

## ORIGINAL ARTICLE

# Diagnostic Accuracy of Doppler Ultrasonography for the Testicular Torsion in Patients with Acute Scrotum taking Intraoperative Findings as Gold Standard

MUHAMMAD YASEEN TAHIR<sup>1</sup>, HAFIZ ZAHEER AHMED<sup>2</sup>, MUHAMMAD HASSAAN<sup>3</sup>, BISHIR AHMAD NOOR<sup>4</sup>, MUHAMMAD ZUBAIR<sup>5</sup>, BURHAN RASHEED<sup>6</sup>, USAMA ANWAR<sup>7</sup>

<sup>1</sup>Consultant surgeon, Tehsil head quarter hospital jaranwala, Distt Faisalabad

<sup>2</sup>Department of Surgery and Surgical Emergency, DHQ Toba Tek Singh

<sup>3</sup>Senior Registrar, General Surgery, Indus Hospital & Health Network-QF, NST & SMP Campus, Lahore, Pakistan.

<sup>4</sup>Consultant surgeon, THQ Hospital, 18-Hazari

<sup>5</sup>Professor of Surgery, Niazi Medical and Dental College Sargodha

<sup>6</sup>Assistant Professor of Radiology, Watim Medical College, Rawalpindi

<sup>7</sup>Undergraduate, KEMU, Mayo hospital, Lahore

Corresponding author: Muhammad Hassaan, Email: [muhammad.hassaan01@tth.org.pk](mailto:muhammad.hassaan01@tth.org.pk)

## ABSTRACT

**Objective:** To analyze the diagnostic accuracy of Doppler ultrasonography in detecting acute testicular torsion in patients presenting with acute scrotal pain against the surgical findings as Gold Standard.

**Material and methods;** Cross-sectional study was conducted at the Department of surgery and Radiology of Indus Hospital, Lahore Watim Medical College, Rawalpindi and Niazi Medical and dental college, Sargodha over 6 months. Total 111 males of age 15-45 years having acute scrotal pain (12-48 hours) and testicular torsion diagnosed clinically were enrolled using non-probability-purposive sampling. Doppler ultrasonography was performed on every patient by single radiologist, by using TOSHIBA Just Vision USG machine equipped with curvilinear probe and Doppler USG facilities. Then patients were referred for surgery which was performed by one team, and per-operative findings were documented.

**Results:** Mean age of patients was  $29 \pm 6.52$  years. Average duration of scrotal pain  $18.12 \pm 5.03$ , average scrotal pain was  $7.17 \pm 1.50$ . Forty-three (38.7%) patients had moderate pain, 68 (61.3%) had severe pain. On doppler ultrasonography testicular swelling was seen in 106(95.5%), decreased echogenicity was absent, 100 (90.1%) patients had decreased blood flow. The sensitivity and specificity of doppler ultrasonography was 98.06% and 87.5%, respectively taking surgical findings as gold standard. Positive and negative predictive value of doppler ultrasonography were 99.02% and 77.78% respectively, diagnostic accuracy of Doppler ultrasonography was 97.3% taking surgical findings as gold standard

**Conclusion:** Our finding suggest, this modality of Doppler ultrasonography can be used to detect testicular torsion in patients having acute scrotum as it has reliable sensitivity (98.06%), specificity (87.5%) as well as high diagnostic accuracy (97.3%).

**Keywords:** Scrotal pain, Echogenicity, Testicular swelling, Doppler ultrasonography, Torsion

## INTRODUCTION

Torsion of the testis, undisputedly, is the commonest reason of having pain scrotum while other causes being orchitis, torsion of appendix testis and/or epididymitis. Testicular torsion is a universal surgical emergency because with passing time, testicular salvage becomes impossible if the duration of ischemia is prolonged [1]. Testicular torsion must be discriminated from rest of the testicular pains as it is a true emergency and any delay in its treatment can cause a patient to lose his testis [2].

Until proven otherwise, all prepubertal and young adult males with acute scrotal discomfort should be believed to have testicular twisting [3]. Testicular Torsion affects around 20% of males who report with an acute scrotum [4]. The most typical clinical manifestations are a red, enlarged scrotum and an extremely painful testicle, which can occur even when etiology is not even trauma. Along with other symptoms, vomiting like symptoms may also persist. [5].

