

# Comparison of demographic and clinical characteristics in distinguishing testicular torsion from torsion of the appendix testis

**Zlatan Zvizdic**

University Clinical Center Sarajevo

**Amila Aganovic**

Ingolstadt Hospital: Klinikum Ingolstadt GmbH

**Emir Milisic**

University Clinical Center Sarajevo

**Asmir Jonuzi**

University Clinical Center Sarajevo

**Denisa Zvizdic**

University Clinical Center Sarajevo

**Semir Vranic** (✉ [semir.vranic@gmail.com](mailto:semir.vranic@gmail.com))

Qatar University <https://orcid.org/0000-0001-9743-7265>

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## Research Article

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# Abstract

## Purpose

The acute scrotum (AS) in the pediatric population is a medical emergency. The most common causes of AS include testicular torsion (TT) and torsion of the appendix testis (TAT). Their distinction may be clinically challenging. The purpose of our study was to compare demographic and clinical characteristics of the pediatric cases of TT and TAT and thus provide clinical evidence for distinguishing these two conditions.

## Methods

We retrospectively analyzed all children  $\leq 16$  years who underwent surgical exploration for AS. The patients were divided into Group 1 or TT and Group 2 or TAT groups.

## Results

Ninety patients were included in the study (24 with TT and 66 with TAT). Patients with TT were significantly older than those with TAT ( $p < 0.001$ ). The peak incidence of TT was in the age of 12–16 years ( $p < 0.001$ ), whereas the peak of TAT was in the age group of 7–11 years ( $p < 0.001$ ). Scrotal pain was more prevalent in patients with TAT ( $p = 0.02$ ), whereas systemic signs (nausea/vomiting and abdominal pain) affected more frequently the TT patients ( $p = 0.003$  and  $p < 0.001$ , respectively). The mean duration of symptoms was significantly longer in the TAT group than in the TT group ( $p < 0.001$ ). Color-Doppler Ultrasound (CDUS) findings of absent or decreased testicular blood flow in the affected testis strongly favored the diagnosis of TT ( $p < 0.001$ ).

## Conclusion

Our data indicate that the older age, shorter duration of symptoms, systemic signs (nausea/vomiting and abdominal pain), and characteristics CDUS findings can help distinguish between the two most common acute scrotum causes.

## Introduction

In childhood or adolescence, the acute scrotum (AS) is a medical emergency characterized by acute scrotal pain with or without swelling and erythema [1]. The most common pathologies encountered in the broad spectrum of pediatric AS are torsion of the appendix testis (TAT), testicular torsion (TT), and epididymo-orchitis (EO). The most important differential diagnosis for AS is TT, which accounts for up to 25% of acute scrotal disease in the pediatric population [2]. In contrast, the most frequently detected

pathology during scrotal exploration is TAT, representing 54–71% of the operative diagnosis of AS [3–5]. TAT makes up to 95% of torsed appendices [6].

Clinical distinction between TT and TAT is frequently tricky but critical because timely assessment and intervention in TT cases can preserve the affected testicle [7, 8]. Various studies have dealt with differentiating TT from TAT [9–11]. However, differential diagnosis of AS, particularly TT, remains challenging and shows a considerable risk of misdiagnosis [11].

The present study analyzed the pediatric cohort of TT and TAT and explored the impact of baseline demographic and clinical characteristics on differential causes of AS.

## Material And Methods

We conducted a retrospective study using a cohort of pediatric patients presenting with AS who underwent scrotal exploration between 2011 and 2016. Data were obtained from the medical records. We divided the patients into two groups according to the operative findings: Group 1 or TT group and Group 2 or TAT group, and compared baseline demographic and clinical characteristics between them. Inclusion criteria for the study were confirmed diagnosis of TT or TAT and age below 16 years. Those with other causes of AS and those with incomplete or missing data were excluded from the study.

