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Role of High Resolution Sonography and Color Doppler Flow Imaging in the Evaluation of Scrotal Pathology

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ABSTRACT

The present study was undertaken to evaluate the usefulness and accuracy of high-resolution sonography, Color Doppler flow imaging and Power Doppler techniques in scrotal abnormalities and to use this multifold data to reduce diagnostic difficulties of these cases.To determine the imaging characteristics and efficacy of real-time, grayscale sonography in the detection of scrotal lesions, and evaluate the sonographic features in characterization, nature (cystic or solid) and the vascularity of these scrotal lesions. To classify scrotal lesions whether intra testicular or extra testicular. To differentiate between benign and malignant nature of a known scrotal mass and to correlate the sonographic findings with guided FNAC and or biopsy wherever indicated.

Keywords:
Lymph nodes, Magnetic Resonance Imaging, sonography and Embryology.

1.Introduction

The clinical examination is often misleading or non-specific. Sometimes, the presence of pain and/or swelling of scrotal contents preclude proper examination.Patients who present with acute onset of scrotal pain pose a diagnostic dilemma for the clinician. Traditionally, early exploration has been advocated. However, this may result in numerous needless operations, since it has been estimated that almost 80% of acute scrotal processes are inflammatory in nature.[1-3] Power Doppler has been found to be more sensitive than color Doppler flow imaging in the detection of intratesticular blood flow. With power Doppler testicular blood flow in healthy children is symmetric, Underscoring that the blood flow in the asymptomatic testis can be used as a baseline for assessing flow in the symptomatic testis. [4]Computed tomography for gonadal examination is not recommended as it employs ionizing radiation. The role of CT in scrotal pathology is confined to the staging of testicular tumors by detecting the exact position of retroperitoneal lymph nodes. [5]

Magnetic Resonance Imaging (MRI) sequence allows display of normal scrotum and its contents with exquisite anatomic details. Its wide field of view allows simultaneous assessment of both right and left hemi scrotal contents and inguinal regions, offering a distinct advantage over ultrasound. Its high contrast, and spatial resolution, allows differentiation of the testes, epididymis, and spermatic cord. However, the disadvantages of MRI are its expense; longer examination time required and image degradation by patient motion.Testicular scintigraphy has high sensitivity and specificity in the diagnosis of testicular torsion. However, it is limited by its poor resolution, lack of structural information, high cost, and use of ionizing radiation. Color Doppler flow imaging combines the strengths of both testicular scintigraphy and gray scale sonography. [6-9]

2. Material And Methods

The study has been conducted for two years in the Department of Radiodiagnosis in association with Department of Surgery, Sri Lakshmi Narayana Institute of Medical Sciences, Medical College and Hospital, Puducherry.A total of 93 patients from all age groups with symptoms

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related to scrotal disease have been included in this study. Patients who failed to report for follow-up were not included in the study.

Clinical assessment:

Relevant history was taken about clinical symptoms and the presenting complaints. Bimanual palpation was performed in all cases in order to determine the status of scrotal contents. Fluctuation, reducibility, and transillumination tests were done as and when required. Sites of possible metastases were examined in cases with suspected testicular tumors.

Radiological examination:

Sonography and toshibanemio x 2.

Inclusion criteria:All cases with clinical manifestations of testicular pathology.Cases of all age groups.

Exclusion criteria:All cases with lacerated trauma.

Technique

The examination was performed in a setting that affords adequate comfort and privacy to the patient. The patient was asked to be supine, with the legs slightly separated. A towel sling was placed beneath the scrotum for support. The penis was elevated onto an anterior abdominal wall and covered by a drape. The examination began with careful palpation of the scrotal contents.

Color Doppler Flow Imaging and Power Doppler, CDFI was performed to depict flow in the vessels. The testicular artery, capsular arteries, intratesticular vessels and cremasteric vessels were identified where possible. The Doppler controls were optimized to detect low flow. Grade 0: No Doppler signals in the evaluated scrotal structure/mass.

Grade 1: Spotty Doppler signals in the evaluated scrotal structure / mass.

(<2 vascular signals per 10 mm).

