

Evaluation of scrotal pathologies by high-resolution ultrasound and color Doppler

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Abstract

Background: The spectrum of scrotal pathologies varies with age (e.g. congenital anomalies and trauma being frequent in childhood, trauma and infertility in adulthood and neoplasm in elderly). This study was an attempt to know the distribution of the scrotal pathologies among the subjects and to understand the sonographic characteristics of the spectrum of scrotal pathologies using High-Frequency Ultrasonography (USG) and Color Doppler.

Aim and Objectives

- 1) Determining the sonographic features of scrotal lesions on Real Time Gray Scale Sonography.
- 2) Evaluating these scrotal lesions on Color Doppler Flow Imaging.
- 3) Classification of the scrotal lesions into testicular or extra-testicular.
- 4) Cor-relation of these sonographic findings with Ultrasound Guided FNAC/Biopsy wherever indicated.

Material and Methods: The hospital based prospective observational study was conducted in the Department of Radiodiagnosis & Imaging, Muzaffarnagar Medical College, Uttar Pradesh (U.P.), for eighteen months with twelve months for data collection and 6 months for data analysis. Gray Scale Ultrasonography with Color Doppler and Power Doppler of inguino-scrotal region using USG machine ALPINION ECUBE8 with 7-12 Hz linear probe was performed in 50 cases referred from Dept. of Surgery, Paediatrics and Casualty who presented with complaints of pain or heaviness in scrotum or tender, swollen or hardened testicle, heavy or dragging sensation in groin or empty scrotal sac.

Results: Maximum number of patients were in age group of 21-30 years (32%), subsequently followed by 11-20 years (18%) and 31-40 years (14%). Most common pathology in the present study was hydrocele noted in 17 cases (34%) followed by Epididymo-orchitis in 14 cases (28%) and Varicocele in 8 cases (16%). Least common pathology was torsion testis as well as spermatocele followed by scrotal tumors, undescended testis and epididymal cyst.

Conclusion: To conclude, High Frequency USG and Color Doppler USG is an extremely valuable tool in evaluation of scrotal and testicular pathologies. Color Doppler sonography is highly sensitive in diagnosing acute scrotal pathology and accurately differentiates testicular ischemia/torsion from acute inflammatory diseases. High Frequency USG with Doppler is

highly sensitive in demonstrating sub clinical cases of varicoceles.

Keywords: High resolution ultrasound, Color Doppler Ultrasound, Scrotal pathologies

Introduction

1. Background

The scrotum is a muscular sac that contains the testis, epididymis and testicular appendages. It is easy to access these structures for clinical examination in absence of any pathology ^[1]. The spectrum of scrotal pathologies varies with age (e.g. congenital anomalies and trauma being frequent in childhood, trauma and infertility in adulthood and neoplasm in elderly) ^[2].

An acute pain onset in the scrotum may be due to serious causes like torsion of testis or epididymitis. Torsion of testis might need surgical intervention where as epididymitis needs an antibiotic course. When left untreated, permanent damage of testis can be the end result of torsion and if it is inflammatory it may result in abscess formation ^[3, 4]. In patients with scrotal mass, through Ultrasound (USG), it can be determined whether the mass is intra or extratesticular. Also, the nature of mass can be evaluated, whether it is cystic/solid/complex ^[5, 6].

Within the last two decades, dramatic advances in sonographic technology and instrumentation have been responsible for emerging Ultrasound as an indispensable diagnostic tool in evaluation of scrotal pathology. High-frequency Ultrasound is an outstanding modality to evaluate the scrotal wall, epididymis, testis and appendages as it provides high-quality anatomical detail ^[7]. The indications for examination could be-pain (due to infection, torsion, trauma), palpable mass (seen in hydrocele, epididymal cysts, tumor, inguinal hernia, varicocele), infertility (due to hypogonadism, varicocele), cryptorchidism (i.e. undescended testis) or an follow up with the previous disease ^[8].

