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Testicular torsion in adults: Demographics and 30-day outcomes after orchiopexy or orchiectomy

Joseph G. Brungardt[a,]*, Matthew T. McLeayll[b], Kurt P. Schropp[a]

[a]Department of Surgery, The University of Kansas, Kansas City, KS, USA; [b]Department of Urology, The University of Kansas, Kansas City, KS, USA

Abstract

Background: Most often studied in the pediatric population, testicular torsion also affects the adult male population. Little data exists on demographics, patient risk factors, and associated outcomes for the surgical management of testicular torsion. This study sought to describe differences in demographics and outcomes for those patients requiring orchiopexy or orchiectomy.

Materials and methods: An analysis of the American College of Surgeons National Surgical Quality Improvement Program database (2015–2018) was performed, capturing patients with a postoperative diagnosis of testicular torsion. Patients were stratified into 2 groups if they received orchiopexy or orchiectomy. Demographics, perioperative variables, surgeon specialty, and outcomes were analyzed.

Results: A total of 769 patients undergoing surgical treatment of testicular torsion were captured. Most of these patients were White (46.81%) and young adults (28.33 ± 12.04 years) and 28.8% required orchiectomy. Those undergoing orchiectomy were more likely to be older, have more comorbidities, and have a systemic inflammatory response syndrome. Mean operative time was longer in the orchiectomy group (48 ± 23 vs. 44 ± 20 minutes, $p < 0.0124$). There were no deaths at 30 days. Length of stay and rate of superficial wound infection were higher in the orchiectomy group and discharge to home was more likely in the orchiopexy group.

Conclusions: Adult testicular torsion should be considered in an acute scrotum differential. Adult patients requiring orchiectomy for testicular torsion are more likely to have confounding medical conditions compared to those undergoing orchiopexy. Clinically, rates of complications between the 2 procedures are small, making the decision to perform orchiopexy or orchiectomy based on the scenario.

Keywords: Orchiectomy; Orchiopexy; Testicular torsion

1. Introduction

Testicular torsion is a condition that is traditionally seen in the pediatric population, but can occur at any age.[1] While it most commonly affects young males in a bimodal fashion with peaks in the perinatal and pubertal ages, its prevalence in adults is higher than previously believed.[1–3]

Testicular torsion occurs when the spermatic cord twists around its own axis which impedes blood flow to the testicle leading to ischemia. The severity of testicular torsion is dependent on the duration of torsion and extent of rotation, which is typically between 180° and 720°. The more extensive the spermatic cord rotation the quicker onset of ischemia.[3] The management of testicular torsion is based on the viability of the testicle.[4] If the testicle is not detorsed in an appropriate amount of time, it can undergo irreversible damage and injury inducing atrophy and loss of function.[3,5]

Adults with testicular torsion have variable salvage rates and may have a higher likelihood of undergoing orchiectomy over orchiopexy. The salvage rates in adults, as in children, have been shown to be primarily time dependent.[1,2,6–8] The differing outcomes between adults and pediatrics are secondary to longer time to initial presentation, greater degree of twist, poor history and physical, as well as the assumed knowledge that testicular torsion in adults is overwhelmingly rare.[1,2,5] Additionally, there are numerous factors that have been studied to determine the reason for non-salvageable testicles resulting orchiectomy such as social determinants of health. A few studies have shown that this may play a role in orchiectomy,[9,10] but this data is exclusively found within the pediatric population and has not been demonstrated ubiquitously.[11] The objective of this study was to identify demographics, perioperative variables, and outcomes for a national population of adult patients who suffered from testicular torsion while distinguishing risks factors for patients requiring orchiectomy versus orchiopexy.

2. Materials and methods

Data was utilized from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database (2015–2018).[12] This database contains patient-level, aggregate data, and is Health Insurance Portability and Accountability Act compliant as it does not identify hospitals, physicians, or patients. This data is free to ACS NSQIP participating hospitals. The benefit of this particular dataset is

* Corresponding Author: Joseph G. Brungardt, Department of Surgery, The University of Kansas, 4000 Cambridge, M/S 2005, Kansas City, KS 66160, USA. E-mail address: joseph.brungardt@gmail.com (J.G. Brungardt).

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a national dataset that collects more granular data of specific pre- and postoperative risk factors and outcomes. The Institutional Review Board of the University of Kansas Medical Center approved this study as non-human subjects research and protocol exempt.

