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Multiparametric ultrasound in torsion of the testicular appendages: a reliable diagnostic tool?

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Abstract

Aim: Torsion of the testicular appendages represents the most common cause of an acute scrotum in prepubertal boys. Its sonographic appearances on gray-scale US and color Doppler US have already been presented in several studies. The aim of this analysis was to expand those already established techniques with strain elastography and thus present typical features of this entity on multiparametric US. **Material and methods:** Retrospective analysis of all patients presented to the urological department with an acute scrotum between January 2018 and July 2020 identified eleven patients 6-17 years old (mean, 11.1 years), discharged with the diagnosis torsion of the testicular appendages that were examined with a high-end ultrasound device. **Results:** On gray-scale US all patients showed a round lesion with heterogenous echotexture adjacent to the upper pole of the testis/epididymis with a diameter of 4 to 11.1 mm (mean, 7.7 mm). Scrotal skin thickening and a concomitant hydrocele were found in 9 (81.8%) and 7 (63.6%) cases, respectively. On color Doppler images, all torsed appendages were avascular and in 9 (81.8%) patients we observed hyperemia of the adjacent epididymis. Strain elastography showed increased tissue stiffness in all documented images. **Conclusion:** Torsion of the testicular appendages has a set of features on multiparametric US. Awareness of this features can facilitate diagnosis of torsion of the testicular appendages and reduce unnecessary surgical scrotal exploration or unwarranted antibiotic treatment.

Keywords: torsion; testicle; appendix; color Doppler ultrasonography; elastography

Introduction

Torsion of the testicular appendages represents the most common underlying cause of an acute scrotum in prepubertal boys, accounting for 40-60% of the cases [1,2]. The testicular and epididymal appendages, found at the upper pole of the testis and at the head of the epididymis respectively, are remnants of the degenerating paramesonephric (Müllerian) and mesonephric (Wolffian) duct. The appendix testis is found more frequently than the appendix epididymis in 83.3-100% (vs. 20-24%) of pediatric testicles [3]. Both appendages are pedunculated and therefore prone to torsion [4]. The actual cause of torsion remains unknown, but may be related to trauma or prepubertal enlargement [5].

Nevertheless, torsion of the testicular appendages is an important differential diagnosis of testicular torsion and based on history and physical examination alone [6], it can be very difficult to distinguish because of a similar clinical presentation. In contrast to testicular torsion, which is a surgical emergency and the affected testicle should be detorsed within hours after onset of symptoms, torsion of the testicular appendages can be treated conservatively. Surgery is rarely indicated and limited to cases with severe, by analgesics uncontrollable prolonged or recurrent pain [7].

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Torsion of the testicular appendages is often overlooked by the clinician, leading to unnecessary surgical scrotal exploration because of erroneously suspected testicular torsion, thus increasing operation-related complications and causing additional costs for the hospital. Ultrasound (US) represents a widely available and recommended diagnostic tool for the evaluation of acute scrotal pain in all age groups [7]. Sonographic appearances on gray-scale US and color Doppler US of torsion of the testicular appendages have already been presented in several studies [8-13].

The aim of this retrospective analysis was to expand those already established techniques with strain elastography and thus present typical appearances of torsion of the testicular appendages on multiparametric US (gray-scale US, color Doppler US and strain elastography) to be able to reliably confirm the diagnosis of torsion of the testicular appendages in order to prevent unnecessary surgical scrotal exploration.

Material and methods

Patients

This study was approved by the Institutional Review Board of the Medical University Innsbruck. All patients' data included in this retrospective study were handled according to the norms of the Declaration of Helsinki and its amendments.

Retrospective analysis of all patients presented to the urological department with an acute scrotum between January 2018 and July 2020 identified 32 patients discharged with the diagnosis of torsion of testicular appendages. Of these, eleven patients 6-17 years old (mean, 11.1 years) were examined with a high-end ultrasound device at the radiological department of our institution.