Thus, linked to specific traits solely, it is harder to identify testicular torsion from torsion of appendix testis and epididymitis/orchitis. The boys with testicular torsion, on the other hand, sought medical assistance sooner.[6] Doppler ultrasonography (DUS) has recently emerged as an imaging tool for the assessment of the acute scrotum with the goal of identifying ischaemia, hence decreasing the indication of operative management. [7]

A swollen heterogeneous testis, an unilateral hydrocele, skin swelling, and no colour Doppler flow signal in the testis or spermatic cord are among the observations in the United States [8]. Doppler ultrasonography for the diagnosis of testicular torsion has a sensitivity of 94% and a specificity of 96% [9].

However, on review of literature it becomes evident that there are shortcomings in considering Doppler as Gold Standard, and stating that testicular torsion is suspected and confirmed clinically requiring consideration of many variables, not only color

Doppler.[10] Rationale of the study is to evaluate the diagnostic accuracy of Doppler USG as the noninvasive technique to detect testicular torsion and avoid undue surgical exploration. DUS is cost & time effective and non-invasive technique. If DUS will yield high diagnostic accuracy for testicular torsion, then in future we will use DUS as primary diagnostic tool to screen patients with scrotal pain. It will help to excessive surgeries and reduce burden of surgeons and hospital

## MATERIALS AND METHODS

This was a cross-sectional study and was performed Department of surgery and Radiology of Indus Hospital, Lahore Watim Medical College, Rawalpindi and Niazi Medical and dental college, Sargodha from 25<sup>th</sup> October 2020 to 25<sup>th</sup> March 2021. After taking permission from ethical committee of hospital, 111 male patients fulfill selection criteria were enrolled in the study from emergency department. Written informed consent was taken from the each patient was taken. Demographic profile (name, age, address) will also obtained from each patient. Doppler ultrasonography was carried out in all the patients by a single radiologist under supervision of my supervisor by using TOSHIBA Just Vision USG machine equipped with curvilinear probe and Doppler USG facilities and the findings was recorded After this, the patients were referred for surgery and per operative findings documented. Surgeries were performed by a single team. All these findings were noted on proforma (attached). Statistical analysis was done by using SPSS version 23. The qualitative data like Doppler USG findings, severity of pain (mild, moderate, severe) for testicular torsion was presented as frequency distribution. Quantitative data in the study like age was presented as means and standard deviations. 2x2 table was generated to calculate sensitivity, specificity, positive predictive values, negative predictive values and diagnostic of CDUS taking surgery as a gold standard. Effect modifiers like age and duration of pain was controlled by

stratifications. Chi-Square test was applied to see significance of these effect modifiers, at p-value ≤ 0.05.

**RESULTS**

The mean age of patients was 29 ± 6.52 years with minimum and maximum ages 15 and 45 years (age range = 30 years) respectively. There were 56 (50.45%) patients who were 15-29 years of age and 55(49.5%) were 30-45 years of age. The mean duration of scrotal pain was 18.12 ±5.03 hours with minimum and maximum duration of pain 12 – 24 hours. There were 61 (54.95%) patients who presented with 12-17 hours of their pain and rest of 50 (45.05%) presented with 18-24 hours. According to visual analog scale (VAS) scrotal pain was also measured, the average scrotal pain was 7.17 ± 1.50. The minimum and maximum scrotal pain was 5 and 10 on VAS respectively. Forty-three (38.7%) patients had moderate pain and 68 (61.3%) presented with severe pain. On Doppler ultrasonography testicular swelling was seen in 106(95.5%) patients, decreased echogenicity was not found in any patient while decreased blood flow was observed in 100 (90.1%) of the patients. Testicular torsion was found positive in 102 (91.9%) patients on Doppler ultrasonography.