Grade 2: Scattered Doppler signals in the evaluated scrotal structure/ mass.

Grade 3: Continuous flow (uninterrupted vessels>25mm in length).

Chest Radiograph (PA view): was taken in those cases, which were suspected to have a testicular tumor, to look for metastases and in suspected tuberculous epididymitis.

Computed Tomography:CT abdomen was done in patient with testicular tumors to detect retroperitoneal lymph nodes and metastases.

3.Laboratory Investigations:

A. Relevant investigations, like urine- routine/microscopic examination and culture, ESR and ELISA for tuberculosis, aspirated fluid microscopy and biochemical analysis was done wherever indicated.

B. USG guided FNAC or biopsy was carried out, wherever indicated and CDFI and PD in various lesions were evaluated.

4. Results

A total of 93 patients referred for pathological conditions of scrotum were evaluated using high-resolution grayscale sonography and Color Doppler flow imaging (CDFI) and power Doppler (PD).The age of these patients ranged from 3 months to 72 years.

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Figure 1: Age distribution of the casesMaximum numbers of patients were of sexually active age group of 21 to 40 years.

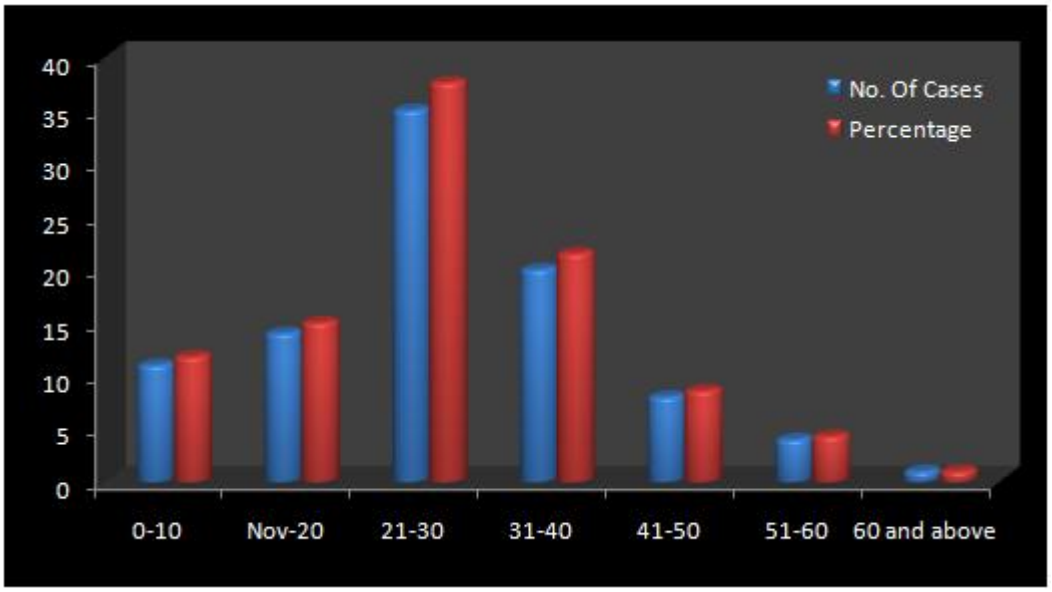

TABLE 1: shows clinical significant symptomatology

S. No	Symptoms	No. of Cases	Percentage (%)
1	Scrotal Swelling	64	44.4
2	Scrotal Pain	46	22.9
3	Empty Scrotal Sac (One Or Both Sides)	4	1.9
4	Trauma	9	4.5
5	Infertility	21	10.5

The most frequent symptom was scrotal swelling (36.3%) followed by scrotal pain (22.9%).

