Journal of Pediatric Urology (2017) 13, 393.e1–393.e6

Ultrasonographic findings in the epididymis of pediatric patients with testicular torsion

C.E. Afsarlar [a,b,c], R. Elizondo [a,b], E. Yilmaz [a,b,d], E. Cakmakci [e], D.J. Ballow [a,b], E. Demir [f], G. Guney [g], C.J. Koh [a,b]

[a]Division of Pediatric Urology, Department of Surgery, Texas Children's Hospital, Houston, TX, USA

[b]Scott Department of Urology, Baylor College of Medicine, Houston, TX, USA

[c]Department of Pediatric Surgery, Faculty of Medicine, Hitit University, Çorum, Turkey

[d]Department of Pediatric Surgery, Dr. Sami Ulus Maternity, Children's Health and Diseases Training and Research Hospital, Ankara, Turkey

[e]Department of Radiology, Dr. Sami Ulus Maternity, Children's Health and Diseases Training and Research Hospital, Ankara, Turkey

[f]Department of Biostatistics, Faculty of Medicine, Hitit University, Çorum, Turkey

[g]Department of Pathology, Faculty of Medicine, Hitit University, Çorum, Turkey

Correspondence to: C.J. Koh, Texas Children's Hospital and Baylor College of Medicine, Clinical Care Center, Suite 620, 6701 Fannin Street, Houston, TX 77030, USA, Tel.: +1 832 822 3160; fax: +1 832 825 3159

Keywords
Testicular torsion; Epididymis; Children; Ultrasound

Received 29 December 2016
Accepted 20 May 2017
Available online 19 June 2017

Summary

Introduction
Although grayscale ultrasound and color Doppler ultrasound characteristics of the torsed testis are well established in the literature, less is known about its anatomic partner: the epididymis.

Objective
The purpose of this study was to describe the ultrasound characteristics of the epididymis in pediatric patients with testicular torsion, and to describe their potential role as prognostic criteria for testicular salvage outcomes.

Study design
During a retrospective review of 217 pediatric patients with acute testicular torsion during 2009–2016, morphological features of the epididymis from scrotal ultrasounds (size, parenchymal characteristics, and vascular flow of both epididymis heads), as well as patient demographics, time duration, surgical outcomes, histopathology results, and follow-up periods were analyzed.

Results
Mean epididymis size and twisting degree were significantly higher in the torsed testes than in the contralateral epididymis ($P < 0.001$) (Summary table). Cystic structures in the epididymis were identified: a higher number of cysts was associated with testicular non-viability ($P = 0.025$) and higher twisting degree ($P = 0.017$). Histopathologic examination showed that these spaces were infiltrated connective tissue most likely formed by venous congestion and vessel rupture.

Discussion
Scrotal ultrasound can provide information on testicular morphology and viability, as well as morphological changes in the epididymis over time in pediatric patients with testicular torsion. These findings may provide potential prognostic information regarding testicular viability, as a higher number of cystic spaces in the epididymis was associated with a higher rate of testicular non-viability and a higher twisting degree. In addition, the epididymis size (volume) can change during the time course of the ischemic state.

Conclusions
This was the first study to describe and analyze epididymis ultrasound findings in pediatric patients with testicular torsion and to correlate them with testicular salvage outcomes. Further prospective studies are needed to determine the role of epididymis ultrasound findings as a potential preoperative prognostic tool.

Summary table Patient demographics, time intervals, and ultrasound measurements of the epididymis in torsed testes, with respect to testicular viability.

	Viable testes ($n = 105$), mean ± SD (min–max)	Non-viable testes ($n = 112$), mean ± SD (min–max)	P
Age (years)	13.5 ± 2.9 (1.9–18.0)	10.7 ± 5.0 (0.1–18.3)	<0.001
Pain to US time (hours)	12:28 ± 17:31 (1:28–97:12)	65:37 ± 52:51 (2:21–290:40)	<0.001
US to surgery time (hours)	3:26 ± 2:18 (0:37–13:31)	4:08 ± 4:22 (0:15–26:41)	0.437
Torsed epididymis size (ml)	1.81 ± 2.29 (0.5–18.04)	1.82 ± 2.04 (0.4–10.12)	0.835
Contralateral epididymis size (ml)	0.29 ± 0.35 (0.01–2.86)	0.25 ± 0.26 (0.02–1.39)	0.278
Torsed/contralateral epididymis ratio	10.33 ± 14.29 (0.39–83.28)	10.14 ± 11.70 (0.59–68.10)	0.642

US, ultrasound; ml, milliliters.

http://dx.doi.org/10.1016/j.jpurol.2017.05.018

Introduction

Testicular torsion (TT) arises when the spermatic cord rotates on its own axis, resulting in decreased or absent blood flow to the testicle. It may result in irreversible parenchymal damage as soon as 6 h after the onset of ischemia [1–4]. The incidence of TT has been estimated to be 1/1500 males aged <18 years, and it accounts for approximately 20% of acute scrotal diseases in children [4–6]. Clinical presentation includes sudden onset of severe testicular pain with or without nausea and vomiting. Swelling, abnormal cremasteric reflex, horizontal lie of the testis, and scrotal erythema are also common clinical signs [7,8].

