(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 7, Issue 1 , Page No: 320-327
January-February 2024

IJMSCR

To Evaluate Etiological Spectrum Of Scrotal Lesions By High-Resolution Ultrasonography And Color Doppler

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: The scrotum, a complex anatomical structure, presents diverse disease processes with overlapping clinical symptoms. Accurate management of scrotal abnormalities relies on precise differentiation through thorough clinical assessment. This study addresses the pivotal role of high-resolution ultrasonography (HRUS) with color Doppler in the timely and accurate diagnosis of scrotal abnormalities, considering the limitations of alternative imaging modalities such as CT and MRI.

Methods: Conducted collaboratively between the Department of Radiodiagnosis and the Department of Surgery at Sri Balaji Action Medical Institute, New Delhi, the prospective observational study spanned one year with a sample size of 95 patients. Patients underwent HRUS with color Doppler for scrotal lesions. Imaging techniques, including chest radiographs and contrast-enhanced CT, were employed selectively. Scrotal ultrasound, utilizing Philips Electronics India Ltd. Models: EPIG7G and AFFINITI 70G, emphasized meticulous positioning and imaging parameters to correlate sonographic findings with clinical observations.

Results: In the study encompassing 95 cases, scrotal pain (57.5%) and swelling (52.5%) predominated. Testicular lesions constituted 22.5%, with 12.5% being malignant. Extra-testicular lesions accounted for 77.5%, aligning with trends observed in previous studies. Varicocele cases (80%) demonstrated the efficacy of Color Doppler ultrasound. Non-neoplastic lesions were discussed, highlighting the importance of accurate imaging for optimal management.

Conclusion: The study underscores the diagnostic significance of HRUS with color Doppler in scrotal abnormalities. The high diagnostic accuracy achieved, particularly in distinguishing benign and malignant lesions, emphasizes the clinical relevance of this imaging modality. Findings contribute valuable insights for clinical decision-making and patient management in scrotal lesions.

Keywords: Scrotum, high-resolution ultrasonography, color Doppler, scrotal abnormalities, diagnostic imaging, testicular lesions, extra-testicular lesions, varicocele, clinical assessment

Introduction

The scrotum, a unique and delicate anatomical structure, is susceptible to a myriad of disease processes that often present with similar clinical manifestations, such as pain, swelling, or the presence of a mass. Effective management of scrotal abnormalities hinges on the accurate differentiation of these conditions through comprehensive clinical history-taking and examination.[1] Two predominant complaints in scrotal health encompass pain and the presence of a mass. Causes of scrotal pain range from

inflammatory conditions like epididymitis and epididymo-orchitis to more urgent issues such as testicular torsion, trauma, and the specter of testicular cancer.[2] A timely and precise diagnosis is crucial, distinguishing emergencies requiring surgical intervention, such as testicular torsion or trauma, from conditions amenable to conservative management, such as epididymo-orchitis or torsion of testicular appendages.[3]

For individuals presenting with a scrotal mass, a key determinant is whether the mass is intra- or extra-testicular. This distinction is paramount, given the higher likelihood of malignancy associated with intra-testicular lesions, in contrast to the predominantly benign nature of extra-testicular lesions. Over time, high-resolution ultrasonography (US) coupled with color Doppler ultrasonography (CDUS) has emerged as the imaging modality of choice for evaluating scrotal diseases.[4] This diagnostic approach offers exceptional anatomical detail of the scrotal wall, testis, and epididymis, while also enabling the assessment of testicular perfusion through the integration of color Doppler and power Doppler imaging. The simplicity, rapidity, non-invasiveness, relative cost-effectiveness, and widespread availability of sonography make it the preferred initial imaging modality for evaluating scrotal pathologies.[6]

While computed tomography (CT) and magnetic resonance imaging (MRI) have revolutionized imaging in various body regions, their application in scrotal disease evaluation is constrained by limitations. CT, due to its radiation exposure to the gonads, is deemed less suitable for scrotal imaging, whereas MRI, despite its high cost and limited accessibility, serves as a valuable problem-solving tool when sonographic findings are inconclusive. Notably, MRI possesses superior contrast and soft tissue resolution, facilitating the characterization of scrotal masses in diverse clinical scenarios, including the detection of intraabdominal undescended testes, which may be challenging with ultrasonography alone.[7]