The following demographic and clinical characteristics were recorded: Age, laterality (right/left), presenting symptoms (scrotal pain, erythema of the scrotal skin, swelling, nausea/vomiting, abdominal pain, and fever), duration of symptoms, seasonality, history of scrotal trauma, and Color-Doppler Ultrasound (CDUS). Patients' age was categorized into five groups: < 1 year, 1–3, 4–6, 7–11, and 12–16 years.

All patients underwent testicular ultrasonography with CDUS before surgery. The access for surgical exploration of the testis in all cases was through the midline scrotal incision. TT was defined as a twisting of the spermatic cord and its contents with resultant ischemia due to compromised blood flow to the testicle. TAT was defined as twisting and ischemia of the testicular appendage located on the superior pole of the testicle between the testis and epididymis.

## Statistical analysis

Mean and median were used to measure central tendency and standard deviation and range as dispersion measures for continuous variables. The values of categorical variables were presented as numbers or percentages. The Kolmogorov-Smirnov test tested the normality of data distribution for each of the variables. Chi-Square and Fisher's exact tests were used to explore the differences between the categorical variables. *P*-values < 0.05 were considered significant. All statistical assays were performed using the Statistical Package for the Social Sciences (SPSS) IBM Version 26 (SPSS) (UNICOM Systems, Inc.).

# Results

The baseline demographic and clinical characteristics of the two pediatric cohorts are presented in Table 1.

Ninety-eight pediatric patients with AS were identified in the period 2011–2016. Eight patients were excluded from the study as they had other pathologies (e.g., EO,  $n = 4$ ) or incomplete clinical histories ( $n = 4$ ). Thus, 90 patients with TT and TAT met the inclusion criteria and constituted the final cohort.

Twenty-four TT cases (26.6%) (Group 1) and 66 (73.4%) TAT cases (Group 2) were seen during the study period. Patients with TT in this study were significantly older [ $13.5 \pm 2.6$  years (range, ten days – 15.8 years)] than those with TAT [ $9.5 \pm 2.8$  years (range 0.7–14.7 years)] ( $p < 0.001$ ).

Although TT and TAT affected the children across different ages, significant differences in both groups were observed. Thus, the peak incidence of TT was in the age of 12–16 years (75%), whereas the peak of TAT was in the age group of 7–11 years (57%) ( $p < 0.001$  for both calculations).

There was no statistically significant difference between the two groups in laterality ( $p = 0.28$ ). However, left-sided scrotal involvement was more common in TT cases (66%), whereas there was no significant difference in affected sides in TAT cases. Interestingly, we found that right-sided TT increases in adolescent patients: Left-side TT involvement was recorded in 100% of patients under 12 years. In comparison, the incidence on that side dropped to 55.6% in patients aged  $\geq 12$ .

Scrotal pain, erythema of the scrotal skin, and scrotal swelling were the most common clinical symptoms in both observed groups (Table 1). Interestingly, scrotal pain (without recorded accurate localization of tenderness and its intensity) was statistically more present in TAT patients ( $p = 0.02$ ). In contrast, nausea/vomiting and abdominal pain occurred more frequently among the TT patients ( $p = 0.003$  and  $p < 0.001$ , respectively). Notably, fever and abdominal pain did not affect any TAT patients (Table 1).

The mean duration of symptoms for the entire cohort was 63.3 hours (range, 30 minutes to 480 hours) with a median of 48 hours. The mean duration of symptoms was significantly shorter in the TT group (42 hours, range, 1-336 hours) than in the TAT group (71 hours, range, 1-480 hours) ( $p < 0.001$ ).

There was no significant difference in the seasons of onset between TT patients and those with TAT ( $p = 0.31$ ). The lowest TT cases (21%) were recorded during the winter, whereas the largest TAT cases (28.7%) were recorded during the same season.

A vast majority of the cases (91.7% of TT and 83.3% of TAT cases) had a spontaneous torsion, whereas the remaining 8.3% of TT cases and 16.3% of TAT cases were trauma-related. However, the difference was not statistically significant ( $p = 0.50$ ).