An analysis of the ACS NSQIP database from 2015 to 2018 was performed, capturing patients with a postoperative diagnosis of testicular torsion. Patients were stratified into 2 groups based on if they received orchiopexy or orchiectomy. The age, sex, race, comorbidities, perioperative variables, elective operation, wound class, preoperative laboratory values, admission quarter, mortality, length of operation, length of stay, discharge destination, surgeon specialty, and postoperative outcomes such as readmission and return to the operating room, as well as complications such as deep vein thrombosis or wound infection, were included in the analysis as available in NSQIP. Not captured within this database are insurance status, urban–rural dwelling, education level of the patient, or preoperative exam findings or imaging findings. Degree of torsion or operative details are not captured either.

Statistical analysis and data management were performed using SPSS (IBM Corp. Released 2015, IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY, IBM Corp.) and Excel (Microsoft version 16.32). Chi-square test and Satterthwaite or Pooled *t* test were used where appropriate. Multivariate regression analysis was not carried out due to the low population size. Significance is indicated by $p<0.05$.

3. Results

A total of 769 patients undergoing surgical treatment of testicular torsion were captured (Table 1). A majority of these patients were White (46.81%) young adults (28.33 ± 12.04 years). Orchiopexy was completed more often than orchiectomy (71.13% vs. 28.87%). Those undergoing orchiectomy were more likely to be older (34.02 ± 15.55 vs. 26.01 ± 12.04 years, $p<0.001$), be of Hispanic ethnicity (13.96% vs. 8.41%, $p=0.02$), have diabetes (5.41% vs. 1.10%, $p<0.001$), have hypertension (12.16% vs. 4.2%, $p<0.001$), and have a systemic inflammatory response syndrome (SIRS) (12.61% vs. 4.75%, $p<0.001$).

Table 2 describes perioperative variables. In the evaluation and comparison of preoperative labs, there was a statistically significant finding of increased white blood cell count (12.0 vs. 9.9×10^9/L, $p<0.01$) in the orchiectomy population. A statistically significant difference was observed in the orchiectomy population, but still within normal laboratory parameters, in a lower hematocrit (42% vs. 44%, $p<0.01$), higher platelets (253 vs. 238×10^9/L, $p<0.01$), elevated alkaline phosphatase (90.6 vs. 75.3 μ/L, $p<0.01$), and lower creatinine (0.9 vs. 1.0 mg/L, $p<0.01$). These were classified as emergency operations in 68.27% of the entire population. There were no variations among admission quarter and most procedures were done under general anesthesia. Table 3 describes that 98.57% of procedures were done by urologists while 11 cases (1.43%) were done by general surgeons.

Mean operative time was longer in the orchiectomy group (48 ± 23 vs. 44 ± 20 minutes, $p<0.0124$) (Table 4). There were no deaths at 30 days. Length of stay and rate of superficial wound infection were higher in the orchiectomy group (3.15% vs. 0.73%, $p=0.0167$) and length of stay was longer in those requiring orchiectomy (0.41 vs. 1.06 days, $p<0.01$). Readmission, return to the operating room, and postoperative complications were otherwise similar between groups.

4. Discussion

Adult testicular torsion has been primarily investigated through institutional case series. To the best of our knowledge, there are no database reviews of adult testicular torsion that delineate patients who have received orchiopexy or orchiectomy. Smaller studies have investigated risk factors, but there remains minimal nationwide data on comorbid factors that may impact the need for orchiectomy especially in adults.[1]

It is well known that time from torsion to treatment plays a fundamental role in improving salvage in both adults and

Table 1

Baseline demographics and comorbidities of adults with testicular torsion.

Characteristic	Total (n = 769, 100%)	Orchiopexy (n = 547, 71.13%)	Orchiectomy (n = 222, 28.87%)	*p*
Age, yr	28.33 ± 12.04	26.01 ± 9.36	34.02 ± 15.55	<0.0001
Race, n (%)				
White	360 (46.81%)	259 (47.35%)	101 (45.50%)	0.6406
Black	233 (30.30%)	159 (29.07%)	74 (33.33%)	0.2434
Hispanic	77 (10.01%)	46 (8.41%)	31 (13.96%)	0.0201
Not reported	141 (18.34%)	105 (19.20%)	36 (16.22%)	0.3333
Comorbidities, n (%)				
Diabetes	18 (2.34%)	6 (1.10%)	12 (5.41%)	0.0003
Current smoker	187 (24.32%)	126 (23.03%)	61 (27.48%)	0.1931
No dyspnea	766 (99.61%)	545 (99.63%)	221 (99.55%)	0.8642
COPD	2 (0.26%)	2 (0.37%)	0 (0.00%)	1.0000
Hypertension	50 (6.50%)	23 (4.20%)	27 (12.16%)	0.0001
Weight loss	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Steroid use	3 (0.39%)	3 (0.55%)	0 (0.00%)	0.5609
Independent	749 (97.40%)	537 (98.17%)	212 (95.50%)	0.0346
Body mass index, kg/m^2	25.98 ± 6.34	25.84 ± 6.25	26.32 ± 25.98	0.3906
ASA 3 or greater	70 (9.10%)	33 (6.03%)	37 (16.67%)	<0.0001
Preoperative SIRS	54 (7.02%)	26 (4.75%)	28 (12.61%)	0.0001

