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Patterns of Care in Testicular Torsion: Influence of Hospital Transfer on Testicular Outcomes

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Abstract

Objective—To investigate patterns of care for testicular torsion and influence of hospital transfers on testicular outcomes. Hospital transfer may be a source of treatment delay in a condition where delays increase likelihood of orchiectomy.

Methods—We used a retrospective cohort of Californian males with ICD-9/CPT-defined torsion from inpatient, emergency department (ED), and ambulatory surgery center (ASC) data. Logistic regression assessed predictors of orchiectomy.

Results—Predictors of orchiectomy were ages <1 year (OR 19.2, 95% CI 6.3–58.9), 1–9 years (OR 2.7, 95% CI 1.4–5.2), and ≥40 years (OR 6.6, 95% CI 3.1–13.9) (vs. masked age). Treatment at mid-volume (vs. high-volume) facilities was associated with lower odds of orchiectomy (OR 0.5, 95% CI 0.3–0.7). Rural location, non-private insurance, and hospital transfer were associated with orchiectomy on univariate but not multivariate analysis.

During 2008–2010, 2,794 subjects experienced torsion (average incidence 5.08 per 100,000 males yearly). Encounters occurred in ASCs (55%), inpatient facilities (36%), and EDs (9%). 60% of

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Approval was not required.

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None.

subjects were privately insured, 2% experienced hospital transfer, and 31% underwent orchiectomy.

Conclusion—Our census found that most cases of testicular torsion were treated in outpatient settings. Hospital transfer was not associated with orchiectomy.

Introduction

Testicular torsion is a surgical emergency occurring in 3.8 per 100,000 boys[1]. Treatment delays beyond six hours increase the likelihood of irreversible ischemia and subsequent orchiectomy[2]. Orchiectomy occurs in up to 41% of torsion cases[1] and can result in reduced fertility, testicular hormonal dysfunction[3], and psychological trauma[4]. As such, torsion is the third leading cause of malpractice lawsuits among teenage boys[5].

Patient transfers between hospitals are a potential source of treatment delay. Transfers result in worse outcomes with other time-sensitive conditions, such as myocardial infarction[6], but no study has definitively proven this association with testicular torsion[7]. Physicians initiate transfers because of real or perceived lack of resources at the originating hospital; therefore not all transfers may be necessary. If transfers contribute to poor outcomes, interventions to identify and reduce inappropriate transfers could improve quality of care.

We used an administrative database encompassing every patient encounter occurring in an inpatient, emergency department, or ambulatory surgery setting in California to provide comprehensive epidemiology on patterns of care in the management of patients with testicular torsion. We also assessed whether inter-hospital transfers influenced torsion outcomes with the hypothesis that hospital transfers increase orchiectomies.

Materials and Methods

Data source

We used a 2008–2010 retrospective cohort provided by the California Office of Statewide Health Planning and Development (OSHPD) containing Emergency Department (ED), Ambulatory Surgery Center (ASC), and Inpatient Discharge files. California mandates reporting of every medical encounter occurring at these locations. To protect confidentiality, OSHPD masked records starting with age and ethnicity/race in subjects with unique demographic combinations. OSHPD-recommended California Department of Finance population estimates were used to calculate incidence rates.

Inclusion Criteria

We included males of all ages with an ICD-9 code for testicular torsion (608.2x) and a CPT/ICD-9 procedure code for reduction of torsion, testicular fixation, or orchiectomy (61.19, 62.30, 62.50, 63.52, 608.20, 608.21, 608.22, 608.23, 608.24, 63.52, 54600, 54620, 54520, 55110). Patients with suspected appendix testis torsion or a scrotal exploration were included only if they also underwent a concurrent orchiopexy or orchiectomy.

Exclusion Criteria

We excluded non-residents of California for the descriptive portion of the study. For the hypothesis-driven component, only the inpatient dataset was used as ED and ASC data did not document transfer status. We excluded those with an ASC as admission source (to avoid potential double-entry between ASC and inpatient files), those living in situations with available medical personnel (e.g., jail), and those whose procedure location could not be verified (i.e., date of procedure preceded date of admission) (Figure 1).

