



HIGH-FREQUENCY ULTRASOUND: A PROSPECTIVE OBSERVATIONAL, LONGITUDINAL STUDY EVALUATING ITS ROLE IN DIFFERENTIATING BETWEEN EXTRATESTICULAR AND TESTICULAR SCROTAL DISEASE

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ABSTRACT

Scrotum masses may be extratesticular, intratesticular, cystic, or solid. Extratesticular cystic masses are typically benign, but intratesticular cystic masses are usually malignant. Painful scrotal enlargement may need more than a physical examination. In rare cases, a palpable scrotal tumor may be testicular. Physicals may miss vital indicators and misunderstand results. According to studies, scrotal disease imaging using ultrasonography (U/S) is safe. We did a study to determine whether high-frequency ultrasound (HF-U/S) can identify extratesticular and testicular scrotal illnesses (TSP). Acute scrotal inflammatory disorders (ASID) may affect anatomy. It targets intratesticular solid and cystic scrotal masses. Big hydroceles don't impair sperm production or delivery. HF-RT-US outperforms CD in distinguishing intratesticular and extratesticular scrotal masses. HF-U/S's non-invasiveness, simplicity, affordability, worldwide availability, and reproducibility helped the study. HF-U/S detected and tracked scrotal and testicular diseases.

Keywords: HF-U/S, TSP, ASID, extratesticular, cystic masses.

INTRODUCTION

The scrotal sac or scrotum, composed of soft skin and smooth muscle, represents a tiny external sac beneath the penis. By the scrotal septum, this sac is separated into two. The wall thickness in the scrotum is 8 mm. The testes, epididymis, spermatic cord, and external spermatic fascia are structures in the scrotal sac.¹ It was considered unaided clinical knowledge previously in many past studies. In addition, there are many scrotal masses that are undetected till now. Studies conclude that extratesticular, intratesticular, cystic, and solid masses may develop in the scrotum masses. The majority of cystic masses are extratesticular in nature, while the majority of malignant masses are intratesticular.²

If the patient feels pain, swelling, or excessive distorting of the scrotal contents, the clinical evaluation of scrotal enlargement may require more than a physical examination. Assessing a scrotal mass that is both palpable and mobile and originates from the testes or other testicular tissues may present a challenge. The standard examination may also skip substantial signs of disease, and the physical examination may be misinterpreted.³ Furthermore, in this respect, studies have shown that for diagnosing scrotal disease, ultrasound (U/S) is the imaging showed the highest level of safety. For both adult and pediatric patients, testes (U/S) is very useful and noninvasive tool. It serves as an effective screening and diagnostic tool, and it may be used to transcribe more information to validate or refute a clinical diagnosis.(CD)⁴ U/S was 1st time reported as diagnostic tool for investigation by Miskin et al.,(1974)⁵ and Bucksan M et al.,(1977)⁶.

Hence, in our investigation we try to evaluate the clinical significance of HF-U/S as diagnostic tool for accurately distinguishing between extratesticular and testicular scrotal pathology (TSP).

AIM

The purpose of our study was to determine the role of high-frequency ultrasonography (HF-U/S) as an investigating modality in properly differentiating between extratesticular and testicular scrotal pathology (TSP).

INCLUSION CRITERIA

1. All patients who reported to the Department Of Radiology with the chief complain of painor swelling in scortal.

2. Patients of all age groups were included in the starting starting from infant ending to 80 year of age.
3. Both the genders male & female were included in the study .

EXCLUSION CRITERIA

1. Patients who are contraindicated with any kind of radiological exposure .
2. Patients who are physically compromised were excluded from the study.
3. Patients who dont show any pathology related to TSP were excluded from the study.

MATERIALS & METHOD

In our investigation we have taken up total of 100 cases of scrotal pathologies patients who underwent diagnostic investigation with the help of High frequency real time ultrasound (HF-RT-US) diagnostic tool. Our study was started in October, 2018 and ended at March ,2020. All those patients reported to the Department of Radiodiagnosis during the period of our study & were fullfing the inclusion criteria of the study were included in the study & underwent U/S by the Department of Surgery & Department of Urology , Krishna Institute Of Medical Science And Hospital, Karad.