Testicular torsion is considered to be a surgical emergency, and prompt intervention is warranted to increase the testicular salvage rate if the history and clinical signs and symptoms are suggestive of torsion. It is a progressively ischemic process; therefore, clinical findings can change with time. Increased swelling of the affected hemiscrotum can make the physical examination difficult to perform and interpret [9]. Although clinical assessment and physical examination are still the most important diagnostic tools to distinguish TT from other acute scrotal diseases, grayscale and color Doppler ultrasound (US) is utilized as an indispensable diagnostic tool due to its high sensitivity (98–100%) and moderate-high specificity (69–90%) for demonstrating testicular perfusion [10].

Color Doppler US can identify absent or decreased blood flow in the torsed testis: however, arterial perfusion may still be present in the early stages of torsion or with incomplete or intermittent spermatic cord twisting [3,7,11]. Additionally, it may show reactive hyperperfusion, which can also be seen with epididymo-orchitis or with spontaneous reduction of TT [3]. Therefore, color Doppler US may not always distinguish TT from other scrotal conditions. To increase the diagnostic accuracy of color Doppler US, various grayscale US morphologic alterations have been previously described for TT, including the changed course and whirlpool or snail-shell appearance of the spermatic cord, increased testicular size, ipsilateral hydrocele development, changes in testicular echogenicity, and scrotal wall thickening [9,12–14]. Previous grayscale US studies have also provided prognostic criteria for testicular viability, where isoechoic-homogenous echotexture of the testis, normal-sized testis, and normal scrotal wall thickness have been predictive of testicular salvage, while enlargement or heterogeneous echotexture of the testis and thickened scrotal wall have been strongly associated with testicular non-viability [9,13,15].

Although grayscale US and color Doppler US findings of the torsed testis are well established in the literature, less is known about the testis's anatomic partner: the epididymis. Previous reports have shown that the epididymis can become an enlarged, avascular, and distorted mass when associated with a torsed testis [11,14,16]. However, the present study hypothesized that additional US morphological characteristics of the epididymis may provide further information regarding the torsed testis in children with TT and may provide potential prognostic criteria for the testicular salvage outcomes.

Materials and methods

After institutional review board approval, the present study retrospectively reviewed the medical records of pediatric patients with acute TT during the period 2009–2016. Exclusion criteria were: unavailable pre-operative scrotal US in the medical records, surgery for other acute scrotal diseases, intermittent TT, perinatal TT, or purposely-delayed surgery for late TT. A reviewer blinded from the clinical data analyzed the scrotal grayscale US and color Doppler US, and measured the size, parenchymal characteristics, and vascular flow of the epididymis heads of the testes. Patient demographics, time duration, surgical outcomes, histopathology results, and follow-up periods were also analyzed. The sizes and parenchymal characteristics of the torsed and contralateral epididymis were analyzed in relation to the time duration of scrotal pain prior to surgery (0–6, 6–12, 12–24, 24–48, and >48 h), twisting degree, and clinical outcomes of the testes. The testes were grouped as viable (detorsed/fixated) or non-viable (orchiectomy), and their associations with other clinical variables were analyzed.

Grayscale and color Doppler US image analysis

Video records of scrotal grayscale US and color Doppler US were analyzed, including the epididymis heads. Three planes (one mid-sagittal, and two mid-axial planes) of both epididymis heads were measured in cm. Head volumes were calculated by using the US device's measurement formula (1st calculation × 2nd calculation × 3rd calculation × 0.52), and the results were represented in ml. Vascular flow to the epididymal heads was analyzed with color Doppler US, and classified as absent, decreased, or normal. Homogeneity and heterogeneity of the epididymis echotexture was determined by comparing the torsed and contralateral epididymis.

Histopathology of the epididymis

Orchiectomy specimens were fixed in 10% formaldehyde for 12 h, and embedded in paraffin. Four-micrometer-thick sections were obtained in the sagittal plane, mounted on slides, and stained with hematoxylin-eosin to examine the overall structure of the epididymis. Immunohistochemistry staining for CD 34 (Biogen) and pancytokeratin staining (AE1/AE3) were performed for the vascular structures and efferent ejaculatory ducts, respectively. All sections were examined under a light microscope (Nikon Eclipse Ci, Japan).

Statistical analysis

Statistical Package for Social Sciences for Windows (SPSS, Inc., Chicago, IL, licensed by Hitit University) version 22.0 was used for statistical analysis. Normality distributions were analyzed with Shapiro–Wilk test. Descriptive statistics for continuous variables were expressed as mean ± standard deviation and median (min–max), whereas numbers and percentages were used for