



# **High Resolution Gray Scale and Color Doppler Ultrasound Evaluation of the Scrotum at the University of Port Harcourt Teaching Hospital, Rivers State, Nigeria**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Author RCO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. She is also the corresponding author for the article. Author DOU managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

**Objectives:** The scrotum and its contents can be affected by a wide variety of pathologic processes which include: congenital, inflammatory and neoplastic pathologies. Scrotal lesions may be grouped into painful and non-painful lesions, while scrotal masses are grouped into testicular and extratesticular masses. Ultrasonography performed with the high-frequency transducer, using pulse and colour Doppler modes is the imaging modality of choice for evaluating acute and non-acute scrotal diseases.

**Methodology:** This was a retrospective study carried out over a period of 18 months (from June 2016 to November 2017), at the Department of Radiology of the University of Port Harcourt Teaching Hospital (UPTH), Rivers State, Nigeria. The study population was patients who

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presented to the department for scrotal evaluation. The inclusion criteria were patients scanned during the 18 months period, whose request forms and written reports were intact. Exclusion criteria were for patients not scanned during the period and those whose document was not complete.

**Results:** 74 cases of scrotal scan which met the inclusion criteria were retrieved and analysed for this study. The age range was 6years to 75years, while the mean age was  $38.89 \pm 1.531$  years. Infertility 17(22.97%), scrotal swelling 11(14.86%) and scrotal pain 11(14.86%) were the most common clinical indications for the scan. Twenty-one (28.38%) of the scans were standard. Hydrocele was the most frequent abnormality detected on ultrasonography constituting 27(36.49%). This was closely followed by varicocele which constituted 16(21.62%) cases.

*Keywords: Ultrasound; scrotum; infertility; hydrocele; varicocele.*

## 1. INTRODUCTION

The scrotum is a fibromuscular sac divided into two compartments by a median raphe. Each sac contains a testis, epididymis, spermatic cord and associated facial coverings [1]. Each of these structures can be affected by a wide variety of pathologic processes which include: congenital, inflammatory and neoplastic lesions [1]. Scrotal lesions may be grouped into painful and non-painful lesions, while scrotal masses are grouped into testicular and extratesticular masses. The normal testes are firm, nearly equal in size, smooth and ovoid. The length ranges from 1.5 to 2 cm before puberty and from 4 to 5 cm after puberty [2]. The epididymis is posterolateral to the testes and consists of head, body and tail. The tail continues as the vas deferens which joins the vascular pedicle of the testicle to form the spermatic cord.

Physical examination lacks specificity for evaluating the structures and diseases of the scrotum and testes, [1] hence the radiologist is often in the position of making the diagnosis using cross-sectional imaging modalities such as computed tomography, magnetic resonance imaging and ultrasonography. Ultrasonography is considered the gold standard for scrotal evaluation as it provides excellent spatial resolution and has been shown to be nearly 100% sensitive in the identification of scrotal masses [3]. It can differentiate a variety of conditions involving the scrotum, testicles and epididymis with similar clinical manifestations.

Ultrasonography performed with high-frequency transducer, and use of pulse and colour Doppler modes is the imaging modality of choice for evaluating acute and non-acute scrotal diseases. It is cheap, readily available and does not use ionising radiation; all these made

ultrasonography the best modality for assessing the gonad which may be sensitive to ionising radiation.

The study aims to evaluate the role of high resolution grayscale and color Doppler ultrasonography in the diagnosis of scrotal pathologies.

## 2. METHODOLOGY

This retrospective study was carried out over a period of 18 months (from June 2016 to November 2017), at the Department of Radiology of University of Port Harcourt Teaching Hospital (UPTH), Rivers State, Nigeria. The study population was patients who presented to the department for scrotal evaluation. These patients had been assessed and referred by the clinicians who provided the clinical details and provisional diagnosis. We retrieved documented Doppler ultrasound scan results of all patients seen during the period under study. The inclusion criteria were patients scanned during the 18 months period, whose request forms and written reports were intact. Exclusion criteria were for patients not scanned during the period and those whose document was not complete.

The study was approved by the ethics committee of our health institution.

The ultrasonography was carried out using our department protocol to ensure uniformity. MINDRAY DC-8 (2013, China) ultrasound machine fitted with the high-frequency linear transducer of 7.5-10MHz was used for scanning the patients, however, in massive hydrocele, curvilinear probe with frequency 2.5- 5MHz was used. Grayscale ultrasound assessment was done first, followed by Doppler, especially where there was a need to assess the vascularity and Doppler signal.