Ultrasonographically, the two diseases presented strikingly different. Thus, twenty-three patients with TT (96%) and only five patients with TAT (7.5%) showed absent or decreased testicular blood flow in the

affected testes, whereas 61 (92.5%) patients with TAT and only 1 (4%) patient with TT showed increased or normal testicular blood flow in the affected testes (Table 1). CDUS findings of absent or decreased testicular blood flow in the affected testes significantly correlated with TT's presence ( $p < 0.001$ ). In contrast, CDUS findings of increased or normal blood flow had a significant correlation with the presence of TAT ( $p < 0.001$ ).

## Discussion

It is well documented that TAT is the most common cause of AS in children who underwent scrotal exploration [12]. Emergency scrotal exploration is the standard means of management, as no other investigation can confidently exclude TT from the differential diagnosis of AS [13]. Our results for the occurrence of TT and TAT are in line with the previous studies [5, 12-16]. Of pediatric patients with AS who underwent emergency surgery, TT is the cause of 17-72% of cases [5, 13, 14, 16]. In our study, TT occurred in ~27% of cases, whereas TAT affected 73% of the AS patients. Like other studies [11], the patients with TT were the eldest, and their presentation was the earliest compared with the TAT patients. Consistent with previous studies, our findings of 24 TT patients indicate that this condition occurs more frequently on the left side [17, 18]. This could be anatomically related to the greater length of the left spermatic cord, which is more prone to twisting [19]. Data in the literature on the association between age and laterality of TT are scarce. Our finding that the occurrence of right-sided TT increases in adolescent patients is consistent with the study conducted by Mukendi et al. [18]. Further studies on a larger sample are necessary to determine the clinical significance of this association. A history of nausea/vomiting and abdominal pain, as markers of a systemic response to an ischemic event in the body secondary to celiac ganglion stimulation, strongly suggest TT. However, they are absent in more than two-thirds of patients. Similar results have been reported in other studies [20, 21]. We believe that the higher frequency of scrotal pain in patients with TAT could be explained by the lack of registration of the exact localization of pain and the initial presentation of a larger number of patients with advanced local scrotal findings. Our previous study showed that the duration of symptoms is the most crucial predictor of testicular salvage following TT in children [22]. In the present study, the duration of symptoms was significantly different between the two groups. Like another study [9], our patients with TT had a significantly shorter time to presentation than patients with TAT. This could be explained by the more extensive symptoms caused by TT compared with TAT symptoms, leading to an earlier visit to the doctor. The seasonal influence on TT or TAT is contradictory in the current literature. While some studies have found a link between cold weather and TT and TAT [23, 24], other studies failed to provide this evidence [25]. Our study has not found a positive association between cold weather and TT. Although most TT and TAT cases develop spontaneously, the causes of TT and TT may be trauma-related (sports or physical activity) in ~5% of cases [26]. History of trauma was present in 8.3% of TT cases and 16.7% of TAT cases. Our study did not reveal a significant difference in the history of trauma between the examined groups. CDUS has substantially improved patients' clinical assessment with AS, determining TT's presence and the extent and reducing the unnecessary exploration rate [27, 28]. On sonography, the torsed testis typically may be enlarged and appear hypoechoic, but sometimes it can appear normal, particularly in the first few hours

[27]. In the evaluation of AS, CDUS has a sensitivity of ~64-100% and a specificity of 97-100%, showing reduced or absent blood flow to the testis as a highly specific finding in the vast majority of the TT patients [29]. However, false-negative and false-positive Doppler evaluations in the diagnosis of TT have been reported in the literature. Our study's data further support the excellent clinical utility of CDUS in differentiating between the TT and TAT. There are several limitations to our study. First, it is a retrospective observational study, and second, the study comprises a smaller number of patients with TT. The present study also lacks some essential clinical data, such as a lack of precise localization of scrotal pain. In conclusion, distinguishing TT from other acute scrotal pathology, including TAT, is crucial for timely surgical intervention and preservation of testes affected by AS. Older age, nausea/vomiting, abdominal pain, shorter duration of symptoms, and CDUS findings of absent or decreased testicular blood flow in the affected testis can distinguish between TT and TAT.

