Ultrasonographic Changes of The Testicle Among Pediatric Patients with A History of Orchiopexy After Testicular De-Torsion in A Three-Year Period, A Cross-Sectional Prospective Study

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Abstract

Introduction: Testicular torsion (TT) necessitates emergent and proper intervention since it can affect sexual health and fertility. Ultrasonography is the gold standard modality for detecting TT. This study aimed to determine the long-term sonographic changes of the testicles in patients with a history of orchiopexy for testicular torsion in the pre-and post-operative stages who were referred to our tertiary pediatric referral emergency department in 2017-2018, northeast of Iran.

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Materials and Methods: In this analytical cross-sectional study, we have collected a sample of pediatric patients who had been referred to the urology department with acute scrotum complaints between years 2016 and 2019, and we have followed them clinically and by sonography regarding the size of their testicles during a maximum period of three years.

Results: The left testicle was found to be torsified in 24 (72.7%) cases. In the control ultrasound exam, 12 (38.7%) cases with involvement of the left side, the testicle were reduced in size. In the post-operative stage, the percentage of involvement in the right testicle (0.87%) was higher than in the left (0.50%). The percentage of parenchymal involvement before and after the operation was compared using Fisher's exact test, which had a significant difference (P=0.001). The testicular blood supply frequency before surgery was impaired in 19 (57.6%) cases. In control ultrasound, in 15 (45.5%) cases testicular tissues had normal blood supply. These results were compared using Fisher's exact test, which had no significant difference (P=0.154.)

Conclusion: The sonographic changes of testicles in the patients suffering from TT were variable over time, and these changes can be widely different; they are also significantly related to testicular dimensions when the patient presents with testicular torsion.

Level of evidence: VII

Abbreviations used: TT: Testicular torsion, ROC: receiver operating characteristic, AUC: Area under the curve, TA: testicular atrophy

Keywords

- Testicular torsion
- Ultrasonography
- Orchiopexy
- Testicular de-torsion surgery

Introduction

TT, one of the known pediatric urological emergencies, necessitates emergent and proper intervention since it can lead to complete necrosis of the testis. It occurs when the testicle twists, maybe even repeatedly, around its spermatic cord, leading to impaired blood supply and possible permanent ischemic testicular damage. The acute scrotum describes this phenomenon, which can affect sexual health, hormone production, and even male fertility. The severity of ischemia varies and is based on the time of torsion and the extent of cord rotation.[1] This urological emergency has the potential of occurrence at any age;[2] however, it has a bimodal distribution, with peaks in the perinatal and adolescence phases, reflecting the clinical distinction between extravaginal torsion in newborns and intravaginal torsion among older children.[3] Primary care, family, and emergency physicians are the first health care providers to confront the condition mentioned above before reaching to the hands of a urologist or a pediatric surgeon. The other differential diagnoses of the acute scrotum among the pediatric population are torsion of testicular appendages, Epididymo-orchitis (EO), inguinal hernia, hydrocele, trauma, testicular tumors, and varicocele. There are various investigating modalities, from urine analysis to color doppler ultrasonography. The latter is the gold standard for detecting testicular torsion. This study aims to determine the long-term sonographic changes of the testicles in patients with a history of orchiopexy for testicular torsion in the pre-and post-operative stages who were referred to our pediatric referral emergency department in 2017-2018 .

Materials and Methods

In this analytical cross-sectional study, the sonographic changes of the testicles of referred patients with testicular torsion to our tertiary pediatric referral hospital in northeast of Iran were studied between 2016 and 2019. For this purpose, we have collected random samples of patients referred to the urology department with acute scrotum complaints. After implementing the necessary protocols to collect testicular sonographic data, we recorded the information regarding these changes in tables and graphs. Using the national orchiopexy surgery code, all the patients who underwent this surgery,

including 40 patients, were identified. Their information was obtained from the medical records section, and the patients who underwent testicular torsion surgery were identified and then included in the study's statistical population. Initially, a questionnaire was prepared, and the patient's demographic information was filled in regarding age, the duration of hospitalization, the interval between hospitalization and surgery, and sonographic data. During a phone call, having obtained verbal informed consent from the parents or the guardian, the patients were referred to the surgical clinic of the hospital, and after obtaining written consent from the parents and giving the necessary explanations for them and the child, the initial examinations of the testicles of both sides were performed, the information A questionnaire was filled. After all, the children were sent to a specific ultrasound center to evaluate their size and blood supply. The second look was also performed by comparing and entering into the questionnaire .

