3 and 8 mm [2], it is more frequently stalked and, like the testicular appendix, may undergo torsion, although this is less common [8]. On occasion both an epididymal and testicular appendage may be seen in the same patient (Fig. 8).

Classically, the testicular artery has a low-resistance waveform with a high forward diastolic flow and a broad systolic peak, whereas the cremasteric and deferential arteries have a higher resistance pattern [5]. Little blood flow is routinely seen at the head of the epididymis and on occasion a small degree of colour Doppler signal may be detected in the testicular appendix (Fig. 9) [4].

**Fig. 2a, b** Normal testicular appendages with hydrocoele. **a** Sessile testicular appendix testis, of higher reflectivity than the adjacent testis, lying in the groove between the testis and epididymis (*arrow*) with a surrounding hydrocoele. **b** Narrow based testicular appendage, of similar reflectivity to the adjacent testis, with a small amount of surrounding fluid



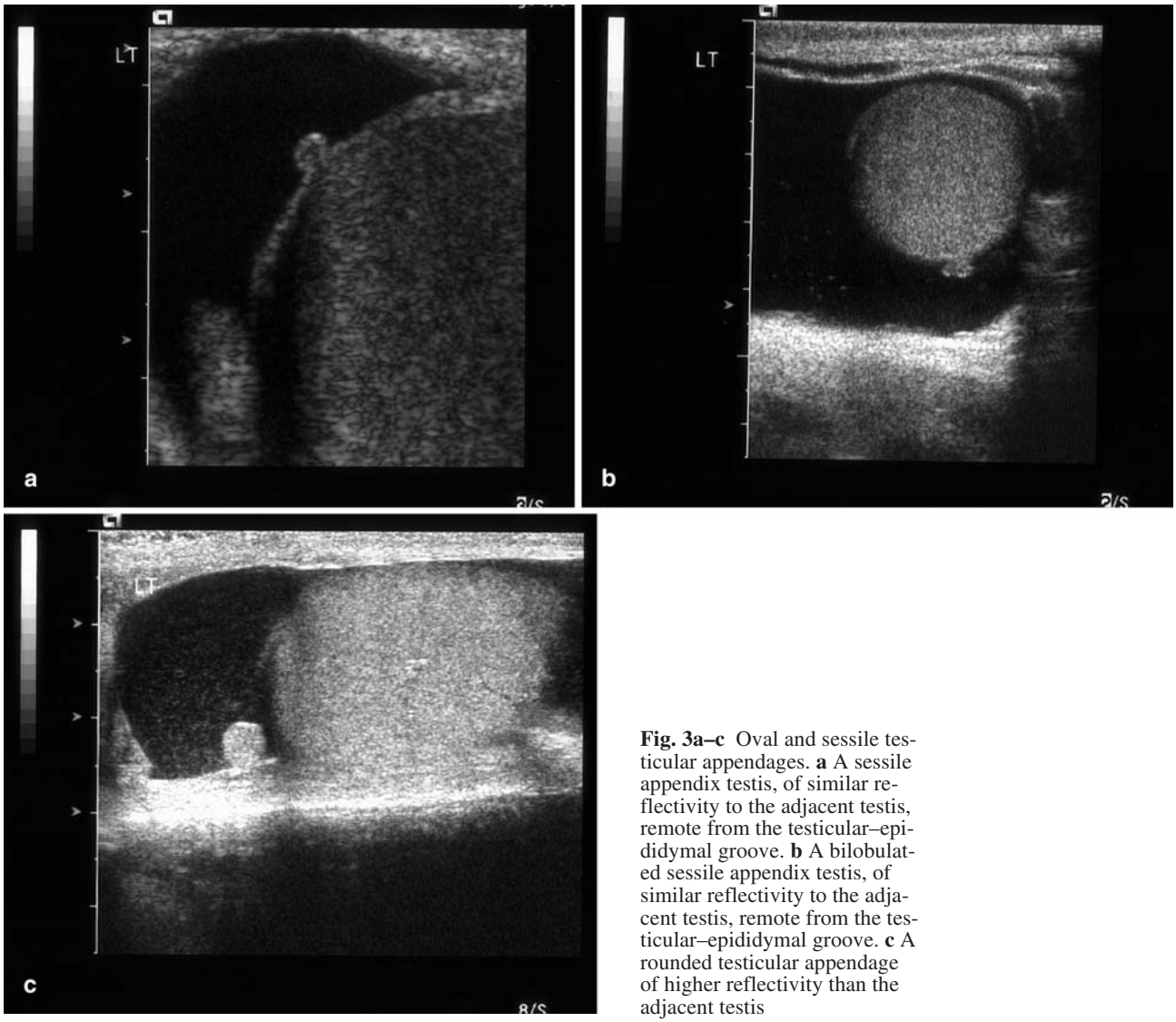



**Fig. 3a–c** Oval and sessile testicular appendages. **a** A sessile appendix testis, of similar reflectivity to the adjacent testis, remote from the testicular–epididymal groove. **b** A bilobulated sessile appendix testis, of similar reflectivity to the adjacent testis, remote from the testicular–epididymal groove. **c** A rounded testicular appendage of higher reflectivity than the adjacent testis

