Long-term impact of testicular torsion and its salvage on semen parameters and gonadal function

Dharmender Aggarwal, Kalpesh Parmar*, Aditya Prakash Sharma, Shantanu Tyagi, Santosh Kumar, Shrawan Kumar Singh, Swati Gupta

Departments of Urology and Anaesthesia, Post Graduate Institute of Medical Education and Research, Chandigarh, India
*E-mail: kalpesh010385@gmail.com

INTRODUCTION

Testicular torsion is a urological emergency requiring urgent decision-making and surgical care. It is caused by twisting of the spermatic cord, causing interruption of blood supply and consequential testicular ischemia. It usually occurs in adolescence but can occur at any age, with literature showing up to 39% of cases occurring in adulthood.[1] The salvage rate of testis following torsion in adults is 38–40%.[1,2] This finding is partly attributed to delayed diagnosis in adults as it is confused with other conditions presenting as acute scrotum, such as epididymitis, viral orchitis, strangulated hernia, spermatic vein thrombosis, and testicular vasculitis. Salvage rate of the testis may depend on the time gap between onset of symptoms and detorsion and on the degree of cord twisting.[3]

It has been hypothesized that testicular torsion causes loss of blood–testis barrier, leading to formation of anti-sperm antibody (ASA) and subsequent reduced fertility potential. Consequences of testicular torsion on hormonal and sexual

ABSTRACT

Introduction: Testicular torsion is a urological emergency, and long-term outcomes of testicular torsion on infertility, hormonal function, and salvaged testicular size are unclear.

Materials and Methods: We conducted an ambispective, observational study from January 2014 to December 2019. Baseline demographics, time of presentation, clinical features, and management details of all the patients of testicular torsion were recorded from the database. All the patients were followed up in the outpatient clinic for testicular size, hormone levels, semen analysis, and erectile function.

Results: Of 85 patients, only 67 could be contacted and included in the final analysis. Group 1 (orchiectomy) comprised 44 patients, and Group 2 (salvage) had 23 patients. Follow-up duration ranged from 2 to 6 years and mean follow-up was 42 ± 12 months. The median time to presentation was significantly higher in Group 1 (48 hours) as compared to Group 2 (12 hours). The rate of testicular salvage did not vary with age of the patients. Doppler ultrasonography of the scrotum detected 92.5% of all cases of torsion. Antisperm antibody levels were within normal range in all patients. Approximately 47% of patients in the salvage group developed testicular atrophy on follow-up. Serum testosterone level was significantly lower in Group 1 and the subset of patients with testicular atrophy. Rest of the hormonal parameters, semen analysis, and erectile function were comparable between two groups.

Conclusion: The time between onset and presentation is an important contributing factor in guiding testicular salvage. Even after salvage, many testes may atrophy on follow-up. Orchiectomy and testicular atrophy in the long term have negative impact on serum testosterone. The patients should be counseled for a long-term follow-up for the risk of testicular atrophy and low testosterone levels.

Access this article online

Quick Response Code:

Website: www.indianjurol.com
DOI: 10.4103/iju.iju_328_21

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com
Received: 01.08.2021, Revised: 08.11.2021,
Accepted: 05.02.2022, Published: 01.04.2022

Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.
function and testicular size (if salvaged) are contentious. Some authors initially reported poor results in semen analysis and testicular atrophy after torsion.[4] However, recent studies showed no difference in sperm motility and sperm counts.[5,6] Hormonal outcome after torsion is also controversial, with studies having contradictory claims.[7] In this study, we report outcomes of a cohort of testicular torsion patients. We compared outcomes of patients who underwent orchietomy versus those whose testis was salvaged in terms of semen parameters, hormonal function, and sexual function.