Facility Definitions

Encounters categorized under ED were seen in the ED and discharged home without an inpatient stay. These patients could have undergone a procedure in the ED or in the operating room, but were not admitted as an inpatient for any length of time. Patients first seen in the ED and then admitted as an inpatient to the same facility would have one record in the Inpatient file and none in the ED file to avoid duplication of encounters. An admission source variable in the Inpatient file would account for patients' origin from the ED. Short inpatient stays (<24 hours) following an ED presentation fall under Inpatient stay. Encounters categorized under ASC were treated at licensed ASCs, which could be part of a general acute care hospital or a freestanding surgery center. Patients originating at an ASC with subsequent transfer to an Inpatient stay would have records in both ASC and Inpatient files. For our analyses, we classified these encounters as Inpatient and dropped the corresponding ASC records, resulting in three mutually exclusive categories (ED-only, ASC-only, Inpatient-only).

Outcome Variable

The primary outcome was dichotomized to orchiectomy vs. testicular salvage (i.e., reduction of torsion or orchiopexy).

Predictor Variables

Predictor variables were selected *a priori* based on content validity and literature review. These included insurance status (private vs. non-private), age, race/ethnicity, facility volume (tertiles based on total facility admission volume), subject's rural location (based on 2010 US census ZIP code and county data; subjects living in an area >20% rural were classified as rural), and hospital transfer status. Hospital transfer status was based on a three digit code provided for every inpatient admission with the first digit representing the site of origin (e.g., ASC, nursing facility), the second digit representing the license of the origin site (e.g., the admitting hospital, outside hospital), and the third digit representing the route of presentation (e.g., the admitting hospital's ED, another hospital's ED).

Given the significant proportion of masked race and age data, we considered a multiple imputation procedure but ultimately deemed it inappropriate because data were non-randomly masked. As an alternative, we compared the race and age distributions between those masked and unmasked for the entire database (data available through OSHPD).

Statistical Methods

We computed means and proportions for predictors, stratified by data source, year, and outcome. We used a multivariable logistic regression model including the *a priori* predictors, regardless of univariate results. Race was kept in the model, despite a large proportion of missing values, to ensure stability. Collinearity between predictors was assessed. All tests were 2-sided and significance level was set at 0.05.

Propensity Score Adjustment

To better account for potential selection biases with respect to hospital transfer, we developed a propensity score model to predict the probability of transfer. Predictors included age, race/ethnicity, rural status, and insurance status. Hospital volume was not included because of collinearity with rural status (87% of 46 rural patients were treated at a high-volume hospital). We incorporated these scores into the final model with no significant changes in results; thus we present only data without propensity adjustment.

Results

Patterns of care

During 2008–2010, we found 2,794 cases of testicular torsion in California, representing an incidence rate of 5.08per 100,000 Californian males per year. Encounters occurred through ASCs (55%), inpatient facilities (36%), and EDs without an inpatient stay (9%) (Table 1).

Seven percent of the population lived in a rural area; 83% were treated at hospitals in the highest-tertile volume; 60% were privately insured and 2% of all subjects experienced inter-hospital transfer. Thirty-one percent underwent orchiectomy while the remainder had a testicular-saving procedure.

While patient characteristics differed minimally over time, significant differences existed based on location of care (Table 1). Subjects treated at ASCs were more likely to have private insurance than those receiving inpatient care (68% vs. 49%, $p<0.0001$). EDs treated more rural patients compared with other locations (11% vs. 5% (inpatient) and 8% (ASC), $p<0.0001$). The proportion of subjects undergoing orchiectomy as an inpatient was twice the proportion undergoing such as an outpatient (47% vs. 23%, $p<0.0001$).

Age and hospital volume were associated with hospital transfer on univariate analysis. Those aged <1 year were more likely while those aged ≥15 years were less likely to be transferred ($p<0.0001$). Highest-tertile hospitals were more likely and mid-tertile hospitals less likely to receive transferred patients ($p=0.03$). Race, rural location, and insurance type were not associated with hospital transfer (Table 2).

Predictors of testicular outcome

The inpatient cohort assembled to analyze factors associated with orchiectomy contained 951 subjects (Figure 1). Univariate analysis comparing those undergoing orchiectomy vs. testicular salvage showed that those undergoing orchiectomy were more likely to be at the extremes of age (≤9 years or ≥30 years), to come from a rural location, to be treated at a high-volume facility, to lack private insurance, or to be transferred prior to surgery (all $p < 0.05$, Table 3).

