

Original Research Article

Evaluation of scrotal pathology: an observational study

M. Borhan Uddin^{1*}, S. M. Sorowar Kamal², Abu Bakar Siddique³, Fahmida Shams⁴

¹Department of Radiology and Imaging, Kurmitola General Hospital, Dhaka, Bangladesh

²Department of Radiology and Imaging, Sheikh Russel National Gastroenterology Institute and Hospital, Dhaka, Bangladesh

³Department of Radiology and Imaging, Sheikh Russel National Gastroenterology Institute and Hospital, Dhaka, Bangladesh

⁴Department of Radiology and Imaging, Kurmitola General Hospital, Dhaka, Bangladesh

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*Correspondence:

Dr. M. Borhan Uddin,

E-mail: borhanuddinbabu@gmail.com

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ABSTRACT

Background: Scrotal issues often prompt patients to seek evaluation through physical examinations and scrotal ultrasonography. Accurate diagnosis requires a comprehensive exploration of potential conditions, with both grayscale ultrasonography (USG) and duplex Color Doppler ultrasonography employed for assessment.

Methods: This prospective observational study, conducted at Dhaka Medical College Hospital in Bangladesh from July 2004 to June 2005, aimed to compare the effectiveness of grayscale ultrasonography and duplex color Doppler ultrasonography in evaluating scrotal pathology. Fifty-two patients with intra-scrotal disease were included using purposive sampling. Grayscale USG and duplex color Doppler ultrasonography were performed, and demographic and clinical data were processed using MS Excel and SPSS version 23.0.

Results: Grayscale ultrasonography identified hydrocele, varicocele, and epididymitis in 21%, 15%, and 13.5% of cases, respectively. Color Doppler imaging revealed various pathologies, with varicocele and hydrocele most common (21.20%). Diagnostic accuracy varied between the two techniques, with Color Doppler excelling in specific conditions such as testicular torsion (100% accuracy, sensitivity, and specificity). Overall, Color Doppler demonstrated superior accuracy (96.10%) compared to grayscale (80%).

Conclusions: While both grayscale ultrasonography and duplex Color Doppler ultrasonography are valuable tools for evaluating scrotal pathology, the latter demonstrates superiority in terms of accuracy, sensitivity, and specificity. Color Doppler's effectiveness in diagnosing specific conditions suggests its preference for comprehensive scrotal assessments.

Keywords: Scrotal pathology, Duplex Color Doppler, Sonography, Testicular torsion, Testicular echo texture, Epididymitis

INTRODUCTION

The scrotum is an integumental pouch of the lower part of the anterior abdominal wall and contains the testes and the lower part of the spermatic cord. The scrotal disease is a common and embarrassing problem of male patients. The cause of the scrotal swelling is mainly extra testicular, hydrocele being the commonest. Of the intratesticular causes, infection and tumors are the commonest. Testicular torsion and trauma are the most important causes of painful acute scrotal swelling.¹ Varicocele which

causes male infertility is another important cause of scrotal swelling.² High-resolution ultrasonography examination with a greater frequency probe (7 to 13 MHz) can provide information valuable for the differential diagnosis of a variety of disease processes involving the scrotum that have similar clinical manifestations (e.g., pain, swelling, or presence of mass). The pathologic condition that may be the origin of such symptoms can vary from testicular torsion to infection to malignancy. The ability of color and power Doppler ultrasonogram to demonstrate testicular perfusion aids in reaching a specific diagnosis in patients

with acute scrotal pain.³ Scrotal inflammatory lesions appear as hypervascularity of the testes or epididymis, even though grayscale findings may be normal or non-specific. In one study grayscale examination was normal in 20% of cases of epididymitis and 40% of cases of orchitis and the hyperemia seen with color flow imaging was the only evidence of inflammation.² In another study, it was found that by using the single criterion of presence or absence of identifiable intratesticular flow, Color Doppler was 86% sensitive, 100% specific and 97% accurate in the diagnosis of torsion and ischemia in the painful scrotum.⁴ The most common differential diagnosis of torsion of the testis is acute epididymal-orchitis where color flow imaging reveals increased flow and thereby Color Doppler reduces the number of unnecessary scrotal explorations.⁵ The varicocele is the most common surgically correctable cause of male infertility and it is found in approximately 30 % of infertile males. Color flow imaging is a highly accurate and nonhazardous imaging modality in diagnosing varicocele.⁶

The modality also demonstrates Valsalva maneuver-induced venous flow augmentation in varicoceles. Testicular neoplasms account for about 1-2 % of all malignancies in men and are the 5th most frequent cause of death in men aged 15 to 34 years.⁷ There are a variety of benign intra-testicular processes, such as hematoma, orchitis, abscess, infarction, and granuloma that mimic testicular malignancy and must therefore be considered in the differential diagnosis. Color Doppler and power Doppler US demonstrate increased vascularity in the majority of malignant tumors and help to better define testicular involvement.⁸

The objective of this study was to assess the comparative effectiveness of grayscale ultrasonography and Duplex Color Doppler ultrasonography in evaluating scrotal pathology.