The patients were scanned in supine position and the scrotum supported by a towel placed between the thighs. The penis was placed on the abdomen and covered with towel. All studies were performed with direct contact of the transducer to the scrotum. Coupling gel was used to eliminate air between the transducer and the scrotal skin. Color, power or spectral Doppler ultrasound with settings optimised for low flow velocities was commonly used to aid in the diagnosis of varicoceles and to demonstrate blood flow in the testes and surrounding structures. The size and echogenicity of each testis and the epididymis were compared with those on opposite side. Scrotal skin thickness was also evaluated. Additional scans of the spermatic cord in the region of scrotal neck and inguinal canal were obtained in special circumstances like undescended testis, torsion of testis, Inguino- scrotal hernia, and varicocele. Abdominal ultrasonography was done in selected cases which included cases of testicular neoplasm, undescended testes and varicocele.

The extracted data were analysed using the IBM SPSS Statistics for Window, version 20.0 (IBM, 2011, Armonk, NY). Frequency tables and text were used in displaying the results.

### 3. RESULTS

Using the inclusion and exclusion criteria, we retrieved 74 cases that met the criteria for inclusion in the study. The age range was 6years to 75years, while the mean age was 38.89± 1.531 years. Majority of the patients 29(39.19%) were in the age range of 31-40 years which constituted 29 (39.19%) cases (Table 1).

Infertility 17(22.97%), scrotal swelling 11(14.86%) and scrotal pain 11(14.86%) were the most common clinical indication for the scan (Table 2).

Twenty-one (28.38%) of the scans were normal (Fig. 1) as there was no lesions detected ultrasonographically.

Hydrocele (Fig. 2) was the most frequent abnormality detected on ultrasonography constituting 27(36.49%). This was closely followed by varicocele (Fig. 3) which constituted 16(21.62%) cases (Table 3).

The hydroceles were bilateral in 17(22.97%) cases, in 9(12.16%) cases it was found only in the right and in 8(10.81%) cases only in the left.

Varicoceles were bilateral in 12(%) cases, isolated right in 2(2.70%) cases and isolated left in 3(4.05%) cases.

**Table 1. Age distribution**

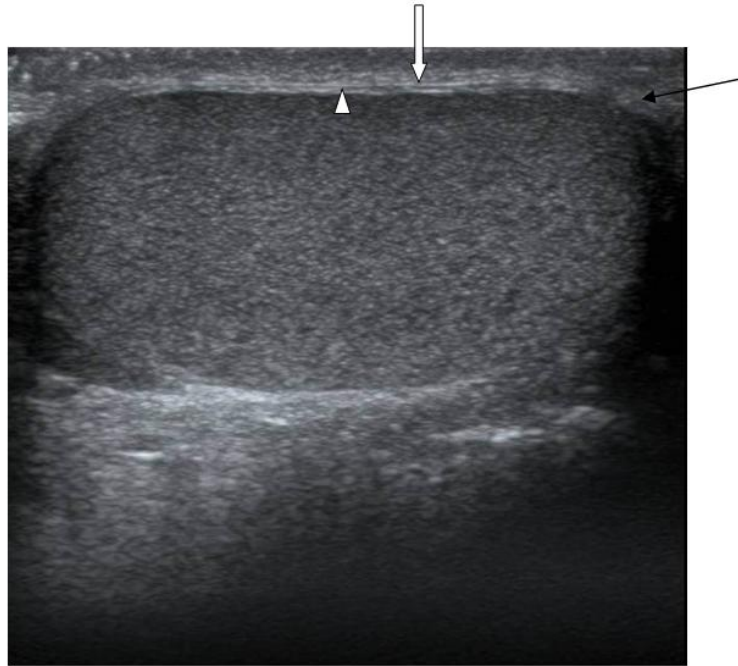
Age	Number of cases	Percentage
≤ 10	2	2.70
11-20	5	6.76
21-30	11	14.86
31-40	29	39.19
41-50	13	17.57
51-60	7	9.46
61-70	5	6.76
71-80	2	2.70
Total	74	100

