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Incidence and Factors Associated with Early Adverse Outcomes of Testicular Torsion among Patients with Acute Scrotum in Western Uganda

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ABSTRACT

Testicular torsion is a condition in which the blood vessels supplying the testicles become twisted, resulting in ischemia and an acute scrotum. It is a urologic emergency that requires prompt surgical intervention to prevent testicular loss and subsequent infertility. The incidence of acute scrotum cases due to testicular torsion has been increasing, leading to morbidity, infertility, and psychological distress. This study aimed to determine the incidence and factors associated with early adverse outcomes of testicular torsion in patients with acute scrotum in selected hospitals in western Uganda. The study was a prospective observational study conducted at Hoima Regional Referral and Kampala International University Teaching Hospitals. Patients with acute scrotum were enrolled and evaluated for testicular torsion. Those diagnosed with torsion underwent surgery, and the outcome in terms of salvageability of the testis was recorded. The data were analyzed using SPSS version 22. During the study period, 232 patients with acute scrotum were enrolled, with a mean age of 35.3 (SD = 20.4) years. Out of these, 41 (17.7%) were diagnosed with testicular torsion. Only 16 (39.02%) of the torsion cases had a viable testis that could be salvaged, while 25 (60.98%) required orchiectomy. Multivariate analysis showed that patients who presented after 48 hours from the onset of symptoms were 34.833 times more likely to undergo orchiectomy compared to those who presented within 12 hours (AOR=34.833, CI=5.020-60.711, P<0.001). This study found a high incidence of testicular torsion and a significant proportion of patients requiring orchiectomy. The only independent factor associated with orchiectomy was the duration from symptom onset to exploration. It is important to educate males about the clinical signs of testicular torsion to ensure early presentation, which can increase salvage rates and reduce the need for orchiectomy.

Keywords: Acute scrotum, Testicular torsion, Male infertility, Orchiectomy.

INTRODUCTION

Since its description by Delasiauve in 1840, testicular torsion has been well-known to happen in babyhood and among grown-ups. It is one of the most fragile operative emergencies, for if not pointed out on the first consultation, it may be too late to initiate any effective treatment to save the testicle at the second or subsequent consultations, even if it is recognized [1]. Risk factors believed to be associated with testicular torsion include abnormal investment of the tunica vaginalis around the testicle, an unusually capacious tunica vaginalis, the absence of the gubernaculum testis and posterior mesorchium, the absence of scrotal ligaments, and abnormal length with a loose attachment of the tunica vaginalis portion of the cord [1]. Testicular torsion has been known for years as a clinical syndrome that is characterized by acute onset, painful swelling of the scrotum or its contents, accompanied by local signs and general symptoms [2]. Pain experienced in scrotal and testicular areas has been known for decades to have varied origins, including abdominal visceral causes, due to its development in the abdominal cavity, whereby during its descent in intrauterine life, the testis carries autonomic nerve supply and vasculature with it, and these nerves travel along the testicular vessels to the aortic and renal plexuses [3]. Lack of knowledge of the differential diagnosis can lead to confusion with other diseases that share similar symptoms but have different causes and pathophysiologies [4]. The acutely painful scrotum has been described as a urologic emergency requiring a high index of clinical suspicion and prompt surgical intervention, the management of which is aimed at avoiding testicular loss and resultant infertility [5]. Historically, it has been shown that once acute scrotal pain has been identified, it can be managed using either conservative or surgical measures, and the

complexity of treatment lies in proper history-taking, clinical examination, and investigations in a restricted time frame to identify the appropriate management path [6]. This study used the Health Belief Model (HBM), which was coined in 1974 by Rosenstock, and it states that an individual's health behaviors will be determined by two aspects, namely threat perception and behavioral evaluation [7]. In threat perception, an individual's behaviors will be modified by their perceived susceptibility to disease and the anticipated severity and complications of the disease. With behavioral evaluation, two distinct aspects are involved: those related to the advantages and efficacy of health recommendations and those related to costs (in terms of money, effort, and time), as well as barriers to carrying out preventive behaviors [8]. When health messaging demonstrates that a potentially life-threatening health condition may be avoided or cured by engaging in certain behaviors, people are more likely to take action [9]. A combination of perceived vulnerability and severity motivates people to take action, while a comparison of perceived advantages and barriers gives them the tools or path of action. As a result, the likelihood of taking preventive health measures improves as perceived vulnerability and severity with advantages get stronger and believed barriers become weaker [7]. According to this model, those at risk should first understand the risks of different acute scrotum pathologies and the severity of associated delays, along with the advantages of early medical advice and interventions, especially in torted testis, for them to adhere to the health recommendations for the prevention of testicular loss and infertility. Those at risk must be educated on the impact of testicular torsion on health and fertility to make informed decisions and seek medical attention promptly so that testicular derotation and subsequent fixation with contralateral orchiopexy are done, reducing the rate of loss and its consequences, like infertility, which has a tremendous negative impact on one's manhood and psychology. The findings from this research will provide an avenue for health promotion and awareness of bottlenecks in the approaches to testicular torsion, a pathology that can't be prevented, but early intervention will prevent the adverse effects of the disease, which can only be done through the patient's education so that they seek surgical intervention involving orchiopexy. The annual incidence of testicular torsion is approximately 3.8 per 100,000 among the general population [10]. Testicular torsion (TT) presents a diagnostic challenge due to the overlap of its clinical presentation with that of epididymitis and the torsion of the appendix testis [11]. Though TT is a surgical emergency that warrants operation within 6 hours of onset [12], epididymitis and torsion of the appendix testis do not require such urgency, and when the diagnosis of TT is not made in time, gangrene of the testis occurs, requiring orchiectomy at the surgery, which has been reported to reduce fertility [10]. Many patients present late as they are waiting for the pain to resolve with medication, but at times clinicians also prescribe antibiotics and analgesics when a misdiagnosis has been made, resulting in a late presentation [13]. In Uganda, a study in Mulago showed that over 50% of the patients reported to the hospital more than 48 hours after the onset of their symptoms, and in 75% of the cases, the testes were already gangrenous on admission [14]. The rate of acute scrotum in western Uganda has been on the rise in recent years. According to preliminary studies done from the surgical ward records at Kampala International University Teaching Hospital (KIUTH) and Hoima Regional Referral Hospital (HRRH), between August and October 2021, among the 167 patients admitted secondary to the acute scrotum, the burden included 52.7% salvage intervention rates, with 79 cases of losing testes while many others had severe morbidity. However, there is no recent data on the early outcomes of testicular torsion in Uganda, specifically western Uganda. More so, the factors that are associated with the adverse outcomes are not well understood. The proposed study focuses on establishing the incidence and factors associated with adverse outcomes of testicular torsion among patients with acute scrotum, which in our setting are not well understood. Therefore, this study was to fill in this knowledge gate.