METHODS

This prospective observational study was conducted at the Department of Radiology and Imaging, Dhaka Medical College Hospital, Dhaka, Bangladesh, from July 2004 to June 2005. A total of 52 patients with intra-scrotal disease were enrolled, ranging in age from 5 to 75 years. The whole intervention was conducted following the principles of human research specified in the Helsinki Declaration and executed in compliance with currently applicable regulations and the provisions of the General Data Protection Regulation (GDPR).^{9,10} Patients were primarily referred from various outpatient departments within Dhaka city, representing cases of intra-scrotal diseases. Detailed history and clinical examinations were conducted, focusing on the genitourinary system. Ethical approval was obtained from the hospital committee, and informed consent was acquired from participants before data collection. Inclusion criteria comprised inguinoscrotal pain and inguinoscrotal or scrotal swelling, while patients with scrotal lacerations or surface ulcers were excluded.

Demographic and clinical data were recorded and processed using MS Excel and SPSS version 23.0. Statistical analysis considered a p value<0.05 as significant.

RESULTS

In this study, the majority of participants fell within the age range of 21-40, constituting a significant portion of the sample at 66% collectively. Specifically, individuals aged 21-30 were the most prevalent, comprising 27.78% of the total cohort, followed by the 31-40 age group at 22.22%. The clinical presentation revealed that the majority of participants (53.85%) had swelling, 15.38% experienced pain, and 30.77% displayed inguinoscrotal swelling. Predominantly, left-sided involvement was observed in 55% of cases, right-sided in 32%, and bilateral in 13%. Among the 14 participants, 57% had epididymal lesions, 7% had testicular lesions, and 36% had combined lesions. Analyzing testicular echo texture in various scrotal pathologies showed normal findings in 78.80% of cases, hypoechoic in 13.50%, and heterogeneous in 7.7%. Gray scale ultrasonography detected noticeable cases of hydrocele, varicocele, and epididymitis in 21%, 15%, and 13.5% respectively. Color Doppler imaging findings portrayed a varied range of scrotal pathologies among the 52 cases studied. Varicocele and hydrocele, at 21.20% each, emerged as predominant conditions, with epididymitis and epididymal-orchitis following at 15.40% and 9.60%. Less common were testicular torsion (3.80%), testicular tumor (7.70%), and orchitis (1.90%). Additionally, 9.60% of cases displayed extra-testicular tumors, while a subgroup had normal scrotal findings (9.60%).

Epididymitis diagnosis achieved 98% accuracy, 87.50% sensitivity, and 100% specificity with USG, all of which were 100% with color Doppler imaging. Similarly, diagnosing varicocele resulted in 90.38% accuracy, 100% sensitivity, and 54.50% specificity with USG, compared to 100% across color Doppler imaging. Color Doppler imaging demonstrated 100% accuracy, sensitivity, specificity, positive predictive value, and negative predictive value in detecting testicular torsion. For diagnosing different intra-scrotal diseases, USG achieved 80% accuracy, 84.40% sensitivity, and 57.10% specificity, whereas color Doppler imaging surpassed 96.10% accuracy, 97.80% sensitivity, and 80% specificity.

Table 1: Age distribution of the participants (N=52).

Age (years)	N	%
≤20	5	9.26
21-30	15	27.78
31-40	12	22.22
41-50	9	16.67
51-60	5	9.26
61-70	4	7.41
71-80	2	3.70

Table 2: Grayscale ultrasonography diagnosis (N=52).

USG findings	N	%
Normal	11	21.20
Testicular tumor	4	7.70
Orchitis	1	1.90
Epididymitis	7	13.50
Epididymo-orchitis	5	9.60
Epididymal tumor	5	9.60
Varicocele	8	15.40
Hydrocele	11	21.20

Table 3: Color Doppler diagnosis of scrotal pathology (N=52).

Color Doppler diagnosis	N	%
Normal	5	9.60
Testicular torsion	2	3.80
Testicular tumor	4	7.70
Orchitis	1	1.90
Epididymitis	8	15.40
Epididymo-orchitis	5	9.60
Extra-testicular tumor	5	9.60
Varicocele	11	21.20

Table 4: USG and Color Doppler in the diagnosis of epididymitis.

