

# Diagnostic accuracy of Color Doppler Ultrasonography to diagnose testicular tumors

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## ABSTRACT

**Background:** Testicular tumors are commonly diagnosed reproductive age group tumors. Color Doppler ultrasound can identify the tumor location as well its perfusion. It is an easily available modality and can differentiate intra-testicular and extra-testicular scrotal pathologies.

**Objective:** To determine the diagnostic accuracy of color Doppler Ultrasonography to diagnose testicular mass / tumors taking histopathology findings as gold standard.

**Patients and methods:** A cross sectional study was conducted at Radiology Department of Civil Hospital Karachi during the period of 1<sup>st</sup> January 2016 to 1<sup>st</sup> July 2017. Total 413 patients having scrotal pathologies/masses since more than 2 months were included. Color Doppler ultrasonography was performed by 2 senior radiologists with more than 5 years post fellowship experience. Transverse images were obtained in all patients and tumor was defined as heterogeneous mass in testes with increased vascularity. Patients were followed till histopathological findings were noted. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated. Stratification was done. Post stratification chi-square test was applied. A p-value  $\leq 0.05$  was considered as significant.

**Results:** The mean age was  $38.72 \pm 7.58$  years. Mean duration of scrotal masses was  $4.64 \pm 1.33$  months. In Color Doppler ultrasound 58.8% patients were found positive for malignancy. Histopathological confirmation of testicular tumour was obtained in 48.4% of these patients. The sensitivity of color doppler ultrasonography was found to be 87%, specificity 67.6%, PPV 71.6%, NPV 84.7% and overall diagnostic accuracy 77.0%.

**Conclusion:** The diagnostic accuracy of Color Doppler Ultrasonography was found to be higher in the diagnosis of testicular tumor.

## Keywords:

Color Doppler Ultrasonography, histopathology and scrotal diseases.

## INTRODUCTION

Testicular cancer is the most frequently diagnosed malignancy in reproductive age group.<sup>1</sup> In a study, its incidence in Asia is revealed as 2.1 per 100,000 cases.<sup>2</sup> The treatment of testicular cancer in current era is very effective and its success is reported to be almost 90 percent.<sup>3</sup> However, the nonspecific sign and symptoms of testicular carcinoma has made its diagnosis highly challengeable task for the clinicians. Studies reported that for the diagnosis of testicular carcinoma, color doppler ultrasonography is an effective tool and has advanced capability to describe all features in real time.<sup>4,5</sup> Color Doppler Ultrasonography is not only useful in detecting broad-spectrum grey scale changes which occurs with testicular ischemia but it also helps in

diagnosis of blood flow in testicular vessels as well.<sup>6</sup> In addition to this, Color Doppler Ultrasonography plays a vital role in differentiating intra-testicular from extra-testicular abnormalities. This feature of Color Doppler Ultrasonography is also important as patients with intra-testicular solid masses are at higher risk of having testicular tumor.<sup>7</sup> Studies reported that Magnetic Resonance Imaging (MRI) could also be an alternative choice and the use of MRI in diseases of scrotum is increasing.<sup>8,9</sup> However, because MRI is expensive and not easily available in all places in developing country like Pakistan, MRI is only recommended when findings of Color Doppler ultrasound is inconclusive.

Objective of this study is to determine the diagnostic accuracy of color Doppler ultrasound in evaluating the testicular masses/tumors and to differentiate various scrotal masses on basis of abnormal vascularity on color Doppler Ultrasonography.

## PATIENTS AND METHODS

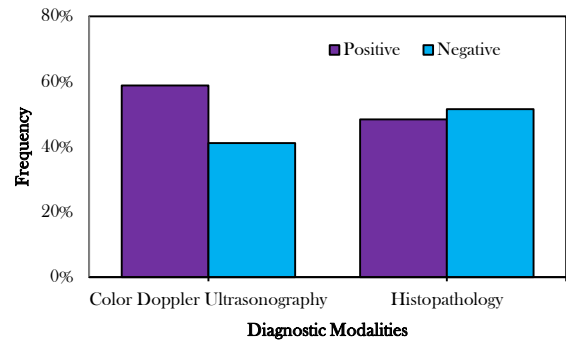
This cross-sectional study was conducted from 1<sup>st</sup> January 2016 to 1<sup>st</sup> July 2017 at radiology department of Civil Hospital Karachi, Pakistan. All consecutive males with 20-50 years of age having scrotal pathologies/lump with history of more than 2 months were enrolled. Those with

