

Acute Scrotum: A 10-Year Review of Colour Doppler Ultrasound Findings of in Jos, North-Central Nigeria

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Abstract

Background: Acute scrotum is a urological emergency requiring immediate attention. Colour Doppler Ultrasound (CDS) is the preferred first-line imaging modality, enabling rapid differentiation between surgical and non-surgical conditions and guiding prompt treatment to prevent irreversible damage

Materials and Methods: A retrospective review was conducted of Doppler ultrasound examinations performed on patients presenting with acute scrotal pain at a peripheral facility between January 2014 and December 2023. The study included 506 patients with complete medical records who fulfilled the predefined inclusion criteria.

We collected and analysed demographic and imaging data using Statistical Package for Social Sciences (SPSS) version 23. Descriptive statistics (frequencies, means $\pm$ SD) were calculated. Results are presented in tabular format. Statistical significance was determined at $p < 0.05$, with a 95% confidence interval.

Results: The Doppler ultrasound examination yielded normal results in 125 patients (24.7%), whereas 381 patients (75.3%) exhibited abnormal findings. The abnormal findings were hydrocele (20.8%), Epididymo-orchitis (20.6%) and testicular torsion 36(7.1%) patients. The age group 21-40 years had the majority of the abnormal findings (38.3%). Scrotal abnormalities constitute 41.2% and 33.3% for right and left respectively and bilateral in 25.5% of cases. Epididymo-orchitis was bilateral in 7.7% of patients and constitutes 58.7% and 33.7% for right and left respectively. Testicular torsion is seen in equal proportions for right and left testicles while Fournier's gangrene and testicular microlithiasis were seen bilaterally.

Conclusion: Scrotal colour Doppler ultrasound is a crucial diagnostic modality for evaluating acute scrotum, enabling accurate detection and differentiation of various scrotal abnormalities. These findings underscore the importance of routine ultrasound examinations in men presenting with acute scrotum.

Keywords: Doppler ultrasound, Acute scrotum, Testicular torsion, Epididymo-orchitis, Hydrocele

Introduction

Acute painful scrotum is one of the most challenging urological emergencies. It is characterized by excruciating testicular or scrotal pain which may be followed by scrotal swelling, and may require emergency surgical treatment. It is analogous to acute abdomen, it requires urgent evaluation to point its differentials as immediate scrotal exploration maybe necessary to forestall irreversible testicular damage. One of the possible causes, torsion of the testis or epididymis requires urgent surgical intervention to salvage the testis. There are no

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pathognomonic clinical signs that clearly differentiate torsion of the epididymis from other possible diagnoses (Cavusoglu *et al.*, 2005; Yu *et al.*, 2012).

The differential diagnosis for acute painful scrotum is broad and age-dependent, encompassing various surgical emergencies. Acute scrotal symptoms are generally caused by infectious, traumatic or vascular aetiologies. Prompt diagnosis and treatment is vital for testicular salvage in cases of testicular torsion, torsion of a testicular appendage, incarcerated hernia with strangulation, testicular trauma leading to rupture or organ-threatening hematomas, and Fournier's gangrene (Sweet *et al.*, 2020). Epididymitis, orchitis, epididymo-orchitis, scrotal abscess, Henoch-Schönlein purpura, varicocoeles, hydrocele, idiopathic scrotal oedema, and testicular tumours can have similar clinical presentations, but these conditions do not require immediate surgery (Wright *et al.*, 2015).

The incidence of the various causes of acute scrotum varies across studies. Torsion of the testis, torsion of a testicular appendage, and epididymitis are the most common causes of acute scrotum, contributing more than 85% of the causes (Cavusoglu *et al.*, 2005; Sidler *et al.*, 1997; Lee *et al.*, 1996; Varga *et al.*, 2007).

Acute scrotal pain often necessitates emergency imaging to guide diagnosis and treatment, as clinical evaluation may be limited by pain and swelling, making it difficult to assess scrotal contents accurately (Kühn *et al.*, 2016).

Colour Doppler Ultrasound (CDU) is the imaging modality of choice for scrotal assessment, providing high accuracy in differentiating surgical from non-surgical conditions, and identifying acute pathologies like epididymitis and testicular torsion with excellent sensitivity and specificity (D'Andrea *et al.*, 2013). In addition, ultrasonography is non-invasive, relatively cheap, and readily available and it is radiation free. The high-frequency linear probe used in scrotal scan as well as the superficial nature of the testes enables detailed sonographic assessment of the scrotum and its contents (Yusuf *et al.*, 2013).