## Torsion of an appendage

Torsion of the testicular appendage is considered to be more common than testicular torsion and an important differential diagnosis among boys under the age of 13 years who present acutely with a painful scrotum (Fig. 10). Although most frequently presenting in patients of between 7 and 13 years, torsion of a testicular appendage can occur at any age. The onset may be associated with trauma or exercise [5, 9, 10] with pain, erythema, tenderness and scrotal swelling common presenting symptoms. In light-skinned individuals the palpable, infracted, tender appendage may be visible at the upper pole of the testis. This "blue-dot" sign is reported to occur in up to 21% of patients presenting with appendiceal torsion [11, 12]. It has been postulated that the risk of synchronous or metachronous bilateral appendiceal torsion is low, approximately 1% (Fig. 11) [6, 12].

With torsion of a testicular appendage, the testis itself usually appears normal on ultrasound with a normal low-resistance arterial supply. There is often an associated localized upper pole hydrocoele and an inflammatory reaction in the epididymis, which is often enlarged. The torsed appendage may have a variable appearance. Most commonly it is of increased homogenous echogenicity, although up to 30% are reported as being of low reflectivity surrounded by an area of increased perfusion [9, 13]. The appendix enlarges due to engorgement and in-

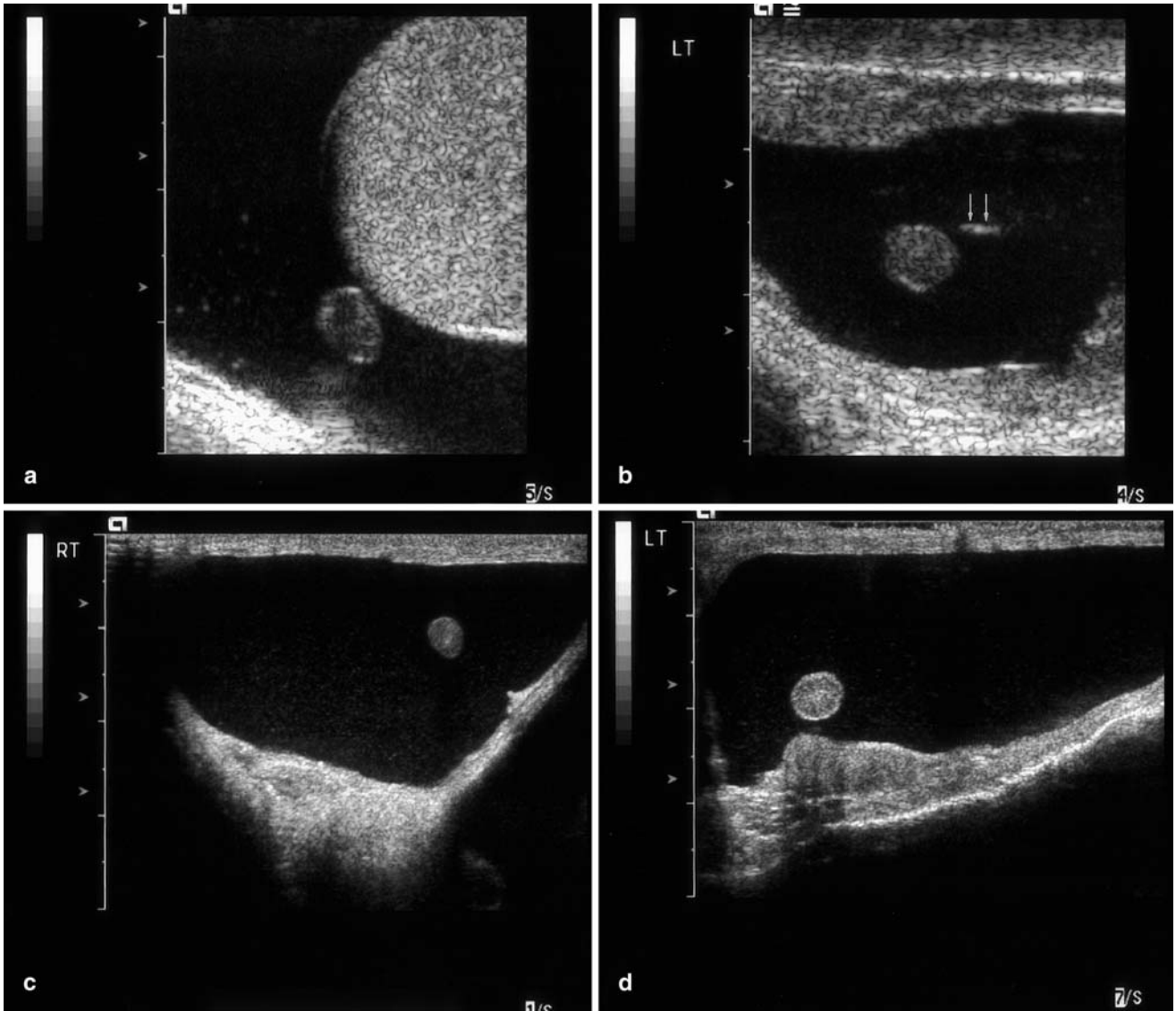



**Fig. 4a–d** Stalk-like and pedunculated testicular appendages. **a** An oval testicular appendage, of mixed reflectivity compared with the adjacent testis, with a short connection to the testis. **b** A pedunculated appendix testis with a clearly visualized "stalk" attachment to the testis (*arrows*). **c** Right and **d** left oval testicular appendages in a patient with bilateral hydrocoeles, demonstrating free-floating appendages on a long "stalk" attachment on the right and a shorter attachment on the left

flammation. There is some overlap on ultrasound between documented normal and abnormal appendiceal size, making absolute measurements unreliable. In one series the diameter of the torsed appendix ranged from 5 to 16 mm [7], whereas in another it was from 3 to 17 mm [14], compared with a normal range of 1–7 mm. Colour Doppler studies may demonstrate an avascular mass separate from the testis and epididymis and an inflammatory reaction with increased blood flow in these adjacent structures [9, 15]. With time the appendix becomes increasingly of higher reflectivity, indicating the onset of calcification (Fig. 12), eventually completely detaching itself. The loose calcified body may be termed a "scrotal pearl", although the origins of these scrotal pearls are uncertain as they may also arise from detached calcified areas of tunica albuginea [5].

These ultrasound appearances help differentiate appendiceal torsion from an acute epididymo-orchitis where the epididymis and testis are enlarged, of heterogenous echo-texture and demonstrate increased blood flow on colour Doppler ultrasound. In testicular torsion the testis is enlarged and of reduced echogenicity due to the presence of congestion and infarction. Haemorrhage leads to a heterogenous increase in reflectivity with the