Statistical analysis: Data analysis was done using SPSS version 24 software. Descriptive statistics methods, including central indices (mean), dispersion (standard deviation), and distribution of absolute frequency (number) and relative frequency (percentage), were used in the description of the data in the form of graphs and tables. Considering that the primary goal of this research project is to compare the long-term morphologic changes of the testicle in an ultrasound before and after surgery, and indeed, the same patients have been compared in two-time situations, and in other words, pairwise comparisons have been made; Therefore, regarding the quantitative variables (size and volume of the testis) in order to compare these changes, within-group t-pair statistical tests (and in case of non-normal distribution, non-parametric Wilcoxon test) have been used. In order to compare the qualitative variables, including state of involvement, parenchymal and testicular blood supply, and hydrocele, a Chi-square statistical test was used. It is obvious that if the "expected frequency ratio" is more than 20% in the intersection tables of qualitative variables, to analyze these variables, the "exact chi-square" statistical test would be used, or the variable sizes would be merged. The meaningful level in all statistical tests was less than 0.05. The inclusion criteria were children with torsion who underwent surgical intervention and whose histopathologic results had confirmed the

torsion. However, those suspected of testicular torsion did not undergo surgery and were treated conservatively. The children suspected of testicular torsion who have undergone surgery but have been diagnosed with another cause other than testicular torsion were excluded from the study. This work has been reported in line with the STROCSS criteria.[4]

Result

After collecting the demographic characteristics of the samples, the normality of quantitative variables was tested using Kolmograf-Smirnov and Shapiro-Wilk tests. To compare the morphological changes of the testicle before and after the operation of the nominal variables, using chi-square and exact chi-square tests (for tables larger than two by two and low expected frequency) and Fisher's exact test (for two-by-two tables and expected frequency) low expectation) and paired t-test were compared and tested for quantitative variables .

The average age of children suspected of testicular torsion who underwent surgery was 8.57 ± 4.25 years. Their age at the time of surgery was 6.12 ± 4.47 years. The duration of pain until surgery was calculated as 1.24 ± 1.27 days **(Table 1).**

Table 1: Mean and standard deviation of age, age at the time of surgery and time interval between pain onset and operation in children suspected of testicular torsion.

	Mean	SD	Min	Max
Age (years)	8.57	4.25	2	16
Age at the time of surgery (years)	6.12	4.47	0	0
Time interval between pain onset and operation (days)	1.24	1.24	0	0

Max: Maximum, Min: Minimum, SD: Standard deviation

Most children (51.5%) suspected of testicular torsion had been delivered term **(Table 2).**

Table 2: The term of pregnancy in children suspected of testicular torsion.

		Frequency	Frequency in percentile
The term of pregnancy	preterm	16	48.5
	term	17	51.5

The findings indicate that the relative frequency of involvement of the left testicle before surgery was reported in 24 (72.7%) cases. In the control ultrasound, in 12 (38.7%) cases with involvement of the left side, the testicle was reduced in size **(Table 3 - 4).**

Table 3: Comparison of testicular involvement before and after surgery in children suspected of torsion.

		Before surgery		After surgery	
Involvement condition	**Right-sided**	8	24.2	1	3.2
	Left-sided	24	72.7	12	38.7
	Bilateral	1	3.0	-	-

Table 4: Comparison of left and right testicle size in children suspected of testicular torsion before and after surgery.

		Mean±SD	P value
Left testicle size (length)	Pre-operative	18.71±7.95	0.810
	Post-operative	18.14±8.19	
Left testicle size (width)	Pre-operative	14.50±5.36	0.021
	Post-operative	9.14±4.78	
Left testicle size (height)	Pre-operative	22.66±11.015	0.785
	Post-operative	23.66±5.68	
Right testicle size (length)	Pre-operative	18.29± 9.12	0.022
	Post-operative	24.25±11.00	
Right testicle size (width)	Pre-operative	13.44±6.72	0/340
	Post-operative	11.81±5.03	
Right testicle size (height)	Pre-operative	22.66±11.01	0.225
	Post-operative	26.66±7.02	

In the post-operative stage, the percentage of involvement in the right testicle (0.87%) was higher than in the left (0.50%) **(Figure 1).**