TABLE 2: Distribution of Cases according to Pathology (N=144)*

S.NO.	NATURE OF LESION	NO.OF CASES	PERCENTAGE(%)
1.	**SCROTAL PAIN**		
	A) Inflammation		
	1) Epididymitis	18	12.5
	2) Epididymo-Orchits	16	11.1
	3) Scrotal Wall Edema	2	1.4
	4) Abscess	1	0.6

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	B)Non Inflammation		
	1) Torsion Testis	3	2.1
	2) Testicular Trauma	4	2.9
2.	**PAINLESS SCROTAL MASS OR SWELLING**		
	A)Extratesticular		
	1) Hydrocele	38	27.1
	2) Hematocele	3	2.1
	3) Pyocele	1	0.7
	4) Testicular &Epididymal Cysts	13	9.3
	5) Varicoceles	15	10.4
	6) Hernias a) Omentoceles b)Enterocele	 3 4	 2.1 2.8
	B)Intratesticular		
	1) Testicular Tumors	6	4.2
	2) Testicular Atrophy	6	4.3
	3) Testicular Microlithiasis	3	2.1
3.	**OTHERS**		
	Malpositioned Testis	5	3.6

*some of the patients had more than one lesion.
Hydrocele was the commonest abnormality noted. Inflammatory lesions accountedfor most of the cases besides hydrocele.
Testicular tumors comprised only 4.2% of the study group.

TABLE 3: Sonographic and CD Features in Varicocele (N=15)

Features	**No. of Cases**	**Percentage (%)**
Maximum size of spermatic veins • 2-3 mm • 3-4 mm • >4 mm	 4 5 6	 26.7 33.3 40.0
Tortuosity of vessels • present • absent	 12 3	 80 20
Accentuation on • Valsalva maneuver • erect posture	 15 15	 100 100
CDFI features • grade 0 • grade 1	 0 0	 0 0

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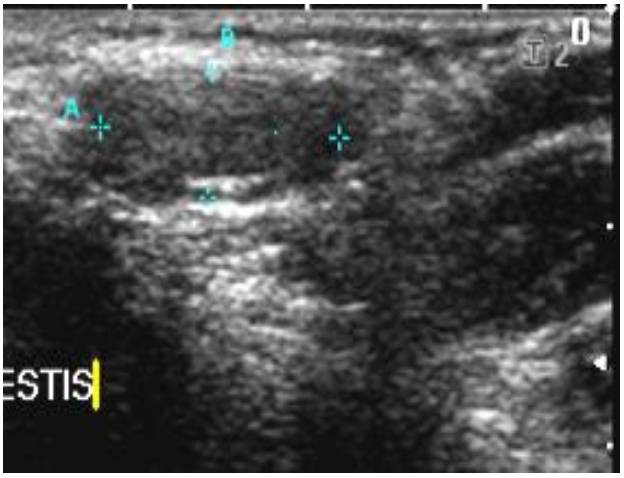
• grade 2	3	20
• grade 3	12	80
Spectral analysis		
1. Maximum flow velocity		
• >6cm/sec	2	13.3
• 4-6cm/sec	6	40
• 2-4cm/sec	5	33.3
• <2cm/sec	2	13.3
1. Reflux grade		
• grade 1		
• grade 2	2	13.3
• grade 3	3	20
	10	66.70

All cases had unilateral varicoceles. Varicoceles were present on left side in 13 cases (86.7%) and on the right in 2 cases (13.3%).
All patients were proven surgically to have a varicocele.
Sonographic, CDFI and PD Features ofEpididymal Cysts andSpermatoceles

Head of the epididymis was involved in 3 cases (50%)of spermatocele and 6 cases (75%) of epididymal cysts.83% cases (5/6) of spermatocele showed echogenic contents while epididymal cysts were anechoic in all cases.Vessels were seen within the septae in 2 cases of spermatoceles and 1 cases of the epididymal cyst.Benign cysts were single, unilocular with smooth thin walls in this study. However, malignant cysts showed shaggy, thick and poorly marginated walls in all cases and were multilocular in 75% cases. Surrounding normal testicularparenchyma was seen in cases of benign cysts while tumor parenchyma was visible around malignant cysts.

FIGURE 2: CONGENITAL SCROTAL DISORDER

CRYPTORCHIDISM



Grey scale sonography shows left testis noted just near the left inguinal canal near the superficial inguinal ring, Small in the size and hypo echoic in echo texture.