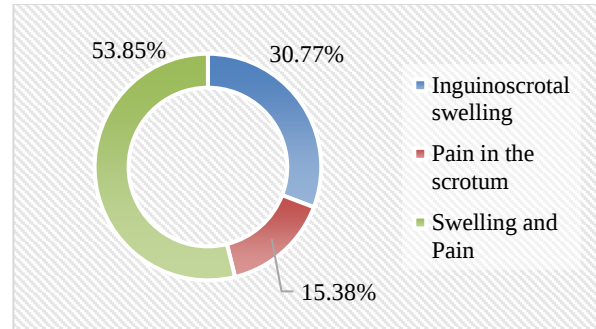
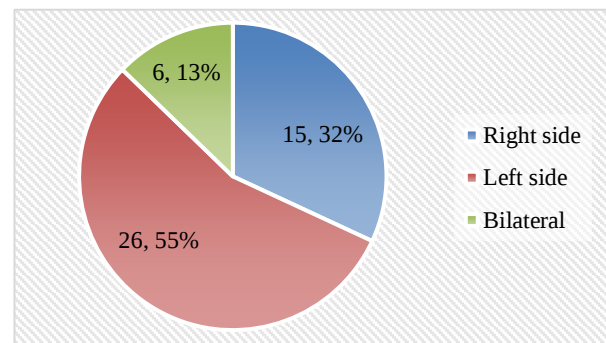
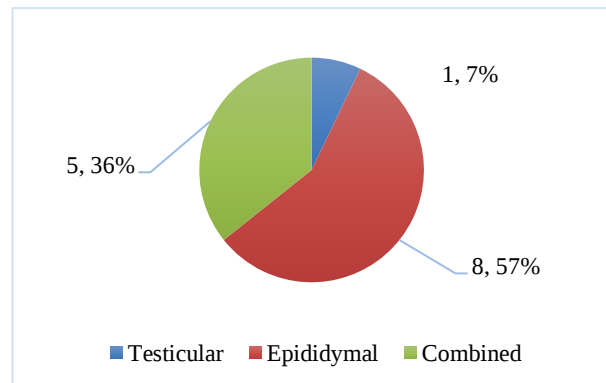
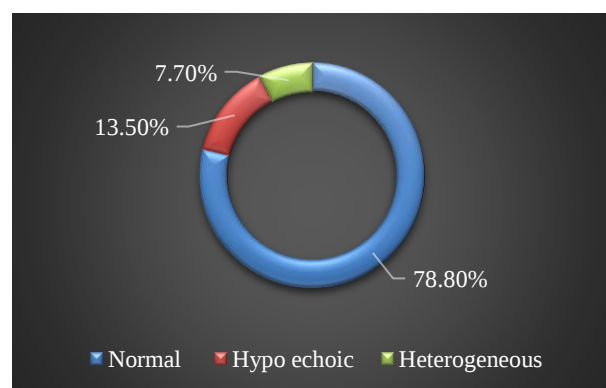
Variables	USG (%)	Color Doppler (%)
Accuracy	98	100
Sensitivity	87.50	100
Specificity	100	100
Predictive value (+ve)	100	100
Predictive value (-ve)	97.70	100

Table 5: USG and Color Doppler in the diagnosis of varicocele.

Variables	USG (%)	Color Doppler (%)
Accuracy	90.38	100
Sensitivity	100	100
Specificity	54.50	100
Predictive value (+ve)	89.13	100
Predictive value (-ve)	100	100

Table 6: Duplex Color Doppler imaging in the diagnosis of testicular torsion.

Variables	Color Doppler (%)
Accuracy	100
Sensitivity	100
Specificity	100
Predictive value (+ve)	100
Predictive value (-ve)	100

**Figure 1: Patterns of clinical presentation (N=52).****Figure 2: Distribution of participants as per side involvement of scrotal lesion (N=52).****Figure 3: Location of the inflammatory lesion (n=14).****Figure 4: Testicular echo texture in different scrotal pathology (N=52).**

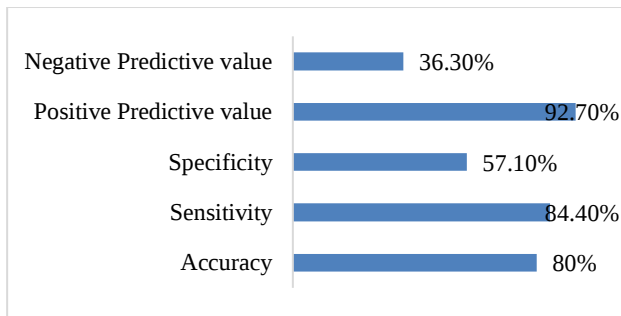


Figure 5: USG in the diagnosis of different intra-scrotal diseases.

