

89278_Auto_Edited.docx

Name of Journal: *World Journal of Clinical Cases*

Manuscript NO: 89278

Manuscript Type: ORIGINAL ARTICLE

Retrospective Study

Clinical Characteristics of Testicular Torsion and Factors Influencing Testicular Salvage in Children: A 12-year Study in a Tertiary Center

Clinical Characteristics of TT

Xianghui Gang, Yuanyuan Duan, Bin Zhang, Zhenggan Jiang, Rong Zhang, Jun Chen, Xiangyu Teng, Duobing Zhang

Xianghui Gang, Bin Zhang, Rong Zhang, Jun Chen, Urology, Suzhou Hospital Affiliated to Anhui Medical University, Suzhou, Anhui., Suzhou 234000, China

Yuanyuan Duan, Ultrasound diagnosis department, Suzhou Hospital Affiliated to Anhui Medical University, Suzhou, Anhui., Suzhou 234000, China

Zhenggan Jiang, Urology, Suzhou Hospital Affiliated to Anhui Medical University, Suzhou 234000, China

Xiangyu Teng, Urology department, The Second Affiliated Hospital of Anhui Medical University, Hefei 230000, Anhui, China

Duobing Zhang, Urology Department, Suzhou Hospital of Anhui Medical University, Suzhou 234000, Anhui, China

Co-first authors: Gang Xianghui; Duan Yuanyuan

Author contributions: Gang Xianghui: ¹ Study conception and design, analysis and data interpretation, drafting of the manuscript, and critical revision. Duan Yuanyuan, Jiang Zhenggan and Teng Xiangyu: study conception and design, data acquisition, and critical revision. Zhang Bin, Zhang Rong, and Chen Jun: data acquisition, analysis, interpretation, and critical revision. Zhang Duobing: ¹ Study conception and design, analysis and data interpretation, drafting of the manuscript, and critical revision.

Supported by Anhui Province Translational Medicine Research Fund Project (No:2021zhyx-C59)

Suzhou Health Research Project (No:SZWJ2022028)

Suzhou Science and Technology Research Project (No: SZSKJJZC027)

Corresponding author: Duobing Zhang, MD, Academic Research, Surgeon, Urology Department, ⁶ Suzhou Hospital of Anhui Medical University, No. 299, Bianhe Middle Road, Suzhou City, Anhui Province, Suzhou 234000, Anhui, China.
zhangduobingsz@126.com

Received: November 26, 2023

Revised:

Accepted:

Published online:

Abstract

BACKGROUND

Testicular torsion is the most common acute scrotum worldwide and mainly occurs in children and adolescents. Studies have demonstrated that the duration of symptoms and torsion grade lead to different outcomes in children diagnosed with testicular torsion.

AIM

4

To predict the possibility of testicular salvage (TS) in patients with testicular torsion in a tertiary center.

METHODS

We reviewed the charts of 75 pediatric patients with acute testicular torsion during a 12-year period from November 2011 to July 2023 at the Suzhou Hospital of Anhui Medical University. Univariate and multivariate logistic regression analyses were used to determine independent predictors of testicular torsion. The data included clinical findings, physical examinations, laboratory data, color Doppler ultrasound findings, operating results, age, presenting institution status, and follow-up results.

RESULTS

Our study included 75 patients. TS was possible in 57.3% of all patients; testicular torsion occurred mostly in winter, and teenagers aged 11–15 years old accounted for 60%. Univariate logistic regression analyses revealed that younger age ($P=0.09$), Body Mass Index(BMI) ($P = 0.004$), torsion angle ($P = 0.013$), red blood cell count($P = 0.03$), neutrophil-to-lymphocyte ratio(NLR) ($P = 0.009$), and initial presenting institution ($P<0.001$) were associated with orchiectomy. In multivariate analysis, only the initial presenting institution predicted TS ($p<0.05$).

CONCLUSION

The initial presenting institution has a predictive value for predicting TS in patients with TT. Children with scrotal pain should be admitted to a tertiary hospital as soon as possible.

Key Words: Testicular torsion; Pediatrics; Predictors

Gang X, Duan Y, Zhang B, Jiang Z, Zhang R, Chen J, Teng X, Zhang D. Clinical Characteristics of Testicular Torsion and Factors Influencing Testicular Salvage in Children: A 12-year Study in a Tertiary Center. *World J Clin Cases* 2024; In press

Core Tip: Testicular torsion is a primary cause of testicular removal in adolescents, which may have long-term implications for the patient's reproductive capabilities and psychological well-being. In response to this issue, we collected and analyzed data from patients with testicular torsion who underwent surgery at our center. Our findings suggest that initial presentation at a tertiary-care hospital correlates with more favorable outcomes of testicular torsion. This highlights the importance of adolescents with scrotal pain seeking care at tertiary-care hospitals as their first point of contact to minimize the risk of misdiagnosis and delayed treatment.