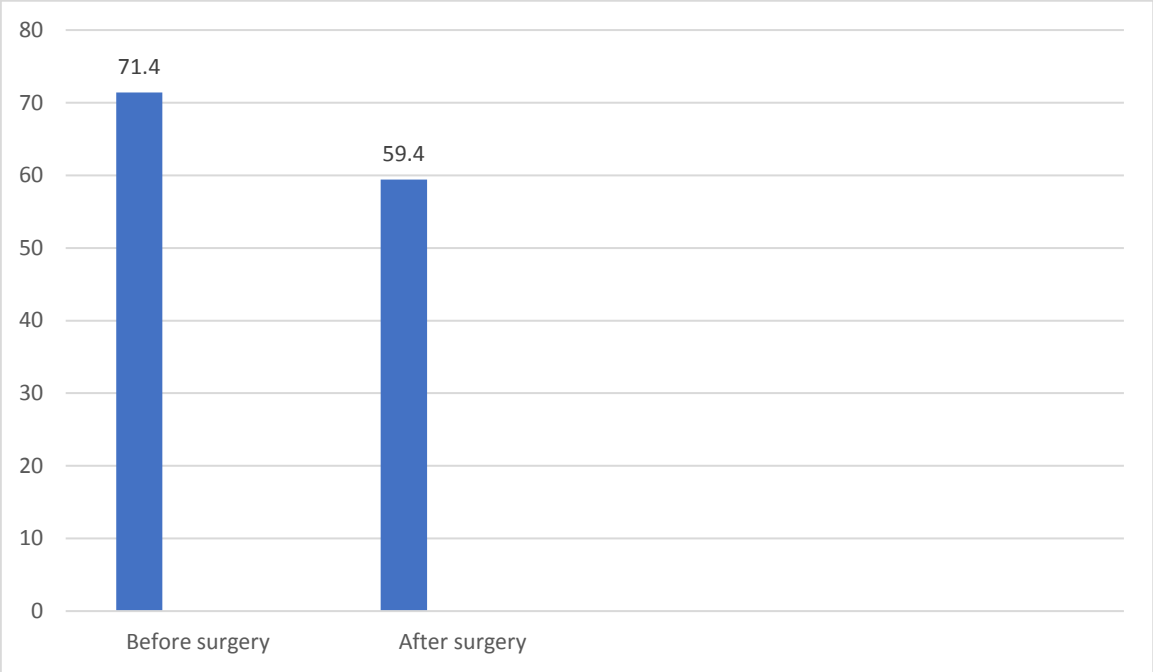

Figure 1: Comparison of overall testicular parenchymal involvement percentage before and after surgery.

One of the essential criteria in statistical tests is the "expected frequency ratio". However, this ratio in this intersection table is 50%, so the chi-square statistical test was used to analyze these variables. The results showed no significant difference between before and after the surgery regarding testicular involvement. The testicular parenchymal involvement frequency percentage before surgery was hypoechoic or echogenic in 15 (71.4%) cases. In control ultrasound, testicular tissue was normal in 19 (59.4%) cases. The percentage of parenchymal involvement frequency before and after the operation was compared using Fisher's exact test, which had a significant difference (P=0.001). The frequency of testicular blood supply before surgery was impaired in 19 (57.6%) cases. In control ultrasound, 15 (45.5%) testicular tissues had normal blood supply **(Figure 2).**