MATERIALS AND METHODS

This was an ambispective, observational case series on testicular torsion. Ethical clearance was obtained from institutional ethical clearance committee (Reference number: NK/6241/Study/40). Data of all patients with the diagnosis of testicular torsion admitted from January 2014 to December 2017 were retrieved from hospital information system of our institute. Prospective arm of our study included patients from January 2018 to December 2019. Baseline demographics such as age, clinical features on presentation, time from the onset of symptoms, investigations performed, management details, and any complications were recorded from the database. Ultrasound with color Doppler was performed for all patients before surgery. 99m-Technetium scan was done in patients with doubtful diagnosis, in which ultrasound Doppler findings were not able to correlate well with clinical findings and had a suspicion of epididymo-orchitis. A finding of cold photopenic area of affected testis in 99m-technetium scan confirmed torsion of testis. All patients underwent surgical exploration under spinal anesthesia. Standard steps were followed for treatment which included detorsion, 100% oxygenation, and wrapping of testis with warm saline for 15 minutes. Return of pinkish color in testis was indicative of viability. If there was still some doubt, we punctured testis with needle at multiple points and looked for ooze of fresh blood, which confirmed testicular viability. If, even after above steps, testis seemed nonviable, we proceeded for orchietomy. In case of salvageable testis, orchioptomy was performed bilaterally. In case of orchietomy, the contralateral testis was fixed with three-point fixation using prolene suture. All the patients from retrospective arm were called for follow-up after the start of the study as a single-point follow-up. Patients from prospective arm were called for a single-time follow-up after 1 year of their surgery. On follow-up, all the patients were called to the outpatient clinic and underwent physical examination, semen analysis, ASA levels, serum testosterone, serum follicle-stimulating hormone (FSH), serum luteinizing hormone (LH), and ultrasound scrotum by an experienced radiologist, and testicular volume was calculated using formula: length × width × height × 0.71.[8] FSH and LH were measured with immunoassay technique and normal range was 1.5–12.4 IU/L for FSH and 1.8–8.4 IU/L for LH. Testosterone was measured with second-generation immunoassay techniques, which has normal range of 9.2–31.5 nmol/L. Samples were collected in red-colored gel–barrier tube with 4 ml of blood collection in the morning. All hormonal test samples were taken at the time of follow-up and evaluated as individual samples in laboratory and not as pooled sample. In case of salvaged testis, the testicular volume was compared to the contralateral testis. Testicular atrophy was defined as 50% reduction in testicular volume as compared to contralateral testis. We also compared size of contralateral testis to find out if there was any testicular hypertrophy in normal testis in response to torsion. Quality of semen parameters was analyzed using the WHO 2010 criteria. Semen analysis was performed only during follow-up. Semen samples were taken during follow-up and after an abstinence of at least 3 days. Semen samples were evaluated for semen volume, sperm counts, and motility. Any lower sperm counts or abnormalities as per the WHO criteria were clearly documented and then compared among two different groups. Patients were categorized into two groups: those patients who underwent orchietomy as Group 1 and those patients whose testis was salvaged were categorized as Group 2. Patients who were not sexually active were assessed with erectile hardness score on a scale of 0–4, with 0 being penis does not enlarge and 4 being penis is completely hard and fully rigid.[9] Patients who were found to be sexually active were assessed with International Index of Erectile Function (IIEF-5) questionnaire score with a maximum score of 25.[10] Measures of central tendency such as mean and median were used with measures of dispersion such as standard deviation and interquartile range (IQR). All the data were analyzed by SPSS version 23 (SPSS Inc., Chicago, IL, USA). Student’s independent t-test was used to compare two means. Mann–Whitney U-test was used for skewed data, and P ≤ 0.05 was considered statistically significant.

RESULTS

From the hospital records, a total of 85 patients with diagnosis of testicular torsion were managed in our institute. However, 67 patients responded to our telephonic calls and agreed to complete the follow-up visit in outpatient clinic for further test and analysis. We were not able to contact of the remaining 18 patients. Of 67 patients, 49 were from retrospective arm and 18 from prospective arm of the study. There were 44 patients in Group 1 (orchietomy) and 23 patients in Group 2 (salvage). Baseline characteristics and clinical features were comparable in both groups (Table 1). There was a significant difference in duration of presentation among two groups. Patients who required orchietomy presented after median time of 48 hours (IQR - 72, 1st quartile - 24, 3rd quartile - 96), whereas patients whose testis was salvaged presented in median time of 12 hours (IQR - 25, 1st quartile - 3, 3rd quartile - 28). The mean
duration of follow-up was comparable in both groups in retrospective arm. Duration of follow-up in prospective arm was kept at 1 year.