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FIGURE 3: EXTRA TESTICULAR SCROTAL DISORDERS

HYDROCELE HEMATOCELE PYOCELE

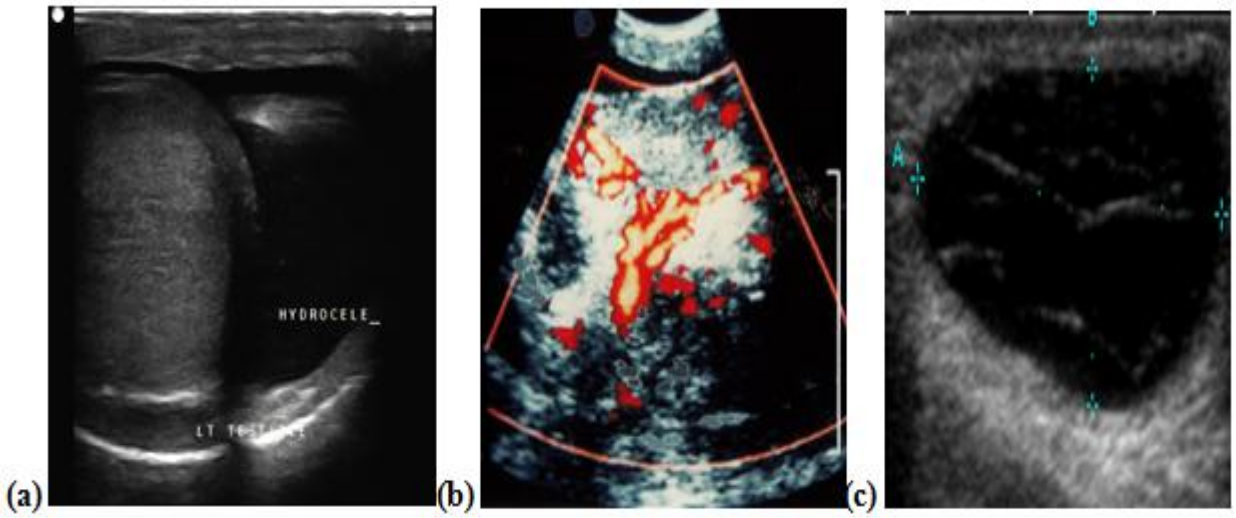

Fig.3: (a) Grey scale sonography with 6 MHz transducer shows a large hydrocele dividing in two sacs – Hydrocele EnBisac. (b) Post-operative patient of hydrocele showing an heterogeneous collection in right scrotum with vessels passing through it - right hematocele, (c) and patient with dense heterogeneous collection- pyocele.

