Original Article

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

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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.

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

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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 orchiectomy 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 orchiectomy. In case of salvageable testis, orchiopexy was performed bilaterally. In case of orchiectomy, 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 orchiectomy 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 $P \leq 0.05$ 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 (orchiectomy) 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 orchiectomy 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].

Table 1: Comparison of demographic profile and clinical parameters of patients with testicular torsion

Parameters	Group 1 (orchiectomy) (n=44)	Group 2 (Salvaged) (n=23)	P
Age (years), median (range)	14 (12-54)	14 (13-53)	0.650
Duration of symptoms (h) (range)	48 (10-360)	12 (4-48)	<0.001
Sudden-onset pain, n (%)	39 (88)	19 (82)	0.89
Testicular swelling, n (%)	29 (66)	17 (74)	0.731
Fever, n (%)	2 (4.5)	3 (6.8)	0.217
Erythema, n (%)	19 (43)	6 (26)	0.134
History of trauma, n (%)	4 (9)	2 (8.6)	0.665
Prehn sign (negative), n (%)	27 (61)	14 (61)	0.586
Cremasteric reflex (negative), n (%)	32 (73)	15 (65)	0.357
Follow-up duration in retrospective arm (months), mean±SD	44±13	39±12	0.995

SD=Standard deviation

Table 2: Investigative and intra-operative parameters

Parameters	Group 1 (orchiectomy) (n=44)	Group 2 (salvage) (n=23)	P
Size of affected testis (ml), mean±SD	11.1±3	12±3.6	0.308
Size of contralateral testis (ml), mean±SD	9.05±2.8	9.3±3.1	0.737
Degree of torsion, mean±SD	364±138	340±130	0.550
Inward rotation of torsion, n (%)	42 (95.5)	22 (95.3)	0.731
Bell clapper deformity, n (%)	16 (36)	15 (65)	0.035

SD=Standard deviation

Table 3: Comparison of hormonal and semen parameters on follow-up

Parameter	Group 1 (orchiectomy) (n=44)	Group 2 (salvage) (n=23)	P
High FSH, n (%)	12 (27)	3 (13)	0.271
High LH, n (%)	7 (16)	4 (17)	0.566
Low testosterone, n (%)	15 (34)	3 (13)	0.039
Semen volume (ml), mean±SD	2.49±0.85	2.8±0.88	0.202
Low sperm counts, n (%)	16 (36.4)	4 (17.4)	0.09
Semen progressive motility (%), median (IQR)	45 (28)	50 (30)	0.874
Size of contralateral testis (ml), mean±SD	10.2±2.93	9.4±3.15	0.267

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

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

Table 4: Subset analysis comparing outcome of atrophied testis with truly salvaged testis

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 (%), median (IQR)	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

torsion. Although it is highly sensitive, the specificity is only 66%.[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.[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.[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.[14] We found that 95.5% had inward rotation and only 4.5% with outward torsion of testis in our study.[1,15] 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.[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.[18] In our study, the median time to presentation was significantly higher in orchiectomy 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.* stating that salvageability was independent of the degree of torsion.[19] Further, in our study, we could not find any statistically significant difference in salvage rate depending on age of patients.

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.[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.[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.[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 Grimsby *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 orchiectomy as there is high rate of testicular atrophy in these patients.[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.[22]

Testicular torsion and subsequent orchiectomy 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 orchiectomy 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.

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