Methodology

Study design

The study was a hospital-based prospective observational study employing a quantitative method of data collection to describe the independent variables associated with the dependent variables which were early outcomes of testicular torsion among patients with acute scrotum in western Uganda.

Area of Study

This study was conducted at KIUTH and HRRH in the surgical department and emergency unit. The study population came from catchment areas of hospitals under study as detailed in geographical scope. Both study sites contain surgical departments which are managed by specialists and resident doctors. Both hospitals contain laboratory and imaging departments managed by qualified laboratory technologists and sonographers while the surgical department where the study was conducted contains accident and emergency, outpatient, and inpatient units including surgical theatres. The surgical department is managed

by surgeons, senior house officers, intern doctors, and nurses. In a low-resource setting, such cases are managed by general surgeons due to the unavailability of urologists.

Study population

The research cases involved all the male patients admitted in the accident and emergency or surgical wards of KIUTH and HRRH with a diagnosis of an acute scrotum, who consented to the study.

Inclusion criteria

All patients admitted with a preliminary clinical diagnosis of acute scrotum accepted to take part in the research.

Exclusion criteria

Patients who came with an open scrotal injury.

Sample size determination

Using Daniel's formula for sample size determination in prospective studies n=,[15] the sample size was determined. Concerning the formula and using the findings by Opio and colleagues who reported that testicular torsion was seen in 16.4% of the patients with acute scrotum at Mulago National Referral Hospital [16],

n= the minimum sample size required,
Z= 1.96(Z value for 2-tailed 95% confidence level),
p= proportion of outcome, 0.164,
q=1-P,
e=0.05(acceptable margin of error at 95% level of confidence),
Therefore, using above formula the sample size will be,

$$\frac{(1.96)^2 \text{x } 0.164(1-0.164)}{(0.05)^2}$$

= 210.7

n=211 participants

The sample size will be computed from modified Daniel's formula for proportions $\frac{Z2XPq}{e^2}$[15]. Considering a study done by Opio and colleagues who reported that testicular gangrene was seen in 90.4% of the 75% patients with acute scrotum and 48 hours after symptoms at Mulago national referral hospital[16],

n= the minimum sample size required,
Z= 1.96(Z value for 2-tailed 95% confidence level),
p= proportion of outcome, 0.096,
q=1-P,
e=0.05(acceptable margin of error at 95% level of confidence),
Therefore, using the above formula the sample size will be,

$$= \frac{(1.96)^2 \text{x } 0.904(1-0.904)}{(0.05)^2}$$

n = 133.3

= 133 participants

Considering the factors associated with adverse outcomes of testicular torsion among patients with acute scrotum we employed OpenEpi, Version 3, an open-source calculator for cohort studies**.** According to OpenEpi, Version 3, open-source calculator for cohort studies http://www.openepi.com/SampleSize/SSCohort.htm and assuming 95% CI, p=0.05 significance, statistical power of 80%, and where the primary exposure was acute scrotum and ratio of unexposed to exposed sample 10. Considering a study done on the Management of Testicular torsion in Mulago Hospital (Uganda) over a 5-year period that found the percentage of unviable testis in patients presenting after 48 hours of onset of clinical features was 100% while those with torsion who seek medical advice within 6 hours was 14.5%[16], the sample size is 68 (as shown).