**Table 2. Frequency distribution of the clinical indications for the scrotal scan as stated in the referral forms**

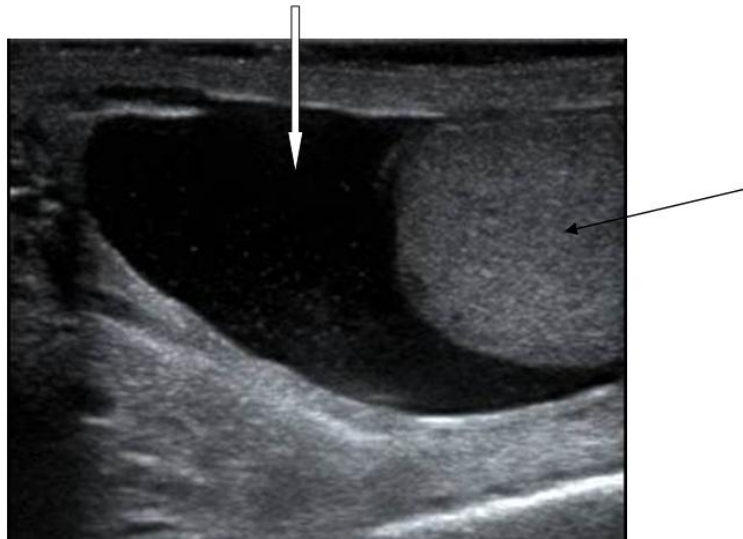
Indication	Number	Percentage
Infertility	17	22.97
Scrotal swelling	11	14.86
Scrotal pain	11	14.86
Erectile dysfunction	7	9.46
Testicular mass	6	8.11
Hydrocele	6	8.11
Epididymorchitis	5	6.76
Varicocele	3	4.05
Inguino-scrotal hernia	2	2.70
Testicular torsion	2	2.70
Epididymitis	2	2.70
Trauma	1	1.35
Orchitis	1	1.35
Total	74	100

**Table 3. Frequency distribution of the ultrasound findings (gray scale and color Doppler)**

Ultrasound diagnosis	Number	Percentage
Hydrocele	27	36.49
Normal	21	28.38
Varicocele	16	21.62
Microolithiasis	6	8.11
Epididymorchitis	5	6.76
Epididymitis	2	2.70
Orchitis	1	1.35
Epididymal cyst	3	4.05
Testicular cyst	2	2.70
Testicular tumour	2	2.70
Testicular torsion	1	1.35
Pyocele	1	1.35
Undescended testes	1	1.35
Inguinoscrotal hernia	1	1.35



**Fig. 1.** Gray scale ultrasound image of a normal testis on longitudinal scan, showing the homogeneous echotexture of the testis, the tunica albugina (arrow head), parietal layer of tunica vaginalis (white arrow) and scrotal skin (black arrow)



**Fig. 2.** Gray scale ultrasound image showing the hydrocele (white arrow) and the testis (black arrow)

#### 4. DISCUSSION

Clinical examination alone is not adequate in evaluating scrotal lesions as studies had shown that the sensitivity is low; [4] there is false positive rate of 50% for the diagnosis of testicular torsion based on clinical findings alone [4].

Introduction of ultrasound scan had improved evaluation of scrotal lesion to an extent that almost 100% sensitivity is achieved [3]. The mean age in this study was 38.89 years, while the majority of the subjects were in the age range of 21-50 years which constituted 71.62%. Similar observation was recorded in other studies

[5,6]. This is the reproductive age, when men are more sexually active and failure to achieve pregnancy in a couple may warrant medical evaluation; complications from sexually

transmitted infections may also contribute to the high frequency of presentation during the reproductive age.