Group 1 comprised 33 (75%) right-sided torsion and 11 (25%) left-sided torsion. In Group 2, 13 (56.5%) patients had right-sided torsion and 10 (43.5%) patients had left-sided torsion. Right side was significantly more involved in both groups than left side ($P = 0.003$). There was no seasonal variation with regard to testicular torsion cases as the patients presented uniformly throughout the year. All patients underwent ultrasonography (USG) of the scrotum with color Doppler imaging for confirmation of diagnosis, and it was able to detect 92.5% of all cases of torsion. 99m-Technetium scan was done in only four patients with doubtful diagnosis. It showed a cold photopenic area of the affected testis in all four cases and confirmed torsion of testis. The mean volume of affected testis and contralateral normal testis on USG was comparable between the two groups [Table 2]. The mean degree of torsion was 360° for Group 1 and 340° for Group 2, which was comparable. In majority of cases, rotation was noted in inward direction, and outward rotation was seen in <5% of cases. Bell clapper’s deformity was more commonly seen in salvage group (65%) as compared to orchiectomy group (36%). The testicular salvage rate was 34% in age <20 years, 36% in 20–50 years, and 33% in age >50 years of patients ($P = 0.84$).

On follow-up, hormonal evaluation showed that the number of patients with low serum testosterone was higher in the orchiectomy group. On semen analysis, 36% of patients in Group 1 showed low sperm counts compared to 17% in Group 2; however, the difference was not statistically significant. Serum FSH, LH, semen volume, and progressive motility were comparable in both groups. Volume of contralateral testis was similar between two groups on follow-up [Table 3].

Of the 67 patients, only seven patients were sexually active at the time of follow-up. The IIEF-5 questionnaire median score was 18.2 ± 3 in Group 1 ($n = 4$) and 17.5 ± 2.5 in Group 2 ($n = 3$), and the difference was not statistically significant ($P = 0.673$). Among the remaining 60 sexually inactive patients, we only assessed their erectile hardness score as validated by Mulhall et al.9 The mean hardness score in orchiectomy group ($n = 40$) was 2.8 ± 0.9 and in salvage group ($n = 20$) was 2.7 ± 0.9, and it was not significantly different ($P = 0.546$). The seminal ASA levels were within normal range for all the patients.

Among the 23 patients in the salvage group, 11 patients had testicular atrophy. We further performed the subset analysis and compared hormonal and semen parameters. The serum testosterone was markedly low in the testicular atrophy group compared to truly salvage group. Rest of the hormonal and semen parameters were comparable [Table 4].

### DISCUSSION

Testicular torsion is an acute urological emergency. Long-term consequences of testicular torsion on hormonal, seminal, and erectile functions are unsettled. In our study, majority of patients presented in early adolescent age group. In our cohort of patients, sudden-onset pain, swelling, and erythema were most commonly reported, whereas fever and history of trauma were noted in <10% of cases. On examination, negative Prehn’s sign and absent cremasteric reflex are considered suspicious of testicular torsion.
torsion. Although it is highly sensitive, the specificity is only 66%.\textsuperscript{11} In our study, the sensitivity of these signs was only 60%–70%. Our study showed that distribution of testicular torsion cases was similar throughout the year. It was in contrast to some assumptions that the effect of cold weather is associated with increased cremasteric spasm, leading to torsion.\textsuperscript{12} However, Williams et al. reported no statistical significance with regard to seasonal or monthly occurrence of acute torsion in their series of 135 patients.\textsuperscript{13}

In our study, 68.7% had right-sided torsion and only 31.3% had left-sided torsion of testis.

The importance of management lies in early detection and prompt treatment of testicular torsion, which is often difficult due to confusion with other acute scrotal conditions. In patients presenting with acute scrotum, it is imperative to rule out testicular torsion, which is a true urologic emergency.\textsuperscript{14} We found that 95.5% had inward rotation and only 4.5% with outward torsion of testis in our study.\textsuperscript{1,13} Doppler imaging is the most commonly performed investigation for diagnosis of testicular torsion. In our study, 92.5% of cases were confirmed having testicular torsion on Doppler imaging. In the remaining cases, clinical features and color Doppler imaging were not correlating. In this subset of patients, 99m-technetium scintigraphy done confirmed cold spots in torsion testis. Scrotal scintigraphy is sensitive in providing reliable results in confirming or excluding testicular torsion.\textsuperscript{16,17}

Ramachandra et al. reported that patients who had early presentation showed a higher salvage rate of testis. It was also concluded that time to surgery was less, indicative of salvage rates when compared with duration of symptoms.\textsuperscript{18} In our study, the median time to presentation was significantly higher in orchidectomy group as compared to salvage group, suggesting that time to presentation is a single crucial factor for salvageability of torsion testis. There was no difference in degree of torsion between the two groups in our study, as also suggested by Cimador et al.