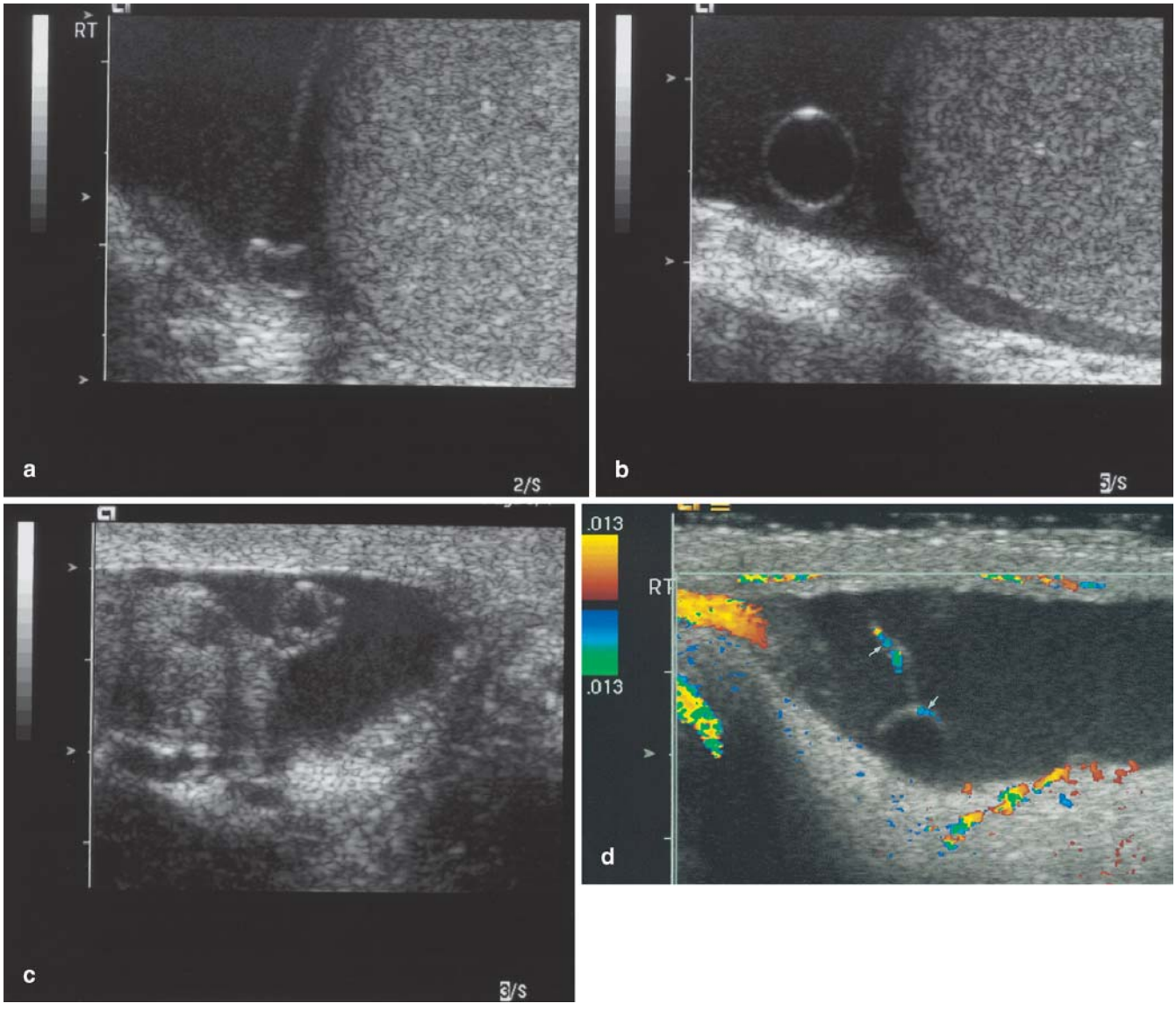



**Fig. 5a–d** Cystic testicular epididymal appendages. **a** An irregular small cystic appendix testis situated in the testicular–epididymal groove. **b** A large well-defined cystic appendix testis situated in the testicular–epididymal groove. **c** An irregular small cystic epididymal appendix with a small amount of surrounding fluid. **d** Colour Doppler image of a cystic appendix with a long stalk attachment with flow demonstrated in the stalk and in the rim of the cyst (*arrows*)

epididymis showing similar changes. There is decreased or absent blood flow to the testis, although the presence of normal intra-testicular Doppler spectral traces may raise the possibility of intermittent torsion [5].

Other imaging modalities, in particular testicular scintigraphy with technetium-99m sodium pertechnetate, have been utilized in the evaluation of the acute scrotum. Nuclear medicine assessment, although providing information regarding testicular perfusion, has a limited ability to differentiate detailed scrotal anatomy particularly in the depiction of an appendage. A "cold area" could represent ischaemia or a hydrocoele, and confirmation with ultrasound would still be required [16].

Clinically, torsion of an appendage presenting with acute scrotal pain and swelling may mimic testicular torsion, epididymitis or epididymo-orchitis. Differentiation between these pathologies can be difficult but is important, as their management is very different. Colour Doppler ultrasound produces a simultaneous real-time display of grey-scale images and blood flow information. Increased flow in the enlarged heterogenous epididymis and testis would suggest epididymo-orchitis, whereas evidence of a normal testis, enlarged epididymis and echogenic testicular appendix with surrounding hyperperfu-