In this context, high-resolution ultrasonography emerges as the predominant and widely accepted diagnostic modality for both acute and non-acute scrotal diseases, owing to its widespread availability, noninvasive nature, and superior imaging quality of the superficial organ. As we delve into the intricate landscape of scrotal lesions, this article aims to explore the diagnostic prowess of high-resolution ultrasonography, elucidating its role as the cornerstone in the accurate and timely diagnosis of scrotal abnormalities.[8]

Materials and Methods

Source of Data: The study was conducted collaboratively between the Department of Radio-diagnosis and the Department of Surgery at Sri Balaji Action Medical Institute, New Delhi.

Study Population: Patients who underwent High-resolution Ultrasonography (HRUS) of the scrotum with color Doppler for scrotal lesions at Sri Balaji Action Medical Institute, Paschim Vihar, New Delhi.

Study Design: Prospective observational study.

Study Duration: One year.

Sample Size: 95

Sample Size Calculation: The sample size calculation followed the formula:

$$n=[d2/Z1-2\alpha 2(N-1)+p(1-p)DEFF\times Np(1-p)]$$

Inclusion Criteria: All patients who underwent High-resolution Ultrasonography (HRUS) and Color Doppler of the scrotum for scrotal lesions.

Study Instruments: Ultrasonography machines used were Philips Electronics India Ltd. Models: EPIG7G and AFFINITI 70G.

Study Methodology:

Data Collection: Data were collected from patients who had undergone High-resolution ultrasonography (HRUS) and Color Doppler of the scrotum for scrotal lesions.

Ultrasound Procedure: High-resolution ultrasonography followed by Color Doppler flow imaging of the scrotum was performed using a linear array high-frequency transducer (5-12MHz) and, at times, a low-frequency transducer (2-5 MHz) for adequate penetration, particularly with large scrotal swellings and for ultrasound abdomen. Examinations were carried out on ultrasound equipment capable of B-mode imaging, Color Doppler flow imaging, and pulse wave duplex scanning.

Volume 7, Issue 1; January-February 2024; Page No 320-327

Chest Radiographs: Chest radiographs were taken in cases of testicular tumor (5 cases) and tubercular epididymo-orchitis (2 cases).

Contrast Enhanced CT (CECT): Contrast-enhanced CT chest and abdomen were performed in five cases (Yolk sac tumor-3 cases; Seminoma-1 case, Tubercular epididymo-orchitis-1 case).

Scrotal Ultrasound Positioning: Scrotal ultrasound was conducted with the patient in the supine position and the scrotum supported by a towel placed between the thighs. The testis was examined in at least two planes (longitudinal and transverse axis), comparing size and echogenicity with the contralateral side.

Color Doppler Imaging: Color Doppler and Pulsed Doppler parameters were optimized to display low-flow velocities, demonstrating blood flow in the testes and surrounding scrotal structures. Suspected varicoceles were evaluated with the patient in the supine position, performing the Valsalva maneuver for optimal visualization.

Targeted Images and Palpation: In patients referred for palpable scrotal lesions, additional targeted images were obtained during palpation to correlate with physical findings. Sonographic findings included scrotal skin thickening, position, size, and echotexture of the testis and epididymis, fluid collection characteristics, inguinoscrotal varicocele, and, if present, lesion position, size, echotexture, and color Doppler vascularity.

Additional Scanning: Liver, spleen, bilateral kidneys, retroperitoneum, urinary bladder, and prostate were scanned in all patients to identify any other findings, lymphadenopathy in cases of tumors, metastasis, or any other mass lesions.

This comprehensive methodology aimed to gather precise data on scrotal lesions utilizing advanced imaging techniques and thorough clinical evaluations.

