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Clinical score for surgical treatment of acute scrotum in pediatric age

Roberta Bonfiglio, Fabiola Cassaro, Chiara Cambiaso, Santi D'Antoni, Angela Simona Montalto, Salvatore Arena, Carmelo Romeo, Pietro Impellizzeri

Department of Human Pathology of Adult and Childhood "Gaetano Barresi", Unit of Pediatric Surgery - University of Messina, Italy

Abstract

Acute scrotum is a set of signs and symptoms that should lead the patient to go to a first aid center. There are different causes of these signs and symptoms, but testicular torsion is identified as the main ones and can be suspected thanks to a careful history, physical examination and testicular ultrasound. It is important to quickly differentiate the various conditions associated with acute scrotum in order to optimize surgery times and preserve testicular vitality.

Often the radiological study is essential to identify the causes of acute scrotum, in particular the testicular Doppler ultrasound is sensitive and specific for testicular torsion, infact it is considered the gold standard for diagnosis. However, the radiological study can delay surgical treatment and reduce testicular vitality.

So TWIST score was proposed. It is based on the identification of signs and symptoms that can lead at clinical diagnosis of testicular torsion.

Our narrative of literature review analyzes TWIST score validity and shows the utility of an adequate clinical examination obtaining a diagnosis of torsion cord, reducing the costs and the time of surgical treatment resulting in a higher likelihood of preserving testicular vitality.

KeyWords: Acute scrotum, Testicular torsion, TWIST score, Doppler ultrasound, Children, Pediatric patients

Introducing Member: Pietro Impellizzeri

Corresponding Author: Roberta Bonfiglio – bonfiglioroberta93@gmail.com

Introduction

Acute scrotum is a common condition in surgical and emergency departments. It includes clinicalentities characterized by pain, redness and scrotal swelling[20]. The most common causes of acutescrotum in childhood are trauma, acute epididymitis, pyocele, vasculitis, tension hydrocele,incarcerated inguinal hernia, varicocele, appendiceal torsion and spermatic cord torsion[19].

The latter is considered the most serious diagnosis of acute scrotum. Testicular torsion is defined astwisting of the spermatic cord along its long axis and can result in strangulation of the blood vesselssupplying the testicles[16].

Even if there is a bimodal distribution with a small peak in the first year of life and a large

peak in adolescence, the overall incidence of testicular torsion is 3,8 per 100.000children per year[15].

Anatomically testicular torsion can be intravaginal or extravaginal. In the first form, the twist occurswithin the vaginal tunic; this type of twist is typical in adolescent boys or young adults, and the maincause is abnormal grafting of the posterior side of the testis into the scrotum, allowing the testes torotate freely, resulting in the formation of a bell-clapper deformity. Conversely, extravaginal torsionis typical in the prenatal and neonatal period and is determined by abnormal descent of the testis; inthis case, testis is typically located in the inguinal canal[13]. Testicular torsion in infancy (< 1 years)is known to be a rare event[15].

Patients may also present with non-specific symptoms, such as severe pain, swollen erythematousscrotum, nausea and vomiting[22].

Because decreased blood flow can lead to ischemia and testicular necrosis, testicular torsion represents one of the most common pediatric urologic emergencies, and a careful but rapid differentialdiagnosis is necessary to optimize time to surgery and preserve testicular viability.

Intervention withinthe first 6 hours after treatment of testicular torsion results in high testicular survival. However, if thepresentation time exceeds 6 hours, orchiectomy can be performed in more than 50% of cases. Somestudies have shown that 34% to 42% of all cases of testicular torsion require orchiectomy[17].

Testicular torsion carries the risk of ligation shows risks of litigation, both criminal and civilprocedures. According to scientific literature data, Aquila et al. identified two main causes oflitigation: delay in diagnosis and misdiagnosis[13].