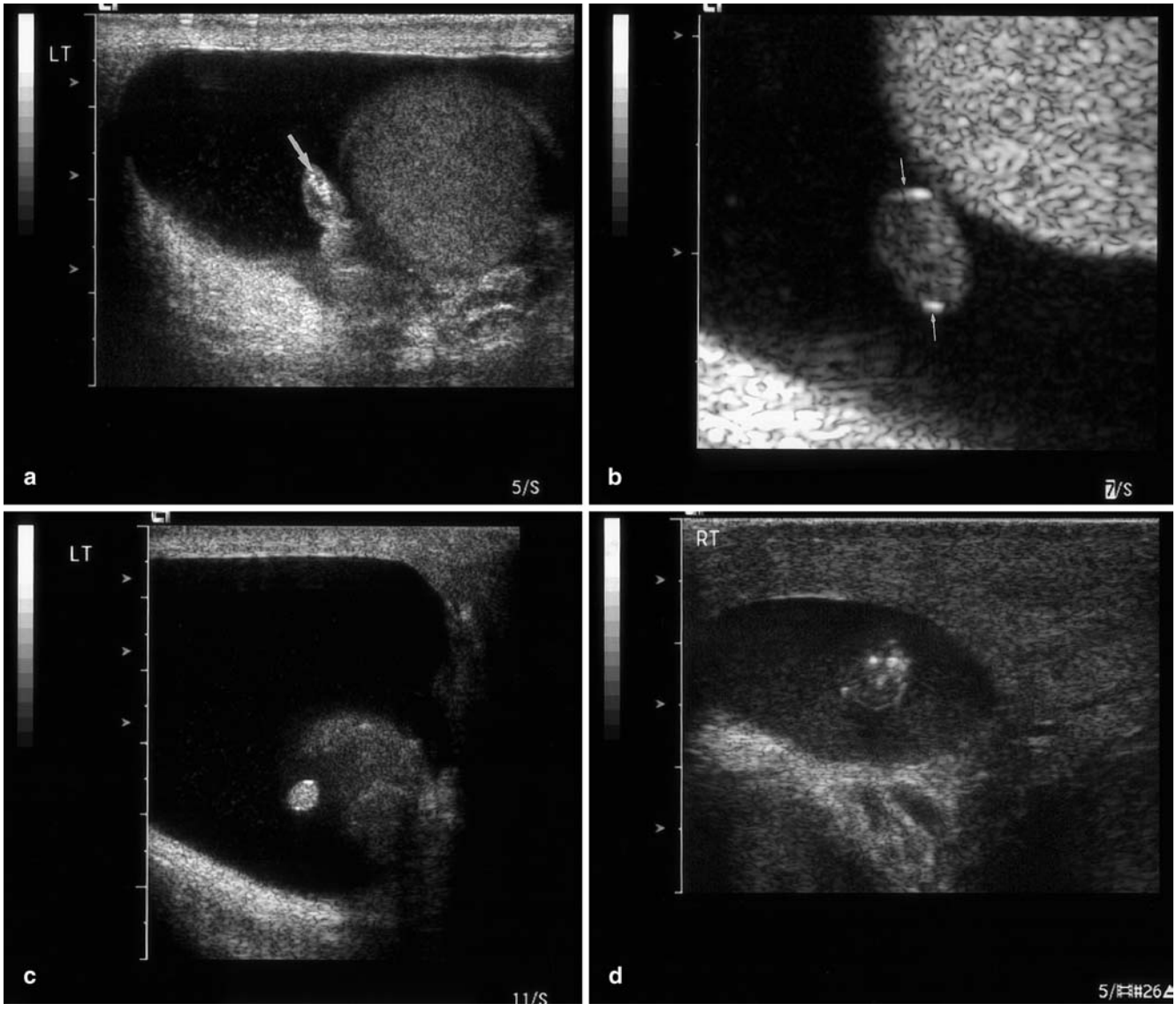



**Fig. 6a–d** Calcified testicular and epididymal appendages. **a** A triangular-shaped appendix testis with an area of high reflectivity indicating the presence of calcification. **b** A pedunculated appendix testis, of low reflectivity compared with the adjacent testis, with areas of high reflectivity in the near and far walls (*arrows*) suggesting linear calcification. **c** An appendix of the epididymis, of high reflectivity compared with the adjacent epididymis, with areas of high reflectivity in the near and far walls suggesting linear calcification. **d** A "mask-like" appendix testis demonstrating punctate areas of calcification, which on real-time ultrasound images is seen to swirl around in the small hydrocoele

sion is seen in appendiceal torsion. The presence of decreased or absent flow to the testis would prompt early surgical management for salvage of the ischaemic testis, whereas bed rest, scrotal support and non-steroidal anti-inflammatory drugs are the treatment of choice for torsion of the testicular appendix [17].