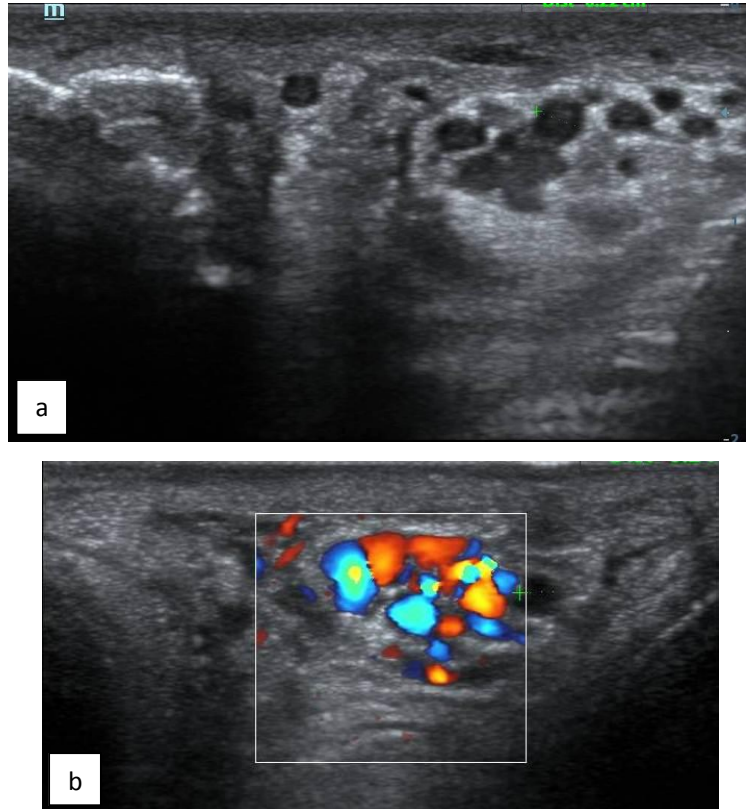


Fig. 3. Varicocele demonstrated in (a) Grayscale and (b) Color Doppler

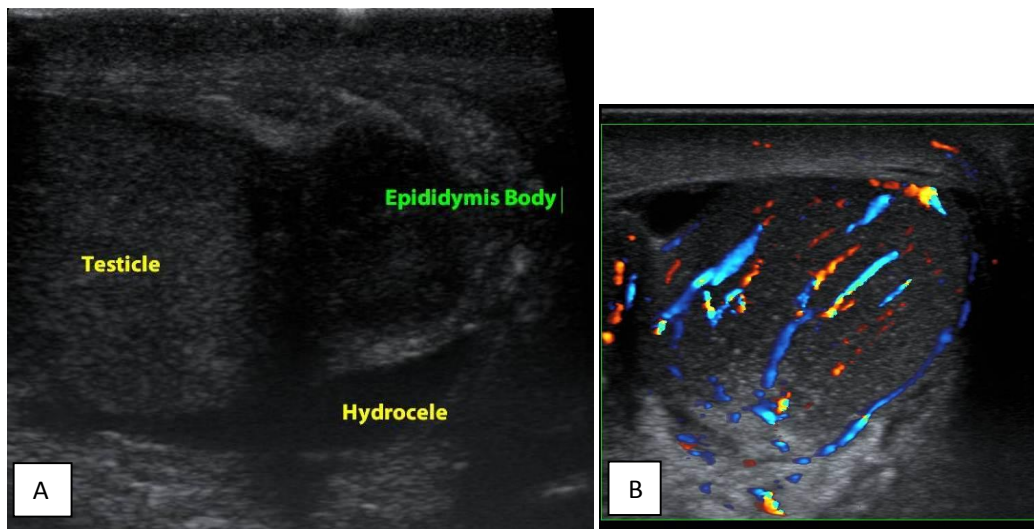
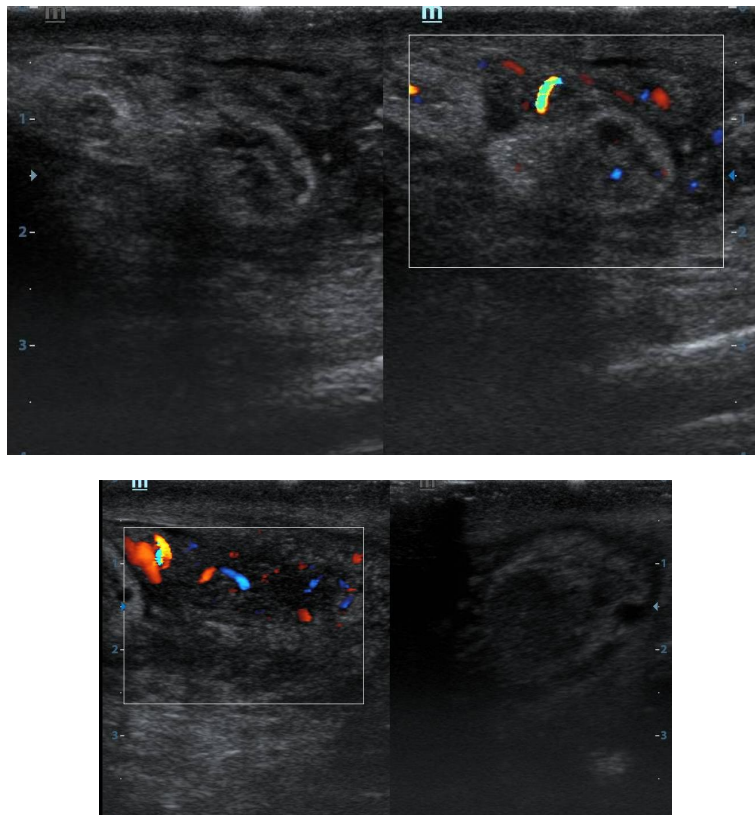
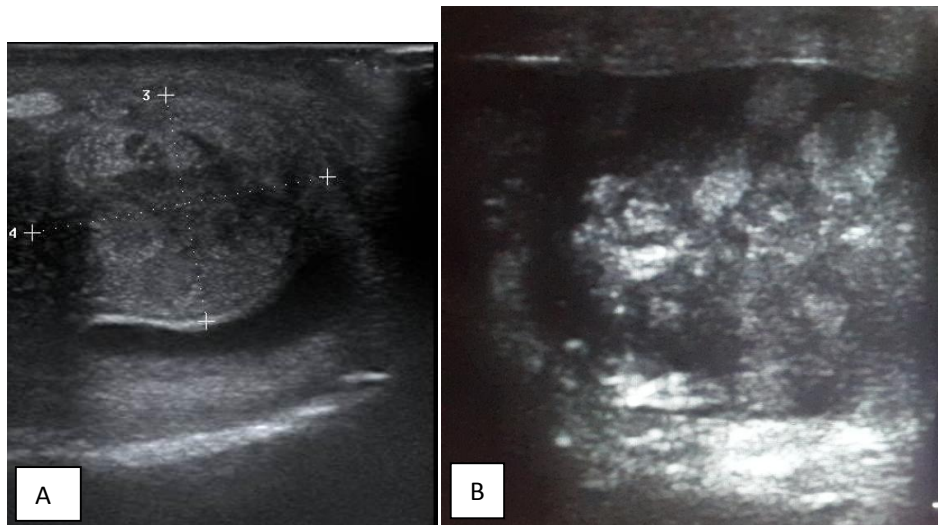