Color Flow Doppler Ultrasound (CDUS) imaging helps in determining the viability and vascularity of the testis, thereby assisting in providing an accurate diagnosis in perplexing situations ^[9]. The advantages of USG and CDUS in the evaluation of scrotal diseases are that -it is non-invasive, easy reproducibility, rapid evaluation with real time examination capability, easy availability, low cost and lack of radiation ^[11].

In this backdrop, this study was an attempt to know the distribution of the scrotal pathologies among the subjects and to understand the sonographic characteristics of the spectrum of scrotal pathologies using High-Frequency USG and Color Doppler. So, this study has been conducted to etiologically classify and to evaluate various scrotal pathologies using USG and describe the role of High Resolution USG and Color Doppler in their diagnosis and differentiation.

2. Aims and Objectives

1. Determining the sonographic features of scrotal lesions on Real Time Gray Scale Sonography.
2. Evaluating these scrotal lesions on Color Doppler Flow Imaging.
3. Classification of the scrotal lesions into testicular or extra-testicular.
4. Correlation of these sonographic findings with Ultrasound Guided FNAC/Biopsy wherever indicated.

3. Materials and Methods

The hospital based prospective observational study was conducted in the Department of Radiodiagnosis & Imaging, Muzaffarnagar Medical College, U.P, for eighteen months with twelve months for data collection and 6 months for data analysis. Total 50 patients of varied

age group presenting with symptoms and signs of scrotal pathologies referred from department of Surgery, Paediatrics and Casualty were studied.

a. Inclusion criteria

Patients of all age group referred to the Department of Radiodiagnosis from Department of Surgery, Paediatrics and Casualty for ultrasound of inguino-scrotal region with clinically suspected scrotal (intra and extratesticular) pathologies.

b. Exclusion criteria

Patients not willing to participate in the study.
Postoperative cases.

4. Procedure

Gray Scale Ultrasonography with Color Doppler and Power Doppler of inguino-scrotal region using USG machine ALPINION ECUBE8 with 7-12 Hz linear probe was performed in 50 cases referred from Dept. of Surgery, Paediatrics and Casualty who presented with complaints of pain or heaviness in the scrotum or tender, swollen or hardened testicle, heavy or dragging sensation in groin or empty scrotal sac.

Before evaluating a patient, written and informed consent and detailed clinical history were taken. Scrotal ultrasound was performed in a supine or standing position. Ultrasound examination was started with an assessment of testicular parenchyma, symmetry, size and echogenicity. Three perpendicular measurements i.e. top-to-bottom, sagittal and frontal dimensions will be used for testicular measurement.

Additional technique, such as upright positioning of the patient or performing a valsalva maneuver, was used to evaluate venous vascularity for varicocele or for inguinal hernia assessment. If any abnormal testicular parenchymal echotexture was seen on Grey Scale Ultrasonography, an assessment was done for the abnormal echotexture location. In case any lesion is found, an assessment of the shape of the lesion i.e. regular/irregular, with/without clear demarcation, hypoechoic /isoechoic /hyperechoic was done. Then Color Doppler was done to assess the flow in testicular and intratesticular vessels and cremestic vessels. Thereafter, Power Doppler mode was applied to assess the area of interest. If a focal lesion was found suspicious of testicular tumour, the examination was further be proceeded to check for evidences of secondaries in the liver, kidneys and retroperitoneal or para-aortic regions.

5. Results

Table 1: Age distribution among the study subjects

Age Group (in years)	Number (N)	Percentage (%)
1-10	4	8
11-20	9	18
21-30	16	32
31-40	7	14
41-50	6	12
51-60	3	6
>60	5	10
Total	50	100

Maximum number of patients were in 21 to 30 years (32%) followed by 11-20 years (18%) and 31-40 years (14%). Minimum number of patients were in 51 to 60 years (6%) followed by 1-10 years (8%) as shown in table 1.

Table 2: Clinical presentation among the study subjects

Variables	Number (N)	Percentage (%)
Scrotal Swelling	17	34
Pain	14	28
Pain with Scrotal Swelling	9	18
Infertility	5	10
Absent testis	3	6
Swelling with Dysuria	2	4

Table 2 shows the clinical presentation among the study subjects. Most common clinical presentation was scrotal swelling (34%) followed by pain (28%) and pain with scrotal swelling (18%). Infertility, absent testis and swelling with dysuria found in 10%, 6% and 4% of the subjects respectively.