Figure 4: VARICOCELE

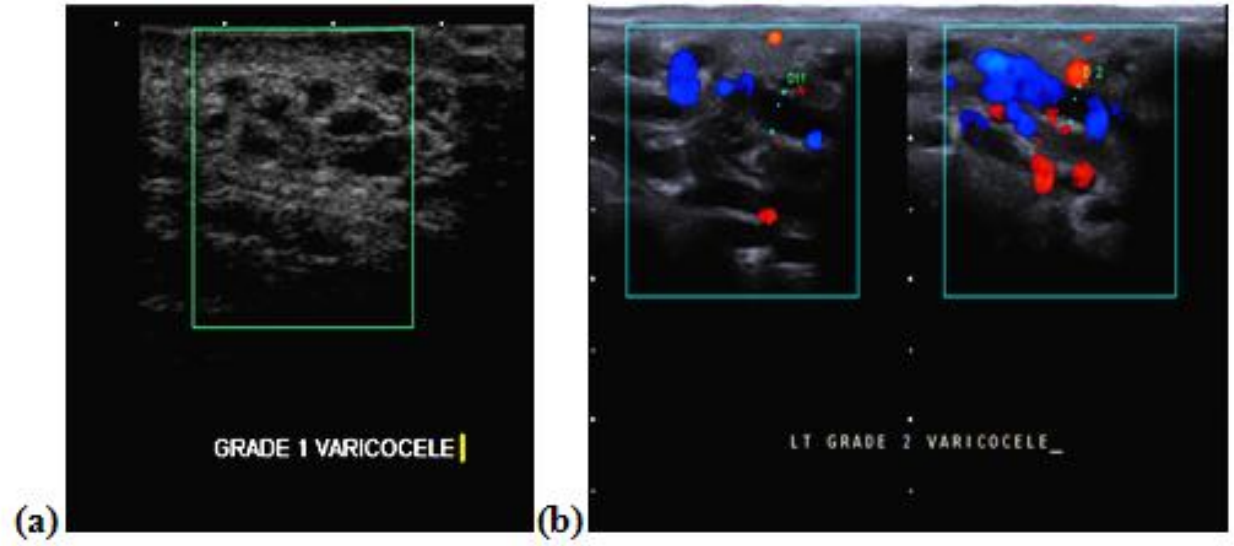

Fig.4 (a) & (b): Grey scale sonography shows multiple dilated anechoic channels are seen in the spermatic cord. Color Doppler during Valsalva.

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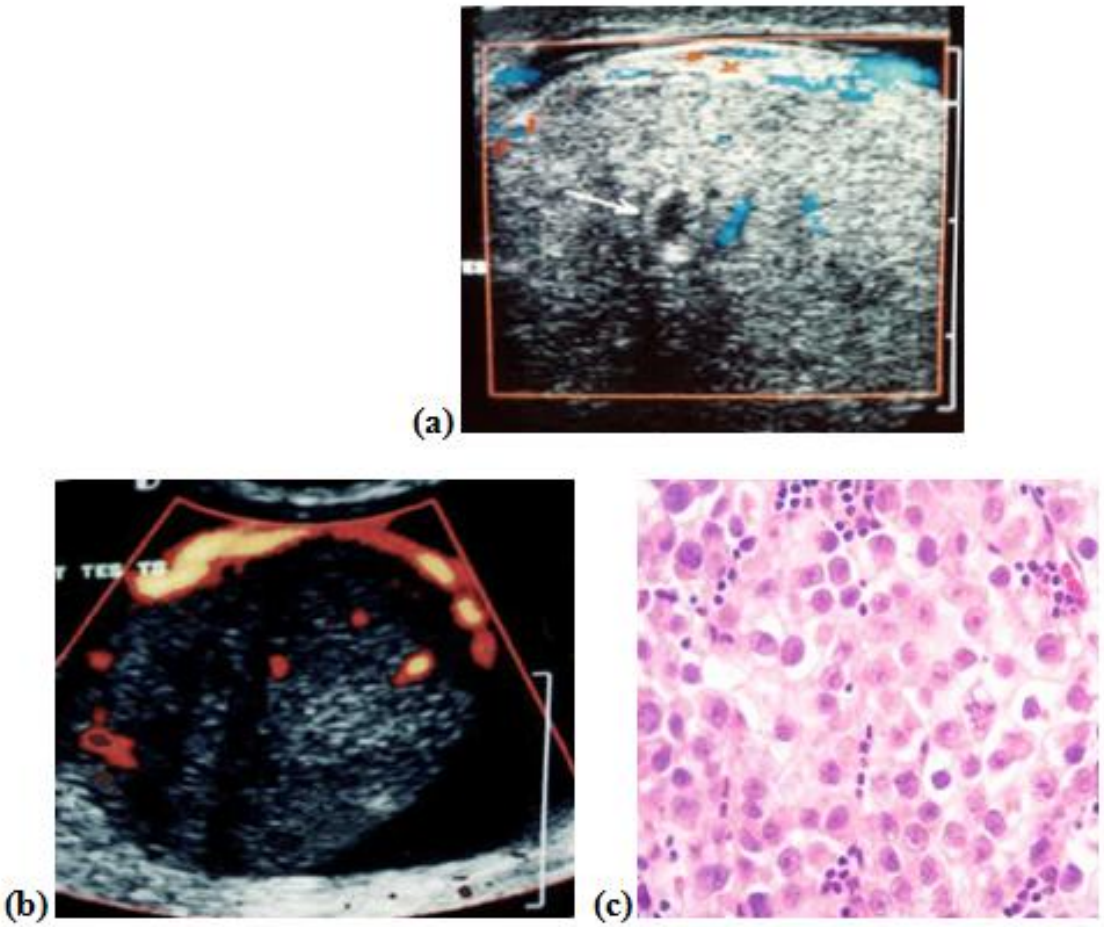
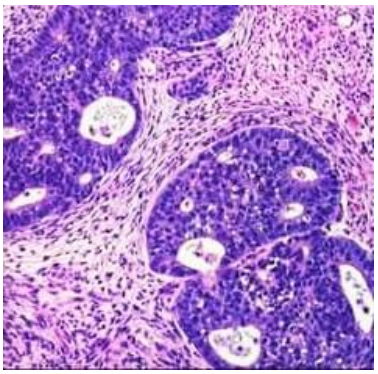
Figure 5: Shows area of cyst formation and heteroechogenicity of the lesion