Testicular torsion was found positive in 103 (92.8%) patients on their surgical findings. Moreover, there were 101 (91%) patients who were diagnosed positive on both Doppler ultrasonography and on surgical findings, 1(0.9%) patient was diagnosed positive on Doppler ultrasonography but was negative on surgical findings, 2(1.8%) patients were diagnosed positive on surgical findings and were negative on Doppler ultrasonography. Lastly, 9(6.3%) cases that were diagnosed negative on both Doppler ultrasonography and surgical findings. The sensitivity and specificity of Doppler ultrasonography was 98.06% and 87.5% respectively taking surgical findings as gold standard. Positive and negative predictive value of Doppler Ultrasonography were 99.02% and 77.78% respectively while overall diagnostic accuracy of Doppler ultrasonography was 97.3% taking surgical findings as gold standard.

We stratified our data over age groups (15-29, 30-45) and duration of pain (12-17 hours and 18-24 hours). Applying chi-square we found significant association between diagnosis of Testicular torsion on surgical and Doppler ultrasonography with respect to age groups and duration of pain (p-value < 0.05).

Table -1: showing the details of testicular torsion diagnosed on Doppler ultrasound and surgical findings (n=111)

	Frequency	Percent	Cumulative Percent
Yes	102	91.9	91.9
No	9	8.1	100
Total	111	100.0	
Surgical Findings of testicular torsion			
	Frequency	Percent	Cumulative Percent
Yes	103	92.8	92.8
No	8	7.2	100
Total	111	100.0	

Table -2: Doppler Ultrasonography for the Testicular Torsion in Patients with Acute Scrotum taking Intraoperative Findings as Gold Standard (n=111)

Sensitivity	98.06%
Specificity	87.5%
Positive Predictive Value	99.02%
Negative Predictive Value	77.78%
Diagnostic Accuracy	97.3%

**DISCUSSION**

The acute scrotum remains to be most challenging diagnostic confusion for radiologists due to absence of any of the examinations or test that could provide definitive results with 100% accuracy. Because of this surgical exploration is considered the only better option. [13] This need further necessitates due to lack of latest and accurate diagnostic materials and therapies. However sometimes surgical exploration may not be required and results in delay or misleading diagnosis issues. [14] The consequences of a

mistaken diagnosis have underscored the need for a non-invasive test for verifying testicular hypoxemia, which has traditionally been cited as a problem in specific diagnosis. [15]

Often urologists recommend rapid surgical probing without radiographic screening if the history and examination are very suspect for torsion. However, up to 70% of patients with acute scrotum include disease that does not necessitate operations. [16] For that reason, there exists a great need for rapid, accurate, noninvasive, widely available radiologic test for testicular torsion that could provide faster and accurate utility for this purpose. One of such modalities that meet most of these defined criteria is color Doppler ultrasound (CDUS). Unsurprisingly, the introduction of CDUS (and later 'power' Doppler and microbubble ultrasound contrast) was met with delight. [12, 15, 17]

Colour Doppler imaging (CDI) has become the preferred method for evaluating the scrotum due to technical developments that have resulted in improved magnification and sensitive Doppler devices. CDI has been especially useful in examining the scrotum in the context of acute illnesses such as spermatic cord torsion, epididymal and testicular inflammation, and scrotal trauma [18] and should conveniently be opted for such investigations. [19] The majority of findings on colour Doppler US in the acute scrotum included patients whose history, physical examination, and laboratory assessment indicated that immediate surgical treatment for torsion without diagnostic imaging study was necessary. Nevertheless, many rare case reports in the urologic annals show cases of missing testicular torsion by colour Doppler US imaging (US), raising legitimate concerns about its usage.[20, 21]

Extravaginal twisting affects newborns throughout the early postnatal period, whereas intravaginal twisting affects men of any ages, but most typically teenaged males.[2] In males <25 years of age, the annual incidence of torsion in the US is 1 in 4000.[22] Torsion can be seen at any age but it is not generally a disease affecting the elderly. [23]

One study included 670 patients with torsion of the spermatic cord presenting in Bristol between 1960 and 1984 to see the incidence and other factors of testicular torsion over the period of 25 years. They determined that perhaps the yearly frequency of torsion has grown four - times between 1960 to 1964, from 11.2 cases to 42.8 cases from 1980 and 1984. During this time, general surgeons cared for ≥90% of cases. Individuals aged 12 to 18 years made up 62% of the total, whereas 20% were 21 or more. The age ranges of our study resemble this review to great extent. [24]