On multivariate analysis significant predictors of orchiectomy were age <1 year (OR 19.2, 95% CI 6.3–58.9), age 1–9 years (OR 2.7, 95% CI 1.4–5.2), and age ≥40 years (OR 6.6, 95% CI 3.1–13.9) (vs. masked age). Treatment at mid-volume (vs. high-volume) facilities lowered odds of orchiectomy (OR 0.5, 95% CI 0.3–0.7). Testicular outcomes were not associated with rural location, insurance type, or hospital transfer on multivariate analysis (Table 3).

Discussion

We present a comprehensive study documenting patterns of care in testicular torsion. Prior studies used single institutional reviews[7], inpatient-only databases[1, 8], or databases focusing on free-standing children's hospitals[9]. Using complete statewide data, we were able to characterize treatment across all types of facilities including rural centers, community hospitals, and outpatient surgery facilities.

Our overall, unadjusted incidence rate was five per 100,000 Californian men per year during 2008–2010, higher than previous reports (1–4.5 per 100,000)[1, 8, 10]. This likely reflects our inclusion of all ages and locations of care. The incidence among those at highest risk (i.e., children) is likely even higher given that the denominator used to calculate unadjusted incidence included older adults who have minimal torsion risk.

Our novel approach revealed that outpatient care, whether through an ASC or ED, represents the majority of torsion encounters. Fifty-five percent of torsion procedures occurred at an ASC, an unexpectedly high percentage in a treatment location not previously described for this condition. This high ASC utilization follows national trends showing an increase in ASC utilization, which increased 300% during 1996–2006[11, 12]. As many as two-thirds of all urologic procedures now occur within ASCs[13]. Reasons behind high ASC utilization could be multi-factorial. First, higher reimbursement at ASCs for equivalent procedures coupled with streamlined scheduling may motivate providers to utilize ASCs[14, 15]. Our finding that subjects treated at ASCs were more likely to have private insurance, a finding consistent with prior studies[16], supports this explanation. Additionally, some torsion procedures could represent cases of intermittent torsion, which is more likely to be treated on an outpatient basis. Small case series have reported that intermittent torsion represents 18–63% of all torsion[17, 18]. As no separate billing code for intermittent torsion exists, we could not confirm this hypothesis; however the lower proportion of subjects undergoing orchiectomy in the outpatient vs. inpatient setting suggests intermittent torsion could be a component influencing this pattern of care.

The overall proportion of subjects undergoing orchiectomy, 31%, was similar to that reported in the literature (32–69%). In this study, orchiectomy was twice as likely to have occurred in the inpatient (46.7%) rather than outpatient setting (23%). This may stem from our findings that males receiving inpatient torsion care were more likely to be <1 year of age and to lack private insurance, both of which possibly reflect access to appropriate care.

These patients may also have had comorbidities precluding outpatient care and predisposing to presentation or treatment delays.

Testicular salvage in torsion depends on timely presentation, diagnosis, and surgical intervention[19]. Efforts to improve outcomes have traditionally focused on public awareness to expedite presentation[6, 20] and provider education to hasten diagnosis[21]. Inter-hospital transfers may signify another avenue for quality improvement as they represent a potentially modifiable step in the process of care. Inter-hospital transfer is associated with worse clinical outcomes in other time-sensitive conditions, such as appendicitis and myocardial infarction[6, 22, 23] where age, race, and insurance status are risk factors for transfer[20, 24]. The impact of transfer on outcomes and the risk factors for transfer in testicular torsion have been the foci of only one other study[7]. We found age and hospital volume to be associated with transfer on univariate analysis, particularly in those <1 year old; unfortunately our small number of hospital transfers made any further analyses of risk factors for transfer difficult.

On multivariate analysis for predictors of orchiectomy, those aged <1 year had an almost 20-fold higher odds of orchiectomy compared with subjects with masked ages. Those aged 1–9 years had an almost 3-fold higher odds of orchiectomy while those aged ≥40 years had an almost 7-fold higher odds of orchiectomy. The increased odds at the extremes of the age spectrum highlight the importance of prompt presentation and high clinical suspicion in the treatment of testicular torsion in these groups. Younger boys less capable of communicating likely effect inefficient presentation and diagnosis, a finding shared by other studies[1, 9]. Additionally, the age category of <1 year includes neonates who are predisposed to non-salvagable testes with in utero torsion events. Subjects over 40 years may contribute to poor outcomes through delayed presentation prompted by fear of genital surgery, a well-documented phenomenon encountered with testicular cancer[25]. Additionally, in older men, correct diagnosis may be delayed by providers who first assess for more likely conditions, such as epididymitis or kidney stones.