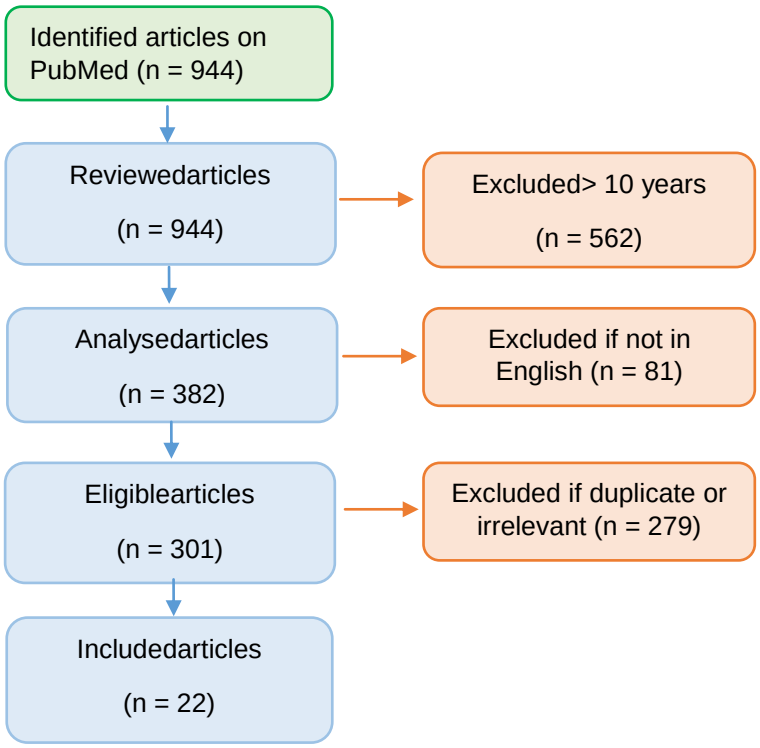
Therefore, the main objective of many studies has been to develop a scoring system that allows earlierdiagnosis of testicular torsion. In 2013 Barbosa et al. introduced the “Testicular Workup for Ischemiaand Suspected Torsion” (TWIST) score for acute scrotal presentations[1].

In this study we performed a narrative review to verify the diagnostic utility of the TWIST clinicalscore and to identify the ideal system for risk stratification.

Materials and Methods

Literature search was performed in PubMed for papers from January 2013 to December 2022. The following keywords were used: “TWIST score testicular torsion”, “TWIST score in children”,“TWIST score in pediatric patients”.“Acute scrotum in children”, and “Acute scrotum in pediatricpatients”.The search was limited to human studies with restrictions to English language literature.Comparativestudies, prospective and retrospective cohort studies were included. Full texts were analyzed. Twenty-two meet the inclusion criteria (Figure 1).

Fig.1 Articles identification: flow diagram.



All patients presenting with acute scrotal pain must be timely evaluated in order to exclude a testicular torsion that is a real surgical emergency[17].

The differential diagnosis of testicular torsion is a critical point in improving the management of acutescrotal pain and preventing gonad loss[18]. Although signs and symptoms associated with testicular torsion are well defined[1], many presentations are diagnostically equivocal and may lead to unnecessary investigations that may delay surgical management. Doppler ultrasound is the most important investigation for differential diagnosis of acute scrotum. Several ultrasound findings (absent or decreased testicular blood flow, presence of spiral and whirlpool sign, or knot twist, increased or heterogeneous testicular echogenicity, and inverted testicular alignment) are helpful in diagnosing testicular torsion[22]. Because of its high sensitivity (98–100%) and moderate to high specificity (69–98%), Doppler ultrasound is the gold standard for diagnosis of testicular torsion, although recent studies have indicated delays in the performance of ultrasound[10-14-18]. Therefore, there is a need to establish a score to assist physicians involved in emergency in order to optimize the use of Doppler ultrasound, to avoid a critical loss of time and to reduce the testicular ischemia time. Therefore, TWIST score was developed to identify patients at risk for testicular torsion. The TWIST score is based on the sum (ranging from 0 to 7) of the following historical and physical examination findings: testicular swelling (2 points), hard testicle (2 points), nausea or vomiting (1 point), absent cremasteric reflex (1 point) and high riding testicle (1 point). Risk stratification scores

ranging from 5 to 7 identified a patient with high risk for testicular torsion, while those 3 to 4 points and 0 to 2 points were considered at intermediate and low risk, respectively[1]. In patients with high suspicion of testicular torsion, urgent surgical exploration is indicated. In low risk patient for testicular torsion, antibiotic therapy should be administered (e.g. acute epididymitis). Only in patients at intermediate risk for testicular torsion complementary imaging studies are recommended[1-12].