Results

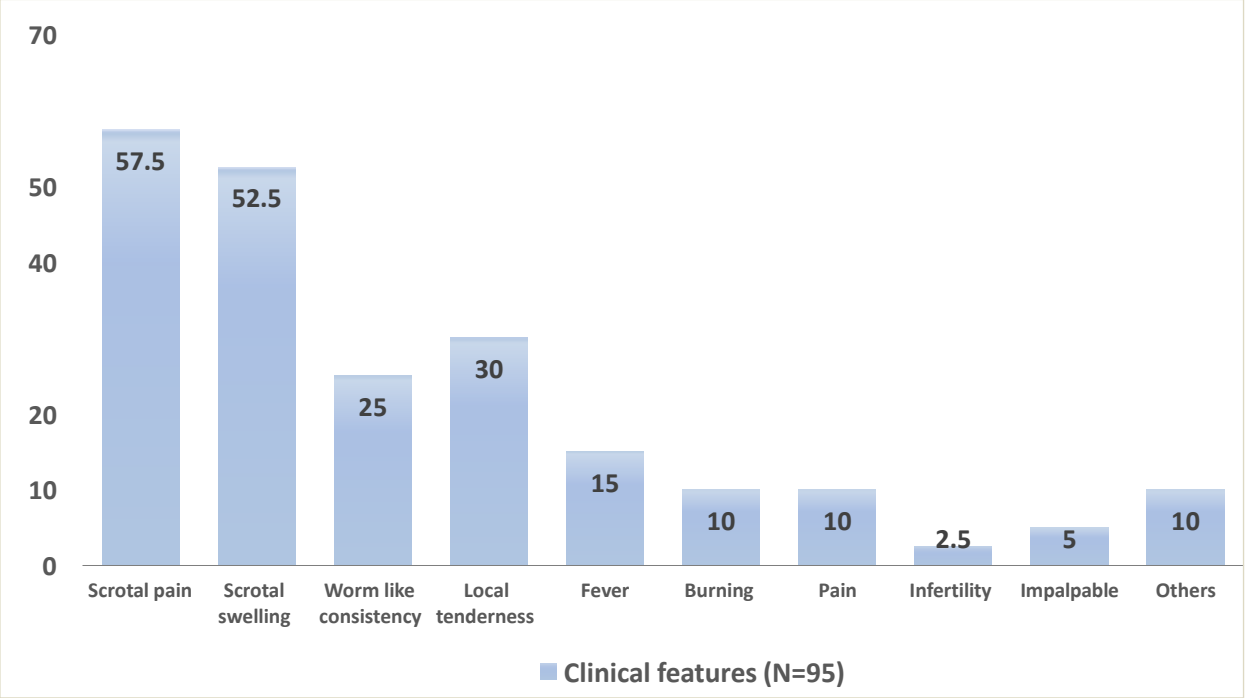
Table 1: Modes of clinical presentation in patients with scrotal lesions (N=95)

Clinical features*	**Number of cases**	**Percentage (%)**
Scrotal pain	23	57.5
Scrotal swelling	21	52.5
Worm like consistency	10	25
Local tenderness	12	30
Fever	6	15
Burning micturition	4	10
Pain abdomen	4	10
Infertility	1	2.5
Impalpable testis	2	5
Others	4	10

** One or more clinical features may be present.*

Volume 7, Issue 1; January-February 2024; Page No 320-327

FIGURE 1: Clinical Features of Scrotal Lesions N=95)



Twenty-three patients (57.5%) experienced scrotal discomfort, while twenty-one cases (52.5%) had scrotal edema. Additional characteristics were impalpable testis in 2 instances (5%), burning micturition in 4 cases (10%), worm-like consistency in 10 cases (25%), and local discomfort in 12 cases (30%).

Table 2: Distribution of final diagnosis in study population. (N=95)

Final diagnosis	Number of cases	Percentage (%)
Testicular lesions	**23**	**22.5**
Tumour	5	
Yolk sac tumour	3	
Seminoma	2	12.5
Mature cystic teratoma	2	
Testicular Torsion	2	5
Infective/orchitis	1	2.5
Miscellaneous	1	2.5
Intra testicular cysts	1	
Extra testicular lesions	**72**	**77.5**
Infective	12	
Acute epididymitis*	5	35
Non specific epididymo-orchitis	4	
Tubercular epididymo-orchitis	2	
Funiculitis	2	