Values are mean (SD) or n (%). ASA = American Society of Anesthesiologists; COPD = chronic obstructive pulmonary disease; SIRS = systemic inflammatory response syndrome.

Table 2

Perioperative variables of adults with testicular torsion.

Variables	Total (n=769, 100%)	Orchiopexy (n=547, 71.13%)	Orchiectomy (n=222, 28.87%)	p
Elective operation, n (%)	163 (21.20%)	130 (23.77%)	33 (14.86%)	0.0062
Emergency operation, n (%)	525 (68.27%)	373 (68.19%)	152 (68.47%)	0.9401
Admission quarter, n (%)				
1	200 (26.01%)	139 (25.41%)	61 (27.48%)	0.5539
2	178 (23.15%)	133 (24.31%)	45 (20.27%)	0.2282
3	160 (20.81%)	110 (20.11%)	50 (22.52%)	0.4551
4	231 (30.04%)	165 (30.16%)	66 (29.73%)	0.9051
Wound class, n (%)				
Clean	402 (52.28%)	308 (56.31%)	94 (42.34%)	0.0004
Clean/contaminated	323 (42.00%)	233 (42.60%)	90 (40.54%)	0.6008
Contaminated	34 (4.42%)	5 (0.91%)	29 (13.06%)	<0.0001
Dirty/Infected	10 (1.30%)	1 (0.18%)	9 (4.05%)	0.0001
General anesthesia, n (%)	753 (97.92%)	535 (97.81%)	218 (98.20%)	0.7300
Preoperative labs				
Sodium, mEq/L	139.1±2.6	139.2±2.5	138.8±2.8	0.0829
BUN, mmol/L	13.8±4.6	14.1±4.3	13.4±5.2	0.1320
Creatinine, mg/dL	1.0±0.2	1.0±0.2	0.9±0.2	0.0002
Albumin, g/dL	4.2±0.6	4.4±0.4	4.0±0.7	0.0000
Bilirubin, mg/dL	0.7±0.5	0.7±0.4	0.7±0.6	0.6589
AST, u/L	27.1±21.5	28.5±24.5	24.8±15.3	0.1386
ALP, u/L	81.0±32.0	75.3±22.2	90.6±42.4	0.0015
WBC, $\times 10^9$/L	10.6±4.0	9.9±3.5	12.0±4.5	<0.0001
HCT, %	43.4±3.9	44.0±3.3	42.2±4.6	<0.0001
PLT, K/L	243.4±66.6	238.6±59.2	253.4±78.8	0.0248
PTT, s	29.6±7.7	28.7±4.5	31.3±11.4	0.1208
INR	1.1±0.1	1.1±0.1	1.1±0.2	0.1626

Values are mean (SD) or n (%). ALP=alkaline phosphatase; AST=aspartate aminotransferase; BUN=blood urea nitrogen; HCT=hematocrit; INR=international normalized ratio; PLT=platelets; PTT=partial thromboplastin time; WBC=white blood cells.

pediatrics.[1,3,9,10,13–16] However, the overall testicular salvage rate is widely variable, ranging from poor to moderate and is worse in the adult population when compared to pediatrics.[1,2,6–8] In our 769 patients, we found that 28.8% of adults who had testicular torsion required orchiectomy. This percentage is lower than previously reported and this may be due to several reasons. In 1980s, there was a high orchiectomy rate, possibly due to misdiagnosis.[6] Witherington and Jarrell[2] in 1990 and Cummings et al.[1] in 2002 also validated poor salvage rates, 38% and 41% respectively, compared to our more recent data 2015 to 2018. Both authors emphasized the importance of an appropriate work-up for testicular torsion in adults which may have led to improved knowledge of providers and in turn decreased time from symptoms to treatment. Additionally, with technological advances, particularly in ultrasound, there has been an improvement of accurate diagnosis. On a recent meta-analysis, testicular ultrasound has a sensitivity of 95% and specificity of 98%.[17] It should not be overlooked though that a strong clinician can make the diagnosis by history and physical and confirm it with imaging.