Negative predictive value for scores of 2 or less was 100%, which supports the safe elimination of ultrasound in these cases. Similarly, the positive predictive value for scores of 5 or more was 100%, justifying surgical exploration in this group, because of the high suspicion of torsion without a definite diagnosis. Thus, the TWIST score could be used as a screening method for indication of ultrasound. While low and high-risk groups could be safely treated according to the score classification, patients at intermediate risk of torsion would benefit from complementary imaging studies. These individuals comprised approximately 20% of all acute scrotum cases, suggesting that the number of ultrasound orders could be reduce by 80%. A limitation in this study is that examination was performed by urologists only.

In Shah et al study Authors included seven criteria and patient age. They reported a recursive partitioning derived decision tool for children at low risk for testicular torsion, in which normal undescendent testis, absence of nausea or vomiting and age from 0 to 10 years were not risk factors for testicular torsion; whereas, horizontal or inguinal testicular lie, an abnormal cremasteric reflex, nausea and vomiting, scrotal edema and age between 11 and 21 years had a significantly higher probability of testicular torsion.

Sheth et al. examined the utility of the TWIST score when measured by trained non-physician, nonurologic personnel, particularly emergency medical technicians (EMTs), who are often the first medical providers to encounter patients in an emergency situation. Clinically meaningful TWIST score cutoffs of 0 and 6 were used to categorize patients into low risk (TWIST = 0), intermediate risk (TWIST = 1-5) and high risk (TWIST $\geq$ 6). No torsion was present in any of the patients with a TWIST score of 0, giving a negative predictive value (NPV) of 100% and specificity of 47.6%. Of the patients with TWIST $\geq$ 6 29/31 had torsion, corresponding to a positive predictive value (PPV) of 93.5% and a sensitivity of 65.9%. In Tanner stage 3-5 patients, the high-risk TWIST score had a PPV of 100% and sensitivity of 65.6%. In contrast, for Tanner stage 1-2 patients, a high-risk TWIST score had a PPV of 77.8% and sensitivity of 70.0%. In their study, ultrasonography was performed in all patients despite a 30-60 minute delay in diagnosis. The cutoff value for the highrisk score was 6, not 5, as previously reported. In addition, low-risk group cutoff of 0 was different than previously published. According to their data, a scrotal ultrasonography could be avoided in about

50% of cases. According to Sheth et al, also Manohar et al. suggested that TWIST score has high positive and negative predictive values, so it can be used as a clinical diagnostic tool for testicular torsion. For Frohlich et al. the TWIST score of 7 accurately identified males presenting with testicular torsion (Sensitivity of 21%, a specificity of 100% and a PPV of 100%). Although the low-risk TWIST score of 0 to 1 was associated with no males with testicular torsion on the initial Doppler ultrasonography, two patients were subsequently diagnosed with torsion with other abnormal Doppler ultrasonography findings; therefore, use of Doppler ultrasonography would be recommended also for males with low score.

Previous studies have suggested that the inherent delay associated with interhospital transfer may contribute to likelihood of orchiectomy; Huang et al. investigated testis outcomes associated with repeat ultrasound in patients with suspected testicular torsion. Their data suggest that testicular outcomes would improve avoiding repeat ultrasounds, minimizing the time between presentation and intervention.

Baskovic et al. supports the practice of early surgical consultation for children in whom testicular torsion is strongly suspected based upon history and physical examination rather than performing imaging. In their study, data were collected exclusively by pediatric surgeons. Cut off for low risk and high-risk patients were 2 and 5, respectively. Negative predictive value of TWIST score for low risk patients was 98.46%, while positive predictive value for high-risk patients was 92.86%. Sensitivity and specificity of TWIST score were 95.12% and 97.71%, respectively. Although they have had a high positive and negative predictive value in their study, a 38-58% of children were included in the intermediate group. Doppler ultrasound has a sensitivity of 83.9% and specific of 99.6% so, in a clinically unclear group of patients, they claim that must not neglect the usefulness of ultrasound in assisting on the final treatment decision.