INTRODUCTION

Testicular torsion (TT) is the most common acute scrotum injury worldwide and mainly occurs in children and adolescents, which causes restricted blood flow to the affected testis, resulting in testicular atrophy and testicular loss in adolescents. According to public data, the incidence of TT is estimated to be 1 in 4,000 males aged <25 years and 1 in 160 males aged >25 years^[1, 2], and TT accounts for 13–54% of cases of acute scrotal disease^[3]. The incidence was high at 21.76 per 100,000 population in 2010 in the country of Ireland, which has cold weather^[4]. Currently, no drugs are effective for treating TT in humans, and the most effective treatment for TT is surgical exploration. However, delays in the diagnosis of TT result in loss of testes, subfertility, or infertility

in patients^[5]. TT is related to a variety of factors, the most important of which is the duration from testicular ischemia to surgery and the torsion angle^[6-8]. In the current study, we reviewed patients who underwent orchiopexy or orchiectomy and were diagnosed with TT from 2011–2023 to summarize the clinical characteristics of TT and identify predictors of TS in patients.

MATERIALS AND METHODS

General information and surgery details

After receiving Institutional Review Board approval from the Ethics Committee of Anhui Medical University Suzhou Hospital(A2023006), we queried a maintained database of patients who underwent scrotal exploration at a tertiary referral medicine center from January 2011 to July 2023. In the current study, 75 patients were enrolled. Prior to study commencement, we obtained informed consent from patients who were preoperatively diagnosed with testicular torsion using Doppler ultrasonography (D-USG)(Supplementary Figure1). Even young children with small testes, where testicular blood flow is difficult to detect, undergo D-USG to prevent misdiagnosis. The exclusion criteria for the retrospective study included: ①Patients younger than one year old. ②Patients who had severe hepatic or renal dysfunction or heart disease. ③Patients who underwent scrotal surgery before TT.

The patient was placed in the supine position, and after anesthesia was administered, the scrotum on the affected side was opened, and a warm, damp gauze was placed on the testis. If no blood supply was restored to the testicle after 15-20 minutes, an orchiectomy was performed. If the testicular blood supply was restored and bright red blood was observed on the needle prick, bilateral orchiopexy was performed.

According to type of surgery, patients were divided into two groups: TS and Orchiectomy groups.

Statistical methods

Categorical data were presented as numbers and percentages. Means and standard deviations were calculated for the continuous variables. Statistical analysis was performed using SPSS (version 22.0; IBM, Armonk, NY, USA). A student's t-test was used to perform parametric comparisons of normally distributed data. The Mann-Whitney U test was used to compare means between non-normally distributed groups. Fisher's exact test and chi-square test were used to compare categorical data between the two groups. Two-sided test values of $P < 0.05$ were considered statistically significant. To identify the predictive factors of orchiectomy and develop a novel predictive model, univariable and multivariable binary logistic regression analyses were used.

RESULTS

Clinical parameters of patients

Patients with testicular torsion confirmed by Doppler ultrasound who were all minors aged 1–18 years were included in the study cohort, and we ultimately collected clinical information from 75 patients through the application of exclusion and inclusion criteria. Among them, 32 underwent orchiectomy, and TS occurred in 43 patients. The mean age of the Orchiectomy group was 12.53 ± 3.29 years younger than 14.42 ± 2.41 years in the TS group (Table 1). The peak TT rate was observed between 11–15 years old (Figure 1A). The probability of TS increased with age (Figure 1B). The incidence of TT was high in the winter (Figure 2). Over 84% of the patients had testicular pain, and 10% had scrotal swelling. A previous history of TT occurred in only 5% of the patients. The time from the event to hospitalization ranged from 4–115 min. The twisted testicle side and location of the testicular torsion were comparable between the TS and Orchiectomy groups.

When comparing the blood test results and testicular color of the affected testes, we found that all patients in the Orchiectomy group presented with a black color. The neutrophil-to-lymphocyte ratio was higher in the Orchiectomy group than in the Salvage group.

We also compared differences between the Orchiectomy and Salvage groups. We find that the initial presenting institution accounts. More than 50% of the patients in the Orchiectomy group visited a primary hospital for the first time, while <20% of the patients in the TS group visited a primary hospital (Table 2).