We also found hospital volume to be predictive of outcomes. Those treated at mid-volume facilities experienced a 50% reduction in odds of orchiectomy compared with those treated at high-volume hospitals. While this might seem counter-intuitive, as high-volume hospitals are generally associated with improved outcomes, our data show that high-volume hospitals accept more transfers and therefore are probably more likely to treat complex cases with delays in care. Mid-volume hospitals that do not accept as many transferred patients may still be adequately equipped to treat testicular torsion promptly, leading to superior testicular outcomes. Low-volume hospitals may not have an advantage over higher-volume hospitals because of lack of resources, such as prompt ultrasonography.

Hospital transfer, while associated with orchiectomy in univariate analysis, did not predict orchiectomy in multivariate analysis. To explore reasons behind the disappearance of the univariate association, post-hoc, we independently assessed the impact each covariate had on the relationship between transfer and orchiectomy. Age was the only covariate to alter this relationship from associated to not associated, making it a likely confounder. We further explored the role of age by repeating the univariate analysis between transfer and orchiectomy, stratified by age categories. Though small cell sizes resulting from the multiple strata prevented definitive conclusions, the results were highly suggestive that those age <1 year were the drivers of the age variable. However, dropping subjects age <1 year (n=56) from the age variable in the multivariable model resulted in no significant changes from the original model. Therefore, age <1 year was not the sole contributor to age as a confounder. Hospital volume was a potential confounder given the large number of transferred patients from high volume centers. Removal of the hospital volume covariate in the model did not affect outcomes. Another explanation of the lack of association between transfer and orchiectomy on multivariate analysis could be that the rarity of transfer denied our analysis the statistical power to detect such differences. Alternatively, transfer-related delays might not affect orchiectomy outcomes if delayed patient presentation irreversibly compromises testicular viability, thus rendering subsequent treatment course irrelevant.

The only other study to assess the impact of transfer on torsion outcomes identified a trend toward orchiectomy with hospital transfer, but was underpowered[7]. In that study, mean transfer delay was 100 minutes in patients who avoided orchiectomy compared with 175 minutes in those who underwent orchiectomy. This suggests that transfer contributes to treatment delay, though the implication on testicular outcomes is not definitive. Based on these findings, transfers could still plausibly lead to increased orchiectomies, but this hypothesis would require a larger sample for more definitive examination.

Race and age characteristics presented in this study should be interpreted with caution. OSHPD requirements resulted in masking of over 25% of age and 65% of race inputs. We considered multiple imputation of missing values, but this was ultimately deemed inappropriate given the non-random nature of missing values. We also attempted a sub-analysis limited to Los Angeles County theorizing that a populous county with fewer unique demographic combinations would result in less masking. Somewhat surprisingly, masking was as prevalent in this populous county as it was for the statewide data; thus, this sub-analysis contributed no additional insight. Finally, we compared the race and age distribution of those masked with those unmasked for the entire database (data available through OSHPD). Those who were age <5 years were over-masked, so could be under-represented in this study. Those who were age 15–19 were under-masked, so could be over-represented. In order to provide some assessment as to the influence of missing age values, we did ultimately impute values two ways. First we imputed age <1 year for all missing values, then age ≥40 years for all missing values (reference group for these models was age <1 year). Results of these two models did not differ significantly from the model including missing data, therefore adding to the robustness of the original analysis.

The number of patients transferred in our study was low compared with prior studies; however, we believe little misclassification occurred. We worked closely with OSHPD analysts in order to correctly categorize patient source codes to correctly identify those transferred, but this does not preclude misclassification at the data-entry level. It is possible that some transfers were not captured when occurring in patients transferred from ED to another ED with no inpatient admission after surgery because of a lack of coding for this scenario; however, considering procedures occurring through the ED without an inpatient admission made up the smallest category of patients (9%), we believe any missed transfers would be few and likely insignificant to the conclusions of this study.

Conclusions

We comprehensively characterized the management of testicular torsion utilizing every inpatient facility, ASC, and ED within California. We also assessed the impact of hospital transfer on testicular outcomes. While transfer was associated with orchiectomy on univariate analysis, the association disappeared on multivariate analysis. We believe this relationship is partially explained by age. Further studies in the area can utilize multi-state analysis to enhance power. Sixty-four percent of all torsion cases were treated as an outpatient. This complete characterization of testicular torsion will inform future studies in the area, which should now include outpatient settings, aid in optimizing management of testicular torsion, and place prior studies into sharper focus.