Colour Doppler ultrasound is vital for acute scrotum management. MRI, although beneficial due to its soft tissue resolution and non-ionizing nature, is limited by cost, availability, and longer imaging time. Contrast enhanced ultrasound (CEUS) and MRI are useful adjuncts when ultrasound results are unclear.

The use of Computed Tomography (CT) and radionuclide imaging in scrotal evaluation is limited due to their significant ionizing radiation exposure.

The aim of the study is to document our scrotal colour doppler ultrasound findings in our environment and high light the import of the imaging tool in the diagnoses of acute scrotum.

Materials and Methods

A retrospective review of 831 patient records from January 2014 to December 2023 was conducted. The study included 506 patients who underwent Colour Doppler Ultrasound for acute scrotal pain, excluding those with incomplete documentation. Initial clinical indications and examination results were documented and reviewed.

A standardized scrotal ultrasound protocol was employed using a GE LOGIQ 7 ultrasound machine with a 10 MHz linear transducer. Patients were positioned in the supine position. The examination comprised:

1. Grayscale ultrasound to assess testicular echotexture and morphological characteristics.
2. Colour Doppler imaging to evaluate blood flow dynamics, including spectral waveform analysis and velocity measurements in the testes and epididymis.
3. A thorough examination of the scrotal sac to identify any concomitant abnormalities.

Data analysis was performed using SPSS version 23. Frequencies, means $\pm$ SD were calculated. Results are presented in frequency tables and percentages. Statistical significance

was set at $p < 0.05$ (95% CI). The study received ethics approval and informed patient consent.

Approval for the study was granted by the hospital research and ethics board, and the informed consent was obtained from all the patients.

Results

This study enrolled 506 patients (mean age: 37.48 ± 19.54 years). The 21-40 age group accounted for 40.9%. Common indications were scrotal swelling (36.6%), scrotal pain (24.5%), and Epididymo-orchitis (20.9%) (Table 1).

Ultrasound examination revealed normal findings in 24.7% ($n=125$) and abnormal findings in 75.3% ($n=381$) of patients. Common abnormalities included hydrocele (20.8%), Epididymo-orchitis (20.6%), and testicular torsion (7.1%) (Tables 1 and 2).

Other findings include varicocele constituting 5.3%, epididymal cyst (4.3%), scrotal cellulitis (4.0%), inguinoscrotal hernia (3.4%), scrotal oedema (2.4%), Microlithiasis and testicular tumour (1.6%). The least finding is Fournier's gangrene constituting 0.002% (Tables 1 and 2).

The 21-40 age group accounted for most abnormal (38.3%) and normal (48.8%) findings. The oldest age group (>61 years) had the fewest normal findings (4.0%), while the 41-60 age group had the fewest abnormal findings (21.3%) (Table 3, $p<0.005$).

Sonographic scrotal abnormalities were detected in 41.2% (right), 33.3% (left), and 25.5% (bilateral) of cases. Epididymo-orchitis was bilateral in 7.7%, with 58.7% (right) and 33.7% (left). Testicular torsion affected both testicles equally, while Fournier's gangrene and testicular microlithiasis were bilateral (Table 3).

Table 1: Relationship between scrotal findings, indications and Age group

Indications	Age Group				Total
	1-20	21-40	41-60	>61	
Scrotal swelling	46	32	52	55	185(36.6)
Scrotal pain	49	51	19	5	124(24.5)
Torsion	7	28	2	0	37(7.3)
Epididymitis	1	1	0	1	3(0.6)
Epididymo-orchitis	6	66	18	16	106(20.9)
Inguinoscrotal hernia	0	4	5	1	10(2.0)
Mass	1	5	3	5	14(2.8)
Orchitis	0	14	0	2	16(3.2)
Scrotal oedema	0	0	0	2	2(0.4)
Trauma	0	6	0	0	6(1.2)
Varicocele	0	0	3	0	3(0.3)
Total	110(21.7)	207(40.9)	102(20.2)	87(17.2)	506(100.0)
Findings					
Normal	28	61	21	5	125(24.7)
Hydrocele	15	24	8	38	105(20.8)
Epididymo-orchitis	11	57	21	15	104(20.6)
Epididymal cyst	3	11	3	5	22(4.3)
Fournier's gangrene	0	1	0	0	1(0.002)
Infarct	1	2	1	1	5(0.01)
Inguinoscrotal hernia	1	5	7	4	17(3.4)