TYPE OF STUDY- Our study was an observational type of study.

STUDY DESIGN- Our study was prospective view with longitudinal & observational type of study design.

TOTAL STUDY PERIOD – We conducted our study for total of 18 months.

STUDY AREA- Patients reported to the Department Of Radiodiagnosis, Krishna Institute Of Medical Sciences & Hospital.

METHOD OF DATA COLLECTION

Before administering U/S to patients , we have taken a comprehensive clinical history, and a meticulous physical assessments of all the patients that were included in the study. Subsequently, the cases were monitored to conduct a comparative analysis of histology, surgery, fine needle aspiration cytology, and treatment efficacy. A supplementary investigation was also conducted in specific instances where further scrutiny was deemed necessary from a medical standpoint. Abdominal U/S scans were conducted in tandem with scrotal scans to detect ectopic testis in instances of undescended testis. In cases of tuberculous epididymo-orchitis, abdominal or intestinal tuberculosis was evaluated. The

cause of testicular vein obstruction was investigated in cases of varicoceles. Additionally, the associated pathology was examined in cases of testicular malignancy.

EQUIPMENT

In our study we have utilized a Seimens acuson (X300 PE Ver R-4.0) machine to conduct high-resolution (HR) and RT-U/S of the scrotum. The procedure was done with a 5–10 MHz linear transducer, while abdominal U/S was conducted using a 3.5–5.0 MHz convex curved array transducer.

SCANNING TECHNIQUE

Patients were told to lie in a supine position during scanning. Additionally, once the patient laid down, the scrotum was lifted using a towel wrapped around the patient's legs, and aptient's penis was pull & kept on the his belly before the towel was wrapped around it. Both hemiscrotums were painstakingly examined in transverse, sagittal, and oblique planes. The scanning was done with the patient in an upright position during the Valsalva maneuver. Extra scans of the spermatic cord in the scrotal neck and inguinal canal areas were taken in the event of an undescended testis, an emcysted testis, or a varicocele.

During U/S scan following parameters were involved :-

1. DIMENSION & SIZE .

2. CONTOUR

- a. NORMAL
- b. ENLARGED
 - DIFFUSE ENLARGEMENT
 - FOCAL ENLARGEMENT

3. ECHOGENICITY

- a. NORMAL
- b. ABNORMALITY
 - FOCAL ABNORMALITY
 - i. Hyoechoic
 - ii. Hyperechoic
 - iii. Heterogenous
 - DIFFUSE ABNORMALITY
 - i. Hypoechoic

- ii. Hyperechoic
- iii. Heterogenous

4. EPIDIDYMIS

a. ENLARGED

- i. Diffuse
- ii. Focal
 - Head
 - Body
 - Tail

b. ECHOGENICITY

- i. Focal abnormality
 - Hypoechoic
 - Hyperechoic
 - Heterogenous
- ii. Diffuse Abnormality
 - Hypoechoic
 - Hyperechoic
 - Heterogenous

5. THICKNESS

6. COLLECTION IN SAC

7. DILATED VEINS

8. ANOMALIES

Further, observations were collected according to above perfoma & underwent for the analysis of the same.

RESULT

AGE

S.No	Age group (years)	No of cases	Percentage
1	0 – 10	09	9.0
2	11 - 20	15	15.0
3	21 - 30	21	21.0
4	31 - 40	29	29.0

5	41 - 50	14	14.0
6	51 - 60	07	7.0
7	61 - 70	03	3.0
8	71-80	01	1.0
	Total	100	100 %

TABLE 1 : AGE DISTRIBUTION OF PATIENTS.

In our study we have found that ,patients were involved in the study ,starting from age range of 2 year to 80 years and in that also most number of cases were presented at age range from 31 to 40 years (29%). Followed by 21 to 30 years group (21%), In total , age group of 21 to 40 years were having approx 50 % cases .