US evaluation

At our institution, US examinations in patients with acute scrotal pain are performed by the Department of Radiology during daytime working hours and by the urologist on duty himself during off hours. All examinations of our study cohort were performed at the Department of Radiology using a high-end ultrasound device and conducted or supervised by a radiologist (A.F.) with more than 10 years of experience in scrotal ultrasound.

Standardized presets were used for gray-scale US examination. Color Doppler US examination was performed with the highest signal gain setting possible without the appearance of background noise to maximize sensitivity to slow flow velocities. Strain elastography was performed with repeated compression and decompression of the testis, with the pressure applied to the testicles adjusted according to the visual indicator for compression seen on the ultrasound device. Tissue elasticity was calculated in real time and displayed as a color-coded overlay on the B-mode. Red was encoded as soft, green as intermediate and blue as hard tissue stiffness.

The standard protocol of pediatric scrotal US examination at our institution includes: 1) transverse gray-scale and Doppler evaluation of both testicles for initial comparison; 2) gray-scale scans of each testicle and epididymis in both transverse and sagittal planes; 3) color Doppler scans of all structures; 4) derivation of Doppler shift for arterial and venous intratesticular blood flow; and 5) strain elastography of suspect findings.

All multiparametric US examinations were performed using a Logic E9 unit with a linear probe (ML, 6–15 MHz; GE Healthcare) or a HI Vision Ascendus unit with a linear probe (EUP-L74M, 5–13 MHz; Hitachi).

Torsion of testicular appendages on multiparametric US

Retrospective viewing of the patients' images was performed by two radiologists (A.F., L.G.) and evaluated in consensus. Based on previous publications [8-13] and our experience, we defined the following findings as the typical appearance of torsion of the testicular appendages on multiparametric US: *Gray-scale US* - 1) heterogenous round lesion with close proximity to the upper pole of the testis/epididymis (fig 1a,b), 2) scrotal skin thickening (fig 1c) and 3) concomitant hydrocele (fig 1d); *Color Doppler US* - 1) avascularity of the round lesion found on gray-scale US (fig 2a,b) and 3) reactive hyperemia of the associated epididymis (fig 2c); *Strain Elastography* - increased tissue stiffness (encoded as blue on strain elastography; fig 3b,d) of the round lesion found on gray scale US (fig 3a,c).

Statistical analysis

Descriptive statistics were performed using SPSS Version 22 (SPSS Inc., Chicago, Illinois). Data are expressed as total numbers, mean and range.

Results

Results are shown in Table I. In all eleven cases of our study cohort the torsed appendix was adjacent or in close proximity to the upper pole of the testis and to the epididymis. A differentiation between testicular/epididymal appendix was not possible. Seven torsions (63.3%) occurred on the right side. A heterogenous round lesion was observed in all cases and had a predominantly hyperechogenic texture in 9 (81.8%), and a predominantly hypoechogenic texture in 2 (18.2%) cases. These round lesions had a maximal diameter ranging from 4 to 11.1 mm (mean, 7.7 mm). Scrotal skin thin thickening was found