| Parameter                        | Testicular atrophy group (n=11) | Truly salvage group (n=12) | P       |
|----------------------------------|---------------------------------|---------------------------|---------|
| FSH (IU/L), median (IQR)         | 5 (5.5)                         | 5.5 (1.65)                | 0.539   |
| LH (IU/L), median (IQR)          | 6 (12)                          | 5 (1.9)                   | 0.165   |
| Testosterone (nmol/L), median (IQR) | 6.5 (9.3)                  | 13.3 (3.4)                | 0.002   |
| Semen volume (ml), mean±SD       | 2.6±1.0                         | 2.9±0.8                   | 0.347   |
| Semen progressive motility (%)    | 45 (50)                         | 51 (24)                   | 0.485   |
| Sperm counts (million/ml), median (IQR) | 50 (75)                | 39 (61)                   | 0.588   |
| Size of contralateral testis (ml), mean±SD | 8.4±3.9                  | 10.3±1.9                  | 0.128   |

IQR = Interquartile range, SD = Standard deviation, FSH = Follicle-stimulating hormone, LH = Luteinizing hormone

It is hypothesized that torsion and necrosis of the testis damage blood–testis barrier and can lead to the formation of ASA and may affect the function of contralateral testis also. On follow-up of all our patients, ASA levels were within normal range. Many authors had advocated that antibody formation is not related to the maintenance or removal of the affected testis but possibly to an irreversible autoimmune response triggered at the moment of torsion.\textsuperscript{6}

In our study on comparison, higher proportion of patients showed lower serum testosterone in orchidectomy group as compared to testicular salvage group. Patients with high FSH and LH were comparable between two groups. Many studies in the past have shown normal levels of serum FSH, LH, and testosterone following testicular torsion compared to controls on follow-up.\textsuperscript{5,7} On the other hand, some studies have also shown that increased levels of FSH and LH with normal or low levels of testosterone.\textsuperscript{20}

In the past, several authors have reported abnormal semen parameters such as sperm concentration and motility after testicular torsion. In our series, semen volume and sperm motility were comparable between two groups. Although 36% of patients in Group 1 showed decreased sperm counts compared to 17% in Group 2, it was statistically insignificant. Testicular atrophy is a significant complication of testicular torsion. In our series, 47% of patients developed atrophy on follow-up in salvage group. In a study by Grimbsby et al., it was found that pain duration >12 h, testis that is black, or hemorrhagic 5 min after detorsion, and preoperative ultrasound showing parenchymal heterogeneity should be considered for orchietomy as there is high rate of testicular atrophy in these patients.\textsuperscript{21} Our higher rate of atrophy may be due to the fact that we preserved testis even with longer duration of ischemia as is evident from median duration of symptoms of salvage group. To date, assessment of hormonal and semen parameters in testicular salvage group and atrophic testis on follow-up is never assessed. We found that there were markedly lower serum testosterone levels in patients who developed testicular atrophy compared to truly salvage group.

There has always been speculation that the impact of testicular torsion on serum testosterone may also affect erectile function. However, we did not find any difference in erectile function among our two groups. Similar reports are found in the literature that erectile function and health-related quality of life are not impaired in patients with testicular torsion compared to controls.\textsuperscript{22}

Testicular torsion and subsequent orchietomy had significant impact on physical and psychological well-being.
Based on results from our study, we can infer that long-term hormonal, semen, and sexual functions following testicular torsion are negligible. Although serum testosterone levels were lower in orchidectomy and testicular atrophy group, erectile function and semen parameters were comparable. We suggest a follow-up after testicular torsion surgery to determine whether the low serum testosterone has any effect on fertility potential and health-related quality of life.

We found that the time to presentation is of utmost importance in diagnosis, treatment, and testicular salvage in torsion testis.

One of the limitations of our study is that it is an ambispective study and not completely prospective study. Further, we did not document fertility status of patients as most of our patients were in adolescent age group and any assessment of fertility will require a longer follow-up. We also adopted a random criterion to define atrophic testis to 50% of contralateral testis. This definition although new may help in giving a quantitative measure to testis atrophy, as compared to only subjective evaluation. Our follow-up investigations were not performed at a fixed time interval after event of torsion, so it may have given some heterogeneity to data; however, still, we managed to keep patients only with minimum 1 year of follow-up. Further, our sample size is small when discussing subgroup analysis of atrophic testis and truly salvaged testis.

CONCLUSION

Effects of testicular torsion on seminal and erectile functions are negligible in 1–4 years of follow-up. Serum testosterone is significantly lower after orchidectomy or testicular atrophy. Long-term deleterious effects of these lower testosterone levels need to be determined in future studies.