**Competing interest:** The authors have declared no competing interests exist.

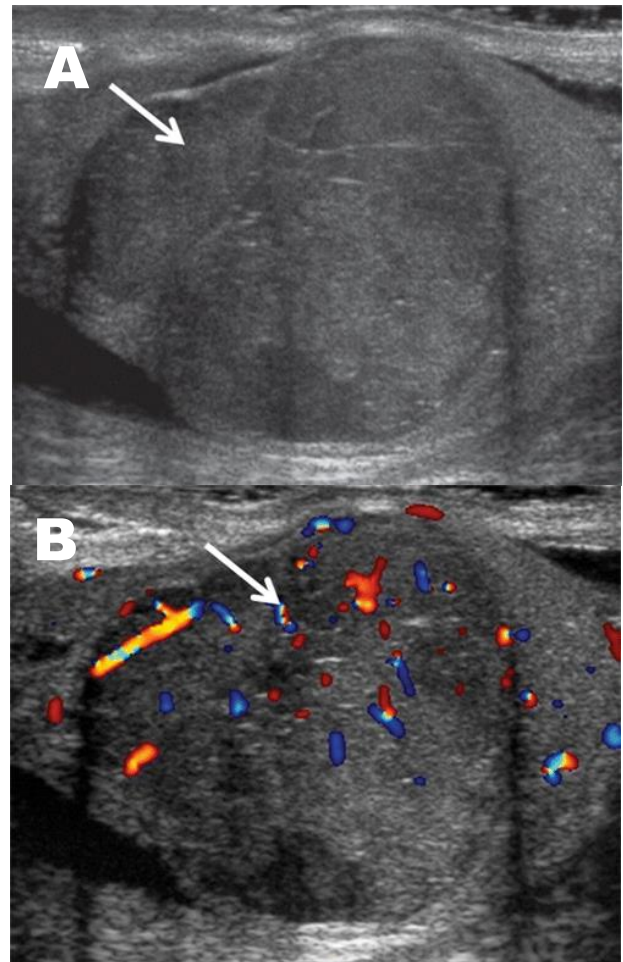
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Inguinoscrotal hernia (confirmed on ultrasound) and undescended testis (confirmed on ultrasound) were excluded. Sample size was calculated by taking sensitivity 87.5%,<sup>8</sup> specificity 66.7%,<sup>8</sup> reported prevalence 16%,<sup>8</sup> margin of error 8%, and confidence level 95%. The calculated sample size was 413 patients. Linear color Doppler multifrequency transducer was used for the scanning by 2 senior radiologists having at least 05 years post fellowship experience. Sagittal and transverse images of scrotal/testicular pathologies were obtained using a LOGIQ 500 (GE Wipro) ultrasound machine with the linear high frequency (9-12 MHz) transducer. All images were protected on the work station and were reviewed by the senior radiologists. Based on high suspicion on color duplex, patients underwent orchidectomy and specimen was sent for histopathology. Testicular tumors on color Doppler ultrasonography was defined as heterogeneous mass in testes with increased vascularity characterized by testicular peak systolic velocity of >10 cm/sec (normal, 5-10 cm/sec) and testicular end diastolic velocity of >5cm/sec (normal, 3-5 cm/sec).<sup>7</sup> Testicular tumors on histopathology were diagnosed by histopathologist by presence of any two or more of following; (1) sheets of polygonal cells separated by dense fibrous with focal lymphocyte infiltration, (2) cytological atypia (3) large pleomorphic nuclei with one or two prominent nucleoli (4) sporadic mitotic figures.<sup>10</sup>

A contingency table was constructed and “sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall diagnostic accuracy” of color Doppler Ultrasonography were estimated by using histopathology as ‘gold standard’. Data analysis was performed using SPSS Version 19. The quantitative variables like age and duration of the scrotal masses were presented by mean  $\pm$ SD. Frequency and percentage were calculated for gender, color Doppler Ultrasonography (Color Doppler Ultrasonography) findings (benign and malignant) and histopathological findings (benign and malignant). Diagnostic value of color Doppler ultrasonography images, its accuracy, sensitivity, specificity, PPV and NPV were determined by taking histopathology as gold standard by using contingency table. Stratification was



**Figure 1:** Frequency of testicular tumor on both diagnostic modalities (n=413)



**Figure 2.** A) Gray-scale US image shows a homogeneous lobular intratesticular mass (arrow). (B) Color Doppler US image shows internal blood flow in the mass (arrow). Findings likely represent testicular malignancy.

done with regards to age and duration of symptoms to see the effect of these on testicular malignancy.