Independent predictors for testicular salvage rate

Interestingly, we found that over 80% of the patients in the Salvage group were sent to tertiary hospitals, while only 65% of the patients in the Orchiectomy group were sent to tertiary hospitals. The guardian type (father or mother) and residence (urban or rural) of the children had no predictive effect on testicular salvage.

Univariate analysis showed that age, BMI, torsion angle, red blood cell count, NLR, and the initial presenting institution were predictive of orchiectomy (Table 3). Univariate and subsequent multivariate logistic regression analyses showed that the initial presenting institution ¹correlated with the risk of a salvageable testis (Table 3).

DISCUSSION

Testicular torsion is a common urological emergency in adolescents that often results in testicular loss, decreased fertility, and even loss of fertility if the diagnosis and management of TT are delayed. It has been reported that the overall incidence is approximately 4 in 100,000 people worldwide, with a higher incidence of TT in Ireland, between 16.8 and 26.3^[4]. At present, the initial causes of TT remain unknown, and mouse models have been used to study the causes of testicular torsion and protective factors of TT^[9]. Some researchers have reported that TT causes dysfunction in mitochondrial oxidative phosphorylation^[10] and that *Insl3* could be a protective factor against TT^[11]. Which clinical characteristics predict a higher risk for testicular orchiectomy? In the Orchiectomy group in our study, the testicular color was black, and the NLR was higher than that in the TS group. Multiple studies have also reported that torsion grade is associated with testicular vitality^[12-14]. In this study, the degree of torsion was associated with TS. The median torsion grade was 568.12±195.501 in the Orchiectomy group compared to 425.93±235.747 in the TS group. Recently, Carlos *et al.*

confirmed that laboratory tests of the NLR should be considered a predictor of pediatric TT in cases with clinical and ultrasound suspicion, which may help anticipate the urgent surgical treatment required in these patients^[15]. Therefore, testicular color, torsion grade, and laboratory tests will help urologists judge the severity of TT.

TT is a urological emergency; therefore, social factors may delay the diagnosis and treatment of patients with TT. Accurate and prompt diagnosis and surgical treatment are important for TS. TT can occur at any age, but teenagers are the main victims, especially children who are 12–16 years old^[16]. Similarly, we found that patients aged 11–15 account for 60% of the cohort (Figure 1A). We found a correlation between age and TS, with younger children being more likely to undergo orchiectomy. This may be because younger children are unable to judge the severity of pain and accurately describe pain symptoms in words^[17]. Similarly, Puneeta *et al* reported that misdiagnosed patients tended to be younger and more likely to have developmental, cognitive, or social disorders than those in an acute setting^[18].

In addition to young age and atypical symptoms, what factors could lead to a delay in TT and failure of TS? In our study, we found that the initial presenting institution was important. TT is a urology emergency; therefore, sociological characteristics, such as tertiary hospital location, were also considered. Univariate and multivariate logistic regression analyses in the current study showed that only patients who visited the tertiary facility shortly after symptom onset had a higher salvage rate, which was similar to research in Brazil^[19]. Tertiary hospitals often have better Doppler ultrasound equipment, more experienced ultrasound diagnosticians, and urologists at higher levels, which results in lower rates of misdiagnosis. In 2016, Douglas pointed out the inclination to refer adolescent patients with TT away from regional hospitals to a tertiary pediatric center and experienced urologists^[20]. However, in northern and central China, many children live in rural areas far from tertiary hospitals in cities, which often causes delays in TT treatment.

In addition to preventing delays in diagnosis, we must avoid long durations before surgery. If patients with TT are diagnosed and treated promptly, the probability of

testicular loss will decrease significantly. The “golden six-hour” window for TT treatment signifies that if patients reach the hospital within six hours of symptom onset, the salvage incidence can reach 90%^[21]. Aderivaldo *et al* reported that presentation delay was a significant predictor of orchiectomy^[19]. If surgical exploration is delayed, the TS rate decreases to 50% when symptoms last beyond 12 h. When symptoms last for over 24 h, the TS rate is reduced to less than 10%^[22].

