

Effect of unilateral testicular torsion at different ages on male fertility

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Xinyu Zhang^{1,2}, Jianzhong Zhang¹,
Zhonglin Cai¹ , Xiyou Wang^{2,3}, Wenhong Lu³
and Hongjun Li¹ 

Abstract

Objective: To investigate the effect of early-life unilateral testicular torsion on adult male fertility.

Methods: Clinical information was collected for 122 patients who had experienced unilateral testicular torsion at a median age of 15.5 years. The recent pregnancy rate and time to pregnancy experienced by the patients' female partners were assessed by structured interviews. Data were analyzed by the chi-squared test and Student's t-test.

Results: Seventy-two patients with testicular torsion met the criteria for inclusion in our analyses; 49 had undergone orchiectomy, while 23 had undergone surgical repositioning/orchiopexy. The pregnancy rate and median time to pregnancy were 83.67% (41/49) and 1.6 years, respectively, in the orchiectomy group, whereas they were 91.30% (21/23) and 0.75 years, respectively, in the repositioning/orchiopexy group. The recent pregnancy rate was higher in patients with torsion in childhood than in patients with torsion in adolescence; it was lowest in patients with torsion in adulthood. Surgical repositioning/orchiopexy yielded a significantly better recent pregnancy rate among the three groups, based on age at the time of torsion, and a shorter time to pregnancy than orchiectomy in patients with torsion in adolescence.

Conclusion: Onset of unilateral testicular torsion early in life has a negligible effect on adult male fertility.

¹Department of Urology, Peking Union Medical College Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, China

²Department of Urology, The Sixth Medical Centre, Chinese PLA General Hospital, Beijing, China

³NHC Key Laboratory of Male Reproductive Health, National Research Institute for Family Planning & WHO Collaborating Center for Research in Human Reproduction, Beijing, China

Corresponding author:

Hongjun Li, The Department of Urology, Peking Union Medical College Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing 100730, China.

Email: lihongjun@pumch.cn



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Keywords

Testicular torsion, male fertility, recent pregnancy rate, orchiectomy, repositioning/orchiopexy, time-to-pregnancy, sexual partners, structured interviews

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Introduction

Testicular torsion (TT) is a relatively uncommon urological emergency, mainly encountered in childhood and adolescence. Non-urological surgeons or physicians typically encounter affected patients during outpatient visits in emergency departments.¹ Because of a lack of knowledge and experience, treatment is often delayed because of suspicions of other disorders, such as inflammation of the testicle, epididymis, and other tissues. Postponed detorsion and surgical intervention can lead to recalcitrant ischemia of the testicular tissue, resulting in permanent testicular damage or necrosis, as well as probable resection of the injured testicle.¹ TT has been reported to affect male fertility in adulthood, and may be an important cause of secondary male infertility.^{2,3} Laboratory analysis of semen samples has revealed low sperm count and poor sperm vitality in >50% of patients with TT.⁴ However, the impact of TT on adult male fertility has not been systematically investigated. In a cohort of 63 patients with a mean age of 20 years at the time of TT, Gielchinsky et al.⁵ found that the pregnancy rate and time to pregnancy for their female partners did not differ from the general population. The recent pregnancy rate was considered reliable evidence of male fertility status in patients who had TT in early life. However, the effects of post-torsion ischemic time, degree of torsion, age at the time of TT, and choice of treatment procedures on the recent pregnancy rate and time to pregnancy have not been

explored. In the current study, we investigated the clinical data of patients who had experienced TT in childhood and adolescence, over a 19-year period. We then interviewed the patients who had reached adulthood to determine pregnancy statuses of their female partners. This study was performed to investigate the fertility statuses of patients with TT using the recent pregnancy rate, as well as to aid clinicians in understanding the potential effects of other factors on male fertility during early clinical management of TT.

Materials and methods

Clinical information

This retrospective study design was evaluated by the review board of the institutional medical ethical committee at the Peking Union Medical College, which granted an exemption from the ethical review process. Written informed consent was obtained from all included patients. Data were collected by retrospective review of medical records for the period from January 1996 to December 2014, at four municipal hospitals around Beijing, China. Before treatment, all patients were examined by using color Doppler flow imaging (CDFI) to determine the degree of impediment of blood flow to the injured testicle.

Study method

Criteria for assessment of male fertility using the recent pregnancy rate. Inclusion criteria were as follows: 1) marriage and/or cohabitation

in a stable relationship with a female sexual partner; 2) regular engagement in unprotected intercourse (with female partner), with the goal of conception, for ≥ 2 years prior to the study; 3) no other male reproductive abnormalities that could prevent pregnancy, such as erectile dysfunction, ejaculation, and/or chromosome abnormality; 4) no gynecological problems (in female partners), such as abnormal ovulation or fallopian tube obstruction; and 5) no medically assisted pregnancy.