Table 3: Side affected among the study subjects

Side	Number (N)	Percentage (%)
Right	23	46
Left	18	36
Both	9	18
Total	50	100

Table 3 shows the side affected among the study subjects. Right side (46%) was slightly more affected as compared to left side (36%) while both sides were affected in 18% of the subjects.

Table 4: Spectrum of scrotal pathologies among the study subjects

Pathology	Number (N)	Percentage (%)
Hydrocele	17	34
Epididymo-orchitis	14	28
Varicocele	8	16
Undescended testis	3	6
Epididymal cyst	4	8
Scrotal Tumors	2	4
Torsion testis	1	2
Spermatocele	1	2
Total	50	100

Table 4 shows the spectrum of scrotal pathologies among the study subjects. Most common pathology was hydrocele (34%) followed by Epididymo-orchitis (28%) and Varicocele (16%). Least common pathologies were torsion of testis and spermatocele followed by remaining pathologies.

Table 5: Spectrum of Hydrocele

Hydrocele	Number (N) = 17	Percentage (%)
Primary	1	5.88
Secondary	13	76.47
Congenital	1	5.88
Funicular	1	5.88
Encysted	1	5.88

Table 5 shows the spectrum of hydrocele among the study subjects. Most common type was secondary hydrocele (13 cases).

Table 6: Spectrum of Epididymo-orchitis

Epididymo-orchitis	Number (N) = 14	Percentage (%)
Acute Epididymo-orchitis	9	64.29
Acute Epididymitis	2	14.29
Chronic Epididymo-orchitis	2	14.29
Funiculitis	1	7.14

Acute epididymo-orchitis was the commonest inflammatory pathology detected, noted in 9 cases (64.29%), followed by 2 cases each of chronic epididymo-orchitis as well as acute epididymitis (14.29%). Funiculitis are noted in 1 case (7.14%) as shown in Table 6.

Table 7: Grading of Varicocele

Grading	Number (N) = 8	Percentage (%)
Grade 1	1	12.5
Grade 2	1	12.5
Grade 3	3	37.5
Grade 4	2	25
Grade 5	1	12.5

Out of 8 cases of varicocele, Grade 3 and 4 was revealed in 3 cases (37.5%) and 2 cases (25%) respectively and 1 case (12.5%) was present in each of grade 1, 2 and 5 of varicocele (Table 7).

Table 8: Spectrum of Neoplastic Scrotal Swellings

Neoplasia	Number (N) = 2	Percentage (%)
Squamous Cell Carcinoma	1	50
Seminoma	1	50

In our study, squamous cell carcinoma of scrotal wall and seminoma left testis was reported in 1 case each (Table 8).

Table 9: Color Doppler Flow Imaging grading in scrotal pathologies

Pathologies	Grading							
	Grade 0 (No Flow)		Grade 1 (Minimal Flow)		Grade 2 (Moderate Flow)		Grade 3 (High vascular Flow)	
	N	%	N	%	N	%	N	%
Hydrocele	17	34	-	-	-	-	-	-
Epididymo-orchitis	-	-	-	-	8	16	6	12
Undescended testis	1	2	2	4	-	-	-	-
Epididymal cyst	4	8	-	-	-	-	-	-
Scrotal tumors	-	-	2	4	-	-	-	-
Torsion Testis	1	2	-	-	-	-	-	-
Spermatocele	1	2	-	-	-	-	-	-

6. Discussion

A wide variety of diseases of scrotum manifest with pain or swelling or both and sometimes with mass. Prompt diagnosis is required to differentiate surgically correctable lesions from the lesions which can be treated medically. To differentiate these pathologies, High-Resolution Ultrasonography and Color Doppler Ultrasonography helps a lot. Collection of fluid and abnormalities of blood vessels which appear as scrotal masses can be well evaluated by USG.