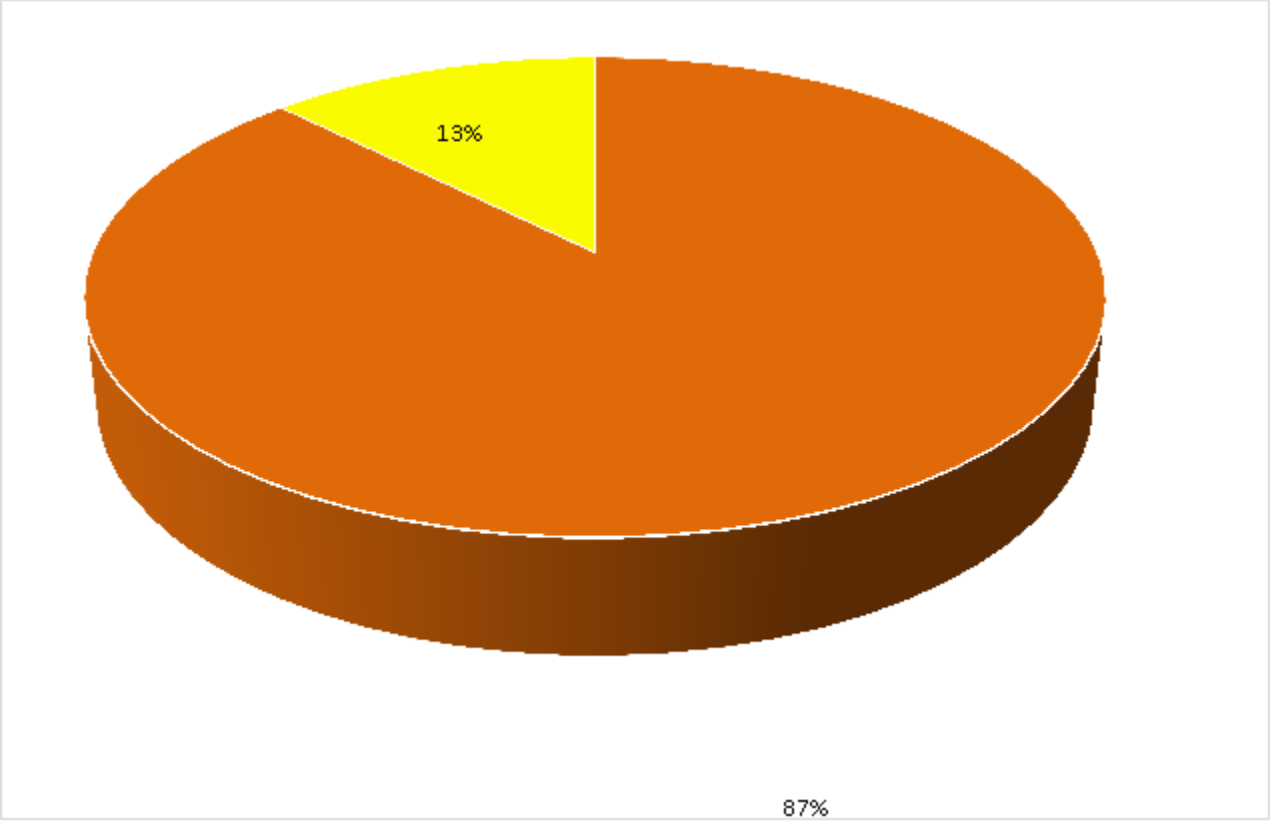
Volume 7, Issue 1; January-February 2024; Page No 320-327

Varicocele	18	25
Miscellaneous	7	
Epididymal cyst	2	
Scrotal wall lesions	2	17.5
Scrotal wall abscess*	1	
Sebaceous cyst	1	

*: The study includes many findings. For example, two instances of acute epididymitis with funiculitis, one case of nonspecific epididymo-orchitis, and one case of scrotal wall abscess all had funiculitis.

Table 3: Benign vs Malignant (N=95)

Final diagnosis	**Number of cases**	**Percentage (%)**
Benign	90	87.5
Malignant	5	12.5
Total	95	100



Volume 7, Issue 1; January-February 2024; Page No 320-327

Five testicular tumor cases (12.5%) out of the 95 cases were malignant, while the other 35 instances were benign. Out of the 90 instances, 5 cases (12.5%) of testicular tumors were malignant, whereas the remaining 90 cases (87.5%) were benign.