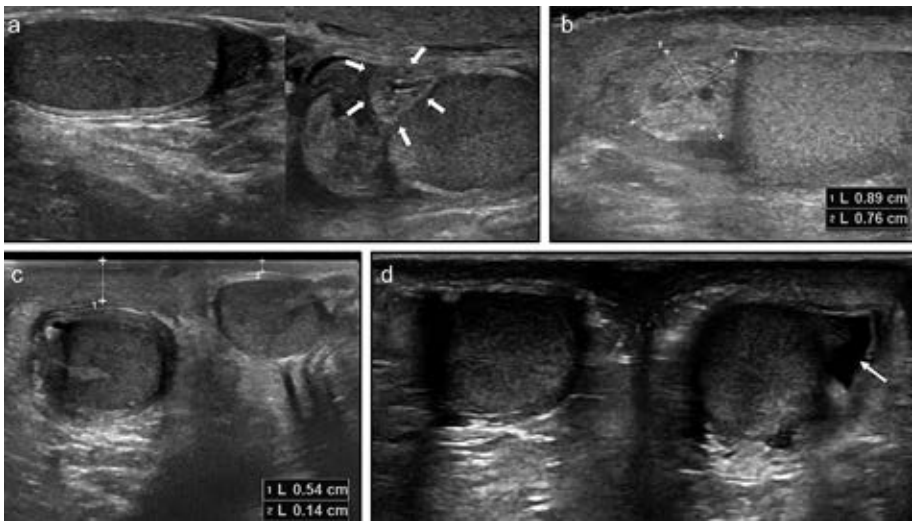

Fig 1. Gray-scale US showing heterogenous round lesion with close proximity to the upper pole of the testis/epididymis (a, b); scrotal skin thickening (c); and concomitant hydrocele (d).

in 9 (81.8%) and a concomitant hydrocele in 7 (63.6%) cases. On color Doppler images all torsed appendages showed total avascularity and in 9 (81.8%) patients we observed hyperemia of the adjacent epididymis. Strain elastography was documented in 7 (63.6%) patients demonstrating increased tissue stiffness of the round lesion in all images. Findings were limited to the affected side of the testicle in all patients.

In the initial radiological report, torsion of the testicular appendages was diagnosed in 9 (81.8%) cases of our study cohort. Of those, six patients were treated conservatively and three had undergone surgical scrotal exploration due to prolonged pain. In two (18.2%) cases, torsion of the testicular appendages was suspected in the radiological report, but final diagnosis was made only after scrotal exploration.

Table I. Multiparametric US findings of torsion of the testicular appendages in eleven patients.

Finding	n (%)
Gray-scale US	
Round lesion with heterogenous echotexture	11 (100)
- predominantly hyperechogenic	9 (81.8)
- predominantly hypoechogenic	2 (18.2)
Diameter of round lesion in mm, mean (range)	7.7 (4 - 11.1)
Scrotal skin thickening	9 (81.8)
Concomitant hydrocele	7 (63.6)
Color Doppler US	
Avascularity of torsed appendix	11 (100)
Hyperemia of associated epididymis	9 (81.8)
Strain elastography	
Increased tissue stiffness	7 (63.6)
No documentation	4 (36.4)

US: Ultrasound

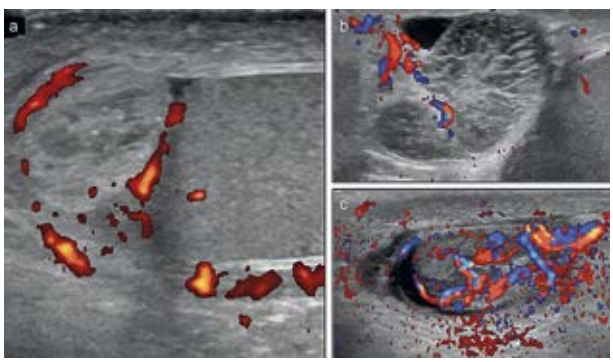

Fig 2. Color Doppler US with avascularity of the round lesion (a, b) and reactive hyperemia of the associated epididymis (c).

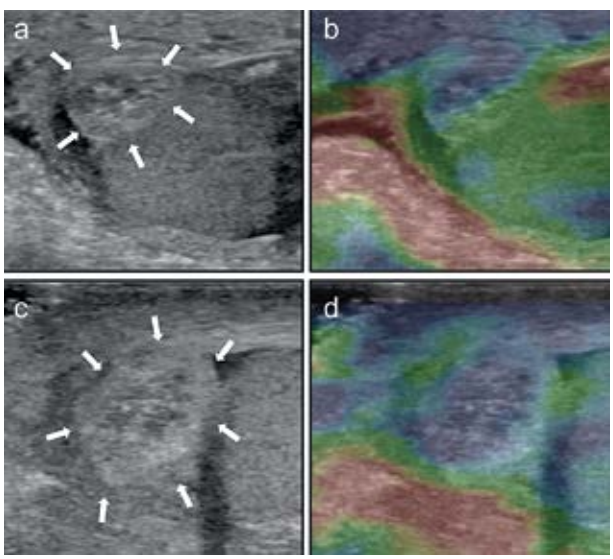

Fig 3. Strain elastography with increased tissue stiffness (encoded as blue) of the round lesion.