Following scrotal trauma, surgery is needed to salvage testis. Use of Color Doppler USG (CDUS) and Power Doppler Sonography gives us information regarding morphology and perfusion [10]. CDUS is the first and initial technique in place of radionuclide imaging in the assessment of acute testicular torsion. Most common indication for Doppler Sonography is acute testicular torsion, scrotal trauma, undescended testis, inflammation and infertility [11].

The present hospital based prospective observational study was conducted in the Department of Radiodiagnosis and Imaging at Muzaffarnagar Medical College, Muzaffarnagar, Uttar Pradesh after ethical approval among 50 patients of all age group referred to the Department of Radiodiagnosis from Department of Surgery, Paediatrics and Casualty for ultrasound of inguino-scrotal region with clinically suspected scrotal (intra and extratesticular) pathologies. Maximum number of patients were in age group of 21-30 years (32%) followed by 11-20 years (18%) and 31-40 years (14%). Minimum number of patients were in age group of 51-60 years (6%) followed by 1-10 years (8%) in our study. Most common clinical presentation was scrotal swelling (34%) followed by pain (28%) and pain with scrotal swelling (18%). Infertility, absent testis and swelling and dysuria found in 10%, 6% and 4% of the subjects respectively in our study. Balaram Prasad *et al.* [12] in their study found that common symptoms were swelling, pain, fever and infertility among which swelling was the most common symptom. These findings are similar to our study.

Right side (46%) was slightly more affected as compared to left side (36%) while both sides were affected in 18% of the subjects. Out of these, majority of the left sided pathology were related to varicocele. Similarly Sudhir Navale *et al.* [7] in their study showed that 11 cases had pathology bilaterally & 35 cases unilaterally. Out of 35 cases of unilateral side involvement, 23 cases of involvement were on right side, 12 cases involvement was on left side.

Scrotal pathologies

Most common pathology in the present study was hydrocele noted in 17 cases (34%) followed by Epididymo-orchitis in 14 cases (28%) and Varicocele in 8 cases (16%). Least common pathology was torsion testis as well as spermatocele followed by scrotal tumors, undescended testis and epididymal cyst.

Donald P Orr *et al.* [13] conducted a prospective study in 20 cases and reported that out of 21 abnormal testes, hydrocele was the commonest diagnosis (34.2%) followed by epididymo-orchitis.

In our present study, the second common scrotal pathology to follow hydrocele was epididymo-orchitis in which, acute epididymo-orchitis was the commonest inflammatory pathology detected, noted in 9 cases (64.29%), followed by chronic epididymo-orchitis and acute epididymitis (14.29%). Funiculitis (Fig 1) is noted in 1 case (7.14%). All the inflammatory pathologies showed more vascularity compared to the normal contra-lateral side, with loss of normal homogenous echotexture of the testis as well the epididymis and spermatic cord according to the site of involvement.