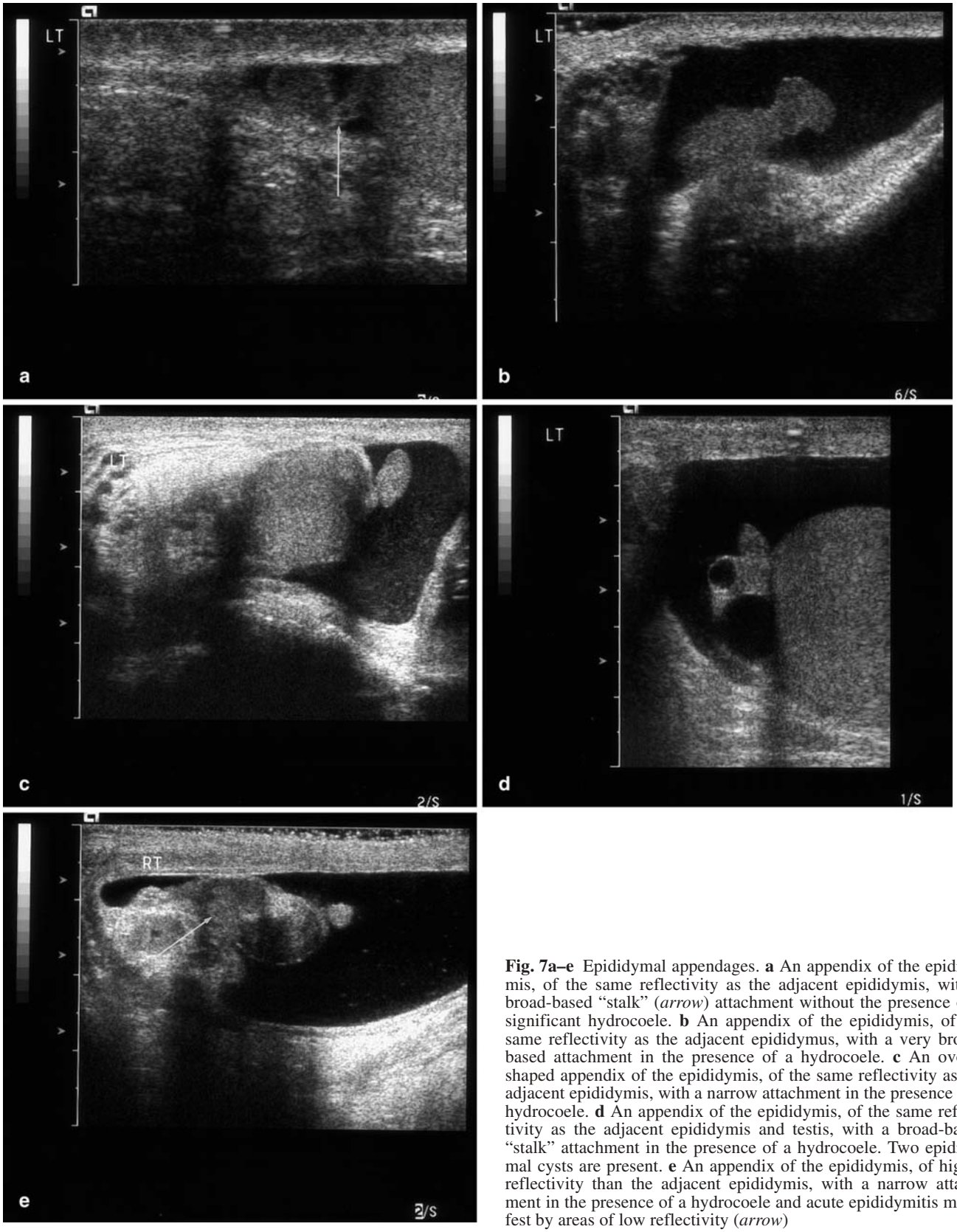



**Fig. 7a–e** Epididymal appendages. **a** An appendix of the epididymis, of the same reflectivity as the adjacent epididymis, with a broad-based "stalk" (*arrow*) attachment without the presence of a significant hydrocoele. **b** An appendix of the epididymis, of the same reflectivity as the adjacent epididymus, with a very broad-based attachment in the presence of a hydrocoele. **c** An ovoid-shaped appendix of the epididymis, of the same reflectivity as the adjacent epididymis, with a narrow attachment in the presence of a hydrocoele. **d** An appendix of the epididymis, of the same reflectivity as the adjacent epididymis and testis, with a broad-based "stalk" attachment in the presence of a hydrocoele. Two epididymal cysts are present. **e** An appendix of the epididymis, of higher reflectivity than the adjacent epididymis, with a narrow attachment in the presence of a hydrocoele and acute epididymitis manifest by areas of low reflectivity (*arrow*)