## Declarations

### Authors' contributions

**Zlatan Zvizdic:** Conceptualization; Data Curation; Formal analysis; Methodology; Writing – original draft.

**Amila Aganovic, Emir Milisic, Asmir Jonuzi, Denisa Zvizdic:** Data curation; formal analysis, Validation.

**Semir Vranic:** Conceptualization; Data curation; Formal analysis; Supervision; Writing – review & editing.

### Declaration of Competing Interest

The authors declare no conflict of interest.

### Availability of data and material

All the data are reported in the study.

### Code Availability

Not applicable.

### Ethical approval

All medical records were de-identified and anonymized for the current study. The study was approved by the local institutional review board (IRB) (Ethical Committee of the Clinical Center, University of Sarajevo, number: 0901–2-678/18).

### Consent to participate

The IRB waived informed consent due to the retrospective nature of the study.

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## Tables

Variable	Testicular torsion	Torsion of the appendix testis	P-value
<b>Demographic characteristics of the cohort</b>			
<b>Patients (n = 90)</b>	24 (26.6%)	66 (73.4%)	
<b>Age (yr; median±SD)</b>	13.5±2.6	9.5±2.8*	<b>&lt;0.001</b>
< 1 year	2 (8.3%)	1 (1.5%)	<b>&lt;0.001</b>
1-3 years	1 (4.2%)	5 (7.7%)	
4-6 years	2 (8.3%)	6 (9.2%)	
7-11 years	1 (4.2%)	37 (57%)	
12-16 years	18 (75%)	16 (24.6%)	
<b>Laterality (n %)</b>			0.28
Right side	8 (33.3%)	33 (50%)	
Left side	16 (66.6%)	32 (48.5%)	
Both sides	0 (0%)	1 (1.5%)	
<b>History of trauma</b>			0.50
Yes	2 (8.3%)	11 (16.7%)	
No	22 (91.7%)	55 (83.3%)	
<b>Presenting clinical symptoms</b>			
<b>Scrotal pain (n %)</b>	20 (83.3%)	65 (98.5%)	<b>0.02</b>
<b>Erythema (n %)</b>	20 (83.3%)	51 (77.3%)	0.77
<b>Swelling (n %)</b>	13 (54.2%)	44 (66.6%)	0.33
<b>Nausea/vomiting (n %)</b>	7 (29.2%)	3 (4.5%)	<b>0.003</b>
<b>Abdominal pain (n %)</b>	6 (25%)	0 (0%)	<b>&lt;0.001</b>
<b>Fever (n %)</b>	2 (8.3%)	0 (0%)	0.07
<b>Duration of symptoms</b>	Mean: 24 hours, median: 48 hours (range, 30 minutes - 480		

	hours)		
≤6 hours	9 (37.5%)	7 (10.6%)	<b>&lt;0.001</b>
6-12 hours	0 (0%)	4 (6%)	
12-24 hours	7 (29.2%)	5 (7.5%)	
>24 hours	8 (33.3%)	50 (75.7%)	
<b>Season</b>			0.31
Spring	4 (16.6%)	18 (27.2%)	
Summer	8 (33.3%)	11 (16.7%)	
Autumn	7 (29.2%)	18 (27.2%)	
Winter	5 (21%)	19 (28.7%)	
<b>Color Doppler Ultrasound findings</b>			
Absent/decreased flow	23 (96%)	5 (7.5%)	<b>&lt;0.001</b>
Increased/normal flow	1 (4%)	61 (92.5%)	

Only significant variable values are bolded.

\*Age is missing for one patient in this category.

SD, Standard deviation

**Table 1.** Baseline demographic, clinical characteristics and ultrasonography findings of patients with testicular torsion and torsion of the appendix testis.

## List Of Abbreviations

AS

Acute scrotum

CDUS

Color-Doppler Ultrasound

EO

Epididymo-orchitis

TAT

Torsion of the appendix testis

TT

Testicular torsion