Table 1: Sample Size for Cohort studies

Two-sided significance level(1-alpha):			95
Power(1-beta, % chance of detecting):			80
Ratio of sample size, Unexposed/Exposed:			1
Percent of Unexposed with Outcome:			5
Percent of Exposed with Outcome:			34
Odds Ratio:			10
Risk/Prevalence Ratio:			6.9
Risk/Prevalence difference:			29
	Kelsey	**Fleiss**	**Fleiss with CC**
Sample Size - Exposed	29	28	34
Sample Size-None exposed	29	28	34
Total sample size:	58	56	68

CC = continuity correction

Results are rounded up to the nearest integer.

Therefore, a larger sample of **211** is considered. 10% is added to account for errors hence the sample size required for this study was **232 participants.** On the proportion of patients from each selected site; KIUTH contributed**36** while **196** participants were from HRRH.

Sampling technique

Participants were recruited using consecutive recruitment till the target sample size was achieved.

Data collection instruments

The main instrument was the investigator-administered questionnaire.

Validity of data collection instruments

The data collection instrument was pretested in Fort Portal Regional Referral Hospital to affirm the questionnaire's effectiveness in capturing appropriate desired information and identify the possible source of errors to strengthen our data collection tools. 15 respondents who were not part of the sample population were administered questionnaires to gauge the inter-respondent concurrence. The item content validity index was determined, where experts in the field were asked to rate the information in the questionnaires from relevant (1), somewhat relevant (2), quite relevant (3), and highly relevant (4) scales test. If more than 80% of the experts agreed, then it was considered a good reflection of the validity of our data collection instruments in answering our research questions.

Recruitment and data collections procedure

Patients who presented with acute scrotum were recruited to the study in the accident &emergency or outpatient department. They were educated and counseled about the study and their consent was requested. The consent for the minors was asked from the legal guardian. Those who accepted were provided with a consent form to sign. Their clinical characteristics were taken and necessary investigations were requested including mid-stream urine to assess urinary tract infection (UTI) and Doppler ultrasonography to assess blood flow to the testis for those who had had low TWIST scores. The participants with suspected or confirmed testicular torsion underwent surgical exploration with orchiectomy for those testis found unviable and contralateral orchiectomy while those

with viable testis were done bilateral orchiopexy. Other cases of acute scrotum confirmed not to have testicular torsion underwent routine management for the condition they had and they were not followed up from this point of the study but were accounted for to determine the incidence of testicular torsion among patients with acute scrotum. The surgery was performed by a qualified surgeon. The participants were routinely reviewed at the surgical wards until recovery. The completeness of the questionnaire was ensured at the end of the follow-up or study. The participants who did not consent to the study were managed according to the hospital protocols.

Quality control

The standard of the data was guaranteed by collecting the right data, ensuring adherence to selection criteria. The investigations (urine analysis and Doppler ultrasonography) were done by a laboratory technologist and sonographer following standard measures.