FREQUENCY OF COMBINATION SYMPTOMS (CLINICALLY)

	SYMPTOMS	NO OF CASES
1.	Pain & Swelling	34
2.	Pain, Swelling and Fever	04
3.	Swelling	23
	Unilateral Swelling	17
	Bilateral Swelling	06
4.	Pain	10
	Acute onset	04
	Chronic onset	06
5.	Infertility	12
6.	Trauma	08
7.	Dysuria	06
8.	Discharging wound on Skin	05
9.	Pain abdomen	02
10.	Erythematous skin rashes	01

TABLE 2 : CLINICAL SYMPTOMS IN FREQUENCY.

In our study we have found that , majority of cases were presented clinically with a combination of various multiple symptoms. Most common among them was combination of Symptoms like scrotal swelling and pain, as in 34 cases (34%), Combination of pain, fever and swelling in 4 cases (4%). Furthermore, out of 92 abnormal cases, 32 cases had bilateral pathology, unilateral in 60 cases which involved right side in 26 cases & left side in 34 cases. Entirely, pathology was seen in 124 hemiscrotum out of 100 patients studied.

SCROTAL SAC & TESTICULAR DISEASE

	PATHOLOGY	NO OF CASES	% OF CASES
1	INFLAMMATORY DISEASE	40	30.5
2	INFERTILITY	16	12
3	CONGENITAL LESIONS	15	11.4
4	TRAUMA	08	6.0
5	SWELLING	29	22
6	NEOPLASTIC	02	1.5
7	OTHERS	14	10.6
8	NORMAL	08	6.0

TABLE 3: DIFFERENT TYPES OF PATHOLOGY IN 2 VARIABLES

SITE OF PATHOLOGY INVOLVEMENT

Site	No. of cases
Unilateral	
Left	34
Right	26
Intotal	60
Bilateral	32

TABLE 4 : SITE OF PATHOLOGY INVOLVEMENT

INFLAMMATORY SCROTAL PATHOLOGY (ISP)

	PATHOLOGY	NO OF CASES	% OF CASES
1	ACUTE EPIDIDYMITIS (AE)	02	5.0
2	ACUTE EPIDIDYMO-ORCHITIS (AED)	09	22.5
3	ACUTE ORCHITIS (AO)	03	7.5
4	CHRONIC EPIDIDYMITIS(CE)	03	7.5
5	CHRONIC EPIDIDYMO- ORCHITIS (CED)	18	45
6	WALL INFLAMMATION	03	7.5
7	FUNICULITIS	01	2.5
8	FOURNIER'S GANGRENE	01	2.5
	TOTAL	40	100 %

TABLE 5 : DISTRIBUTION OF INFLAMMATORY PATHOLOGY

In our study we have found that,40 cases were having inflammatory pathology on HF-U/S. Furthermore, we found that chronic Epididymo-orchitis was the most common inflammatory pathology with (45%, 18 cases) and 2nd most common was Acute Epididymo-orchitis, (22.5%, 9 cases).

HR-U/S FOR ISP

S.No	Echo pattern	Acute epididymitis	Acute Orchitis	Acute Epididymo-orchitis	Chronic epididymitis	Chronic Epididymo-orchitis
1	Hyper echoic				2	
2	Hypo echoic	2	3	7		
3	Iso echoic			1		
4	Heterogeneous					

				1	1	13
5	Complex cystic					5
6	Purely cystic					
7	Epididymal calcification					2
8	Testicular calcification					2

TABLE 6 : HR-U/S FOR ISP

NON-NEOPLASTIC SWELLING OF SCROTUM

	PATHOLOGY	NO OF CASES	% OF CASES
1	HYDROCELE	24	52
2	EPIDIDYMAL CYST	06	13
3	SPERMATOCELE	03	7.0
4	VARICOCELE	13	28
5	TESTICULAR CYST		
	TOTAL	46	100 %

TABLE 7: NON-NEOPLASTIC SWELLING

In our study we have found that , among all non-neoplastic pathology(N-NP), hydrocele was the most common pathology(54%, 24 cases). The incidence of N-NP was much more higher than compared to NP , incidence of extratesticular pathology was more than intratesticular swellings . Henceforth, we conclude that HF-U/S was 100% sensitive to differentiate intratesticular swellings from extratesticular swellings.