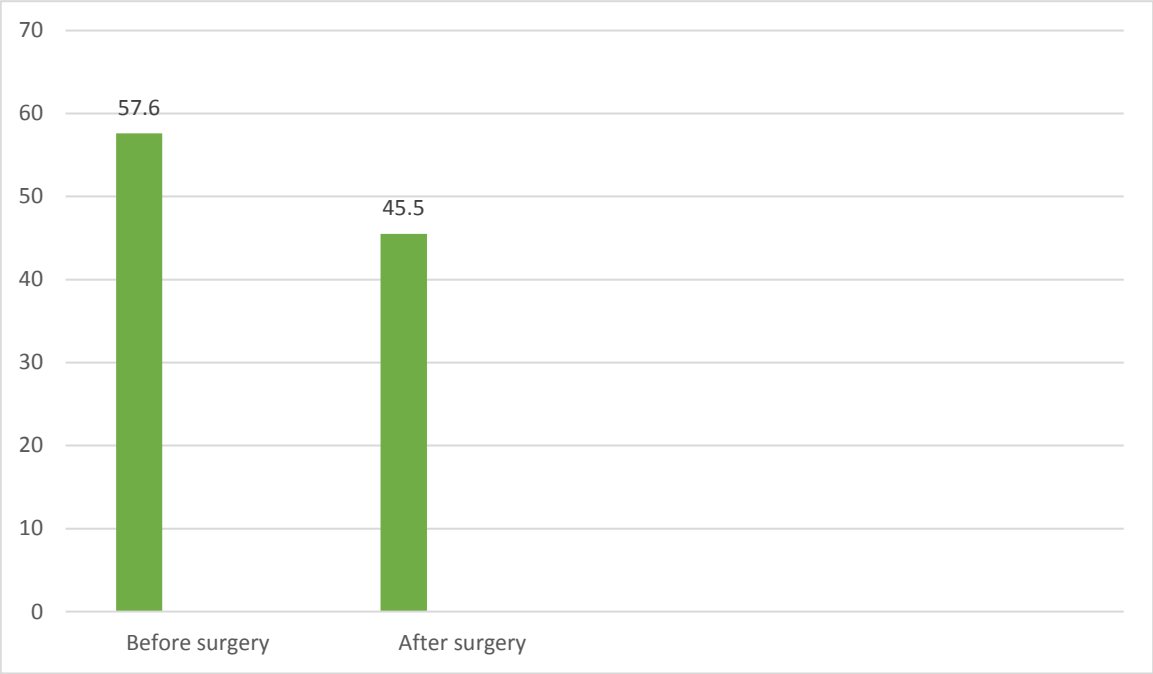

Figure 2: Comparison of testicular blood supply frequency before and after surgery

These results were compared using Fisher's exact test, which has no significant difference (P=0.154). From the view of hydrocele frequency, it has been reported in 6 (28.6%) cases before the surgery. On the opposite, in the control ultrasound, only one (3.1%) case of hydrocele was reported. The percentage of hydrocele frequency reported before and after the operation was compared using Fisher's exact test, which revealed no significant difference (P=0.517) **(Figure 3).**

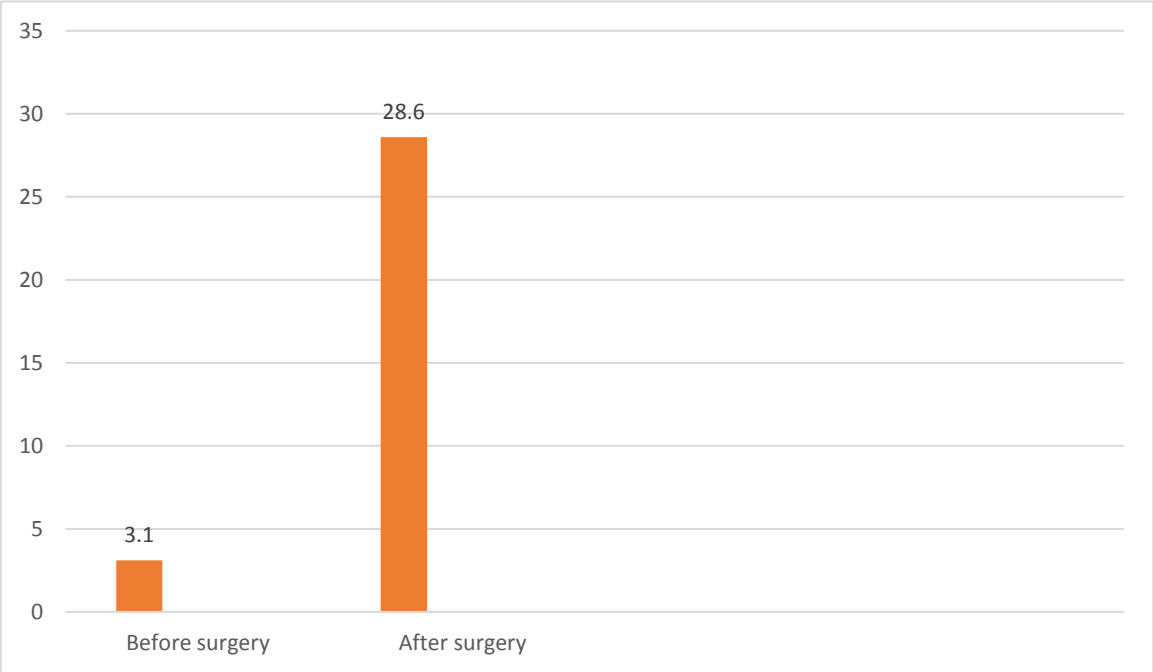

Figure 3: Comparing the frequency of testicular hydrocele before and after surgery

In the secondary findings section, initially, in order to determine the effect of background and intervening variables on the long-term sonographic changes of the testicle in patients with a history of orchiopexy following testicular torsion referred to the hospital emergency department, a two-way analysis of variance statistical test was used. It is noteworthy that to perform this statistical test, quantitative variables were first classified to be analyzed in the two-way ANOVA statistical test. The mentioned analysis of variance showed that none of the background and intervening variables had a significant effect on it ($p>0.05$). Therefore, none of the background and intervening variables had a confounding role in the present study **(Table 5).**

Table 5: Intervention results of two-way analysis of variance to determine the effect of background and intervening variables on long-term sonographic changes of the testis.

