

# Use of TWIST Score and BAL Score in Diagnosing Testicular Torsion in Children with Acute Scrotum: A Retrospective Study

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## ABSTRACT

**Introduction:** Early diagnosis and management of Torsion Testis (TT) in children is challenging. To improve the reliability of diagnosis, various clinical scoring systems have been proposed. Testicular Workup for Ischaemia and Suspected Torsion (TWIST) score and Boettcher Alert (BAL) score have been used for the diagnosis of TT in children with acute scrotum.

**Aim:** To find the utility of TWIST and BAL score for diagnosing testicular torsion in children with acute scrotum.

**Materials and Methods:** This was a retrospective record-based study that included medical records of children with acute scrotum who underwent surgery between January 2019 and December 2021 in a tertiary care hospital. A total of 112 patients were included in the study. TWIST and BAL scores were calculated, retrospectively. Univariate analysis of the clinical features were done using Chi-square test. Sensitivity, specificity, Positive

Predictive Value (PPV) and Negative Predictive Value (NPV) for scoring systems were calculated.

**Results:** There were 73 patients in TT group and 39 in Non Torsion Testis (NTT) group. The mean age was  $4.5 \pm 2.98$  years in torsion group and  $5.2 \pm 2.2$  years in non torsion group. Among the components of TWIST and BAL score, absent cremasteric reflex, hard testicle, high riding testis, nausea/vomiting and pain duration <24 hours were found to be statistically significant. PPV and specificity of TWIST score  $\geq 5$  were 98.15% and 97.44%, respectively whereas NPV and sensitivity of BAL score  $\geq 2$  group was 100%.

**Conclusion:** TWIST and BAL scores are reliable bedside and easy to perform clinical diagnostic tools for TT. These scores can help in early detection and plan surgical intervention to reduce ischaemia time of TT.

**Keywords:** Boettcher alert, Cremasteric reflex, High riding testis, Ischaemia, Testicle, Testicular workup for ischaemia and suspected torsion

## INTRODUCTION

Testicular torsion is a major, known cause of morbidity in the paediatric age group. The annual incidence of testicular torsion in males less than 18 years of age is 4 per 100,000 [1]. Acute scrotum is defined as new onset pain with tenderness or swelling of contents within the scrotum. The common aetiology of acute scrotum in paediatric age group include testicular torsion, torsion appendage of testis, and acute epididymo-orchitis [2]. The most common presenting symptom of TT is the acute onset of testicular pain. The clinical examination findings are scrotal swelling, horizontal lie of testis and absence of cremasteric reflex [3]. The clinical spectrum of TT and NTT are similar [4]. Management and intervention within six hours is crucial to avoid permanent testicular loss from a compromised arterial flow. Absence of timely intervention has resulted in orchiectomy rates of 35-40% [5,6].

The standard tool for diagnosing acute scrotum is ultrasonography and doppler study of scrotum [7]. The limitation of this tool is high investigator dependence and false negative reports. The delayed presentation of cases to the hospital may be due to various reasons. These include lack of awareness, embarrassment and denial by the patient or caregiver, delayed diagnosis, and missed investigations at peripheral hospitals [8]. Hence, the need arises for a Clinical scoring tool. Barbosa JABA et al., described TWIST score based on easy to elicit five clinical variables [9]. Another simple prediction score was described by Boettcher M et al., BAL score based on four clinical variables [10,11]. Such clinical scores may be used by non specialists with accuracy [12]. Use of a clinical scores along with ultrasonography may be the best approach for diagnosis of

testicular torsion [13]. As these clinical scores (TWIST and BAL Score) are easy to perform at bedside, this will help medical personnel to diagnose testicular torsion without delay.

Many a times, a delay in diagnosis at peripheral hospitals and delay in ultrasound scan can result in patients ending up with a gangrenous testis. Thus, clinical scores like TWIST and BAL score, which are easy to perform at bedside will aid doctors in emergency department to diagnose TT without delay. The aim of the study was to find the utility of TWIST and BAL score for testicular torsion in paediatric population presenting with acute scrotum.

## MATERIALS AND METHODS

The present retrospective study was conducted at Government Medical College Thiruvanthapuram, Kerala, India from records of patients admitted between January 2019 to December 2021 and data analysis was done in November 2022. This study was approved by Institutional Research and Human Ethics committee review board (HEC NO: 10/04/2022/MCT).

**Inclusion criteria:** All children who were treated surgically in Department of Paediatric Surgery with acute scrotum during the study period were included in the study.

**Exclusion criteria:** (i) Children with penetrating trauma to scrotum and where clinical assessment was difficult; (ii) Children whose complete clinical data/imaging report/relevant surgical data were unavailable were excluded from the study.

## Study Procedure

Data was collected from case records of 129 children with acute scrotum who underwent surgical exploration with high clinical

suspicion of TT as per institutional protocol. Findings at surgery was taken as gold standard. The patients were then categorised into TT group and NTT group. The TWIST and BAL scores were calculated retrospectively for all the patients based on symptoms and signs at admission. TWIST score is based on five variables: (a) Testicular swelling (2 points); (b) hard testis (2 points); (c) nausea or vomiting (1 point); (d) high position of testis (1 point); (e) abnormal cremasteric reflex (1 point). Patients are divided into low (0-2), intermediate (3-4) or high risk groups (5-7) according to total score [9].