Study flow chart

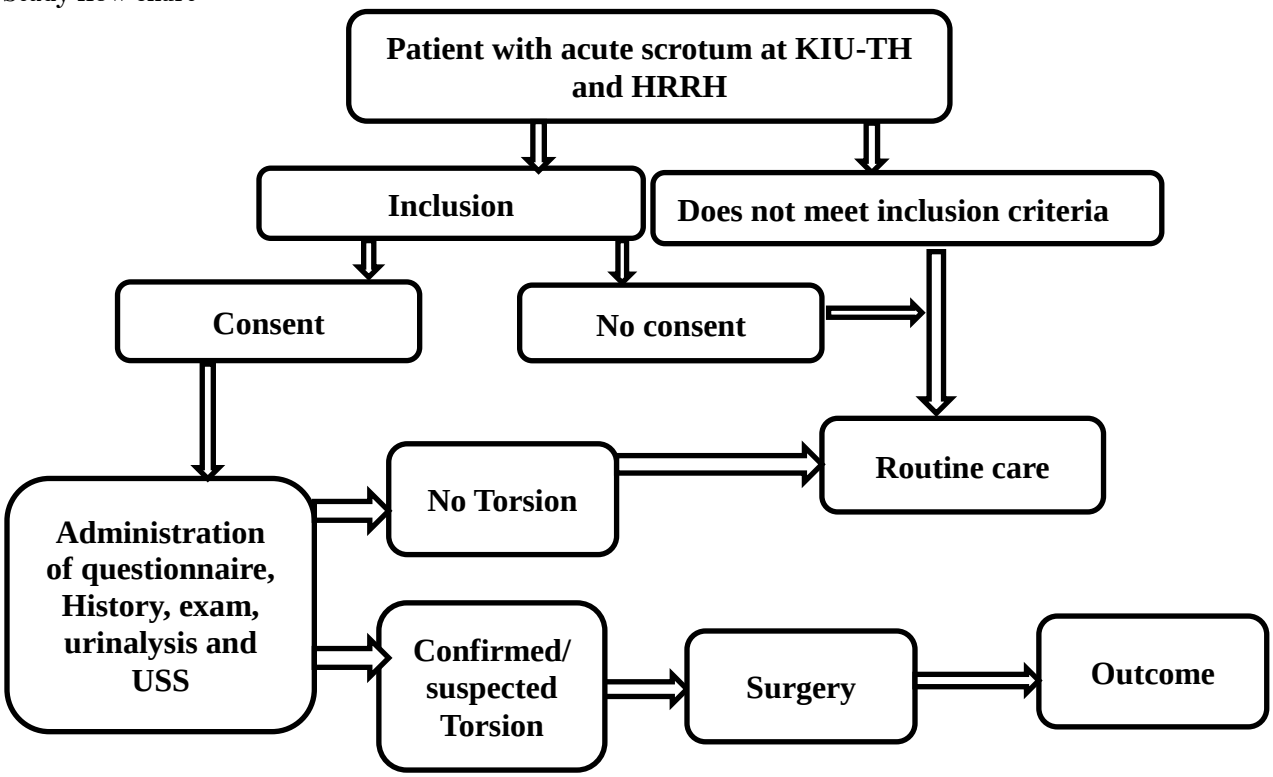

Figure 1: flow chart for patient flow during the data collection period

Data analysis

Data were summarized and entered using Epi-data software and the summarized data was analyzed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, USA, version 22.0 for Windows). Continuous variables, such as age were presented as the mean ± standard deviation. Categorical variables, such as outcome, were expressed as frequencies. This was presented as a percentage and computed as a proportion of patients confirmed to have torsion among all presenting with acute scrotum. The corresponding 95% confidence intervals were also reported. The Outcomes were presented as percentages of the different outcomes computed as a proportion of the number of participants with a particular outcome among all patients with TT in a pie chart. The corresponding 95% confidence intervals were also reported. Bivariate analysis was conducted and the variables with p-values of ≤0.2 in bivariate analysis and those factors with biological plausibility were considered for multivariate analysis. Those variables with p-values of ≤0.05 in the stepwise backward binary logistic regression analysis were regarded to be significantly and independently associated with the outcome. The study was feasible within the duration of the 6 months because KIUTH and HRRH attend to more than 250 cases of the acute scrotum and the desired sample size was 232.

Ethical considerations

Adequate education and information were offered to the patients before seeking informed consent. It was clear to the participant that declining to join the study would not have any bearing on the service she would receive at the Hospital. There was the utmost respect for the patient's autonomy and confidentially. We were guided by the principle of beneficence, non-maleficence, and truth-telling to the best of our knowledge. The questionnaire was in clear English and translated into the local language (Runyoro and Runyankole). No study participant was coerced to join the study. It was made crystal clear to the participant that they could opt out of the study at any time without fear or favor.

RESULTS

Study profile

During the study period, 232 patients with acute scrotum were enrolled. Of the 232, only 41 were diagnosed with testicular torsion. Following surgery, only 16 of the 41 patients with torsion had a salvageable testis and therefore 25 of them underwent orchiectomy. The details of the study profile with corresponding numbers are shown in figure 2 below