Fig. 4. Gray scale (A) Ultrasound images of epididymorchitis, showing enlarged epididymis, swollen testis with reduced echogenicity and hydrocele. (B) is the color Doppler ultrasound image showing increased flow due to inflammation



**Fig. 5. Gray scale and color Doppler ultrasound images of epididymitis show enlarged epididymis with heterogeneous echotexture and mildly increased vascular flow**

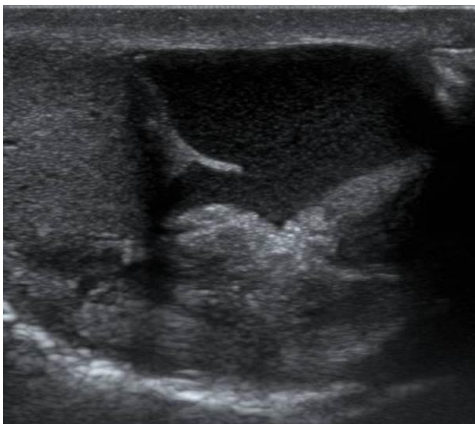


**Fig. 6. Showing ultrasound images of torsion testicles with hydrocele in A and intratesticular heamorrhage in B**

This study shows that the most common clinical indication for patients' referral for scrotal ultrasound scan was infertility. This was also

observed in similar study in Northern part of our country where more than 60% of the scrotal scans were for infertility evaluation [6]. This is not

surprising considering the fact that among the infertile couples, the cause of infertility involves the male partners in approximately 50% of cases [7]. Testicular failure or dysfunction, also referred to as primary hypogonadism, is the most common identifiable cause in males [8] and imaging plays a vital role in identifying potentially correctable causes of infertility especially congenital anomalies and disorders that obstruct sperm transport [9]. Other infertility associated complaints are erectile dysfunction and varicocele. Varicocele is a common finding in approximately 20% of adolescent and adult males and in up to 40% of infertile patients [10]. On gray scale ultrasonography a varicocele is seen as serpinginous tubules posterior to the testis and may extend to the inferior pole of the testis with at least two or three veins of the pampiniform plexus measuring  $>2 - 3$  mm in diameter (see figure).



**Fig. 7. Gray scale ultrasound image of testicular pyocele**

Color Doppler ultrasound is a routine component of the evaluation as identification of flow reversal on erect position and on valsalva manuevre improves diagnostic accuracy. Colour Doppler evaluation also enables classification of varicocele base on vascular valve deficiencies. The most widely accepted grading was given by Sarteschi [11]. The Sarteschi classification includes 5 stages and is based on assessment of the lesion when the patient is standing and lying down. Varicocele was ultrasonographically diagnosed in 21.62% of the subjects in the index study and majority was of Sarteschi grade 1 to 3.