(a) & (b)-High frequency scan shows area of cyst formation and heteroechogenicity of the lesion. On color Doppler and PD the mass lesion was hypervascular (grade III) with large vessels in disorganized manner. (c) HPE shows clear tumor cells and lymphocytes- suggested seminoma.

Figure 6: Shows mature and immature cells.

(a) 

(a) HPE of Teratocarcinoma. Shows mature and immature cells.

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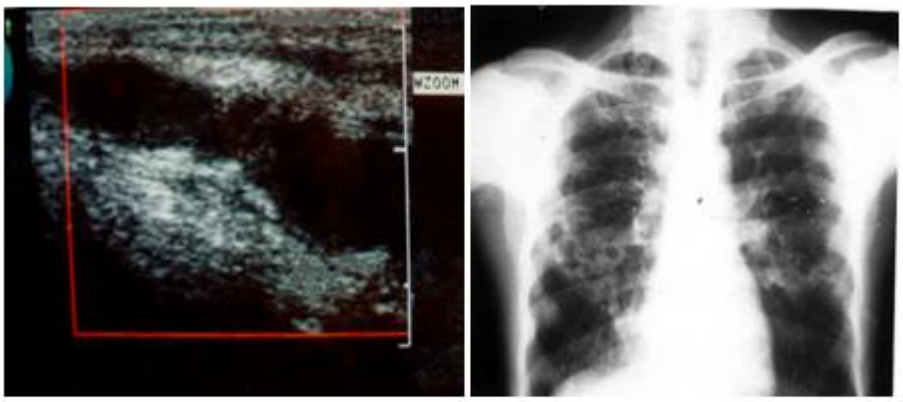
Figure 7: Shows Doppler of the same patient shows multiple spotty signals.



(c) (d)

Fig.7:(c) The spermatic cord was thickened,hypoechoic and showed a beaded appearance.(d) Chest X ray shows fibrotic and infiltrative lesions in right upper and lower zone.

5. Discussion

The patient study was undertaken to evaluate the role of high–resolution sonography, CDFI and PD in the evaluation of scrotal pathology.Ninety-three patients with scrotal lesions were induced in the study. The youngest patient in the study was 3 months of age and the oldest was 72 years. [10]The majority of patients were between 21 to 40 years of age and the predominant group in the study was 21 to 30 years comprising of 35 patients (34%).The commonest presenting complaint was that of scrotal swelling in 36.3% followed by scrotal pain in (22.9%) patients. Positive transillumination suggestive of the fluid collection was positive in 32 patients (26.2%) while tenderness of scrotal swelling was noted in 24 patients (19.2%).[11-13] The incidence of cryptorchidism was 4.3% (4/93) in our series. It is more than as observed by Scorer et al24. This may be due to focussed nature of our study in a selected group in a referral hospital. One (25%) of the four patients had bilateral undescended testes. In unilateral involvement right side was more often affected than the left in the ratio of 2:1.The most common position of cryptorchid testes in our patients was in the inguinal canal (60%) followed by abdominal location (40%) just beneath the deep inguinal ring. [14] Reported location of cryptorchid testes in inguinal canal in 72% and abdominal in 8% cases.On sonography three testes (60%) were homogenous and hypo echoic in echo texture.Sizes of three testes were smaller than their contra lateral counterpart. Madrazo et al described similar ultrasonic features of undescended testes. [15]