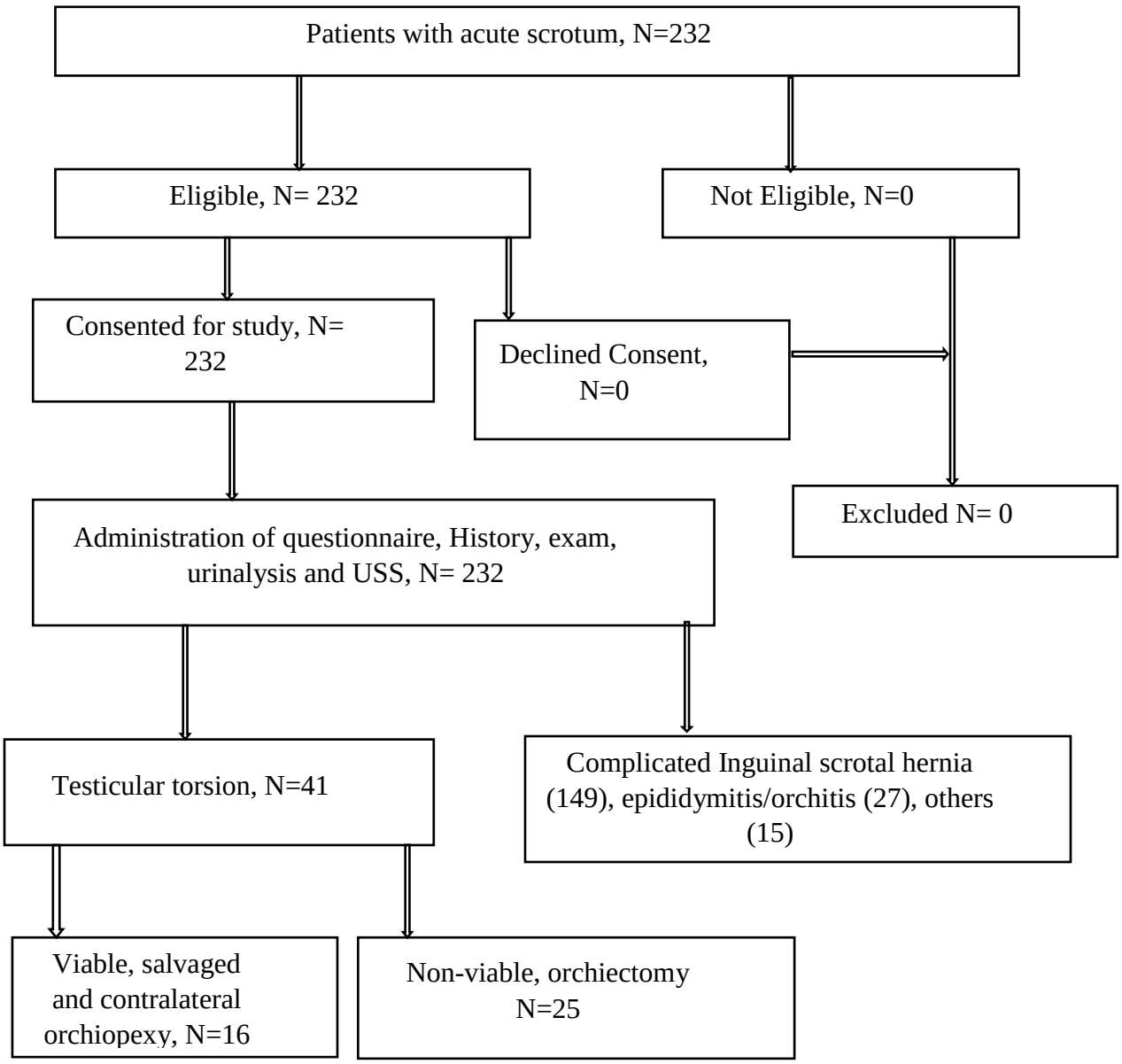

Figure 2: shows the details of the study profile with corresponding numbers

Socio-demographic characteristics of the study participants

In this study, the mean age was 35.3 (SD=20.4) years. The majority of the participants came from rural 154(66.4%) and were admitted at Hoima regional referral hospital 196(84.5%).

Table 2: Socio-demographic characteristics of study participants

Characteristic	Statistic	
Age in years	Mean=35.3, SD= 20.4, Min=.06, Max=86.0.	
	Frequency	**Percentage**
WHO Age category		
0-16	39	16.8
17-30	66	28.4
30-45	61	26.3
>45	66	28.4
Residence		
Rural	154	66.4
Urban	78	33.6
Education level		
No Formal Education	89	38.4
Primary	50	21.6
Post Primary	93	40.1
Monthly Income		
<500,000	106	45.7
500,000-1 Million	100	43.1
> 1 Million	26	11.2
Hospital		
HRRH	196	84.5
KIU-TH	36	15.5

SD=Standard deviation, Min=Minimum, Max=maximum, HRRH=Hoima regional referral hospital, KIU-TH= Kampala international university teaching hospital

Incidence of testicular torsion among patients with acute scrotum.

In this study, 41 of the participants were diagnosed with testicular torsion. This represents an incidence of 17.7% with a 95% confidence interval of 13.4%-22.4%. The rest of the diagnoses are shown in Table 3 below.

Table 3: Shows the different causes of acute scrotum among the study participants

Diagnosis	Frequency	Percentage	95% CI
Complicated Inguinal scrotal hernia	149	64.2	57.3-69.8
Torsion	41	17.7	13.4-22.4
Epididymitis/orchitis	27	11.6	7.8-15.5
Others(Testicular cyst, Scrotal mass, scrotal abscess)	15	6.5	3.4-9.9

CI=Confidence interval

Early outcomes of testicular torsion among patients with acute scrotum.

In this study, of the 41 patient that was diagnosed with torsion, only 16 (39.0%) had viable testis that was salvaged (95% CI=24.4%-53.7%). Orchiectomy was done for 25 (61.0%) (95% CI=46.3%-75.6%). Figure 3 shows the early outcome relating to salvageability.