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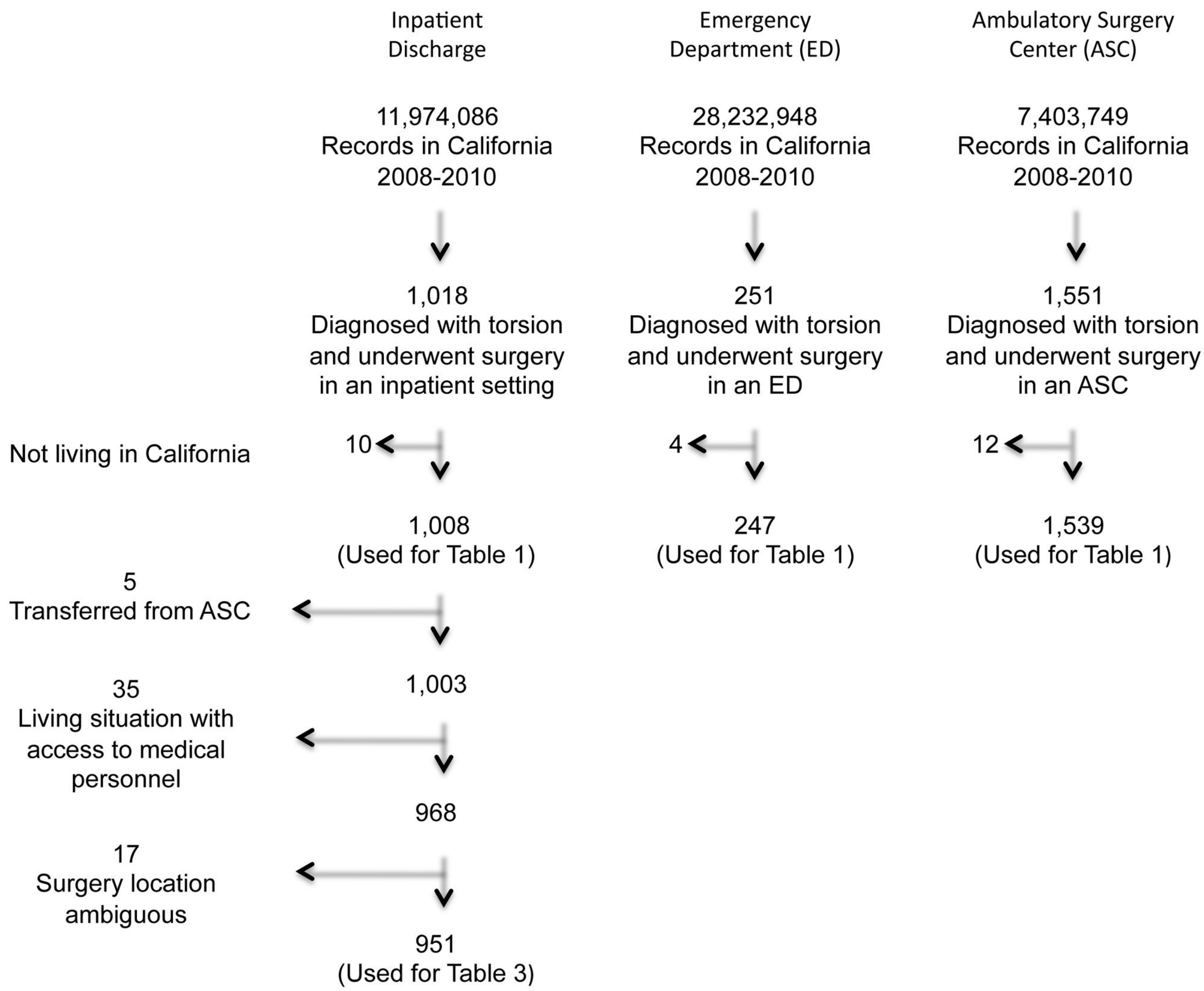

Figure 1.
Construction of study cohort.

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Table 1

Demographic characteristics of men treated for testicular torsion by year or by location of treatment. Included subjects had a diagnosis for torsion and a procedure code for orchiectomy, detorsion, or orchiopexy.