The BAL score is based on four variables: (a) <24 hour duration of pain; (b) nausea or vomiting; (c) high position of testis; (d) abnormal cremasteric reflex. Each factor is marked as one point. Total score being 4. A score ≥2 has high probability of TT [10,11].

### STATISTICAL ANALYSIS

Data was presented as numbers and percentages. Data was analysed using Statistical Package for the Social Sciences (SPSS) version 27.0 statistical software. Univariate analysis of the clinical features between the TT and NTT group was analysed with Chi-square test. The p-value <0.05 was considered statistically significant. PPV, NPV, sensitivity, and specificity of both clinical scoring systems were calculated for different risk groups.

### RESULTS

In this study, 129 patients with acute scrotum underwent surgery for suspected TT. Seventeen patients were excluded from the study as complete details were not available to score them. Thus a total of 112 patients were included in the study. A total of 73 patients were in TT group and 39 patients in NTT group. There were 26 patients (23.2%) with torsion appendage of testis, 12 patients (10.7%) with acute epididymo orchitis and 1 patient (0.9%) with infected hydrocele in NTT group.

The youngest patient in testicular torsion group was 10-day-old and NTT group was one year. The oldest patient in testicular torsion group was 12 years of age and NTT group was 12.5 years [Table/Fig-1]. Of the 112 patients, 104 patients underwent scrotal ultrasound scan with doppler and TT was reported in 58 patients. Torsion detorsion episode and suspected TT was reported in five patients.

Variables	Testicular Torsion (TT) (n=73)		Non Testicular Torsion (NTT) (n=39)	
	Mean	Range	Mean	Range
Age	4.5±2.98	10 days-12 years	5.2±2.2	1 year-12.5 years
Duration of pain	38.2 hours	6 hours-5 days	58.8 hours	12 hours-14 days

**[Table/Fig-1]:** Comparison of mean age and pain duration in Testicular Torsion (TT) and Non Testicular Torsion (NTT) group.

Among the components of TWIST and BAL score, absent cremasteric reflex, hard testicle, high riding testis, nausea/vomiting and pain duration <24 hours were found to be statistically significant [Table/Fig-2].

Clinical sign	Testicular Torsion (TT) (n=73)	Non Testicular Torsion (NTT) (n=39)	p-value
Pain duration <24 hours	4 (5.5%)	7 (17.9%)	<0.0001
Nausea/vomiting	53 (72.6%)	6 (15.4%)	<0.0001
Testicular swelling	73 (100%)	39 (100%)	1.0000
Absent cremasteric reflex	56 (76.7%)	2 (5.1%)	<0.0001
Hard testicle	47 (64.4%)	1 (2.6%)	<0.0001
High riding testis	53 (72.6%)	2 (5.1%)	<0.0001
Fever	7 (9.6%)	5 (12.8%)	0.598
Erythema	56 (76.7%)	33 (84.6%)	0.973
Dysuria	11 (15.1%)	6 (15.4%)	0.964

**[Table/Fig-2]:** Clinical data of children in Testicular Torsion (TT) and Non Testicular Torsion (NTT) group.

A total of 42 patients with TT presented within 24 hours; in which seven patients presented within eight hours. Thirty three patients (45.2%) underwent orchipexy and 40 (54.8%) underwent orchiectomy in TT group. In NTT group, 26 (60%) patients with torsion appendage of testis underwent excision of torsted appendage.

In TT group, mean TWIST score was 5.5±1.44 (range=2-7). In NTT group, mean TWIST score was 2.3±0.69 (range=0-5) [Table/Fig-3]. In TT group mean BAL score was 2.8±0.81 (Range 2-4) and in NTT group, the mean BAL score was 0.44±0.77 (Range 0-3) [Table/Fig-4].

Risk group	Twist score	Testicular Torsion (TT)	Non Testicular Torsion (NTT)	Total
Mean twist score		5.5±1.44	2.3±0.69	
Low (0-2)	0	0	0	33 (29.5%)
	1	0	0	
	2	2 (1.8%)	31 (27.7%)	
Intermediate (3-4)	3	5 (4.5%)	5 (4.5%)	25 (22.3%)
	4	13 (11.6%)	2 (1.8%)	
High (5-7)	5	13 (11.6%)	1 (0.9%)	54 (48.2%)
	6	14 (12.5%)	0	
	7	26 (23.2%)	0	
Total		73 (65.2%)	39 (34.9%)	112 (100%)

**[Table/Fig-3]:** TWIST score of Testicular Torsion (TT) and Non Testicular Torsion (NTT) group.

BAL score	BAL score	Testicular Torsion (TT)	Non Testicular Torsion (NTT)	Total
Mean BAL score		2.8±0.81	0.44±0.77	
<2	0	0 (0%)	28 (25%)	34 (30.3%)
	1	0 (0%)	6 (5.4%)	
≥2	2	33 (29.5%)	4 (3.6%)	78 (69.7%)
	3	22 (19.6%)	1 (0.9%)	
	4	18 (16.1%)	0 (0%)	
Total		73 (65.2%)	39 (34.8%)	112 (100%)

**[Table/Fig-4]:** BAL score of Testicular Torsion (TT) and Non Testicular Torsion (NTT) group.

The PPV and specificity of TWIST score for high-risk patients (Score ≥5) were 98.15% and 97.44%, respectively whereas the NPV and sensitivity of BAL score ≥2 group was 100% [Table/Fig-5]. Clinical images of the patients of both the groups is depicted in [Table/Fig-6-8].