Microlithiasis	2	3	2	1	8(1.6)
Orchitis	6	3	1	0	10(2.0)
Scrotal cellulitis	3	2	10	5	20(4.0)
Scrotal haematoma	0	5	0	1	6(1.2)
Scrotal oedema	0	1	2	9	12(2.4)
Testicular tumour	2	2	1	3	8(1.6)
Torsion	23	12	1	0	36(7.1)
Varicocele	5	18	4	0	27(5.3)
Total	110	207(40.9)	102	87	506

Note: Mean: 37.48±19.54 years

Table 2: Relationship between scrotal ultrasound findings and Age group

Findings	Age Group (years)				Total
	1-20	21-40	41-60	>61	
Normal	38 (30.4)	61 (48.8)	21 (16.8)	5 (4.0)	125 (24.7)
Abnormal	72 (18.9)	146 (38.3)	81 (21.3)	82 (21.5)	381 (75.3)
Total	110	207	102	87	506

Note: $X^2 = 25.803$ (df = 3): P = 0.000

Table 3: Relationship between abnormal scrotal ultrasound findings with location of lesion

Findings	Location of lesion			Total
	Right	Left	Bilateral	
Epididymal cyst	9	13	0	22
Epididymo-orchitis	61(58.7%)	35(33.7%)	8(7.7%)	104
Testicular torsion	18(50.0)	18(50.0)	0	36
Fournier's gangrene	0	0	1	1
Hydrocele	38	30	37	105
Infarct	4	1	0	5
Inguinoscrotal hernia	11	5	1	17
Microlithiasis	0	0	8	8
Orchitis	4	6	0	10
Scrotal cellulitis	0	0	20	20
Scrotal haematoma	1	1	4	6
Scrotal oedema	0	0	12	12
Testicular tumour	4	4	0	8
Varicocele	7	14	6	27
Total	157(41.2%)	127(33.3%)	97(25.5%)	381

Discussion

Acute scrotum, a urological emergency characterized by acute scrotal pain, necessitates expedited clinical and radiological evaluation to ensure timely diagnosis and minimize testicular loss. Aetiologies commonly include testicular torsion, epididymitis, and orchitis. Notably, the West African sub-region continues to grapple with elevated testicular loss rates attributable to delayed patient presentation, diagnostic errors, and surgical delays (Ogbetere *et al.*, 2021).

This study analysed the diverse indications and radiological findings of acute scrotum in a North-Central Nigerian healthcare facility over a 10-year period. A total of 506 patients, with a mean age of 37.48 ± 19.54 years, underwent examination for scrotal pain. The observed mean age is consistent with the findings of Ibrahim *et al.*, in North-West (39.12 ± 11.89 years) and Ehigiamusoe *et al.* (37.96 ± 1.43 years) in South-South Nigeria, underscoring regional similarities in demographic characteristics (Ibrahim *et al.*, 2016; Ehigiamusoe *et al.*, 2017).

A notable discrepancy exists between the mean age observed in this study (37.48 years) and that reported by Dakum *et al.* (29.4 years) in Jos, Nigeria. This variance may be attributable to the limited sample size ($n=29$) of the latter study, which potentially introduces sampling bias and which may not be representative of the larger population.

Advances in ultrasound technology have established high-frequency ultrasound with colour Doppler as the imaging modality of choice for acute scrotum. This combination enables precise differentiation between epididymitis, testicular torsion, and acute trauma, while also facilitating the detection, localization, and characterization of intra-testicular and extra-testicular masses and other scrotal abnormalities.

The indications for scrotal Doppler ultrasound are multifaceted, spanning infectious, vascular, traumatic, and congenital aetiologies. Our study demonstrated that scrotal pain and swelling constitute the most prevalent indications (61.1%), a finding consistent with the research findings of some researchers (Ehigiamusoe *et al.*, 2017; D'Andrea *et al.*, 2013). Conversely, our results diverge from those reported by Ibrahim *et al.*, who found primary infertility to be the dominant indication.