	By Year				By Location			
	2008 N=993	**2009 N=908**	**2010 N=893**	**P value**	**Ambulatory Surgery N=1539**	**Emergency Department[a] N=247**	**Inpatient Admission N=1008**	**P value**
Age (years), N(%)				0.001				<0.0001
<1	39 (3.9)	38 (4.2)	21 (2.4)		20 (1.3)	1 (0.4)	77 (7.6)	
1–9	65 (6.6)	64 (7.1)	69 (7.7)		116 (7.5)	17 (6.9)	65 (6.5)	
10–14	178 (17.9)	186 (20.5)	189 (21.2)		283 (18.4)	75 (30.4)	195 (19.4)	
15–19	198 (19.9)	203 (22.4)	193 (21.6)		288 (18.7)	79 (32.0)	227 (22.5)	
20–29	116 (11.7)	110 (12.1)	84 (9.4)		148 (9.6)	41 (16.6)	121 (12.0)	
30–39	57 (5.7)	15 (1.7)	35 (3.9)		65 (4.2)	5 (2.0)	37 (3.7)	
≥40	54 (5.4)	40 (4.4)	47 (5.3)		67 (4.4)	8 (3.2)	66 (6.6)	
Missing/masked	286 (28.8)	252 (27.8)	255 (28.6)		552 (35.9)	21 (8.5)	220 (21.8)	
Race, N(%)				0.04				<0.0001
Caucasian	161 (16.2)	136 (15.0)	128 (14.3)		215 (14.0)	76 (30.8)	134 (13.3)	
Hispanic or Latino	140 (14.1)	143 (15.8)	149 (16.7)		174 (11.3)	68 (27.5)	190 (18.9)	
African-American	39 (3.9)	34 (3.7)	15 (1.8)		16 (1.0)	20 (8.1)	53 (5.3)	
Asian, Native American, Other	32 (3.2)	19 (2.1)	34 (3.8)		32 (2.1)	22 (8.9)	31 (3.1)	
Missing/masked	621 (62.5)	576 (63.4)	566 (63.4)		1102 (71.6)	61 (24.7)	600 (59.5)	
Rural location, N(%)	77 (7.8)	66 (7.3)	57 (6.4)	0.5	126 (8.2)	27 (10.9)	47 (4.7)	0.0002
Treatment hospital volume, N(%)				0.4				<0.0001
Lowest tertile	36 (3.6)	21 (2.3)	22 (2.5)		41 (2.7)	27 (10.9)	11 (1.1)	
Mid tertile	151 (15.2)	128 (14.1)	128 (14.3)		225 (14.6)	64 (25.9)	118 (11.7)	
Highest tertile	806 (81.2)	759 (83.6)	743 (83.2)		1273 (82.7)	156 (63.2)	879 (87.2)	
Insurance type, N(%)				0.2				<0.0001
Non-private	394 (39.7)	345 (38.0)	376 (42.1)		501 (32.6)	103 (41.7)	511 (50.7)	
Private	599 (60.3)	563 (62.0)	517 (57.9)		1038 (67.5)	144 (58.3)	497 (49.3)	
Orchiectomy, N(%)	322 (32.4)	288 (31.7)	258 (28.9)	0.2	340 (22.1)	57 (23.1)	471 (46.7)	<0.0001
Hospital Transfer, N(%)	16 (1.8)	16 (2.0)	26 (3.3)	0.1	-	-	-	

	By Year				By Location			
	2008 N=993	2009 N=908	2010 N=893	P value	Ambulatory Surgery N=1539	Emergency Department[a] N=247	Inpatient Admission N=1008	P value
Treatment location, N(%)								
Ambulatory Surgery Center	531 (53.5)	505 (55.6)	503 (56.3)	0.4	-	-	-	
Inpatient Hospital	380 (38.3)	316 (34.8)	312 (34.9)		-	-	-	
Emergency Department	82 (8.3)	87 (9.6)	78 (8.7)		-	-	-	
Incidence per 100,000 men	5.46	4.95	4.83		-	-	-	

[a]Categorization in the Emergency Department required the subject to have been evaluated in an emergency room, undergone the procedure, and been discharged from the emergency room with no inpatient admission. Initial evaluation in an emergency room leading to an inpatient admission would be categorized under Inpatient Admission.

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Table 2

Patient characteristics of males treated in an inpatient setting for testicular torsion by transfer status (N=951).