Table 4: Clinical features in patients with testicular tumors (n=5)

Clinical features	Yolk sac tumour			Seminoma	Mature cystic teratoma
Age (years)	3	3	16	28	16
Scrotal swelling	+	+	–	–	+
Pain	+	+	–	–	–
Firm non tender mass	–	–	–	–	+
Empty scrotum	–	–	+	+	–
Abdominal lump	+	+	+	+	–

There were five testicular tumor instances in the research. Three examples of yolk sac tumors were seen, one of which had an undescended testicular mass. The other cases were one immature teratoma case, one seminoma case, and one undescended testicular mass lesion case.

Discussion

The present study conducted in the Department of Radiodiagnosis in association with the Department of Surgery at Sri Balaji Action Medical Institute, Paschim Vihar, New Delhi, aimed to investigate scrotal lesions and provide insights into their characteristics and diagnoses. A total of 95 cases were included in the study, with 76 cases (80%) presenting testicular lesions and 19 cases (20%) exhibiting extra-testicular lesions.[9]

The age distribution of the patients ranged from 1 year to 70 years, with the majority falling in the 21-30 years age group (40%), followed by the 31-40 years age group (27.5%). Pediatric cases constituted 15% of the study population, presenting with various lesions such as tumors, testicular torsion, and epididymo-orchitis. Notably, 80% of the testicular tumors were found in the pediatric population, with all four cases being pure non-seminomatous germ cell tumors (NSGCTs).[10]

Scrotal pain (57.5%) was the most common clinical feature in the study, followed by scrotal swelling (52.5%). These findings align with previous studies by Thinyu et al, Philips et al, and Sample et al, which noted scrotal pain as a prevalent symptom associated with infections and scrotal masses.

Extra-testicular lesions were more common (77.5%) than testicular lesions (22.5%) in the present study. Woodward et al (2003) observed a similar trend, noting that the majority of extra-testicular lesions tend to be benign, while testicular lesions are more likely to be malignant.[11]

Tumors, particularly testicular tumors, were a focus of the study. Out of the 5 cases of testicular tumors, 4 were benign and 1 was malignant (seminoma). The study emphasized the importance of imaging, especially high-resolution ultrasound (HRUS), in the diagnosis and differentiation of various lesions. The detection of tumors in the pediatric population, including yolk sac tumors and mature cystic teratoma, highlighted the significance of early diagnosis and management.[12]

Specific tumor markers, such as serum AFP for teratoma and raised AFP levels in yolk sac tumors, were discussed, emphasizing their relevance in the diagnostic process. The study correlated imaging findings with the histopathological characteristics of different tumors, providing a comprehensive understanding of their presentations.[13]

Infective lesions, including epididymitis, nonspecific epididymo-orchitis, tubercular epididymo-orchitis, and funiculitis, were also a significant focus. The study emphasized the role of HRUS in detecting inflammatory changes, with increased vascularity and

Volume 7, Issue 1; January-February 2024; Page No 320-327

specific sonographic features aiding in the diagnosis of infective lesions.[14]

Tubercular epididymo-orchitis presented unique challenges in diagnosis, as it could mimic testicular lymphoma. The study highlighted the importance of FNAC and additional imaging modalities, such as CT scans, in confirming the diagnosis.[15]

Varicocele cases were common, with unilateral involvement (80%) being more prevalent than bilateral involvement (20%). The study supported the high sensitivity and specificity of Color Doppler ultrasound in detecting varicoceles. The presence of varicoceles in patients with infertility emphasized the role of ultrasound in the evaluation of reproductive health.[16]

Other non-neoplastic lesions, such as testicular microlithiasis, scrotal wall abscess, sebaceous cyst, epididymal cysts, intratesticular cysts, and testicular torsion, were discussed. The study highlighted the varied sonographic appearances of these lesions and the importance of accurate imaging for appropriate management.[17]

Conclusion

In conclusion, the study demonstrated that HRUS, combined with Color Doppler, is a valuable tool for the comprehensive evaluation of scrotal lesions. The high diagnostic accuracy achieved in benign and malignant lesions, as well as in infective scrotal conditions, underscored the significance of this imaging modality in clinical practice. The findings contribute to the existing body of knowledge on scrotal lesions and provide insights that can guide clinical decision-making and patient management.

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Volume 7, Issue 1; January-February 2024; Page No 320-327

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Volume 7, Issue 1; January-February 2024; Page No 320-327