CDFI and PD were useful in demonstrating the absence of vascular signals in a case of torsion of undescended testes. Of the three unilateral undescended testes, two demonstrated grade I vascular signals as compared to grade II on the contra lateral side.Both testes in a case with bilateral undescended testes depicted grade I color signals on CDFI and grade II on PD. [16,17]Fluid collections were the most common abnormality detected on sonography. Hydrocele was seen in 38 (26.3%) Hemiscrotum and was the most frequent fluid collection. These were subsequently proved on aspiration and cytology. Thus, the accuracy of 100% was achieved in diagnosing hydrocele on sonography. Gutman et alhave also reported 100% accuracy in their series.Hydrocele presented as anechoic collection surrounding the testes. In 17 cases (44.7%) the

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fluid was minimal while it was large only in 8 cases. All 3 cases of hematoceles showed fluid with internal echoes and septations. Two cases of hematoceles occurred following direct scrotal trauma and one case occurred following surgery. [19]On CDFI and PD the vascularity of the underlying testes was maintained in idiopathic hydroceles. However, reduced diastolic flow was noted in 5 cases of large hydroceles. Nye and prati33also reported a case of large idiopathic hydrocele with RI of 1.0 without any evidence of coexisting disease.In this series 15 cases of varicoceles were included. All of these cases were correctly diagnosed. They comprised 16.1% of a total number of cases. Varicoceles have been reported to be present in 10% to 15% of adult men by Berger et al. On spectral analysis flow velocity in spermatic vein were 4–6cm/sec in six cases (40%) and less than 2 cm/sec in two cases (13.3%).[20] These two cases demonstrated poor color filling of grade II on CDFI and on power Doppler.Thus detecting reflux was found to be sensitive criteria to diagnose varicoceles. Greenberg et al40 found reflux in all 75 men with clinical varicoceles. No significant difference in PSV in relation to presence or absence of varicocele and the degree of reflux was noted. [21]

In our study testicular microlithiasis was encountered in 3 testes in 2 patients with an incidence of 2.1% (2/93). They were observed as multiple small (1-2 mm) diffusely scattered hyper echoic foci within testicular parenchyma without acoustic shadowing. This study was undertaken to evaluate the multifold data obtained by high-resolution grayscale sonography, and Color Doppler flow imagingin the evaluation of scrotal pathology. [22-24] Ninety-three patients with evidence of lesion in scrotal structures were included in this study.Out of the 93 patients included in the study, 144 pathological lesions were observed. The final diagnosis was fluid collections in 42 cases, acute and chronic inflammations in 16 and 18 cases, testicular tumor in 6 cases, torsion of testes in 3 cases, malpositioned testes in 5 cases, testicular trauma in 4 cases, testicular and epididymal cysts in 17 cases, varicocele in 15 cases and the rest were miscellaneous lesions including testicular atrophy, testicular microlithiasis, hernia and scrotal wall thickening. [25-27]

6. Conclusion

The various parameters in scrotal diseases have been studied and evaluated sonographically(gray-scale, CDFI& PD) in the background of clinical and laboratory data. On the basis of this study, the following conclusions are arrived:Scrotal diseases were seen in all age groups with predominance in young males. Sonography was highly accurate in evaluating the consistency of scrotal mass-solid or cystic.High–resolution sonography with color Doppler flow imaging (CDFI) and power Doppler (PD) could reliably define the morphological features and vascularity of scrotal lesions.Varicoceles were accurately diagnosed using CDFI and PD.

The present study concludes that high-resolution sonography, along with color Doppler flow imaging and power Doppler should be used as first-line investigations in the evaluation of scrotal pathologies. Color Doppler Flow Imaging and Power Doppler add useful information and complement gray-scale sonography in reaching a correct diagnosis.

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

Conflict of interest

The authors declare no conflict of interest.

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References

[1] Bree RL, Hoang DT: Scrotal ultrasound. RCNA 1996:34(6): 1183-1205.

[2] Miskin M, Bain J: B mode ultrasonic examination of the testis. J Clin Ultrasound 1974; 2: 306-311.

[3] Field R. Middleton WD: Recent advances in sonography of the testis and scrotum. RCNA 1992: 30(5)" 1033 – 1051.