The causes of acute scrotum vary across studies, but testicular torsion, torsion of testicular appendages, and epididymitis account for over 85% of cases (Cavusoglu *et al.*, 2005; Sidler *et al.*, 1997; Lee *et al.*, 1996; Varga *et al.*, 2007).

Prevalence of Abnormalities

Our study reveals a substantial proportion of abnormal scrotal ultrasound findings, with 75.3% of patients ($n=381$) displaying abnormal results, whereas 24.7% ($n=125$) had normal examinations. This high prevalence of abnormalities highlights the diagnostic utility of scrotal colour doppler ultrasound in evaluating scrotal symptoms, corroborating the results of Ehigiamusoe *et al.* (85.3% abnormal, 14.7% normal).

Scrotal Doppler Ultrasound Findings

Our investigation revealed that hydrocele and epididymo-orchitis were the predominant scrotal abnormalities, affecting 20.8% and 20.6% of the study population, respectively. These findings align with the findings of Ehigiamusoe *et al.*, which reported hydrocele as the most common abnormality (35.3%) followed by epididymo-orchitis (24.6%). However, our results diverge from those of Hazarika *et al.* and Potey *et al.*, who documented substantially higher epididymo-orchitis rates (43.33% and 72.54%, respectively).

Hydrocele, the accumulation of fluid around the testicle, was the most common abnormal finding in our study. This condition can result from various causes, including trauma, infection, or tumor. The high prevalence of hydrocele in our study population may be attributed to the fact that it is a common condition in men, especially in the older age group. However, further investigation is needed to determine the underlying causes of hydrocele in our study population.

Epididymo-orchitis, inflammation of the epididymis and testis, was the second most common abnormal finding. Our study revealed that 54.8% of patients with epididymo-orchitis belonged to the 21-40 age category. This age distribution is comparable to the findings of previous studies, suggesting a peak incidence of epididymo-orchitis in young to

middle-aged adults (Hazarika *et al.*, 2016; Potey *et al.*, 2020). This condition is often caused by bacteria or viral infections and can be acute or chronic. The high incidence of epididymo-orchitis in our study may indicate a need for improved preventive measures, such as education on safe sexual practices and prompt treatment of urinary tract infections.

The findings of our study have significant clinical implications. Scrotal colour doppler ultrasound is a valuable diagnostic tool for evaluating scrotal abnormalities, and our results highlight the importance of routine ultrasound examinations in men presenting with scrotal symptoms. Early detection and treatment of hydrocele and epididymo-orchitis can prevent complications, such as testicular atrophy, infertility, and chronic pain.

Notably, testicular torsion was identified in 7.1% of our study population, consistent with the research of Potey *et al.* (5.88%) and Sharma *et al.* (6.0%). Conversely, our finding is at variance with the results reported by Ehigiamusoe *et al.* (0.8%) and Hazarika *et al.* (21.11%), highlighting variability in testicular torsion incidence across studies.

Testicular torsion is a surgical emergency characterized by spermatic cord twisting, resulting in compromised vascular supply and potential testicular necrosis. Notwithstanding its preventable nature, the West African sub-region reports persistently high rates of testicular loss attributable to delayed patient presentation, diagnostic errors, and deferred surgical interventions (Ogbetere *et al.*, 2021).

The incidence of testicular torsion is estimated to be approximately 1 in 4,000 young males per annum, representing a quarter of all acute scrotum cases. Our investigation, however, yielded a lower percentage (7.1%) attributable to testicular torsion. This discrepancy may be ascribed to the underrepresentation of adolescent males in our sample, who comprised only a fraction (just over 20%) of the study population.

Testicular torsion demonstrates a pronounced propensity to affect adolescent males, albeit its potential to occur across various age groups. Our research indicates that 63.9% of patients experiencing acute testicular torsion belonged to the 1-20 age category, corroborating the observations of preceding investigators ((Ogbetere *et al.*, 2021; Hazarika *et al.*, 2016; Potey *et al.*, 2020).

Varicoceles, a condition marked by abnormal dilatation of the pampiniform plexus due to compromised venous drainage, frequently remain asymptomatic. However, large varicoceles can elicit pain. Moreover, varicoceles may adversely impact testicular development, resulting in diminished testicular volumes and increased risk of male infertility. Importantly, painful varicoceles can mimic the clinical presentation of acute scrotal pathologies, including testicular torsion, epididymo-orchitis, and hydrocele.