COMPARISON BETWEEN SONOLOGICAL DIAGNOSIS (SD) & CD

S. No	CD		HF-U/S	
1	Intratesticular	1	Intra	2
		2	testicular	6
			Extra	4
			testicular	
			Both intra + extra testicular	
2	Extratesticular	2	Extra	18
		4	testicular	--6
			Intra	
			testicular	
			Both intra + extra testicular	
3	Both intratesticular + extratesticular	6	Intra	--5
			testicular	1
			Extra	
			testicular	
			Both intra + extra testicular	
4	No diagnosis	4	Normal	2
			Intra testicular	--
			Extra testicular	2
			Both intra + extra testicular	--
5	Unilateral	3	Bilateral	18
		2	Unilateral	16
6	Bilateral	1	Unilateral	4
		0	Bilateral	8

TABLE 8 : COMPARISON BETWEEN SD & CD.

In our study we have compared specificity and sensitivity of HF-U/S along with physical examination in differentiating a masses concerning intratesticular or extratesticular . We have found a low specificity (50%) and low sensitivity & specificity approx. (15%) w.r.t. physical examination, whereas for HF-U/S showed highly sensitive and specific (almost 100%) in

differentiating masses as either intratesticular or extratesticular compared to physical examination.

DISCUSSION

In our study we have found that total of 100 patients with a HF-U/S done in relevant cases for detection of STP . All the cases were referred from the Department Of Urology & Department Of Surgery with strong clinical suspicion of intrascrotal pathology.

AGE

In our study, patients ranged in age from 2 to 73 years old. According to our findings, the age group of 31 to 40 years old had the greatest number of cases (29%, 29 cases), followed by the age group of 21 to 30 years old (21%, 21 cases), and the age group of 71 to 80 years old had the fewest (1%, 1 case).

PATHOLOGY

We have found that ,most common physical examination includes combination of symptoms like swelling and pain in around 34 cases (34%), fever, pain and swelling in around 4 cases (4%).

SWELLING

We have found that , out of 100 patients ,23 cases (23%) presented only with swelling. Where, unilateral swelling in around 17 cases (76%), bilateral in 6 cases (26%). Furthermore, out of 17 unilateral sidescrotal swelling, 10 cases seen on the left side (59%), 7 cases on the right side (41 %). Out of 23 cases, 6 cases (26%) presented with acute onset with duration of 2days to 10days and 17 cases presented with insidious onset (74%) with duration of 15 days to 6 months.

PAIN

According to the study results, a proportion of 10% of the cases exhibited pain as the only symptom, whereas 40% of the cases manifested an abrupt onset of symptoms that persisted for a duration ranging from a few hours to 5 days. Furthermore, a majority of the cases, specifically 60%, exhibited symptoms of persistent pain that lasted for a duration ranging from 15 days to 6 months. Out of a sample of 10 cases of pain, 80% of the cases were observed to be unilateral, with a total of 8 cases falling under this category. The remaining 20% of cases, which accounted for 2 cases in total, were bilateral. In a cohort of 8 individuals who reported experiencing unilateral scrotal pain, it was observed that 63% of cases (n = 5)

were localized on the left side, whereas 37% of cases (n = 3) were localized on the right side. Furthermore, the severity of the discomfort demonstrated a varying spectrum, ranging from a slight pulsation to severe anguish. In most instances characterized by an abrupt onset of pain, pyrexia is commonly observed, whereas cases featuring a gradual onset are not typically concomitant with pyrexia but rather manifest as persistent, throbbing pain. Out of the 23 occurrences of abrupt enlargement, 30% (7 instances) were correlated with a past of physical injury, 26% (6 instances) were associated with a history of painful urination, and 8% (2 instances) were linked to a history of discomfort in the abdominal region. Furthermore, several associated symptoms were noted, including a discharge from the scrotal skin in five instances and the presence of erythematous skin rashes in one instance.