Fig. 8


Fig. 9

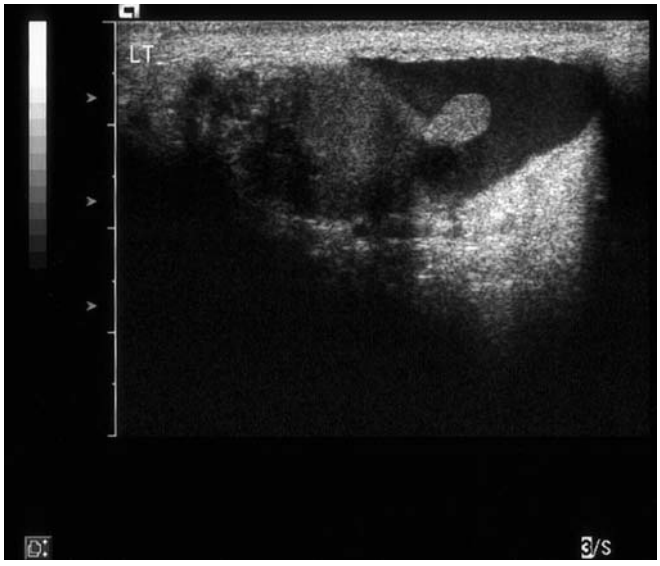



Fig. 10

**Fig. 8** Both an appendix of the epididymis and testis are demonstrated in this patient

**Fig. 9** An epididymal appendix demonstrating central colour Doppler flow. Note the small hydrocoele and increased echogenicity of the epididymal appendix

**Fig. 10** Acute presentation with testicular pain thought to be testicular torsion, in a patient with a highly reflective epididymal appendix, a small hydrocoele and normal colour Doppler flow to the testis, suggestive of torsion of an appendix. The appendix epididymis did not demonstrate any colour Doppler flow

**Fig. 11a, b** Bilateral torsion of the appendix testis, confirmed at surgery, in a patient with bilateral testicular pain. The image of **a** the right testis demonstrates a higher reflective appendix, suggesting torsion of a greater age than on the left (**b**)