TT often occurs in cold weather at low temperatures. In cold zone countries, such as Ireland and Canada, the incidence rate of testicular torsion is relatively higher than that in other countries^[4, 23, 24]. Even in tropical countries, TT follows a seasonal pattern and is more frequent in the colder months of the year^[25]. Why do low temperatures cause TT? Researchers have suggested that contraction of the cremasteric muscle at low temperatures increases the risk of TT^[26]. In Japan, researchers found that over 70% of TT cases occurred in winter^[27], and in Brazil, the TT incidence was higher in the southern area than in the northern area (the cold zone in the south)^[24]. According to a report in Taiwan, 73.7% of the patients had TT when the diurnal temperature change was $\geq 6^{\circ}\text{C}$. Compared to the torsion rate for diurnal temperature changes $< 6^{\circ}\text{C}$, the relative risk of TT at $\geq 6^{\circ}\text{C}$ was 1.8 ($p < 0.05$)^[28]. This finding is similar to the results of the present study. We found that TT occurred more frequently in winter than in the other seasons, and winter was the season with the most severe temperature changes in northern and central China.

From the perspective of disease characteristics, the degree of TT and laboratory indicators of blood tests affect the success rate of TS in TT. However, it should be noted that TT is a urologic emergency, and the delay in diagnosis due to sociological characteristics leads to the loss of testes. In rural areas or small towns, the lack of tertiary hospitals causes delays in diagnosis. Therefore, for better treatment, we should popularize emergency knowledge among parents and children^[29], and provide corresponding diagnosis and treatment training for doctors in rural areas to avoid misdiagnosis of TT.

This study has several limitations. First, it is a retrospective study, which is subject to selection bias. Secondly, the study is single-centered with a limited number of cases included. In the future, larger-scale multicenter studies will be needed to identify factors that influence the outcomes of testicular torsion.

CONCLUSION

The initial presenting institution has a predictive value for predicting outcomes in children with acute TT. Children with scrotal pain should be referred to a tertiary hospital as soon as possible for an accurate diagnosis and timely surgery.

ARTICLE HIGHLIGHTS

Research background

Testicular torsion (TT) is currently the leading cause of testicular removal in adolescents, with an incidence rate of 1 in 4,000 among males under the age of 25. Delayed medical consultation for TT and misdiagnosis could lead to orchiectomy. Therefore, we aim to analyze the factors influencing orchiectomy or testicular salvage by reviewing the data of patients who presented at our center.

Research motivation

Various factors, such as delayed presentation to the healthcare facility and excessive degree of torsion, can lead to orchiectomy in adolescents with testicular torsion. Hence, we conducted a retrospective analysis of data from our center to identify the factors affecting the prognosis of TT.

Research objectives

Factors to ⁴predict the possibility of testicular salvage (TS) in patients with testicular torsion in our tertiary center.

Research methods

By collecting clinical data from patients with testicular torsion treated at our center, we performed univariate and multivariate regression analyses to compare between the testicular salvage group (TS) and the orchiectomy group.

Research results

Our study has identified that younger age , Body Mass Index(BMI) , torsion angle , red blood cell count and neutrophil-to-lymphocyte ratio have predictive value for TS. And we found a new factor that the type of institution where patients first presented as a predictive factor for the outcome of TT; patients who initially presented to a tertiary-care hospital were more likely to have testicular preservation.

Research conclusions

The initial presenting institution is a new predictive factor for outcome of TT. Patients with scrotal pain should be presented to a tertiary hospital as soon as possible.

Research perspectives

Future research will focus on enhancing public health education regarding scrotal emergencies to prevent delays in the presentation of patients with conditions such as testicular torsion.

6%

SIMILARITY INDEX

PRIMARY SOURCES

- | | | |
|----------|--|----------------------|
| 1 | www.karger.com
<small>Internet</small> | 54 words — 2% |
| <hr/> | | |
| 2 | www.nature.com
<small>Internet</small> | 38 words — 1% |
| <hr/> | | |
| 3 | Carlos Delgado-Miguel, Antonella García, Antonio J. Muñoz-Serrano, Pedro López-Pereira et al. "The role of neutrophil-to-lymphocyte ratio as a predictor of testicular torsion in children", Journal of Pediatric Urology, 2022
<small>Crossref</small> | 25 words — 1% |
| <hr/> | | |
| 4 | www.pubfacts.com
<small>Internet</small> | 24 words — 1% |
| <hr/> | | |
| 5 | f6publishing.blob.core.windows.net
<small>Internet</small> | 18 words — 1% |
| <hr/> | | |
| 6 | Chun-Hui Tian, Xiao-Juan Chen. "Severe bleeding after operation of preauricular fistula: A case report", World Journal of Clinical Cases, 2021
<small>Crossref</small> | 17 words — 1% |

EXCLUDE QUOTES ☐ ON

EXCLUDE BIBLIOGRAPHY ☐ ON

EXCLUDE SOURCES

EXCLUDE MATCHES

< 1%

< 10 WORDS