Interview and information collection. Patients in this study were interviewed by telephone or face-to-face, with or without their partners. The following information was collected for analysis: 1) timing of the first pregnancy of the female partner and the result (i.e., live birth, abortion, or miscarriage); 2) the length of time between beginning unprotected intercourse and experiencing the first pregnancy (time to pregnancy); and 3) the length of time from first pregnancy to any subsequent pregnancies.

Data analysis

The chi-squared test was used to compare pregnancy rates of couples in which patients with TT had undergone orchiectomy, compared with repositioning/orchiopexy, in three age groups (based on age at the time of TT). Student's *t*-test was used to determine whether age at the time of TT and type of surgery influenced the time to pregnancy. SPSS Statistics, version 13.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Statistical significance was set at $p < 0.05$.

Results

In total, 122 patients who had experienced unilateral TT were screened for inclusion in this study (Table 1). The median patient age at the time of TT was 15.5 years (range,

Table 1. Clinical characteristics of patients with testicular torsion.

Characteristic	Value
Age, years (median [range])	15.5 (6–26)
Side of torsion	
Left	63 (51.64)
Right	59 (48.36)
Degree of torsion	
180–360°	34 (27.87)
360–720°	62 (50.82)
>720°	9 (7.38)
Unknown (no record)	17 (13.93)
Torsion direction	
Clockwise	53 (43.44)
Anti-clockwise	52 (42.62)
Unknown (no record)	17 (13.94)
Pain at	
Scrotum	94 (77.05)
Perineal region	25 (20.49)
Inguinal region	3 (2.46)
Inducible causes	
Intensive sport activity	24 (19.67)
No sport activity	36 (29.50)
Unknown (no record)	62 (50.83)
Time between torsion and treatment	
0.5–6 hours	52 (42.62)
7–24 hours	41 (33.60)
25–72 hours	29 (23.78)
Treatment method	
Non-surgical repositioning	17* (13.93)
Orchiectomy	72 [#] (59.02)
Surgical repositioning	33 [‡] (27.05)

Data are shown as n (%), except where indicated.

*50 patients underwent attempted manual reposition, but only 17 patients had successful outcomes; 33 patients underwent secondary surgical repositioning or orchiectomy.

[#]49 of 72 patients were included in the study.

[‡]23 of 33 patients were included in the study

6–26 years). Sudden pain was the main clinical complaint, with 24 patients reporting sudden pain after intensive sports activities and 36 reporting pain while at rest. Physical examination found an enlarged tortuous testicle with tenderness, and a positive Prehn sign. Postoperative CDFI showed that blood flow to the unaffected testicle

was unchanged from preoperative status. Time between torsion and treatment varied from 0.5 hours to 3 days. Of the 122 patients, non-surgical repositioning was attempted in 50; 17 had successful outcomes, while 33 did not. In total, 105 patients with torsion in the tunica vaginalis underwent exploratory surgery; 53 patients had clockwise torsions, while 52 had counterclockwise torsions. The degree of torsion varied among patients. Orchiectomy was performed in 72 patients after confirmation of testicular necrosis and/or incurable spermatic cord ischemia. In 33 patients, the testicle was preserved and repaired via orchiopexy within 6 hours of torsion onset. Additional details regarding patients' clinical characteristics are shown in Table 1.

Of the 122 patients with TT to whom consent forms were sent, 109 returned the forms and agreed to participate in the interview portion of this study. Of those 109 patients, 33 were excluded because they did not have a stable relationship with a female sexual partner; four were excluded because they and/or their female partners did not meet other

assessment criteria. The remaining 72 patients were included in the analyses. Of these 72 patients with TT, 49 had undergone orchiectomy, while 23 had undergone surgical repositioning/orchiopexy.

Late pregnancy rates and times to pregnancy, as related to patient age at the time of TT and type of surgery, are summarized in Table 2. In the orchiectomy group, 41 couples (83.7%) had a first successful pregnancy culminating in a live birth; in the surgical repositioning/orchiopexy group, 21 couples (91.3%) had a successful first pregnancy culminating in a live birth. Differences between the groups with respect to the pregnancy rate and mean time to pregnancy were statistically insignificant, although the repositioning/orchiopexy group tended to exhibit a slightly higher pregnancy rate and a shorter mean time to pregnancy. None of the couples pursued a subsequent pregnancy during the study.

As shown in Table 2, medical records indicated that 37 patients (51.4%) had experienced TT in childhood (<14 years of age; median, 9.6 years), respectively;

Table 2. Fertility statuses of female partners of 72 adult male patients with testicular torsion that occurred at different ages and was treated with two surgical maneuvers.