Background and intervening variables	General effect	Time effect (pre-and post-surgery)	Variable effect	Interaction effect
Age	0.12	0.24	0.31	0.19
Age at the time of surgery	0.25	0.35	0.42	0.54
Time from pain onset to surgery	0.19	0.09	0.19	0.44
Gestational age at the time of delivery	0.21	0.26	0.32	0.37

Discussion

Acute scrotum among the pediatric population is a common complaint with an estimated yearly incidence of 3.8 in 100,000 males less than 18 years of age,[5] requiring early and proper referral and prompt investigations for testicular salvage.[6] The predisposing risk factors for TT have not been well understood. The "bell-clapper deformity" and other familial abnormalities involving the development of the gubernaculum are clearly implicated.[7]

Here, the role of ultrasonography, an easy and accessible modality in predicting the viability of testicular tissue, is important. So that the testicular salvage rate has been revealed to fall from 90% to less than 10% as the delay from onset of symptoms to time of de-torsion operation increases from 6 to 24 h.[8] The current study aimed to determine the long-term radiologic changes of the testicles in those with a history of orchiopexy for testicular torsion in a tertiary referral center. For this, we followed a sample group of 40 patients aged 2-16 years, clinically and by ultrasonography, in the pediatric referral pediatric hospital in northeast of Iran. This study showed that these sonographic changes of the testicle are significantly related to two factors: the dimensions of the testicle and the time of presentation of the patients with testicular torsion. The findings of the present study also indicated

that the size of the left testicle has decreased significantly in terms of width after surgery. Furthermore, the size of the right testicle has decreased significantly in length after surgery. However, regarding the size and volume of the right and left testicles, there was no significant change in the stages before and after surgery. A study was conducted in Turkey in 2022 to evaluate the sonographic testicular volume of patients who underwent surgical de-torsion due to testicular torsion and to reveal the frequency of the testicular volume loss and the factors affecting it. The authors followed up the patients in a mean period of 24 months. Of the 97 patients, the affected testicular volumes decreased in 23 patients (range 1.1-100%), there was no change in testicular volume in two patients, and there was an increase in testicular volume in 18 patients (range 3.8-100%). They also concluded that in the receiver operating characteristic analysis (ROC), the risk of testicular volume loss could be predicted with 87.5% sensitivity and 83.9% specificity when the time from the onset of pain to surgery exceeds 5.5 hours (Area under the curve [AUC] = 0.904).[9]

Another retrospective cohort study was conducted at the Children's Hospital of Chongqing Medical University since November 2004 till December 2020 to investigate the long-term follow-up results after TT in children. They analyzed 145 cases in the study; approximately 56.6% of patients who underwent salvage orchiopexy had testicular atrophy (TA). The median testicular volume loss of the testes was 57.4%. From the point of their work view, age less than six years, delayed surgery, and intraoperative poor blood supply were associated with TA in pediatric TT after orchiopexy. Most atrophied testes appeared within 3–6 months after surgery. Compared with the corresponding age-matched healthy controls, the contralateral testicular volumes were larger in the orchiopexy (P = 0.001 without TA, and P = 0.042 with TA) and orchiectomy groups (P = 0.033).[10] In another study with the aim of which factors could predict testicular atrophy after testicular salvage following torsion, the conclusion came out that half of the patients with testicular torsion undergoing salvage surgery will develop atrophy, even when intraoperatively assessed as viable and should be followed up carefully. Duration of pain of more than one day and sonographic heterogeneous echogenicity are predictive elements .

Conclusion

The results showed that the sonographic changes of testicles in the patients suffering from TT were variable over time, and these changes can be widely different. We can also conclude that testicular sonographic changes in TT patients are significantly related to testicular dimensions when presenting with testicular torsion and other medical conditions. According to these results, we suggest that in these patients, the sonographic changes of the testis should be considered a valuable tool for diagnosing and managing testicular torsion.

Ethical Consideration

This study received ethical code from the ethical committee of Mashhad university of medical sciences (IR.MUMS.MEDICAL.REC.1401.668).

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Not applicable

Conflict of interests

There is no conflict of interest

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