Fig: 1a

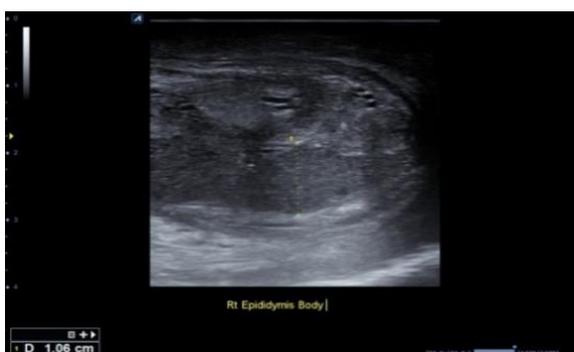


Fig: 1b

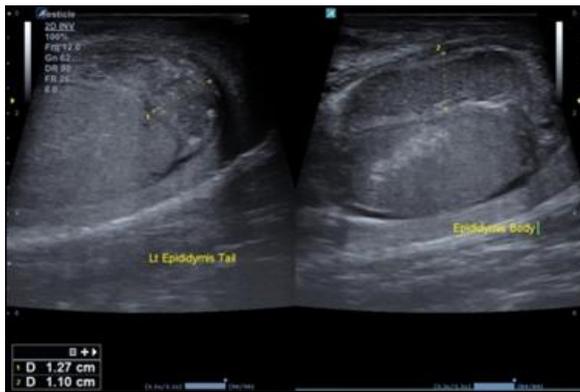


Fig: 1c



Fig: 1d

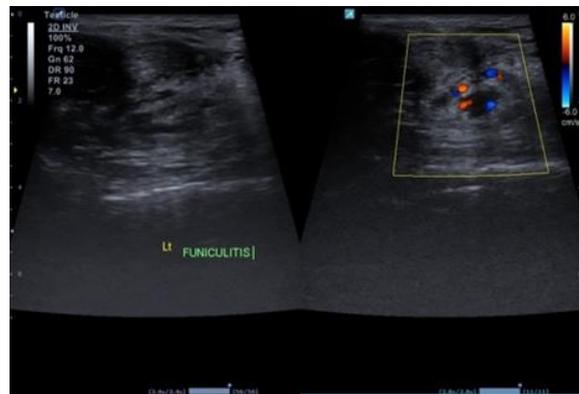


Fig: 3e

A 60 yrs old patient came with a history of scrotal pain radiating to B/L groin. HRUSG and CD showed, (Fig 7a-7c) B/L epididymal body and tail are thickened with increased vascularity, however, B/L epididymal head are normal. (Fig 7d, 7e) B/L spermatic cord regions are inflamed.

F/S/O-B/L epididymitis with funiculitis.

Horstman *et al.* in his study of 45 patients found that, acute epididymitis was present in 25 cases (56%), acute epididymo-orchitis in 19 cases (42%) & acute orchitis in 1 case (2%).

Out of 8 cases of Varicocele, Grade 3 and 4 was revealed in 3 cases (37.5%) and 2 cases (25%) respectively in this study, followed by 1 case (12.5%) in each of Grade 1, 2 and 5. All of the cases of varicocele were left sided, as left spermatic vein opens at a sharp angle to the left renal vein.

Malignancies

In our study, squamous cell carcinoma of scrotal wall and seminoma left testis was reported in 1 case each.

The patient with squamous cell carcinoma had the long history (1 year) of progressive swelling and distortion of the penis and the scrotum. Patient had no history of occupational and prior radiation risk factors for carcinoma. Upon HR USG and CD (Fig 2), thickening with fibrotic changes of the scrotal wall was seen with mild vascularity. Thickening also noted to extend to the subcutaneous layer of penis. Few subcentrimetric lymph nodes noted in bilateral inguinal regions. With co-relation to past history of bilateral hernioplasty, lymphatic obstruction was considered to be the most likely diagnosis. However, on biopsy report, it was unveiled to be Squamous Cell Carcinoma (SCC) of the scrotal wall. Squamous Cell Carcinoma (SCC) is rare form of scrotal/testicular malignancy and in grey-scale presents as solitary nodule rather than diffuse involvement which was seen in our case.