	No Transfer	Transfer	P value
Age (years), N(%)			< 0.0001
<1	35 (4)	21 (36)	
1–9	57 (6)	5 (9)	
10–14	177 (20)	12 (21)	
15–19	217 (24)	6 (10.3)	
20–29	113 (13)	1 (2)	
30–39	32 (4)	0	
≥40	59 (7)	1 (2)	
Missing/masked	203 (23)	12 (21)	
Race, N(%)			0.7
Caucasian	108 (12)	8(14)	
Hispanic or Latino	162 (18)	13 (22)	
African-American	48 (5)	1 (2)	
Asian, Native American, Other	26 (3)	2 (3)	
Missing/masked	549 (61)	34 (59)	
Rural location, N(%)	43 (5)	3 (5)	0.8
Treatment hospital volume, N(%)			0.03
Lowest tertile	11 (1)	0	
Mid tertile	114 (13)	1 (2)	
Highest tertile	768 (86)	57 (98)	
Insurance type, N(%)			0.4
Non-private	452 (51)	33 (57)	
Private	441 (49)	25 (43)	

Chi-squared analysis was used for all comparisons.

Table 3

Univariable and multivariable analysis for predictors of orchiectomy among those treated as inpatient admissions.

	All age groups	All age groups		All age groups		Age <1 excluded	
	Orchiopexy/Detorsion N=516	Orchiectomy N=435	P Value	Multivariable OR (95% CI) N=951	P Value	Multivariable OR (95% CI) N=895	P Value
Age (years), N(%)			<0.0001				
<1	4 (0.8)	52 (12.0)		19.2 (6.3–58.9)	<0.0001	------	------
1–9	19 (3.7)	43 (9.9)		2.7 (1.4–5.2)	0.003	**2.8 (1.4–5.3)**	**0.002**
10–14	115 (22.3)	74 (17.0)		0.9 (0.6–1.4)	0.6	**0.9 (0.6–1.4)**	**0.6**
15–19	149 (28.9)	74 (17.0)		0.7 (0.5–1.1)	0.1	**0.7 (0.5–1.1)**	**0.1**
20–29	69 (13.4)	45 (10.3)		0.9 (0.5–1.5)	0.8	**0.9 (0.6–1.6)**	**0.8**
30–39	(14 (2.7)	18 (4.1)		1.8 (0.8–4.0)	0.2	**1.8 (0.8–4.0)**	**0.1**
≥40	13 (2.5)	47 (10.8)		6.6 (3.1–14.0)	<0.0001	**6.9 (3.2–14.6)**	**<0.0001**
Missing/masked	133 (25.8)	82 (18.9)		Reference		**Reference**	
Race, N(%)			0.0006				
Caucasian	58 (11.2)	58 (13.3)		0.7 (0.4–1.2)	0.2	**0.6 (0.4–1.1)**	**0.1**
Hispanic or Latino	76 (14.7)	99 (22.8)		1.5 (1.0–2.2)	0.06	**1.5 (1.0–2.2)**	**0.06**
African-American	25 (4.8)	24 (5.5)		1.3 (0.7–2.4)	0.5	**1.3 (0.7–2.4)**	**0.5**
Asian, Native American, Other	10 (1.9)	18 (4.1)		2.4 (1.0–5.7)	0.05	**2.3 (1.0–5.6)**	**0.06**
Missing/masked	347 (67.3)	236 (54.3)		Reference		**Reference**	
Rural location, N(%)	18 (3.5)	28 (6.4)	0.03	1.8 (0.9–3.5)	0.1	**1.8 (0.9–3.5)**	**0.1**
Treatment hospital volume, N(%)			<0.0001				
Lowest tertile	5 (1.0)	6 (1.4)		1.5 (0.4–5.6)	0.5	**1.5 (0.4–5.5)**	**0.5**
Mid tertile	84 (16.3)	31 (7.1)		0.5 (0.3–0.7)	0.001	**0.5 (0.3–0.7)**	**0.001**
Highest tertile	427 (82.8)	398 (91.5)		Reference		**Reference**	
Insurance type, N(%)			0.04				
Non-private	247 (47.9)	238 (54.7)		1.3 (1.0–1.7)	0.1	**1.2 (0.9–1.6)**	**0.2**
Private	269 (52.1)	197 (45.3)		Reference		**Reference**	
Transferred between hospitals, N(%)	20 (3.9)	38 (8.7)	0.002	1.2 (0.6–2.3)	0.6	**1.0 (0.5–2.0)**	**1.0**