Age at torsion, n (%)	Surgical maneuvers, n (%)	Fertility statuses of patients' female partners	
		Pregnancy rate ^A , n (%)	Time to pregnancy, years (mean \pm standard deviation)
<14 years, 37 (51.4)	Orchiectomy, 27 (72.9)	25 (92.6)	0.68 \pm 0.32*
	Orchiopexy, 10 (27.2)	10 (100)	0.63 \pm 0.29
14 to 18 years, 28 (38.9)	Orchiectomy, 18 (64.3)	14 (77.8)	1.42 \pm 0.45* [‡]
	Orchiopexy, 10 (35.7)	9 (90)	0.74 \pm 0.38 [‡]
>18 years, 7 (9.7)	Orchiectomy, 4 (57.1)	2 (50)	2.14 ⁺
	Orchiopexy, 3 (42.9)	2 (66.7)	0.85 ⁺
Total n = 72	Orchiectomy, 49 (68.1)	41 (83.7)	1.41 \pm 0.73
	Orchiopexy, 23 (31.9)	21 (91.3)	0.74 \pm 0.11

^Arow \times column chi-squared test showed a significant difference in pregnancy rate across the three age groups, between patients who had undergone orchiectomy and those who had undergone surgical repositioning/orchiopexy ($p < 0.02$).

* $p < 0.001$ (Student's t-test).

[‡] $p < 0.01$ (Student's t-test).

⁺Statistical analysis (Student's t-test) was not conducted because of the small number of patients in this group.

28 patients (38.9%) had experienced TT in adolescence (14–18 years old; median, 16.3 years); and seven patients (9.72%) had experienced TT in adulthood (>18 years old; median, 23.8 years). The pregnancy rate was higher in patients who had TT in childhood, compared with patients who had TT in adolescence. The lowest pregnancy rate was observed in patients who had TT in adulthood. Among patients who had TT in childhood, there were no significant differences in recent pregnancy rate or time to pregnancy between the orchiectomy and orchiopexy groups. Among patients who had TT during adolescence, a significantly longer time to pregnancy was observed in the orchiectomy group, compared with the orchiopexy group ($p < 0.01$). Among patients whose testicles had been preserved, there was no significant difference in recent pregnancy rate between patients who had TT in childhood and those who had TT in adolescence. Repositioning/orchiopexy yielded a significantly better pregnancy rate than orchiectomy for all three age groups ($p < 0.02$).

Discussion

TT is a relatively rare urological emergency, most commonly encountered in vulnerable children and adolescents. Torsion of the left testicle is more common than the right one,^{6–9} consistent with findings in the present study. Some abnormalities that occur during development of the male reproductive system have reportedly been associated with TT morbidity.⁷ Torsion in the tunica vaginalis (a common anatomical site for TT) was observed in 86% of patients in the present study. Ischemic infarction and necrosis of the twisted testicle is dependent on the degree of torsion, as well as the time between onset and relief of torsion.⁸ Thus, early diagnosis and timely management is critical for resolution of ischemia and preservation of the injured testicle. CDFI is

considered a reliable method for diagnosis of TT, with accuracy of 97% and specificity near 100%.¹⁰ Partial or complete impediment of arterial blood flow to a twisted testis can be clearly observed in CDFI images. In the present study, the results of preoperative CDFI images were consistent with visible findings during surgical exploration, indicating the value of CDFI in clinical decision-making with respect to diagnosis and selection of surgical procedures. In clinical practice, it is generally accepted that irreversible injury to testicular tissue occurs when ischemia is present for >24 hours.¹¹ Testicular necrosis was observed by surgical exploration in nine patients when the duration of torsion was >24 hours. Injured testicles were preserved in 50 of 52 patients (96.15%) when the duration of torsion was <6 hours. These outcomes indicate that the optimal time for torsion relief is within 6 hours of onset. All physicians should consider this critical timing when managing cases of TT in the emergency department.

Previous studies revealed that low sperm counts and poor sperm motility were probable sequelae of TT, regardless of preservation or removal of the injured testicle.¹² Frequent examination of semen is impractical for long-term follow-up, unless patients encounter infertility problems. It has been unclear whether the alteration of semen quality caused by TT in early life has an adverse effect on adult male fertility. Arap et al.⁴ studied the recent endocrine profile (e.g., levels of follicle-stimulating hormone, luteinizing hormone, and testosterone), seminal parameters, and antisperm antibody levels in 24 patients with TT; they found that sperm quality was preserved in most patients, with the exception of sperm morphology, which was better in patients who had undergone orchiectomy than in patients who had undergone detorsion. Marco et al. did not find associations between changes in sperm motility and