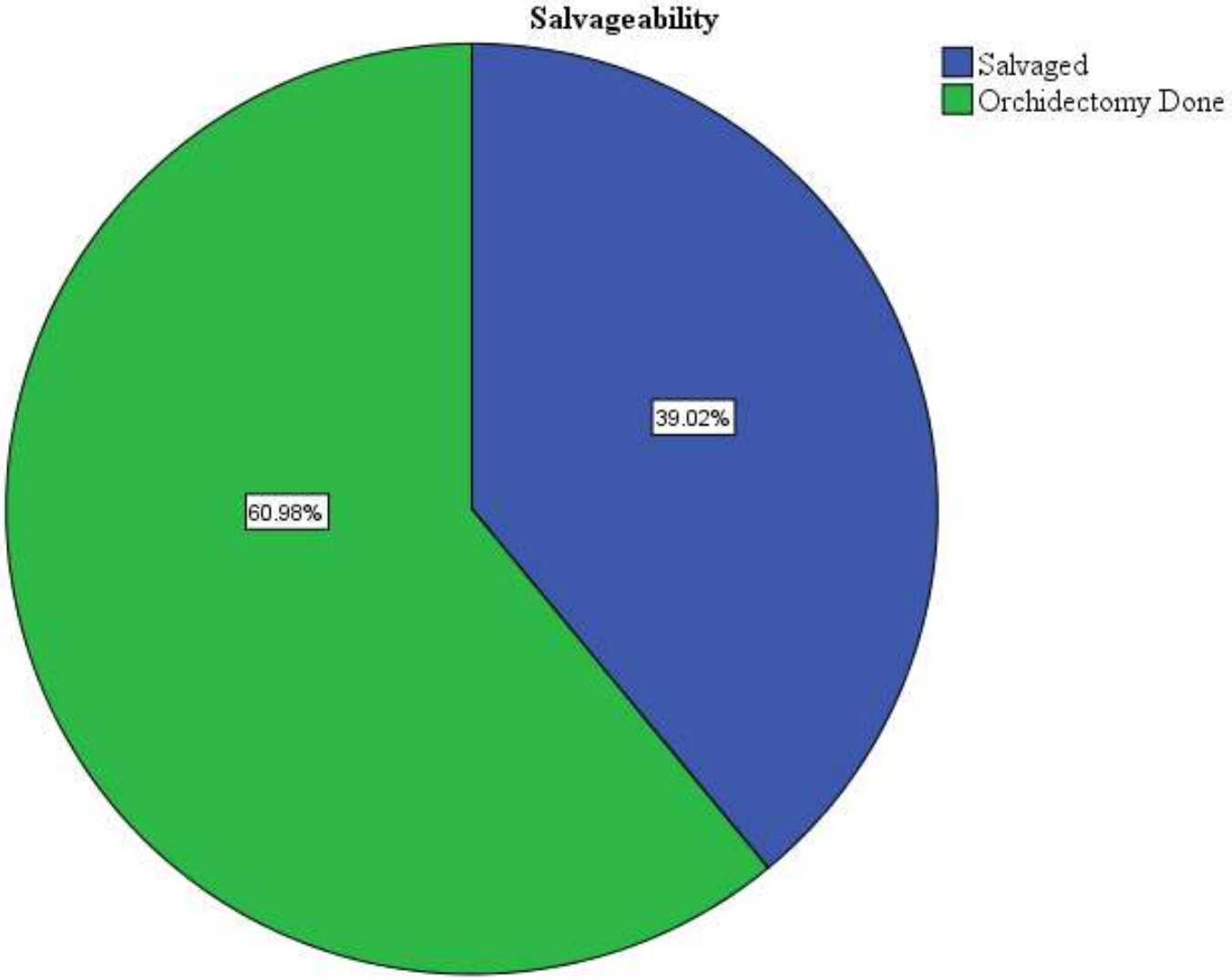

Figure 3: Pie chart showing the salvageability of testicular torsion among study participants.

Factors associated with early adverse outcomes of testicular torsion.

At bivariate analysis, the factors that had a p value less than 0.2 and therefore qualified for multivariate analysis were time to presentation 13-24 hours (cOR=11.000, CI=0.646-187.166, P=0.097), 25-48 hours (cOR=11.000, CI=0.646-187.166, P=0.097), >48 hours (cOR=34.833, CI=5.020-241.711, P<0.001), loss of cremasteric reflex (cOR=4.000, CI=1.000-15.994, P=0.050), presence of tachycardia (cOR=11.786, CI=1.342-103.515, P=0.026) and the TWIST score category (cOR=5.538, CI=0.522-58.756, P=0.155). The results of the bivariate analysis are shown in Table4.

Table 4: Bivariate analysis of factors associated with early adverse outcomes of testicular torsion among patients with acute scrotum in selected hospitals in Western Uganda

Characteristic	Salvaged N=16 n (%)	Orchiectomy, N=25 n (%)	Bivariate analysis		
			cOR	95% CI	P value
WHO Age category					
0-16	7(17.1)	15(36.6)			
17-30	8(19.5)	7(17.1)	0.408	0.105-1.582	0.195
30-45	1(2.4)	3(7.3)	1.400	0.123-15.974	0.786
Residence					
Rural	11(26.8)	19(46.3)	1.439	0.355-5.837	0.610
Urban	5(12.2)	6(14.6)	Ref		
Education level					
Non-Formal	9(22.0)	11(26.8)	1.222	0.291-5.128	0.784
Primary	1(2.4)	8(19.5)	8.000	0.750-85.313	0.085
Post Primary	6(14.6)	6(14.6)	Ref		
Monthly income					
<500,000	7(17.1)	12(29.3)	0.843	0.239-2.975	0.790
500,000- 1M	9(22.0)	13(31.7)	Ref		
Time to presentation (in hours)					
0-12	11(26.8)	2(4.9)	Ref		
13-24	1(2.4)	2(4.9)	11.000	0.646-187.166	**0.097**
25-48	1(2.4)	2(4.9)	11.000	0.646-187.166	**0.097**
>48	3(7.3)	19(46.3)	34.833	5.020-241.711	**<0.001**
Referred from health facility					
Yes	6(14.6)	13(31.7)	1.806	0.502-6.498	0.366
No	10(24.4)	12(29.3)	Ref		
Referred from an academic institution					
Yes	7(17.10	11(26.8)	1.010	0.285-3.578	0.987
No	9(22.0)	14(34.1)	Ref		
From Home					
Yes	5(12.2)	8(19.5)	1.035	0.268-3.995	0.960
No	11(26.8)	17(41.5)	Ref		
Scrotal swelling					
Yes	15(36.6)	23(56.1)	0.767	0.064-9.220	0.834
No	1(2.4)	2(4.9)	Ref		