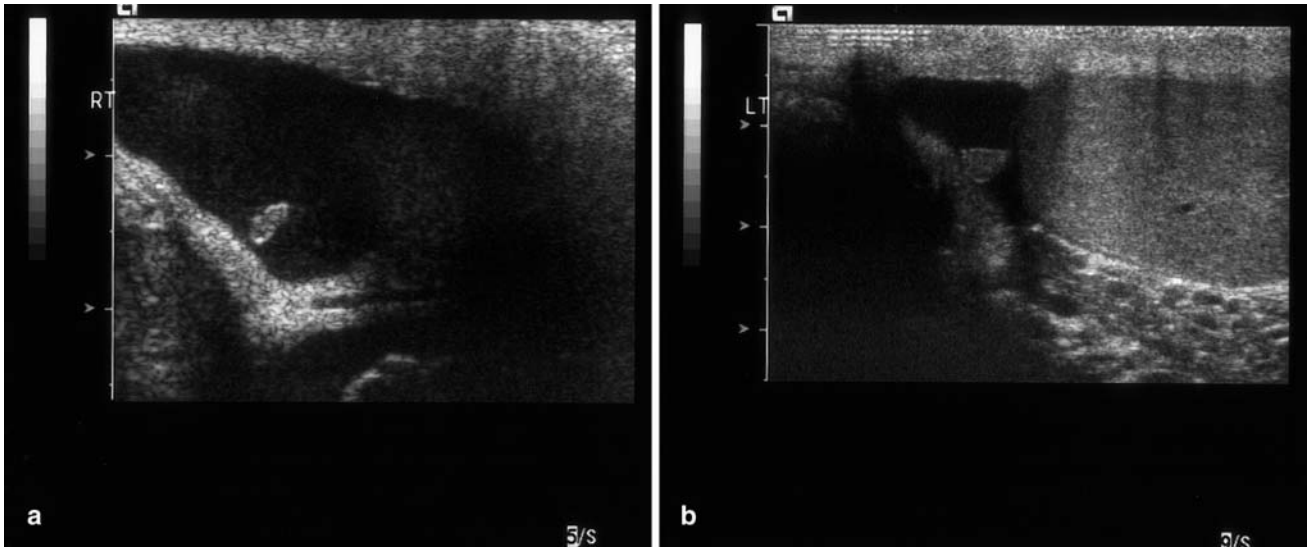



Fig. 11a, b

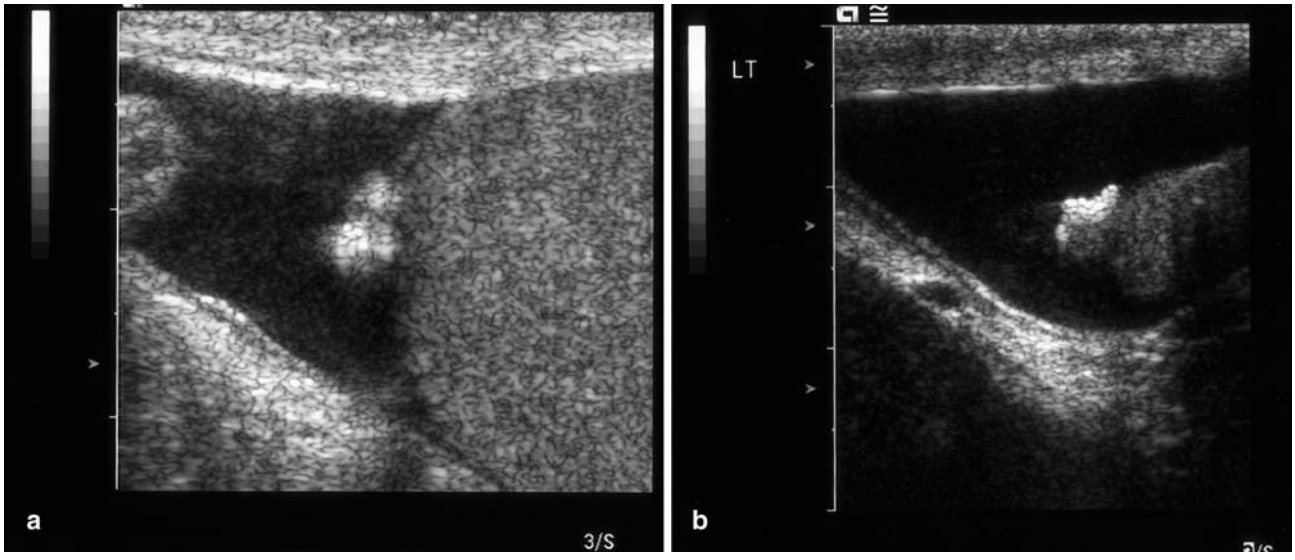



**Fig. 12a, b** Torsion of an appendix imaged in **a** the acute phase and **b** 9 months later, after conservative management. The areas of high reflectivity in the appendix have become more prominent and suggest that infarction and calcification have occurred

## References


1. Moore KL, Persaud TVN (1993) The urogenital system. In: Moore KL, Persaud TVN (eds) The developing human clinically orientated embryology. Saunders, Philadelphia, pp 265–303
2. Johnson KA, Dewbury KC (1996) Ultrasound imaging of the appendix testis and appendix epididymis. Clin Radiol 51:335–337
3. Rolnick D, Kawanoue S, Szanto P, Bush IM (1968) Anatomical incidence of testicular appendages. J Urol 100:755–756
4. Horstman WG, Middleton WD, Melson GL, Siegel BA (1991) Color Doppler US of the scrotum. Radiographics 11:941–957
5. Sidhu PS (1999) Clinical and imaging features of testicular torsion: role of ultrasound. Clin Radiol 54:343–352
6. Williamson RCN (1976) Torsion of the testis and allied conditions. Br J Surg 63:465–476
7. Strauss S, Faingold R, Manor H (1997) Torsion of the testicular appendages: sonographic appearance. J Ultrasound Med 16:189–192