As mentioned, Cummings et al.[1] investigated a case series comparing testicular torsion in adults concurrently with a pediatric population. Patients older than 21 years had 41% salvage versus 70.3% in the younger population. They found that the time to detorsion (102 vs. 11 hours) and the degree of torsion in adults (585° vs. 431°) played a statistically significant role in their ability to salvage. They concluded that the salvage rates were poorer in adults potentially due to the extent of twist in the cord.

We found that patients with increased age, Hispanic ethnicity, presence of comorbid conditions including diabetes, hypertension, American Society of Anesthesiologists of 3 or greater, and preoperative SIRS were statistically higher in those receiving orchiectomy. Additionally, laboratory statistical differences seen in the orchiectomy population including increased white blood cell counts, lower hematocrit, elevated platelets, elevated alkaline

Table 3

Surgeon specialty of adults with testicular torsion.

Surgeon specialty, n (%)	Total (n=769, 100%)	Orchiopexy (n=547, 71.13%)	Orchiectomy (n=222, 28.87%)	p
Urologic surgery	758 (98.57%)	540 (98.72%)	218 (98.20%)	0.5806
General surgery	11 (1.43%)	7 (1.28%)	4 (1.80%)	0.5806

Values are mean (SD) or n (%).

Table 4

Perioperative outcomes of adults with testicular torsion.

Characteristic	Total (n = 769, 100%)	Orchiopexy (n = 547, 71.13%)	Orchiectomy (n = 222, 28.87%)	*p*
Hospital days to operation, d	0.12 ± 1.16	0.10 ± 1.34	0.16 ± 0.44	0.3946
Hospital length of stay, d	0.60 ± 2.06	0.41 ± 1.48	1.06 ± 2.99	0.0023
30-Day mortality, n (%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Operative time, min	45 ± 21	44 ± 20	48 ± 23	0.0124
Discharge destination (home), n (%)	701 (91.16%)	521 (95.25%)	180 (81.08%)	0.0011
Complication, n (%)				
Readmission	9 (1.17%)	4 (0.73%)	5 (2.25%)	0.1300
Related to operation	6 (0.78%)	3 (0.55%)	3 (1.35%)	0.3629
Return to operating room	6 (0.78%)	2 (0.37%)	4 (1.80%)	0.0611
Related to operation	4 (0.52%)	2 (0.37%)	2 (0.90%)	0.3282
Orchiectomy	1 (0.13%)	1 (0.18%)		
Unplanned intubation	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
On ventilator >48 hr	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Wound infection (superficial)	11 (1.43%)	4 (0.73%)	7 (3.15%)	0.0167
Wound infection (deep)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Organ/space surgical site infection	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Wound dehiscence	4 (0.52%)	2 (0.37%)	2 (0.90%)	0.1477
Pneumonia	2 (0.26%)	0 (0.00%)	2 (0.90%)	0.0831
Urinary tract infection	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Deep vein thrombosis	1 (0.13%)	0 (0.00%)	1 (0.45%)	0.2887
Pulmonary embolism	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Cardiac arrest requiring cardiopulmonary resuscitation	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Myocardial infarction	1 (0.13%)	1 (0.18%)	0 (0.00%)	1.0000
Sepsis	2 (0.26%)	0 (0.00%)	2 (0.90%)	0.0831
Shock	1 (0.13%)	0 (0.00%)	1 (0.45%)	0.2887
Bleeding transfusion	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.0000
Renal complications	1 (0.13%)	0 (0.00%)	1 (0.45%)	0.2887

Values are mean (SD) or n (%).

phosphatase, and lower creatinine, though only white blood cell count was elevated and other values were within normal ranges.

Little is described in the literature concerning patient comorbid conditions in adult testicular torsion. Tanaka et al.[18] have examined clinical predictors in children with testicular torsion and found that torsed testicles were able to be salvaged in 60.5% of cases. Interestingly, they also found that along with duration and degree or torsion, C-reactive protein (CRP) was significantly higher in the non-salvageable testis group. The predicative factor of non-salvageable testis was a CRP level > 10 mg/dL.