## RESULTS

Out of total 413 patients, mean age was  $38.72 \pm 7.58$  years. There were 230 (56%) patients under 40 years and 183 (45%) patients over 40 years of age. The mean duration of scrotal masses was  $4.64 \pm 1.33$  months. There were 227 (55%) patients with less than 4 months and 186 (45%) with more than 4 months of duration of scrotal masses.

The finding of Color Doppler Ultrasonography for detection of testicular tumor showed that 243 (58.8%) patients were found positive and 200 (41.2%) were found negative for testicular tumor. While on histopathology, 200 (48.4%) patients were found positive and 213 (51.6%) were found negative for testicular tumor (Figure 1 and 2)

Diagnostic accuracy showed that there were 174 true positive and 144 true negative. The sensitivity of color doppler ultrasonography was found to be 87%, specificity 67.6%, PPV 71.6%, NPV 84.7% and overall diagnostic accuracy 77.0% (Table 1). When stratified on the basis of age and duration of scrotal mass, the overall diagnostic accuracy of Color Doppler Ultrasonography to diagnose testicular tumor was 75% for patients under 40 years of age, 80% for patients over 40 years of age, 74% for less than 4 months of duration of scrotal masses and 81% for more than 4 months of duration of scrotal masses (Table 2).

## DISCUSSION

Testicular ultrasonography is a useful noninvasive imaging tool and is considered a gold standard for initial imaging exploration of the testis.<sup>11</sup> For the

appropriate management of testicular tumor, color doppler ultrasonography is a valuable screening and diagnostic modality.<sup>12,13</sup> Various studies have reported that testicular ultrasonography has a wide range of applications, varying from "acute scrotal pain to more chronic and nonspecific symptoms".<sup>12-14</sup> Grey scale scrotal ultrasonography can differentiate between solid and cystic masses and localize the mass as either testicular or paratesticular.<sup>12,15</sup> A study conducted by Middleton and coauthors on evaluation of acute scrotal pain reported diagnosed accuracy of color Doppler ultrasonography in all patients.<sup>16</sup> Another study has reported that color doppler ultrasonography is fast, easily available, dynamic and non-invasive imaging modality.<sup>17</sup>

Various studies have reported higher diagnostic accuracy of color Doppler ultrasonography for the diagnosis of testicular pathologies like torsion.<sup>18-23</sup> In several studies, diagnostic accuracy of color Doppler ultrasonography was found to be hundred percent sensitive and specific for the determination of acute scrotal pathologies.<sup>20,23</sup>

In this study, diagnoses of inflammatory scrotal diseases and testicular torsion by color doppler ultrasonography showed higher sensitivity and specificity. Derouet and colleagues reported diagnostic accuracy of color Doppler ultrasonography to be sensitive in 90% and specific in 55% cases for detection of testicular neoplasms.<sup>22</sup> In another study, reported sensitivity and specificity was 88% and 67% respectively in testicular neoplasms detection.<sup>4</sup> These reports are comparable with findings of present study.

It is reported in literature that majority of the patients with testicular pathologies presented with non-specific signs and symptoms<sup>18</sup>, therefore it is very

**Table 1.** Diagnostic accuracy of color Doppler ultrasound to diagnose testicular tumor taking histopathology as gold standard (n=413)

Color Doppler ultrasound findings	Histopathology findings			p-value
	Present (n=200)	Absent (n=213)	Total	
Present (n=243)	174	69	243	<0.001
Absent (n=170)	26	144	170	
Total	200	213	413	
<b>Sensitivity</b>	<b>Specificity</b>	<b>PPV</b>	<b>NPV</b>	<b>Accuracy</b>
87.0%	67.6%	71.6%	84.7%	77.0%

**Table 2.** Diagnostic accuracy of color Doppler ultrasound to diagnose testicular tumor taking histopathology as gold standard with respect to age and duration of scrotal masses (n=413)

	No. of Patients	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
<b>Age in years</b>						
≤40	230	85.50%	65%	69.10%	83%	75%
>40	183	88.90%	71%	74.80%	86.80%	80%
<b>Duration of scrotal masses, months</b>						
≤4	227	85.50%	62.40%	68.10%	82%	74%
>4	186	88.90%	74%	76.20%	87.70%	81%

difficult for clinicians to diagnose the underlying pathology. For this, color doppler ultrasonography is an important diagnostic modality for the determination of scrotal diseases. It not only has high accuracy for the

diagnosis of scrotal pathologies but also accurately determines the normal anatomy as well.

## CONCLUSION

The finding of this study revealed that color Doppler ultrasonography has a high sensitivity, moderate specificity and high diagnostic accuracy in diagnosing testicular tumors

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