The TWIST score was not considered reliable in Asian population. For this reason, Liam et al. developed the testicular torsion (TT) score. This score bases on a total of six factors: age group (<1 years old or >10 years old), nausea/vomiting, testicular swelling, testicular firmness, absence of cremasteric reflex and abnormal lie of testes. Score weightage was done using the odds ratio of each factor with age group, absence of cremasteric reflex and testicular firmness being given a score of 1. Meanwhile, nausea/vomiting, testicular swelling and abnormal lie being given a score of 2 as the latters were more strongly indicative of presence testicular torsion. The minimum score is 0 and the maximum score is 9. Analysis for both the TWIST score and Testicular Torsion score suggested that both scores were comparable at diagnosis of early testicular torsion (AUC of 0.87, 95% for TWIST and AUC of 0.91, 95% for TT score). They found that the diagnostic utility of the Testicular Torsion score to be better for risk stratification compared to the TWIST score in their population.

This may be due to: a lower cutoff value which resulted in a more inclusive scoring system to avoid misdiagnosis by junior doctors; their patients tend to present earlier with less classical signs suggestive of testicular torsion, which may result in higher likelihood of missed torsions; furthermore, one other reason for reduced utility of the TWIST score, as compared to the Testicular Torsion score was the clinical experience and training of junior doctors.

In this study, prehospital delay of >6 h was found to correlate with decreased testicular viability. Although this factor cannot be controlled, a multi-pronged approach of reducing time to surgery and reducing need for ultrasonography for testicular torsion cases may improve outcomes. The testicular torsion score is a good alternative to the TWIST score for use amongst non-specialists and has a sensitivity and negative predictive value of 100% for excluding testicular torsion in the Asian population. It has also a high specificity and positive predictive value as a clinical diagnostic tool for testicular torsion.

Shunmugan et al. demonstrated that timing of patient presentation after symptom onset was directly linked to rates of orchiectomy. The major opportunity to salvage testicular function after symptom onset is suggested to be 4 to 8 hours as the rate of orchiectomy increases and testicular function decreases not intervening within this time. Use of the TWIST score resulted in a negative predictive value of 100% for the low-risk (score 0) group and a positive predictive value above 93% for the high-risk (score $\geq$ 6) group. A TWIST score of 6 or 7 can make a clinical diagnosis of testicular torsion, and surgical consultation should be done immediately; patients with a TWIST score of 0 require no follow-up; patients with a TWIST score of 1 to 5 need of Doppler Ultrasound or surgical consultation. When patients are in the moderate-risk category, Doppler ultrasound can be used to supplement the TWIST score, although it should not delay definitive management.

Robert et al. show that TWIST score based on history and physical exams performed by emergency physicians and pediatric surgeons appeared to effectively predict which patients had testicular torsion and which patients did not have testicular torsion without the use of Doppler ultrasound groups. Application of TWIST may eliminate the need for Doppler ultrasound, and thereby, decrease ischemic time and cost of care in high-risk patients. It may likewise eliminate the need for Doppler ultrasound and surgical consultation, and thereby, decrease Emergency Department length of stay and cost of care in low-risk patients.

In their retrospective study, Pinar et al. demonstrated that Doppler ultrasound before scrotal exploration for suspected testicular torsion was safe, feasible and useful in patients with low testicular torsion suspicion. Its use did not increase the risk of orchidectomy or delay surgery by slightly more than 1 h. Doppler ultrasound performance was better among patients who presented more than 6 h after the onset of their symptoms and for older patients. However, physical

examination remains superior to imaging, especially when suspicion of testicular torsion is strong

Conclusion

Although there are differences in the classification of patients into high, intermediate and low-risk and in the percentage value of predictability and sensitivity, all authors agree that an adequate physical examination with the identification of symptoms and signs of TWIST score allows to make the diagnosis of testicular torsion in patients with high score and to reduce the number of requiring doppler ultrasound thus reducing costs and, above all, intervention times, which are useful for maintaining gonadal vitality. While, our literature review, in patients with low and intermediate risk, Doppler ultrasound is recommended to exclude or confirm suspicion of testicular torsion.

Conflicts of interest: The authors declare no conflict of interest.

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