Systemic illness, diabetes, and hypertension all have been shown to increase inflammatory markers, which can lead to vascular compromise and microvascular dysfunction in other organs.[19] In our patients that required orchiectomy, patients with diabetes and hypertension were found to have an increasing risk of non-salvageable testicles. In sepsis, or patients meeting SIRS criteria, there is damage to the endothelium resulting in tissue hypoperfusion potentially leading to end-organ failure.[20] The vascular damage seen in other organ systems due to diabetes and hypertension as well as the effects of sepsis may be insightful for explanation as to the cause of this as organs are more tenuous as a result of their commorbidy condition.[18–22] The more vascular damage a patient has from either an acute or chronic illness, it results in a compromise in direct and collateral blood flow to the testicle resulting in ischemia faster than those without any risk factors for vascular compromise. The elevated CRP in Tanaka's paper is consistent with our data, finding that high inflammatory response and/or prior illness increases risk for orchiectomy.[18]

There have been others who have attempted to identify hematologic parameters for the diagnosis of testicular torsion. Since neutrophils play a vital role in the inflammatory processes, the neutrophil to lymphocyte ratio (NLR) has been shown to be predictive of prognosis of both acute and chronic inflammatory diseases. Güneş et al.[23] found that NLR was 84% sensitivity and 92% specificity in identifying testicular torsion and was related to the duration of symptoms. Interestingly, in another study, the NLR was also shown to be equally as sensitive and specific as doppler ultrasonography for testicular torsion.[24]

There was also a statistically significant increase in platelet count. While the values may be clinically insignificant, the statistical significance may be indicative of a larger overall inflammatory process that is seen in non-salvageable testicles. Palmer et al.[25] demonstrated that an increase in platelet activating factor, which is a biochemical marker of ischemic injury, leads to testicular ischemia in rats. It appears reasonable that patients that are systemically ill, with a prior elevation of inflammatory makers, may yield a higher propensity to develop ischemia requiring more frequent management with orchiectomy.

The increased orchiectomy rate based on race is not a novel concept. We found that in adults, Hispanics were more likely to undergo orchiectomy. In 2 prior data base reviews in the pediatric population, both Cost et al.[9] and Zhao et al.[10] demonstrated that insurance type and race were shown to be independent predictors of orchiectomy. However, Zhao et al.[10] found this to be in African American males with an odds ratio 1.33 (95% CI 1.04–1.71) and Cost et al.[9] saw 37.6% vs. 28.1% ($p < 0.0001$) in comparing Black and White children. Not captured within this study were variables such as delays in care or language barriers which may play a role in delays to treatment.

One limitation of this study, similar to other national database reviews, is that the total length of time of torsion is unknown. The time to operation is a substantial component for salvage, but extrapolating this data, it could account for delayed time for Hispanic patients due to limited access to care and a language barrier delaying care. Gold et al.[5] demonstrated that every minute is valuable in management, and found that the time from arrival to the emergency department to treatment was an independent risk factor for testis survival.

We affirm that orchiectomy does not have benign consequences. Orchiectomy patients postoperatively had increased hospital stay and superficial wound infection. We hypothesize that these factors may both be related to patients being systemically ill at the time of orchiectomy and inherently having poorer blood supply either due to comorbid or concurrent conditions. In addition to immediate complications, a unilateral orchiectomy has been shown to decrease fertility.[26] All of these components should be discussed with the patient and family preoperatively in all torsion cases in the chance that they require orchiectomy.

Our study has several other limitations that are inherent to the nature of a retrospective study and limitations of a database. The ACS NSQIP database acknowledges several limitations inherent to their database.[12] Generic variables are collected, patient follow-up is only 30 days, data is only from participating hospitals, and some variables are not present for each case. Additionally, information regarding each individual case and the complex circumstance is not available including time to operation, torsion to operative time length, which all remain an important factor for decision making. Additionally, with such short follow-up, there is no ability to describe long-term outcomes or recurrence postoperatively. The ACS NSQIP has attempted to eliminate sampling error, but complete removal of bias is not possible without randomly generated assignment of cases. A regression analysis of the data may be able to pinpoint risk factors, but the population we analyzed with the data available to us did not allow for a statistically sound model or regression.

5. Conclusion

Adult testicular torsion should be considered in an acute scrotum differential as it can occur at all ages. Adult patients requiring orchiectomy for testicular torsion are more likely to have confounding medical conditions compared to those undergoing orchiopexy. Clinically, rates of complications between the 2 procedures are small, making the decision to perform orchiopexy or orchiectomy based on the scenario, but the risk and possibility of orchiectomy should be discussed with patient preoperatively.

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Statement of ethics

This study was designated "Non-Human Subjects Research" by the Human Subjects Committee at the University of Kansas School of Medicine. Thus, the participants' consent was not required.

Conflicts of interest statement

The authors have no disclosures or conflicts of interest. "American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors."

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