8. Sahni D, Jit I, Joshi K, Sanjeev S (1996) Incidence and structure of the appendices of the testis and epididymis. Anatomy 189:341–348
9. Wallace AD, Hollman AS (1996) Colour Doppler ultrasound of the paediatric scrotum. Imaging 8:324–334
10. Collie MHS, McNeill AD, Anderson JH (1994) Metachronous torsion of the appendix testis. Br J Urol 73:211
11. McCombe AW, Scobie WG (1988) Torsion of scrotal contents in children. Br J Urol 61:148–150
12. Rajfer J (1998) Congenital anomalies of the testis and scrotum. In: Walsh PC, Rehk AB, Vaughan ED, Wein AJ (eds) Campbell's urology. Saunders, London, pp 2172–2192
13. Lerner RM, Mevorach RA, Hulbert WC, Rabinowitz R (1990) Color Doppler US in the evaluation of acute scrotal disease. Radiology 176:355–358
14. Hesser U, Rosenborg M, Gierup J, Karpe B, Nystrom A, Hedenborg L (1993) Gray-scale sonography in torsion of the testicular appendages. Pediatr Radiol 23:529–532
15. Atkinson GO, Patrick LE, Ball TI, Stephenson CA, Broeker BH, Woodard JR (1992) The normal and abnormal scrotum in children: evaluation with color Doppler sonography. Am J Roentgenol 158:613–617
16. Chen DCP, Holder LE, Melloul M (1983) Radionuclide scrotal imaging: further experience with 210 patients. J Nucl Med 24:735–742
17. Steinhardt GF, Boyarsky S, Mackey R (1993) Testicular torsion: pitfalls of colour Doppler sonography. J Urol 150:461–462