Nausea/Vomiting					
Yes	15(36.6)	20(48.8)	0.267	0.028-2.527	0.249
No	1(2.4)	5(12.2)	Ref		
Loss of Cremasteric reflex					
Yes	8(19.5)	20(48.8)	4.000	1.000-15.994	**0.050**
No	8(19.5)	5(12.2)	Ref		
Trauma history					
Yes	7(17.1)	9(22.0)	0.723	0.201-2.605	0.620
No	9(22.0)	16(39.0)	Ref		
Fever history					
Yes	4(9.8)	6(14.6)	0.947	0.221-4.067	0.942
No	12(29.3)	19(46.3)	Ref		
Hypertension					
Yes	1(2.4)	3(7.3)	2.045	0.194-21.586	0.552
No	15(36.6)	22(53.7)	Ref		
Tachycardia					
Yes	1(2.4)	11(26.8)	11.786	1.342-103.515	**0.026**
No	15(36.6)	14(34.1)	Ref		
Tachypnea					
Yes	10(24.4)	13(31.7)	0.650	0.181-2.339	0.510
No	6(14.6)	12(29.3)	Ref		
Other symptoms					
None	7(17.1)	9(22.0)	Ref		
Dysuria	4(9.8)	5(12.2)	0.972	0.188-5.034	0.973
Others	5(12.2)	11(26.8)	1.711	0.403-7.271	0.467
Compromised blood supply on Doppler					
Yes	7(17.10	11(26.8)	1.010	0.285-3.578	0.987
No	9(22.0)	14(34.1)	Ref		
Urinalysis					
Normal	10(24.4)	17(41.5)	Ref		
Abnormal	6(14.6)	8(19.5)	0.784	0.210-2.923	0.717
Anemia					
Yes	7(17.1)	15(36.6)	1.929	0.541-6.875	0.311

No	9(22.0)	10(24.4)	Ref		
TWIST Score					
2-4	3(7.3)	1(2.4)	Ref		
>4	13(31.7)	24(58.5)	5.538	0.522-58.756	**0.155**

Ref= Reference category, cOR= Crude odds ratio, CI= Confidence interval

In multivariate analysis, the factor that was significantly associated with orchiectomy was time to presentation. A patient who presented after 48 hours from the onset of symptoms was 34.833 times more likely to have orchiectomy compared to one that presented within 12 hours (AOR=34.833, CI=5.020-60.711, P<0.001). The results of the multivariate analysis are shown in Table 5.

Table 5: Multivariable analysis of factors associated with early adverse outcomes of testicular torsion among patients with acute scrotum in selected hospitals in Western Uganda

Characteristic	Multivariate analysis		
	AOR	**95% CI**	**P value**
Time to presentation (in hours)			
0-12			
13-24	11.000	0.646-57.166	0.097
25-48	11.000	0.646-57.166	0.097
>48	**34.833**	**5.020-60.711**	**<0.001**
Loss of cremasteric reflex			
Yes	3.935	0.287-53.876	0.305
No			
Tachycardia			
Yes	2.750	0.211-35.838	0.440
No			
TWIST Score			
2-4			
>4	2.436	0.028-212.302	0.696

AOR= Adjusted odds ratio, Ref= Reference category, CI= Confidence interval.

DISCUSSION

Incidence of testicular torsion among patients with acute scrotum

In this study, 41 out of the 232 participants were diagnosed with testicular torsion. This represents an incidence of 17.7% with a 95% confidence interval of 13.4%–22.4%. This is comparable to what was reported in Mulago after doing ultrasound scans for all patients who presented with scrotal pain. The Mulago study reported that 16.4% of the patients with scrotal pain had testicular torsion [16]. The slight increase noted in our study is possible because surgery is more sensitive to confirming a torsion than sonography [17]. In addition, our findings are comparable to what was reported in a systematic review by Sharp and his colleagues, who reported that testicular torsion accounts for 10% to 15% of acute scrotal disease in children [18]. Since the confidence interval in our study was 13.4%–22.4%, it can be noted that our confidence interval overlaps with the range reported in the previous review report, meaning that there was no significant difference between our findings and the findings reported in the previous review. Contrary to our findings, a study by Ambroise and colleagues reported that 8.6% of the patients with scrotal pain who had sonography in Cameroon were found to have torsion [19]. This was much lower than the incidence found in our study. The difference could be due to sonography's low sensitivity [17]. The difference in geographical location could have contributed to the difference in incidences. Furthermore, one study in the USA observed a significant increase in the number of cases of testicular torsion during the COVID-19 pandemic [20], though the explanation for this was not given. Another literature review reported that among children aged 7–13 years, testicular torsion accounted for 24%–46% of the patients with acute scrotum [21]. This range was much higher than that found in our study. This can be explained by the difference in the age ranges since our study participants were aged between 3 weeks and 86 years, with only 1 case of 3 weeks old being under 10 years, while the review focused on the ages between 7 and 13 years. Another study that reported a much higher percentage was a systematic review by Baruga and Munabi, where testicular torsion accounted for 36% of the patients with acute scrotum [22]. This proportion was much higher than that seen in our study because of the difference in the inclusion criteria. In this systematic review, only patients with testicular torsion or orchitis were included, yet in our study, other causes of acute scrotum, such as inguinal scrotal hernia, were also included, hence the big difference in the incidences. The other causes of acute scrotum seen in our study included inguinal scrotal hernia, epididymitis/orchitis, and others. This is in agreement with a report by Thomas and colleagues where the causes of acute scrotum included hernia/hydrocele, epididymitis/orchitis, trauma/abuse, cellulitis, vacuities, and varicocele [23]. In addition, in agreement with our findings, the causes of acute scrotum included spermatic cord torsion, incarcerated inguinal hernia, epididymo-orchitis, missed torsion, and trauma to the testis [24].