[4] Shawker TH; B-mode ultrasonic evaluation of scrotal swellings. Radiology 1976, 118: 417-419.

[5] Miskin M, Buckspan M, Bain J: ultrasonographic examination of scrotal masses J Urol 1977.

[6] Sample WF, Gottesman JE, Skinner DG, Enrich RM: Gray scale ultrasound of the scrotum. Radiology 1978: 127: 225-228.

[7] Leopold GR, Woo VL Scheible FW, Nachtsheim D, Gosink, B: High resolution ultrasonography of scrotal pathology, Radiology, 1979, 131: 719.

[8] Wilson PC, Valvo JR, Gramiak R, Frank IN: Automated water bath ultrasonic examination of the scrotum. Urology 1981: 18: 94-99.

[9] Stavros AT, Rapp C: Color Duplex sonography of acute scrotal pain. RSNA special course in ultrasound 1996; 143-154.

[10] Albrecht T, Lotzof K, Hussain HK, Shedden D, Cosgrove DO, Bruyn R, de. Power Doppler US of normal prepubertal testis. Does it live up to be promise? Radiology 197; 203; 227-231.

[11] Campbell MF: Anomalies of the genital tract in Urology, eds Campbell MF. Harrison JH. Philadelphia, W B Saunders company, Chapter 39, Vol 2 1970:1625-1644.

[12] Scorer CG, Farrinton GH (eds), Congenital deformities of testes and epididymis. Appleton-Century-Crofts-New York, 1975 p 15-27.

[13] Sample WF: renal, adrenal, retroperitoneum and scrotal ultrasonography. In diagnostic ultrasound – text and cases. Edssarti DA, sample WF, boston, GK hall, 1980.

[14] Stewart R, carol BA.: the scrotum. In diagnostic ultrasound, rdsRumack CM, Wilson SR, Charbonneau JW Ed 2ndst. Louis, Mosby year book, 1991.

[15] Martin LC, Share JC, Peters C, Atala A.: Hydrocele of the spermatic cord: embryology and ultrasonographic appearance. Pediatrradiol1996; 26:528-530.

[16] Nye PJ, Prati Jr: idiopathic hydroceles and absent testicular diastolic flow. JCV 1997; 25:43-46.

[17] Chung SE, Frush DR, Fordham LA: Sonographic appearances of extratesticular fluid and fluid containing scrotal masses in infants and children: clues to diagnosis. AJR 1999; 173:741-745.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 893 - 903
Received 20 January 2021; Accepted 08 February 2021.

[18] Dubin L, Amelar RD: varicocele size and results of varicocelectomy in selected subfertile men with varicocele. Fertile Steril1970; 21:606-609.

[19] Cockett ATK, Urry RL, Dougherty KA: the varicocele and semen characteristics. J urol1979; 121:435.

[20] Marks JL, Mc Mahon, Lipshultz LI: Predictive parameters of successful varicocele repair. J Urol1986; 136:609.

[21] Petros J, Andriole G, Middleton W, Correlation of testicular color Doppler ultrasonography, physical examination and venography in the detection of left varicoceles in men with infertility, J Urol 1991;145;785-787.

[22] Hoekstra T, Witt M. The correlation of internal spermatic vein palpability with ultrasonographic diameters and reversal of venous flow. J Urol 1995;153;82-84.

[23] Grasso LF, Pepe P, Panella P, Pepe F: Velocimetric evaluation of spermatic vessels with echo color Doppler in patients with idiopathic varicocele. Minerva Urol-Nefrol 1997;49;179-182.

[24] Vieras F, Kuhn CR, Nonspecificity of the “rim-sign” in the scintigraphy diagnosis of missed testicular torsion, Radiology 1983;146;519-522.

[25] Hricak. H, Lue TF, Filly RA et al; Experimental study of the sonography diagnosis of testicular torsion, J Ultrasound Med 1983; 2;349-356.

[26] Nachtsheim DA, Scheible FW, Gosinki B. Ultrasonography of testis tumors. J Urol 1983; 129; 978-981.

[27] Tumeh SS, Benson CB, Richie JP. Acute diseases of the scrotum. Semin US CT MR 1991; 12; 115-130.