Notably, our study found that varicocele comprised 5.3% of acute scrotum cases, highlighting its significance as a contributing factor to scrotal pain and warranting consideration in differential diagnoses. This prevalence of 5.3% corroborates existing literature, which documents a range of 4.4% to 16.4% (D'Andrea *et al.*, 2013; Ehigiamusoe *et al.*, 2017; Sharma *et al.*, 2016). The relationship between varicocele size and pain severity remains an area requiring further elucidation, and future studies should prioritize investigating this association to inform clinical management.

Epididymal cysts, benign fluid-filled structures, accounted for 4.3% of scrotal abnormalities in our study. These cysts are common, non-neoplastic lesions that arise from the epididymis. Our study's prevalence (4.3%) aligns with previous reports (Ehigiamusoe *et al.*, 2017; Sharma *et al.*, 2016).

The prevalence of scrotal cellulitis, a bacterial infection affecting the scrotal skin and subcutaneous tissue, was found to be 4.0% in our study. This finding is corroborated by existing literature, which documents a comparable range of 2.5% to 5.5% (Yu *et al.*, 2012; Yusuf *et al.*, 2013).

This condition requires prompt antibiotic treatment to prevent complications such as abscess formation, Fournier's gangrene and sepsis. Scrotal cellulitis is more common in older adults, diabetics and immunocompromised individuals.

Inguinoscrotal hernia, a condition where intestinal tissue protrudes through the inguinal canal into the scrotum, accounted for 3.4% of scrotal abnormalities in our study. This condition necessitates surgical repair to prevent complications. Our study's prevalence (3.4%) aligns with previous reports 2-5% (Ruhl *et al.*, 2013; Fitzgibbons, *et al.*, 2020).

Scrotal edema, characterized by swelling of the scrotal skin and tissues, accounted for 2.4% of scrotal abnormalities in our study. This condition often results from trauma, infection, or systemic conditions.

Testicular microlithiasis refers to the presence of small, calcified deposits within the testicles. This is associated with increased risk of testicular cancer (3-5 times higher) and a prevalence of 1.5-5.6% in general population (Yilmaz *et al.*, 2017).

Testicular microlithiasis, detected in 1.6% of our study population, are crucial findings for testicular cancer screening. This finding is in agreement with previous reports (Yilmaz *et al.*, 2017; Gökgöz *et al.*, 2015).

The early detection of microlithiasis is paramount for mitigating the risk of testicular cancer, identifying susceptible individuals, and enhancing therapeutic efficacy. Prompt intervention substantially improves patient outcomes, reducing morbidity and treatment-related complications.

Fournier's gangrene is a medical emergency requiring prompt recognition and treatment. It is a life-threatening necrotizing fasciitis of the genital and perineal area characterized by sudden onset of pain and swelling, rapid progression to necrosis and gangrene and high mortality rate (20-40%) despite treatment. It is more common in older adults men with diabetes or immunocompromised states and patients with traumatic injuries.

Fournier's gangrene was detected in only one patient in our study (0.002%), underscoring the rarity of this life-threatening condition requiring prompt recognition and treatment. Our study's prevalence (0.002%) aligns with previous reports of the prevalence of 0.001-0.04% in the general population (Sorensen *et al.*, 2016; Leslie *et al.*, 2023). However, this is at variances with the findings of other researchers who documented values between 2.22% -16.67 % (Ehigiamusoe *et al.*, 2017; Sorensen *et al.*, 2009; Sorensen *et al.*, 2016). The prevalence rates vary depending on population studied, study design, and criteria.

Limitations and Future Directions

While our study provides valuable insights into the prevalence of scrotal abnormalities, it has some limitations. The study population was limited to 506 patients, and further studies with larger sample sizes are needed to confirm our findings. Additionally, the underlying causes of hydrocele and epididymo-orchitis were not investigated in our study, highlighting the need for future research in this area.

Conclusion

Our study demonstrates the significance of scrotal colour doppler ultrasound in detecting a range of abnormalities, from common conditions like hydrocele and epididymo-orchitis to less common but serious conditions like testicular torsion. These findings underscore the importance of routine ultrasound examinations in men presenting with scrotal pain.

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Conflicts of Interest

There are no conflicts of interest.

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