Fig: 2a

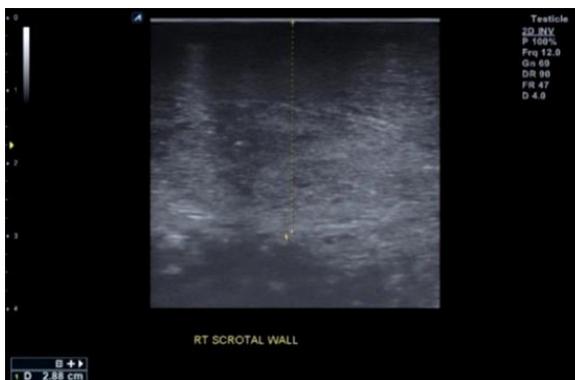


Fig: 2b

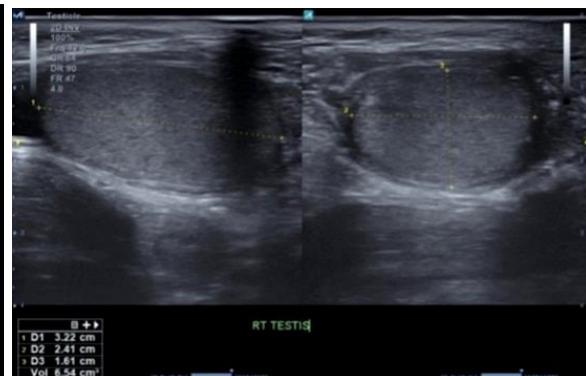


Fig: 2c

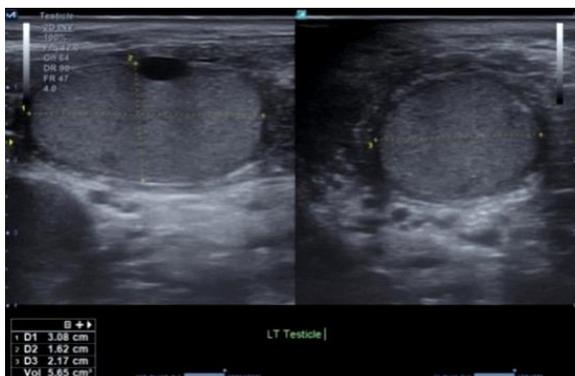


Fig: 2d



Fig: 2e

A 68 yrs old male came with complain of (Fig 2a) hardened scrotal wall and swollen penis which was distorted in shape. On HRUSG and CD, it was found that there was (Fig 2b, 2e) diffuse thickening of the scrotal wall with minimal vascularity. (Fig 2c, 2d) B/L testes were normal in size, shape and echotexture, however, a tiny anechoic cystic lesion noted in the left testis. Thickened subcutaneous layer of penis also noted (not shown). Findings were described in the USG report and advised for biopsy (Histopathological co-relation). Biopsy report revealed Squamous cell carcinoma of the scrotal wall.

Seminoma, on the other hand, is the most common form of testicular malignancy. In our study, the patient had history of painless scrotal mass and secondary infertility. HR USG and CD (Fig 3), showed relatively small left testis with two well defined, hypoechoic and mildly vascular lesions along with B/L testicular microlithiasis. Keeping with the high incidence of Seminoma and USG findings, neoplastic etiology with likely possibility of Seminoma was reported and biopsy report confirmed the same.



Fig: 3a

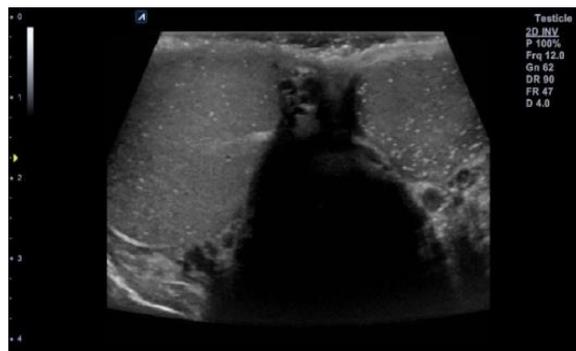


Fig: 3b

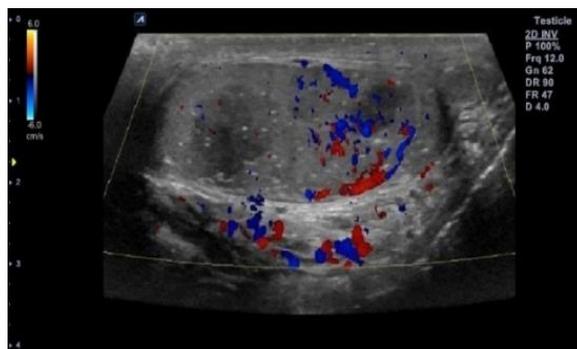


Fig: 3c

A 38 yrs old male came with complain of dull pain in the scrotum. HRUSG and CD of the scrotum revealed, (Fig 3a, 3b) two moderately well-defined hypoechoic lesions in left testis showing internal vascularity. (Fig 3c) Size of left testis was relatively smaller than right testis. Microlithiasis seen in B/L testes. Findings were described in USG report giving neoplastic etiology as the provisional diagnosis and MRI pelvis and biopsy (Histopathological co-relation) was advised. On follow up, biopsy report confirmed neoplastic etiology which was specified to be Seminoma of left testis.