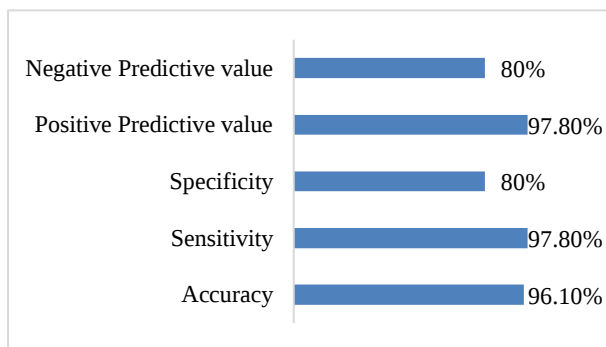


Figure 6: Duplex Color Doppler in detecting different intra-scrotal diseases.

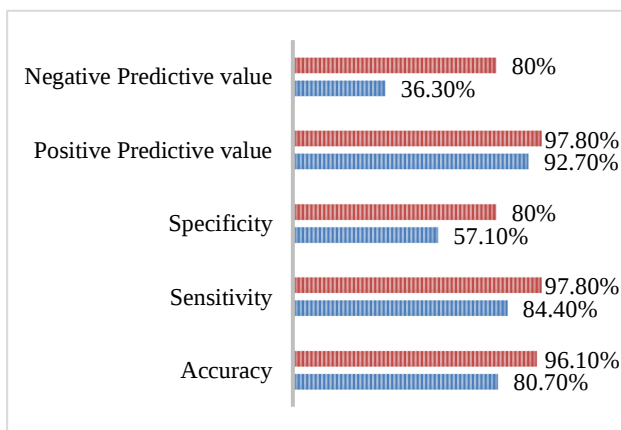


Figure 7: USG and Color Doppler in detecting different intra-scrotal diseases.

DISCUSSION

This study aimed to assess the comparative effectiveness of grayscale ultrasonography and duplex color Doppler ultrasonography in evaluating scrotal pathology. In this study, epididymitis emerged as the predominant intra-scrotal inflammatory ailment, with 57% of 14 patients bearing inflammatory lesions diagnosed with this condition. This finding aligns with Micallef et al work (2000), which observed that 64% of infections were attributed to epididymitis.¹ In cases of inflammation, grayscale ultrasound revealed the enlargement and hypoechoic nature of the affected epididymis and testis,

while Color Doppler ultrasound displayed increased visible blood flow. Notably, 12.5% of patients with epididymitis and 40% with epididymal-orchitis displayed normal grayscale findings, whereas color flow imaging revealed hyperemia.

A study also reported normal findings in 20% of epididymitis and 40% of orchitis cases through grayscale imaging, with Color Doppler sonography revealing inflammation-specific hyperemia.⁸ These outcomes closely mirror the current study. The presence of an intra-testicular mass raises suspicions of an underlying testicular neoplasm. High-resolution ultrasound with color flow imaging proves highly sensitive in detecting focal intra-testicular lesions. All the examined tumors displayed hypoechoic characteristics compared to normal testicular tissue, often accompanied by focal hyper-echogenicity or cystic regions. In two out of three tumor cases, color flow imaging indicated hypervascularity. However, a small teratoma (10 mm in size) was an exception and did not exhibit hyper-vascularity. This finding resonates with Horstman et al study, which highlighted that tumors smaller than 1.6 cm tend to be hypovascular, while larger tumors above 1.6 cm also show hypo-vascularity.¹¹ This observation aligns with the present study. According to standard teaching, solid focal lesions within the testis are typically regarded as potentially malignant until confirmed otherwise.¹²

The most prevalent epididymal mass identified in this study was an epididymal cyst, with three out of four epididymal space-occupying lesions (75%) being diagnosed as such. These cysts often appeared anechoic with septations, paralleling findings by Dewbury in 2000.¹² A patient with a cystic mass in the head of the epididymis was diagnosed as a spermatocele, confirmed through surgical intervention. The solitary solid lesion of the epididymis proved to be an adenomatoid tumor, exhibiting a homogenous appearance with a well-defined margin and low vascularity on Doppler imaging. This aligns with Dewbury's findings in 2000, where the most common solid epididymal mass was an adenomatoid tumor, recognized as hypovascular using Color Doppler.¹² This consistency is observed in the present study. Among 11 varicocele patients, 91% had left-sided involvement, while a single patient (9%) exhibited bilateral varicoceles. This observation is consistent with the frequent anatomical obstruction of venous drainage from the left testis, resulting in over 90% of cases being affected on the left side.^{12,13} This finding demonstrated consistency with the current study's results. In a study by Horstman, it was revealed that bilateral varicoceles occur in about 15% of cases.²