REFERENCES

1. Witherington R, Jarrell TS. Torsion of the spermatic cord in adults. J Urol 1990;143:62-3.
2. Cummings JM, Boullier JA, Sekhon D, Bose K. Adult testicular torsion. J Urol 2002;167:2109-10.
3. Sessions AE, Rabinowitz R, Hulbert WC, Goldstein MM, Mevorach RA. Testicular torsion: Direction, degree, duration and disinformation. J Urol 2003;169:663-5.
4. Daljuta DG, Granberg CF, Villanueva C, Baker LA. Contemporary review of testicular torsion: New concepts, emerging technologies and potential therapeutics. J Pediatr Urol 2013;9:723-30.
5. Woodruff DY, Horwitz G, Weigel J, Nania K. Fertility preservation following torsion and severe ischaemic injury of a solitary testis. Fertil Steril 2010;94:352.e4-5.
6. Arap MA, Vicentini FC, Cocuzza M, Hallak J, Athayde K, Lucon AM, et al. Late hormonal levels, semen parameters, and presence of antisperm antibodies in patients treated for testicular torsion. J Androl 2007;28:528-32.
7. Romeo C, Impellizzeri P, Arigo T, Antonuccio P, Valenzise M, Mirabelli S, et al. Late hormonal function after testicular torsion. J Pediatr Surg 2010;45:11-3.
8. Sakamoto H, Saito K, Ohta M, Inoue K, Ogawa Y, Yoshida H. Testicular volume measurement: Comparison of ultrasonography, orchidometry, and water displacement. Urology 2007;69:152-7.
9. Mulhall JP, Goldstein I, Bushmakin AG, Cappelleri JC, Hvidsten K. Validation of the erection hardness score. J Sex Med 2007;4:1626-34.
10. Rhoden EL, Telóken C, Sogari PR, Vargas Souto CA. The use of the simplified international index of erectile function (IIEF-5) as a diagnostic tool to study the prevalence of erectile dysfunction. Int J Impot Res 2002;14:245-50.
11. Nelson CP, Williams JF, Bloom DA. The cremasteric reflex: A useful but imperfect sign in testicular torsion. J Pediatr Surg 2003;38:1248-9.
12. Leibovitch I, Mor Y. The vicious cycling: Bicycling related urogenital disorders. Eur Urol 2005;47:277-86.
13. Williams CR, Heaven KJ, Joseph DB. Testicular torsion: Is there a seasonal predilection for occurrence? Urology 2003;61:638-41.
14. Gatti JM, Patrick Murphy J. Current management of the acute scrotum. Semin Pediatr Surg 2007;16:58-63.
15. Kyriazis ID, Dimopoulos J, Sakellaris G, Waldschmidt J, Charissis G. Extravaginal testicular torsion: A clinical entity with unspecified surgical anatomy. Int Braz J Urol 2008;34:617-23.
16. Haynes BE, Bessen HA, Haynes VE. The diagnosis of testicular torsion. Jama 1983;249:2522-7.
17. Ringdahl E, Teague L. Testicular torsion. Am Fam Physician 2006;74:1739-43.
18. Ramachandra P, Palazzi KL, Holmes NM, Marietti S. Factors influencing rate of testicular salvage in acute testicular torsion at a tertiary pediatric center. West J Emerg Med 2015;16:190-4.
19. Cimador M, DiPace MR, Castagnetti M, DeGrazia E. Predictors of testicular viability in testicular torsion. J Pediatr Urol 2007;3:387-90.
20. Brasso K, Andersen L, Kay L, Wille-Jørgensen P, Linnet L, Egense J. Testicular torsion: A follow-up study. Scand J Urol Nephrol 1993;27:1-6.
21. Grimby GM, Schlomer BJ, Menon VS, Ostrov L, Sheth KR, et al. Prospective evaluation of predictors of testis atrophy after surgery for testis torsion in children. Urology 2018;116:150-5.
22. Mäkelä EP, Roine RP, Taskinen S. Paternity, erectile function, and health-related quality of life in patients operated for pediatric testicular torsion. J Pediatr Urol 2020;16:44.e1-4.

How to cite this article: Aggarwal D, Parmar K, Shama AP, Tyagi S, Kumar S, Singh SK, et al. Long-term impact of testicular torsion and its salvage on semen parameters and gonadal function. Indian J Urol 2022;38:135-9.