Grantham JG *et al.* 1995 reported that testicular tumors represent 1-2% malignancy in males. Patients usually presented with a painless mass. Seminomas are the most common type of non-mixed testicular tumor. Rickfeld and Middleton (1992) ^[15] described the features of seminoma on ultrasound as, well defined, homogenously hypoechoic, round to oval shape, with possible multifocal involvement. These features were correlating with our study.

Color Doppler flow imaging

No flow was seen in hydrocele, Epididymal cyst, Torsion Testis and Spermatocele cases, while out of 14 cases of Epididymo-orchitis, 8 were having moderate flow while 6 were having high grade flow. Mild flow was found in both the cases of scrotal tumors.

17 patients of hydrocoele, on clinical and grey-scale USG findings were also subjected to CDUS, which did not show any color flow supporting the diagnosis.

15 patients were suspected to have epididymo-orchitis, epididymitis and funiculitis on grey-scale USG which showed heterogenous echotexture. With the help of CDUS, the correct diagnosis were made in 14 out of 15 patients which showed moderate intratesticular vascularity (in 8 cases) and high intratesticular vascularity (in 6 cases). The remaining 1 patient was diagnosed with torsion testis where CDUS showed absence of intratesticular blood flow with atrophied testis confirming the diagnosis.

CDUS also helped in appropriately grading the varicocele and confirming their laterality.

Grade 3 and 4 was revealed in 3 (37.5%) and 2 (25%) subjects respectively in this study, followed by others.

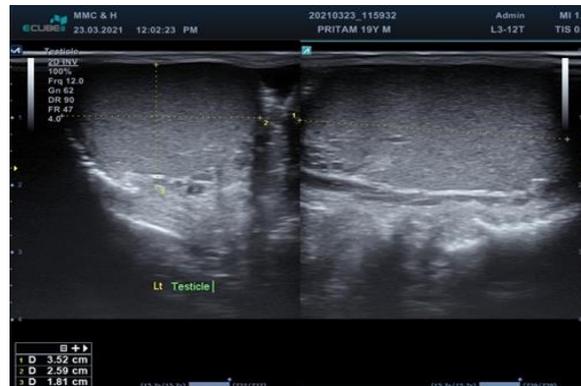


Fig: 4a



Fig: 4b

Fig: 4c

A 29 yrs old male with H/O infertility. HRUSG and CD scrotum showed, (Fig 4a) normal size and echotexture of left testis. (Fig 4b) Few dilated veins noted at upper pole of testis in supine position. (Fig 4c) On standing position, dilated veins also noted in lower pole of left testis. F/S/O-Left sided va ricocele Grade III.

The viability of the 3 undescended testes could be confirmed with the use Color Doppler, in which 2 cases showed intratesticular vascularity, whereas 1 of the cases showed no vascularity.

Out of the two scrotal tumors cases, one was correctly diagnosed to be seminoma of testis with mild intralesional vascularity (confirmed by biopsy) which showed features of testicular abscess on grey-scale USG while the other case was misdiagnosed to be lymphatic obstruction and which later turned out to squamous cell carcinoma of scrotal wall (confirmed by biopsy).

7. Conclusion

The advantages of High frequency Ultrasound and Color Doppler include non-invasiveness, lack of ionizing radiation, simplicity, wide availability, cost effectiveness and repeatability. High Frequency USG is invaluable in demonstrating normalcy of testes and epididymis in the presence of large hydroceles. High Frequency USG enables clear demonstration of the morphological alterations associated with acute scrotal inflammatory diseases.

Color Doppler sonography is highly sensitive in diagnosing acute scrotal pathology and accurately differentiates testicular ischemia/torsion from acute inflammatory diseases. High Frequency USG with Doppler is highly sensitive in demonstrating sub-clinical cases of

varicoceles.

Hence, we conclude that High Frequency USG and Color Doppler USG is an extremely valuable tool in evaluation of scrotal and testicular pathologies.

8. References

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