Variables	Sensitivity (CI 95%)	Specificity (CI 95%)	PPV (CI 95%)	NPV (CI 95%)
TWIST score ≥3	97.26% (90.45 to 99.67%)	79.49% (63.54% to 90.7%)	89.87% (82.70% to 94.28%)	93.94% (79.65% to 98.40%)
TWIST score ≥5	72.6% (60.91% to 82.39%)	97.44% (86.52% to 99.94%)	98.15% (88.40% to 98.73%)	65.52% (56.59% to 73.47%)
BAL score ≥2	100% (95.07 to 100%)	87.18% (72.57 to 95.7%)	93.59% (86.56% to 97.07%)	100%

**[Table/Fig-5]:** Predictive capabilities of TWIST and BAL score in predicting Testicular Torsion (TT).



**[Table/Fig-6]:** Torsion Testis (TT) with gangrene (testicular torsion group). **[Table/Fig-7]:** Torsion appendage of testis (Non Testicular Torsion (NTT) Group). **[Table/Fig-8]:** Acute epididymo-orchitis (Non Testicular Torsion (NTT) Group). (Images from left to right)

## DISCUSSION

The aetiology of acute scrotum includes testicular torsion, torsion of testicular appendage, acute epididymo-orchitis, and infected hydrocele [14]. In this study, testicular torsion was found in 65.2% of patients with acute scrotum. In study by Manohar CS et al., TT comprised of 38% of boys with acute scrotum and in a study by Sheth KR et al., incidence of TT was 34.4% [5,12]. Selection bias may have contributed to higher incidence of TT in this study. Patients who underwent surgery were only included in this study. It could also be because of the fact that this institution is a referral tertiary care centre for paediatric patients.

The mean duration of pain in torsion group was 38.2 hour. Only 9.6% of the torsion cases presented to the hospital within eight hour. The orchiectomy rate in this study was 54.8%. In the study by Manohar CS et al., the mean duration of pain was 50.6 hours, 20% of torsion cases presented within eight hours and orchiectomy rate was 76% [5]. Literature reported orchiectomy rates of 28-50% in various series [15,16]. High orchiectomy rate in this study was due to delay in presentation to the centre. This emphasises the need of clinical diagnostic score for the early detection of TT. In this study, 72.6% had nausea/vomiting, 100% had testicular swelling and 76.7% had absent cremasteric reflex. In the study by Sazgar M et al., 37.1% had vomiting, 84.3% had testicular swelling and 81.4% had absent cremasteric reflex [17]. Thus, absence of cremasteric reflex does not rule out TT.

In this study, 72.6% of patients in testicular torsion group were in TWIST high risk (Score  $\geq 5$ ). There were none in TWIST low risk in TT group (Score 0 or 1). None in TT group had BAL score  $< 2$ . All testicular torsion patients had BAL score  $\geq 2$ . One patient with TWIST high risk (score 5) and BAL 3 was a case of infected hydrocele; for whom scrotal exploration and drainage was done. In study by Manohar CS et al., 57.8% of patients in TT group were in TWIST high risk and 4.4% in TWIST low risk group [5]. In study by Klinke M et al., all patients with testicular torsion showed BAL score  $\geq 2$  [13].

The NPV of TWIST score for low risk patients was 93.94% and PPV for high-risk patients was 98.15%. Barbosa JABA et al., reported NPV and a PPV of 100% in their series and stated that no patient with TT would be missed with TWIST score [9]. Manohar CS et al., reported NPV of TWIST score for low risk patients as 96.6% and a PPV for high-risk patients as 92.8% [5]. Although the NPV and PPV this study are not as high as the Barbosa JABA et al., study, this is still within acceptable limits. BAL score showed excellent capability to predict testicular torsion and reduce negative exploration as shown by 100% sensitivity and NPV. This was in concurrence with study by Klinke M et al., [13]. Clinical scores TWIST and BAL are helpful to assess and diagnose testicular torsion in patients presenting with acute scrotum. As both are convenient and easy to

perform bedside tests for patient evaluation, these can be used even by non specialist medical personnel. However, future prospective studies are required to validate them.

## Limitation(s)

The greatest limitation of the present study was the retrospective design. Conclusions were based on observation from a single study centre. Thus, a prospective multicentre study is required to validate the scores.

## CONCLUSION(S)

The TWIST and BAL are simple to perform clinical scores to diagnose TT. This will help to reduce complications and aid in early management of TT patients.

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