



Role of Ultrasonography and Colour Doppler in the Evaluation of Scrotal Pathologies.

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Abstract

Background: Scrotal pathologies commonly present with pain, swelling, infertility, trauma or palpable mass. Ultrasonography with colour Doppler is the first-line imaging modality because it provides anatomical and vascular assessment without radiation.

Purpose: To evaluate the role of ultrasonography and colour Doppler in the diagnosis and characterization of scrotal pathologies. **Materials and Methods:** This hospital-based cross-sectional observational study included 100 patients presenting with scrotal symptoms. High-frequency grayscale ultrasonography and colour Doppler were performed. Lesions were classified as testicular or extratesticular, inflammatory, vascular, traumatic, cystic or neoplastic. Doppler vascularity was assessed and correlated with clinical diagnosis. Data were analysed using descriptive statistics. **Results:** The commonest presentation was scrotal pain in 42 patients, followed by swelling in 36 patients. Inflammatory pathology was the most frequent diagnosis, seen in 34%, followed by hydrocele in 22%, varicocele in 18%, testicular torsion in 8%, trauma-related lesions in 6%, tumors in 4% and other lesions in 8%. Colour Doppler showed increased vascularity in inflammatory lesions, absent or markedly reduced vascularity in torsion and venous reflux in varicocele. Most extratesticular lesions were benign. **Conclusion:** Ultrasonography with colour Doppler is a reliable, non-invasive and cost-effective first-line investigation for scrotal pathologies. It helps differentiate testicular from extratesticular lesions, inflammatory from ischemic causes of acute scrotum and benign from suspicious masses, thereby guiding timely management.

Keywords: Scrotum, Ultrasonography, Colour Doppler, Epididymo-orchitis, Testicular torsion, Varicocele.



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INTRODUCTION

Scrotal pathologies are a common cause of acute and chronic scrotal symptoms and may present as pain, swelling, infertility, trauma or palpable mass. Ultrasonography is considered the imaging modality of choice because it is readily available, non-invasive, inexpensive and free of ionizing radiation.¹

High-frequency grayscale ultrasonography provides excellent anatomical detail and accurately differentiates intratesticular from extratesticular lesions. Most extratesticular lesions are benign, whereas intratesticular solid lesions are considered potentially malignant until proven otherwise.²

Colour Doppler ultrasonography further enhances diagnostic accuracy by evaluating vascularity and perfusion. It is particularly valuable in the assessment of acute scrotum, where differentiation between epididymo-orchitis and testicular torsion is crucial because torsion requires urgent surgical intervention.^{3,4}

Colour Doppler also plays an important role in the evaluation of varicocele, infertility, scrotal trauma and testicular neoplasms.^{5,6} Recent studies have demonstrated high diagnostic accuracy of combined grayscale and Doppler ultrasonography in the assessment of a wide spectrum of scrotal disorders.^{7,8}

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted in the Department of Radiodiagnosis, Krishna Vishwa Vidyapeeth (Deemed To Be University), Karad, Maharashtra, over a period of 12 months after obtaining approval from the Institutional Ethics Committee. A total of 100 consecutive patients presenting with scrotal symptoms such as pain, swelling, palpable scrotal mass, infertility, trauma, suspected torsion, varicocele, epididymo-orchitis, or other scrotal

abnormalities were included in the study after obtaining written informed consent. Patients with previous scrotal surgery causing significant anatomical distortion, inadequate imaging quality, or unwillingness to participate were excluded from the study.

All patients underwent detailed clinical evaluation including history, physical examination findings, duration of symptoms, side involved, history of trauma, fever, infertility, and relevant laboratory investigations wherever available. Ultrasonographic examination was performed using a high-resolution ultrasound machine equipped with a high-frequency linear array transducer (7–15 MHz). Patients were examined in the supine position with adequate scrotal support. Both testes, epididymides, spermatic cords, scrotal wall, and surrounding structures were evaluated in longitudinal and transverse planes. Gray-scale ultrasonography was used to assess testicular size, echotexture, focal lesions, hydrocele, haematocele, epididymal abnormalities, scrotal wall thickening, and extratesticular masses.

Subsequently, colour Doppler and spectral Doppler imaging were performed in all patients using optimized low-flow settings. Testicular and epididymal vascularity were assessed and compared with the contralateral side. Doppler evaluation was used to identify hyperemia in inflammatory conditions, absent or reduced flow in testicular torsion, vascularity within testicular masses, and venous reflux in varicocele. In suspected varicocele cases, examination was performed during Valsalva maneuver and, whenever necessary, in both supine and standing positions to demonstrate venous dilatation and reflux.

Based on ultrasonographic and Doppler findings, lesions were categorized as inflammatory, vascular, cystic, traumatic, neoplastic, congenital, or miscellaneous pathologies. Final diagnosis was established using a combination of clinical findings, laboratory investigations, surgical findings, histopathological examination, or follow-up imaging wherever available. The location of lesions was classified as intratesticular, epididymal, extratesticular, vascular, or scrotal wall related.