INVESTIGATION

We have found that, leucocytosis was the most common positive finding, noted in 31 cases (31%), chest X-ray abnormality was present for 8 cases (8%), semen analysis report with abnormal findings like Oligospermia, Aesthenospermia in total of 10 cases (10%). Furthermore, Among inflammatory pathology, 8 cases showed positive histopathology report, 6 of them showed tubercular pathology, 2 cases showed malignant pathology.

TYPES OF TSP

In our investigation, we discovered that, out of a sample size of 100 cases, 92 cases exhibited pathological processes while 8 cases displayed normal results. 32 of the 92 cases in the sample exhibited bilateral pathology, while the remaining 60 displayed unilateral pathology. In the sample of 60 cases with unilateral involvement, 34 cases exhibited involvement on the left side and 26 cases exhibited involvement on the right. In a study of 100 patients, it was observed that 124 hemiscrotum pathologies were exhibited. In addition, it was observed that 40 cases exhibited inflammatory conditions, 15 cases presented with congenital lesions, 16 cases exhibited pathology associated with male infertility, 8 cases displayed traumatic lesions, and 2 cases were identified as having neoplastic lesions. Fourteen cases were observed to have a variety of conditions, including testicular microlithiasis and inguino-scrotal hernia.

Author	No of Cases	IP	N-IP
Willscher et al ⁷	43	12 (28%)	28 (65%)
Richie et al ⁸	124	31 (27 %)	75 (66%)
Arger et al ⁹	62	16 (26%)	45 (67%)
Present study	100	40 (30.5%)	29 (22%)

TABLE 9 : COMPARISON OF OTHER STUDIES WITH PRESENT STUDY FOR INFLAMMATORY PATHOLOGY (IP) & NON-INFLAMMATORY PATHOLOGY(N-IP).

In our study we have found that pathology can be divided as inflammatory pathologies and non-inflammatory pathology . This was due to high incidence of chronic IP and complication rate in our study.

INFLAMMATORY PATHOLOGY (IP)

In our study we have found that , 40 cases showed IP on HF-U/S study. Where, CED was the most common IP detected in 18 cases (45%). AED was seen in 9 cases (22.5%). Other IP include AO 3 cases (7.5%), CE , 3 cases (7.5%), wall inflammation 3 cases (5%), AE 2 cases (5%), Fournier’s gangrene and Funiculitis in 1 case each(2.5%).

NON-INFLAMMATORY (N-ID)

In our study, we detected a total of 34 cases with N-ID (34%), of which 29 cases (85%) presented only with swelling and 5 cases (15%) presented with swelling and pain. All five cases experienced lasting low-intensity pain, indicating that the scrotal swellings were not inflammatory. Only two of the 34 cases of non-inflammatory scrotal swelling were neoplastic tumors. Histopathology verified seminoma, a germ cell tumor, in both cases of neoplastic swelling. In one case, the echotexture showed a well-defined, homogeneous hypoechoic zone, but in another, it showed multiple well-defined hypoechoic patches. Of the remaining 32 cases, pathology was seen in both hemiscrotum in 8 cases, unilateral in 24 cases. Of total 40 hemiscrotum, more than one pathology noted in 6 cases. So in total 46 pathologies were detected.

	No of cases	Neoplastic	Non-neoplastic
Arger et al ⁹	54	16 (30%)	38 (70%)
Richie et al ⁸	117	22 (19%)	53 (45 %)
Willscher et al ⁷	40	5 (12 %)	20 (50%)
Present study	46	2 (4%)	44 (96%)

TABLE 10 : COMPARISON OF STUDIES WITH PRESENT STUDY.