The slightly lower percentage (9%) of bilateral varicoceles in the present study might be attributed to the limited sample size. The study showcased 100% sensitivity and specificity of Color Doppler sonography in diagnosing testicular torsion. Similarly, a study by Patriquin et al. in 1993 reported 89% sensitivity and 100% specificity in the

diagnosis of testicular torsion using Color Doppler sonography, aligning closely with the current study's outcomes.¹⁴ The minor discrepancy is likely due to the small sample size.

This study underscored the significant role of color flow imaging in diagnosing various intra-scrotal diseases, with an accuracy of 96.1%, sensitivity of 97.8%, specificity of 80%, positive predictive value of 97.8%, and negative predictive value of 80%. In contrast, grayscale imaging achieved an accuracy of 80.7%, sensitivity of 84.4%, specificity of 57.1%, positive predictive value of 92.6%, and negative predictive value of 36.3%. Color Doppler's predictive accuracy, sensitivity, and negative predictive value in diagnosing scrotal diseases were notably higher than those of grayscale diagnosis. The findings of this study could provide valuable insights for future similar research endeavors.

Limitations

This was a single-centered study with small-sized samples. Moreover, the study was conducted over a very short period. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION

As per the findings of this current study, we can conclude that although, grayscale USG and duplex color Doppler ultrasonography both are valuable tools to evaluate scrotal pathology, considering accuracy, sensitivity, and specificity duplex color Doppler sonography show some superiority over grayscale ultrasonography.

Recommendation

Combined use of both methods may be more specific. For getting more specific results, we would like to recommend conducting similar studies in several places with larger-sized samples.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Micallef M, Torreggiani WC, Hurley M, Dinsmore WW, Hogan B. The ultrasound investigation of

- scrotal swelling. Int J STD AIDS. 2000;11(5):297-302.
2. Horstman WG. Scrotal imaging. Urol Clin North Am. 1997;24(3):653-71.
3. Dogra VS, Gottlieb RH, Oka M, Rubens DJ. Sonography of the scrotum. Radiology. 2003;227(1):18-36.
4. Burks DD, Markey BJ, Burkhard TK, Balsara ZN, Haluszka MM, Canning DA. Suspected testicular torsion and ischemia: evaluation with color Doppler sonography. Radiology. 1990;175(3):815-21.
5. Wilbert DM, Schaerfe CW, Stern WD, Strohmaier WL, Bichler KH. Evaluation of the acute scrotum by color-coded Doppler ultrasonography. J Urol. 1993;149(6):1475-7.
6. Sigman M, Howards SS. Male infertility. In: Walsh CP, Retik BA, Vaughn DE, Wein JA, eds. Campbell's urology. 7th ed. Philadelphia: Saunders Company; 1998: 1313.
7. Gorman B, Carrol BA. The scrotum. In: Rumack CM, Wilson SR, Charboneau JW, eds. Diagnostic ultrasound. 3rd ed. St Louis: Mosby; 2005: 853.
8. Horstman WG, Melson GL, Middleton WD, Andriole GL. Testicular tumors: findings with color Doppler US. Radiology. 1992;185(3):733-7.
9. WMA. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bulletin WHO; 2001;79(4):373-4.
10. Voigt P, Bussche A. Enforcement and fines under the GDPR. The EU General Data Protection Regulation (GDPR). Springer: Cham; 2017: 201-217.
11. Horstman WG, Middleton WD, Melson GL. Scrotal inflammatory disease: color Doppler US findings. Radiology. 1991;179(1):55-9.
12. Dewbury KC. Scrotal ultrasonography: an update. BJU Int. 2000;86(1):143-52.
13. Gabella G. Cardiovascular system. In: Williams PL, Bannister LH, Berry MM, Collins P, Dayson M, Dussek JE, et al, eds. Gray's Anatomy. 38th ed. Edinburgh: ELBS with Churchill Livingstone; 1995: 1601.
14. Patriquin HB, Yazbeck S, Trinh B, Jéquier S, Burns PN, Grignon A, et al. Testicular torsion in infants and children: diagnosis with Doppler sonography. Radiology. 1993;188(3):781-5.

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