According to visual analog scale (VAS) scrotal pain was also measured, the average scrotal pain was 7.17 ± 1.50, 5 and 10 as minimum and maximum on VAS respectively. Forty-three (38.7%) patients had moderate pain and 68 (61.3%) had severe pain. Scrotal pain is the first indication for possibility of testicular torsion. A two year retrospectively performed examination of 238 instances of acute scrotal discomfort revealed that the rates of testicular torsion, testicular appendage torsion, and epididymitis were 16%, 46%, and 35%, respectively. They concluded that the testicular disease was dependent on duration from onset of pain till surgical exploration. [11].

In our study, on Doppler ultrasonography testicular swelling was seen in 106(95.5%) patients, decreased echogenicity was not found in any while decreased blood flow was observed in 100 (90.1%). Testicular torsion was found positive in 102 (91.9%) patients on Doppler ultrasonography. Testicular torsion was found positive in 103 (92.8%) patients on their surgical findings.

Moreover 101 (91%) patients were diagnosed positive on both Doppler ultrasonography and on surgical findings, 1(0.9%) patient was diagnosed positive on Doppler ultrasonography but was negative on surgical findings, 2(1.8%) patients were diagnosed positive on surgical findings and were negative on Doppler ultrasonography. Lastly 9(6.3%) cases were diagnosed negative on both Doppler ultrasonography and surgical findings. The sensitivity and specificity of Doppler ultrasonography was 98.06% and 87.5% respectively taking surgical findings as gold standard. Positive and negative predictive value of Doppler

Ultrasonography were 99.02% and 77.78% respectively while overall diagnostic accuracy of Doppler ultrasonography was 97.3% taking surgical findings as gold standard.

Another study compared the clinical accuracy of ultrasound with that of surgical exploration. The findings revealed that periodic testicular twist was found in three individuals and that urgent intervention was undertaken in 17 cases for ultrasonographic diagnosis of torsion. Following that, 25 subjects (22.7 percent) were missed to follow-up. A follow-up of 85 individuals with negative sonographic findings for testicular torsion (mean follow-up = 466.9 days) indicated no testicles shrinkage in 83 of them. For undetected testicle torsion, two patients received late orchiectomy/contralateral orchiopexy. As a result, in their investigation, colour Doppler ultrasonography for the ambiguous acute scrotum gave a 1% false-positive rate, a sensitivity of 88.9%, and a specificity of 98.8% [25].

Another study compared the diagnostic accuracy of Color Doppler Sonography (CDS) and Ultrasound with surgical exploration. They found that out of 150 patients to be examined Conventional ultrasonography was abnormal in 95 (63.3 percent) subjects; CDS was pathogenic in cases diagnosed, with 42 of these indicating testicular twisting. The sensitivity and specificity of ultrasonography in the or before surgery assessment of scrotal emergencies were 100 percent and 90 percent, respectively, while the sensitivity and specificity of medical examination and CDS were 100 percent vs 95.7 percent and 86.5 percent compared 85.3 percent, in both.[26]

All the above cited studies are compatible with our results and support that inclusion of Doppler ultrasound should be appreciated for its advantages like speed, accuracy, non-invasive nature and safety. Further studies are recommended to explore all diagnostic options in depth and generate evidence for usage of ultrasound for possibility of testicular torsions after acute scrotal pain.

## CONCLUSION

As per this study, Doppler ultrasonography can be utilized to diagnose testicular torsion in patients with acute scrotal pain with reliable sensitivity (98.06%), specificity (87.5%) and good diagnostic accuracy (97.3%). DUS is cost & time effective and non-invasive technique so in future we can use DUS as primary diagnostic tool to screen patients with scrotal pain that will help to get rid of excessive surgeries and reduce burden of surgeons and hospital.

**Limitations:** are that we did not have a large sample size and it is a single center study. It needs to be done at multi institutional level.

**Strengths:** were that all the imaging and surgeries were performed by same sets of teams which reduced the bias.

**Acknowledgement:** Department of surgery and Radiology of Indus Hospital, Lahore Watim Medical College, Rawalpindi and Niazi Medical and dental college, Sargodha.

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