morphology with recent pregnancy rates among different groups of patients. Thus, we investigated possible associations, by measuring the recent pregnancy rate and time to pregnancy for female partners of patients with TT; this study aimed to provide evidence regarding the long-term effect of TT on adult male fertility. Our measurements are more objective than semen analysis and testicular hormonal function. We found that the recent pregnancy rate and median time to pregnancy were 83.67% and 1.6 years, respectively, for couples in the orchiectomy group. This recent pregnancy rate was very close to the general fertility rate of healthy couples (85%); the median time to pregnancy was also similar to that of healthy couples (i.e., slightly more than 1 year from unprotected intercourse to first conception).¹³ The difference in recent pregnancy rate between couples in the orchiopexy group (91.30%) and healthy couples (85%) was not statistically significant. These results were consistent with the findings of Gielchinsky et al.⁵ Based on our results and the prior findings, we conclude that human male fertility is not affected by unilateral TT in early life.

Notably, investigations regarding age at the time of TT and corresponding fertility status revealed the following trend in the present study: older age at the time of TT was associated with more severe adverse effects to fertility, regardless of whether the injured testicle was resected or preserved. The highest pregnancy rate was observed among patients in whom TT had occurred in childhood; the pregnancy rate among patients in whom torsion had occurred in adolescence was slightly lower than the general fertility rate of healthy couples; and the lowest pregnancy rate was observed among patients in whom torsion had occurred in adulthood. These observations suggest that functional compensation of the unaffected testicle plays a role in male fertility, and that the

compensation ability decreases with increasing age at the time of TT. Several experimental studies with animal species (e.g., rat, rabbit, beagle, and rhesus monkey) demonstrated that the quantity of seminiferous epithelium in seminiferous tubules did not increase in the unaffected testicle when the opposite testicle was resected during adulthood.¹⁴⁻¹⁶ This phenomenon may have contributed to the results in the present study.

In clinical practice, the decision to preserve or remove an injured testicle depends on duration of ischemia, as well as the viability of testicular tissue during surgical exploration. Surgical repositioning/orchiopexy can only be performed following transient ischemia-reperfusion injury when the duration of disruption to testicular function is short.¹⁷ In the present study, the pregnancy rate was higher and time to pregnancy shorter in patients who had undergone preservation of the injured testicle, compared with patients who had undergone orchiectomy following onset of torsion at a similar age. When torsion occurred in adolescence, the time to pregnancy was significantly longer in the orchiectomy group than in the repositioning/orchiopexy group. Significant differences in pregnancy rates were also observed between orchiectomy and orchiopexy patients in all three age groups. Remarkably different recent pregnancy rates and time to pregnancy, based on whether orchiectomy is performed, warrant the preservation of an injured testicle whenever possible.

Most experimental studies have shown that a lesion in one testicle resulted in reduced male fertility in animals, based on changes in sperm production and blood supply involving both testicles.^{18,19} Furthermore, blood–testis barrier injuries caused by unilateral TT have been reported to trigger immune responses, which cause further damage to both testicles.^{4,20} The results of the present clinical study

contradict the conclusions regarding reduced male fertility in the aforementioned studies. Onset of TT early in life does not affect adult male fertility status, whereas age at the time of TT does. Further research is needed regarding the mechanisms involved in functional compensation within the human testis.

A limitation of this study was that the hormonal levels of patients with TT were not measured by means of long-term follow-up after the onset of TT. Romeo et al.²¹ reported that when endocrine profiles (e.g., serum follicle-stimulating hormone, luteinizing hormone, and testosterone) of 12 patients with TT were assessed during 5 years of long-term follow-up, hormonal testicular function was compromised in all 12 patients. However, Arap et al.⁴ reported that monitoring of the same endocrine profile indicated no difference between patients with TT and a control group of fertile healthy men. The debate regarding the effect of hormonal testicular function on male fertility after TT will continue until further information is gathered regarding the relationship between the long-term change in the endocrine profile of patients with TT and the corresponding recent pregnancy rate.

Clinical implications of this study are as follows: 1) TT should be relieved within 6 hours of onset; 2) CDFI examination is an accurate tool for evaluation of arterial ischemia in an injured testicle, if sufficient time is available for CDFI; 3) an injured testicle should be preserved when possible, especially in men >18 years of age; and 4) regular semen analysis may help to further understand the functional compensation of an injured and/or opposite testicle in patients with different ages at the time of TT.

Conclusions

Onset of unilateral TT early in life did not affect adult male fertility capability.

However, age at the time of TT affected the recent pregnancy rate and time to pregnancy. Compared with orchiectomy, surgical repositioning/orchiopexy yielded a better fertility result.

Declaration of conflicting interest

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ORCID iDs

Zhonglin Cai  <https://orcid.org/0000-0002-8098-8922>

Hongjun Li  <https://orcid.org/0000-0001-6040-5251>

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