The index study showed that 28.38% of the cases had normal findings; no lesion was detected despite the fact that clinical evaluation

made a pathological diagnosis. This re-emphasized the assertion that clinical examination has lower sensitivity than ultrasonography which is the gold standard for scrotal evaluation. The rate of normal finding in the index study is slightly higher than 10.43% reported by Ibrahim et al. [6] in a similar study in the Northern part of Nigeria.

Hydrocele is an abnormally large collection of serous fluid and is the most common cause of painless scrotal swelling [12]. Hydrocele may be communicating or non-communicating. Communicating hydroceles has an opening into the peritoneal cavity while the non-communicating hydrocele does not open into the peritoneal cavity. Hydroceles are anechoic fluid collections with good sound transmission; hydrocele may occasionally manifest low-level echoes secondary to high protein or cholesterol content [13]. Chronic hydrocele may be difficult to differentiate from hematoceles and pyoceles (Fig. 7) which appear as complex cystic scrotal lesions with internal septations and loculations. There may be associated skin thickening and calcifications in chronic cases. In this study scrotal hydrocele was the most common finding on ultrasonography; 36.49% of the cases had hydrocele which may or may not be associated with intrascrotal pathologic conditions such as epididymitis (Fig. 5), epididymorchitis (Fig. 4) or orchitis. Similar to our observation, Khatri and Sohail [14] reported hydrocele to be the more common pathology in their patients. 34.29% of their patients had hydrocele on ultrasonography. In the same study, varicocele was the second most common ultrasonographic finding. Siddiqui et al. [15] also reported that hydrocele was commonest finding in pediatric age group but varicocele was the most common in adult age group, however when both groups were combined, hydrocele was found to be the most common pathology found on ultrasonography in their study. Contrary to our findings, some studies reported varicocele [6] and epididymitis [16] respectively as the most common ultrasonographic findings.

Testicular microlithiasis appears as multiple non shadowing echogenic foci measuring 2-3mm and randomly scattered throughout the testicular parenchyma; when five or more are seen in one transducer field it is considered abnormal. We observed a high rate of microlithiasis 8.11% in the index study compare to 3.48% reported in previous literature [6]. This high rate requires future evaluation as testicular microlithiasis had

been report to be associated with malignant testicular tumours; [17] however there was no malignant tumour found in this study.

Epididymorchitis and epididymitis are common causes of acute scrotal pain in adolescent boys and adults. Gray scale ultrasonography findings of acute epididymitis include an enlarged hypoechoic or hyperechoic epididymis. There may be an associated hydrocele or pyocele with scrotal wall thickening. Solitary orchitis is rare, most cases were as a result of descending infection from the epididymis, therefore, epididymorchitis is more common and are readily diagnosed by ultrasonography. 6.76% of the cases in this study were epididymorchitis, this was similar to the finding by Ibrahim et al. [6] who got 6.96%, but lower than 16.5% reported by Siddiqui [15].

Color and spectral Doppler scan are the gold standard in making the diagnosis and also in differentiating epididymorchitis or epididymitis from testicular torsion which simulates these inflammatory lesions clinically. Doppler evaluation will show the usual hyperemia of the epididymis, testis or both; there is usually a high flow, low resistance pattern as shown on Fig. 4.

The role of color Doppler and power Doppler ultrasonography in the diagnosis of acute testicular torsion is well established [18,19]. By using the absence of identifiable intratesticular flow as the only criterion for detecting testicular torsion, Burks et al. [20] reported that color Doppler ultrasonography was 86% sensitive, 100% specific, and 97% accurate in the diagnosis of torsion. Grayscale ultrasonography findings vary with the duration and degree of rotation of the spermatic cord, but are nonspecific for testicular torsion and often appear normal if the torsion had just occurred [19]. There was only one case of testicular torsion in the index study, Ibrahim et al. [7] and Rizvi et al. [16] respectively had four cases in their studies while Siddiqui et al. [15] recorded none in their study.

## 5. CONCLUSION

Ultrasonography with grayscale and Doppler applications is the gold standard for scrotal evaluation. It is invaluable in assessing the scrotal anatomical morphology, size and pathology. The parenchymal echotexture, echogenicity and vascularisation of the scrotum and intrascrotal structures are adequately evaluated non invasively. Hydrocele and

varicocele are the most common lesions of the scrotum detected ultrasonographically. In every scrotal examination, Doppler is very important to enable detection of both extra-testicular and intra-testicular varicocele, especially in couples being managed for infertility.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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