All observations were entered into a predesigned proforma and subsequently transferred to Microsoft Excel for data compilation. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequency and percentage. Associations between clinical presentation and ultrasonographic diagnosis were assessed using Chi-square test. A p-value of less than 0.05 was considered statistically significant.

The collected data were coded and entered into Microsoft Excel and analysed using SPSS version 25.0. Descriptive statistics were used to summarize demographic characteristics, clinical presentation, and imaging findings. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between clinical symptoms and ultrasonographic diagnoses were evaluated using Chi-square test or Fisher's exact test wherever appropriate. Statistical significance was considered at a p-value <0.05 with a 95% confidence interval.

RESULTS

A total of 100 patients were included. The mean age was 32.8 ± 15.6 years. The highest number of patients belonged to the 21–40-year age group. The commonest clinical presentation was scrotal pain, followed by scrotal swelling and infertility evaluation.\

Table 1. Age distribution and clinical presentation of study participants

Variable	Number	Percentage
Age group		
0–20 years	24	24.0
21–40 years	43	43.0
41–60 years	25	25.0
>60 years	8	8.0
Clinical presentation		
Scrotal pain	42	42.0
Scrotal swelling	36	36.0
Infertility evaluation	12	12.0
Trauma	6	6.0
Palpable mass	4	4.0

Inflammatory lesions were the most common sonographic diagnosis, seen in 34 patients. Hydrocele was noted in 22 patients and varicocele in 18 patients. Testicular torsion was identified in 8 patients, trauma-related lesions in 6 patients and tumors in 4 patients.

Table 2. Spectrum of scrotal pathologies detected on ultrasonography and colour Doppler

Diagnosis	Number	Percentage
Epididymo-orchitis	34	34.0
Hydrocele	22	22.0
Varicocele	18	18.0
Testicular torsion	8	8.0
Trauma-related lesions	6	6.0
Testicular tumor	4	4.0
Epididymal cyst/spermatocele	5	5.0
Scrotal wall edema/others	3	3.0

Table 3. Colour Doppler findings in major scrotal pathologies

Condition	Typical Doppler finding	Number
Epididymo-orchitis	Increased vascularity	34
Testicular torsion	Absent/reduced vascularity	8
Varicocele	Venous reflux on Valsalva	18
Testicular tumor	Internal vascularity	4
Trauma	Variable vascularity/hematoma	6

Among the 42 patients with acute scrotal pain, epididymo-orchitis was diagnosed in 24 patients and torsion in 8 patients. Colour Doppler helped differentiate inflammatory hyperemia from ischemia. Among extratesticular lesions, hydrocele and epididymal cysts were benign-appearing. All suspicious intratesticular masses were advised further clinical, laboratory and histopathological correlation.

Table 4. Location-based classification of lesions

Lesion location	Number	Percentage
Intratesticular	18	18.0
Epididymal	25	25.0
Extratesticular cystic	27	27.0
Vascular	18	18.0
Scrotal wall/others	12	12.0

DISCUSSION

Inflammatory lesions were the most common pathology in the present study. Similar observations have been reported by Dogra et al.¹ and Muttarak et al.⁹ who found epididymo-orchitis to be among the most frequent causes of acute scrotal pain. In the present study, colour Doppler demonstrated increased vascularity in inflammatory lesions and absent or markedly reduced vascularity in torsion. These findings are in agreement with those reported by Horstman et al.³ and Pepe et al.¹⁰ who highlighted the usefulness of Doppler ultrasonography in differentiating ischemic from inflammatory causes of acute scrotum.

Varicocele constituted a significant proportion of cases in our study. Similar findings have been reported by Aso et al.⁵ who demonstrated that Doppler ultrasonography is highly sensitive in identifying venous reflux and pampiniform plexus dilatation.

Hydrocele was the most common benign extratesticular lesion. Woodward et al.² reported that the majority of extratesticular lesions detected on ultrasonography are benign and can be accurately characterized using grayscale imaging. Traumatic lesions accounted for a smaller proportion of cases. Bhatt and Dogra⁶ emphasized that ultrasonography remains the primary imaging modality in scrotal trauma because it accurately identifies hematoma, hematocele and testicular rupture.

The findings of the present study support previous literature demonstrating that ultrasonography with colour Doppler remains the first-line imaging modality for evaluation of both acute and chronic scrotal disorders.^{1,7,8}

CONCLUSION

Ultrasonography with colour Doppler is a reliable, non-invasive and cost-effective modality for evaluation of scrotal pathologies. It provides accurate anatomical and vascular information, differentiates testicular from extratesticular lesions and helps distinguish inflammatory from ischemic causes of acute scrotum. It should be considered the first-line imaging investigation in patients presenting with scrotal pain, swelling, infertility, trauma or palpable scrotal mass.

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