Early outcomes of testicular torsion.

In this study, of the 41 patients that were diagnosed with torsion, only 16 (39.0%) had viable testis that was salvaged (95% CI = 24.4%–53.7%). Orchiectomy was performed for 25 (61.0%) (95% CI = 46.3%–75.6%). Our findings are comparable to what was reported in Mulago, where 63.7% of the patients with testicular torsion underwent orchiectomy [1]. Since the upper limit of our confidence interval was 75.6%, there was no significant difference between the percentages of patients that underwent orchiectomy in the Mulago study compared to our study. Also in agreement with our findings is a systematic review that reported that the salvage rates ranged from 14% to 81% [25]. Contrary to our findings, multiple studies in high-income countries reported much lower percentages of orchiectomy, including a review of literature from Iowa, which reported that 42% had an orchiectomy [26], a study in Canada, which reported that 28% underwent orchiectomy [27], and in Jordan, 40% of the patients that were found to have cord testicular torsion underwent orchiectomy [28]. Studies that reported a significantly higher rate of orchiectomies include a study in Kenya, where 82% had an orchiectomy [13], and in Ethiopia, where 83% had an orchiectomy [25]. It can be noted that higher orchiectomy rates were reported in low-income countries, while lower orchiectomy rates were reported in high-income countries. This can be explained by the difference in the health systems, which could have affected the time from onset of symptoms to diagnosis and intervention, and also by the differences in health-seeking behaviors that could result in the delayed presentation given that more than 50% of our study participants presented after 48 hours of symptoms. The wide variations in the rates of orchiectomy among patients with torsion can be explained by the time variations from the onset of symptoms to presentation. In our study, which had a high rate of orchiectomy, 53.7% of the patients with testicular torsion presented after 48 hours, yet presentation after 48 hours increased the risk of orchiectomy to 75% [6]. According to the literature, when twisting takes more than 6–8 hours, the blood supply is interrupted, and cellular death ensues, necessitating the removal of the dead testis [12]. Also, the variations in age of the

participants in the different studies could explain the difference in salvage rates since, according to the literature, neonates have a salvage rate of only 9% [29], and in our study, we had only one neonate.

Factors associated with early adverse outcomes of testicular torsion.

At multivariate analysis, a patient who presented after 48 hours from the onset of symptoms was 34.833 times more likely to have orchiectomy compared to one that presented within 12 hours (AOR=34.833, CI=5.020-60.711, P<0.001). This is in agreement with what has been reported in other studies. According to a systematic review, testicular torsion is a surgical emergency and requires prompt surgical exploration and management. Once surgical management is decided on, it should occur as quickly as possible. Testicular salvage rates are associated with the duration of ischemia, with a "golden" window of 4 to 8 hours from the time of torsion to the time of detorsion [30]. According to a literature review by Prendergast and the team, intervention for torsion is time-sensitive, with a 97% salvage rate in the first 6 hours, decreasing to 61.3% beyond 12 hours [31]. At bivariate analysis, loss of cremasteric reflex and presence of tachycardia also had a p value less than 0.05 but were not significant at the multivariate level. The association seen at bivariate between the risk of orchiectomy and loss of cremasteric reflex is possibly due to the worsening ischemia as the duration of the torsion increases. Also, the association between tachycardia and the risk of orchiectomy could be due to the increased release of inflammatory mediators as the testis gets ischemic and gangrene. In this study, age was not a significant factor, as was seen in other studies. This is possible because this study had only one neonate, yet the risk of orchiectomy associated with age is more pronounced among neonates [29].

CONCLUSION

In this study, the incidence of testicular torsion was high. The proportion of patients that had orchiectomy was also high in comparison to existing literature previously reported by local studies. The only factor that was independently associated with an orchiectomy was the time from the onset of symptoms up to the time of intervention, here referring to surgical exploration.

Strengths of the study

To the best of the author's knowledge, this was the first study that assessed factors associated with orchiectomy among patients with testicular torsion in Uganda.

Study Limitations

This study was not without limitations. First, considering 12 hours as opposed to 6 hours of presentation as a reference in the analyses is reasonable in low-income settings for the reasons aforementioned but limits the generalizability of our findings in the context of "late presentation" in high-income countries. Secondly, in this study, age was not significantly associated with testicular salvageability, as was seen in other studies [32]. This is possibly because this study had only one neonate, a small representation to demonstrate the validity of this association. Thirdly, there was no long-term follow-up after surgery to assess other outcomes, like infertility.

Recommendations

Through awareness campaigns, all males should be sensitized about the clinical features of testicular torsion to ensure early presentation, which can increase salvage rates and reduce the number of patients that undergo orchiectomy. A study with a longer follow-up is recommended to look at other outcomes, like infertility.

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