Discussion

This retrospective analysis confirms US as a valid diagnostic tool to verify the diagnosis of torsion of the testicular appendages.

The normal testicular appendages are oval or pedunculated in shape and up to 7-8 mm in length, with the appendix epididymis being slightly larger than the appendix testis [12,14,15]. Several studies confirm the torsed testicular appendages as round, enlarged extratesticular structures with heterogenous echotexture. Hesser et al [11] reported diameters ranging from 3 to 17 mm. Two other studies [8,12] compared the size of normal vs. torsed testicular appendages and described thresholds of 5 and 5.6 mm, respectively as suggestive for torsion of the testicular appendages. In our analysis the mean size of the torsed testicular appendage was 7.7 mm and only one had a diameter less than 5 mm. Therefore, the described thresholds seem to be a viable indicator to suggest torsion of the testicular appendages. The echogenicity of the torsed appendix has been described as heterogenous, low and increased [11-13]. One study [10] reports, that the echogenicity of the torsed appendix changes according to the time of onset, associating a hyperechoic texture with later sonography (>24 hours after onset of symptoms). In our study almost all torsed appendages were hyperechoic (81.8%). Thus, we cannot confirm this thesis as it does not seem to apply to our cases, since most of the patients received a sonographic evaluation of the scrotum very promptly after onset of symptoms. Overall, we agree with Yang et al [12] and claim that the echogenicity of the testicular appendages should not be used as a viable indicator in differentiating between torsed and normal testicular appendages. It is reported that torsion of the testicular appendages is often accompanied by scrotal skin thickening and a concomitant hydrocele [9,11,14]. This is in line with our findings, as we observed it in 81.8% and in 63.6% cases of our study cohort, respectively.

On color Doppler US, the normal and the torsed appendix have no blood flow [12]. In fact, all round lesions of our study cohort were avascular. One study [9] described the avascular appendages as “an island in a sea of color”, due to the reactive hyperemia of the surrounding structure. We can confirm this finding, as we observed reactive hyperemia of the adjacent epididymis and surrounding structures in 81.8% of our cases. Our study was the first to assess findings of torsion of the testicular appendages on strain elastography. All documented images showed increased tissue stiffness of the round lesion found on gray-scale US. Therefore, strain elastography can be used to reliably confirm the diagnosis. The increased tissue stiffness can be explained by the swelling of the torsed appendix and the consequent stasis. We strongly believe that strain elastography should be given more attention in the management of cases with acute scrotum as it seems to be an additional, reliable US technique for the diagnosis of torsion of the testicular appendages. Thus, further prospective studies are required to establish multiparametric US as a valid tool for the assessment of an acute scrotum.

Major limitations of our study lie in its retrospective design and the single center bias. Moreover, the number of patients included was relatively small. The small number of cases can be attributed to the fact that many patients with an acute scrotum received initial examination during off hours at our institution. These US examinations could not be evaluated as they were performed by the urologist on duty not using a high-end ultrasound device and with no standard documentation protocol. This underlines the importance of standardized documentation, the need of a high-end ultrasound device and a careful device introduction, especially for young trainees in order to guarantee a reliable diagnostic evaluation. Another limitation we encountered is the inability to differentiate between torsion of the appendix testis and torsion of the appendix epididymis. However, since the treatment of both entities is the same, a differentiation has no clinical impact.

In **conclusion**, our review revealed a set of features on multiparametric US, which can help to reliably diagnose torsion of the testicular appendages. These features include 1) a round, extratesticular lesion with heterogenous echogenicity 2) scrotal skin thickening and concomitant hydrocele 3) an avascular torsed appendix with surrounding hyperemia and 4) increased tissue stiffness of the torsed appendix on strain elastography. Overall, we think awareness of the multiparametric US features presented in this study can facilitate diagnosis of torsion of the testicular appendages and reduce unnecessary surgical scrotal exploration or unwarranted antibiotic treatment.

Conflict of interest: none

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