	No of cases	Intra testicular	Extra testicular	Intra + Extra testicular
Arger et al ⁹	54	13(24%)	41(76%)	
Richie et al ⁸	117	22 (19%)	53 (45%)	
Willscher et al ⁷	40	5 (12 %)	20 (50%)	
Present study	46	2 (4%)	31 (67%)	13 (28%)

TABLE 11 : COMPARISON OF STUDIES WITH PRESENT STUDY.

In our study, we have found that the incidence of non-neoplastic swellings was substantially higher than that of neoplastic swellings. The incidence of extratesticular swellings was greater than that of intratesticular swellings. The co-occurrence of intratesticular and extratesticular swellings within an individual was noted in 28% of instances, despite the 100% sensitivity of HF-U/S in distinguishing between the two types of swellings.

However, twenty-four cases (54%), or hydrocele, are the most prevalent pathology noted among non-neoplastic scrotal swellings. Twenty-one of the 24 cases had a primary vaginal hydrocele (87%), whereas three involved a cord hydrocele that had been encysted (13%). Out of a total of 24 cases, hydrocele was noted unilaterally in 17 cases and bilaterally in 4. Arger et al.,⁹ and Willscher et al.,⁷ found comparable features in earlier studies. A collection of transparent fluid developed in all cases of hydrocele between two tunica layers. Sonographic imaging reveals the presence of anechoic lesions in the vicinity of the

$$\text{Sensitivity} = \frac{A}{A + C} \times 100$$

$$\text{Specificity} = \frac{D}{B + D} \times 100 \text{ where,}$$

A : True positive

B : False positive

C : False negative

D : True negative

spermatic cord, which are indicative of a mild hydrocele. These lesions exhibit a characteristic response to changes in spermatic cord tension and are associated with the accumulation of clear fluid along the spermatic cord. In conjunction with hydrocele, two cases of inguino-scrotal hernia were noted in the current investigation. A hernial sac with bowel loops was seen on a HF-U/S scan of the inguinal area, reaching all the way to the top of the testis. Normal testes and epididymis were seen on the ipsilateral side.

When compared to a physical examination, the sensitivity and specificity of HF-U/S in determining whether a mass was intratesticular or extratesticular were evaluated. In contrast, HF-U/S was very specific and sensitive (nearly 100%) when classifying a scrotal mass as intratesticular or extratesticular, explaining the latter's limited sensitivity. In addition, we found that HF-US detected 3 cases of hematocele as an anechoic wall without any scrotal hematoma and/or sediments; 2 cases showed multiple testicular and hypoechoic echoes within the wall; 1 case of hematoma was noted in a patient aged 10 years old on the right side, which showed an enlarged hematoma and decreased echogenicity; and 1 case of hematoma appeared as an irregular hem. Furthermore, no cases of testicular rupture were found in our current disease.

According to our study, the HF-U/S test was less sensitive for detecting clinically palpable cases and was not a valid diagnostic tool for detecting abdominal ectopic testes. Similar findings were noted in a recent study by Robert Weiss et al.,¹⁰ who studied 20 cases of palpable undescended testes and were able to identify 14 cases of undescended testes (70%) and only one case of non-palpable testes using the HF-US. They concluded that the HF-U/S was insufficient as a primary screening technique, particularly in young patients. However, studies have also concluded that HF-U/S is sensitive in differentiating clearly between testes and lymph nodes on a textural basis.

CONCLUSION

Acute scrotal inflammatory diseases (ASID) may have structural alterations as well. In the identification of intratesticular microlithiasis, it is highly sensitive in differentiating solid scrotal masses from cystic masses and solid masses from cystic masses. It helps prove that enormous hydroceles do not influence testes and epididymis function. The (HF-RT-US) is highly sensitive in differentiating between intratesticular and extratesticular scrotal masses and is obviously superior to CD. Advantages of HF-U/S according to study that it was non-

invasive, simple, affordable, widely accessible, and reproducible. Therefore, we have come to a conclusion that HF-U/S was a useful tool for identifying and monitoring scrotal and testicular disorders predictors.

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