



**ORIGINAL RESEARCH PAPER**

**Radiology**

**SONOLOGICAL EVALUATION OF SCROTAL PATHOLOGY BY HIGH FREQUENCY ULTRASOUND AND COLOR DOPPLER EXAMINATION**

**KEY WORDS:**

ultrasonography; Color Doppler; scrotum; Orchitis; Epididymitis; Seminoma

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**ABSTRACT**

Clinical presentation of scrotal pathologies are non-specific, though superficial structure, based on physical examination alone, it is often difficult to diagnose the specific scrotal pathologies. The aim of the study was implementation of ultrasonography and its application to scrotal imaging, diagnosis of scrotal pathologic conditions by using High frequency real time ultrasonography. There is a focus on evaluating the sonographic appearance of spectrum of scrotal diseases.

**INTRODUCTION**

Scrotum is a cutaneous bag containing right and left testis, the epididymis and the lower part of the spermatic cord. It is divided into right and left parts by a ridge or median raphe, which is continued forwards on to the undersurface of the penis and backwards along midline of the perineum to the anus. The testis separated from the examining fingers by little more than few mm covering of loose skin and fibro muscular tissue, so is most accessible for clinical examination.

In the clinical examination of the scrotal swelling, physical evaluation by itself may be inadequate due to tenderness, swelling or gross distortion of scrotal contents. Clinical signs and symptoms are usually nonspecific, variable and misleading. Until mid-1970 clinical evaluation of scrotal contents was confined to palpation, trans-illumination, supplemented by investigative modalities like, thermography and venography. The present day diagnostic tools include gray scale Ultrasonography, Doppler studies, Magnetic Resonance Imaging, in addition to radioisotope studies and testicular angiography.

CT and MRI have dominated imaging of other regions of the body, but they have certain limitations in evaluation of scrotal diseases. Computed Tomography delivers radiation to gonads, while MRI imaging is costly and not readily available. Ultrasonography is exceptionally well suited to study of scrotum and its contents. Sonography is simple to perform, rapid, non-invasive relatively inexpensive, easily reproducible, widely available and does not involve irradiation of gonads. The study is done to assess the usefulness of high frequency gray scale US and color Doppler study in evaluation of various scrotal pathologies.

**REVIEW OF LITERATURE**

In 1992, George O Atkinson et al<sup>1</sup>, Studied 32 children with scrotal pain or swelling using 7.5 MHz linear transducer. They conclude that color Doppler sonography is helpful in the initial evaluation of pediatric Testes, provides accurate evaluation of the involved hemiscrotum.

In 1997, Sanjeev Agarwal et al<sup>2</sup>, conducted study on 40 patients who were referred for intrascrotal imaging. They concluded that Color Doppler sonography could rapidly and reliably differentiate epididymitis and orchitis from testicular torsion.

A study conducted by Farriol VG, Comella XP, Agromayor EG<sup>3</sup> on 25 patients in 2000 to describe the spectrum of gray-scale and power Doppler sonographic appearances in inflammatory scrotal diseases. They concluded that power Doppler imaging is an easy and fast Doppler modality for evaluating inflammatory conditions of the scrotum.

Kho VK, Chan PH<sup>4</sup> in 2012 reported a 20-year-old man who presented with a slow-growing painless scrotal tumor for 2 months. Workup was suspicious for a right paratesticular tumor. At the day of surgical resection severe pain and redness over the patient's right hemi-scrotum were noted further work up confirmed a chronic inflammatory process rather than a malignancy.

Adejolu M, Sidhu PS<sup>5</sup> (2011) studied 18 patient to describe the appearance of the "filarial dance" is which was not characteristic of filariasis but occurs in nonendemic areas as a manifestation of epididymal obstruction. The mean patient age was 47.7 (range, 28-91) years. The characteristic condition in patients with filariasis and our patients is lymphatic obstruction, likely the underlying cause of the appearance in both groups.

In 2005 Gorman B, Carrol BA detected sensitivity for intra scrotal masses on ultrasonographic examination can be nearly 100%. Sonography is important in evaluation of scrotal masses because its accuracy is 98% - 100% in distinguishing intra testicular and extra testicular pathologic features.

According to Jędrzejewski G, Wozniak MM et al (2012) in a study performed in 1448 patients (under 3 years of age group) describing affect of pathological on volume of testis. They concluded that volume of the pathological testes was lower than the volume of the normal ones. Abnormalities were found 20.1% of boys. Undescended, cryptorchid testes were found in 4.8% of patients, mobile testicle in 7.6% and hydrocele in 2.8%.

Günther P, Rübber I (2012) studied the inadequate evaluation and delays in diagnosis and treatment can result in irreversible harm. They concluded that physical examination and properly performed doppler ultrasonography gives adequate evaluation of the acute scrotum in childhood and adolescence.

**MATERIALS AND METHODS:**

The prospective study was conducted on patients referred for

evaluation of scrotal pathology to the department of Radio diagnosis, for the period of 2 years. About 112 cases were studied with HRCD by using linear array transducer of 7-12 MHz on ACUSON X300 and ACUSON ANTARES machines.

**Scanning technique:**

Scanning was routinely performed in supine position, after elevating scrotum using a towel draped over thighs, and the penis is held up by the patient. Both hemiscrotum was examined in transverse, sagittal and oblique planes. Scanning was also done with patient position in upright and during performing Valsalva maneuver.

**During ultrasound scan, on a routine basis following parameters were evaluated:**

Testis, Epididymis, spermatic cord, scrotal wall thickness, presence or absence of any collection in scrotal sac and presence of any anomalies in scrotum.

**SCROTUM**

The scrotum is a cutaneous, fibro muscular sac separated by a midline septum, with each half of the scrotum containing a testis and associated structures. The scrotal wall is composed of the following structures, listed from the superficial to the deep layers: rugated skin, superficial fascia, dartos muscle, external spermatic fascia, cremasteric fascia, and internal spermatic fascia. The layer lining the scrotal wall is termed the parietal layer, and the layer extending over the testis and epididymis is referred to as the visceral layer.

**ULTRASOUND FEATURES OF SCROTAL AND TESTICULAR DISEASES**

**Pathology, Clinical Features and Ultra Sound Features of Scrotal and Testicular Diseases**

**Classification**

**A. Congenital lesions**

**Testicular:** Anomalies of testicular descent, Cryptorchidism, Incomplete descent and Complications.

**Scrotal sac:** Congenital hydrocele.

**B. Inflammation of scrotum and its contents.**

Acute Epididymitis and Epididymoorchitis, Chronic Epididymitis and Epididymoorchitis, Acute Orchitis, Complications of inflammatory disease of testis and epididymis, Scrotal wall inflammatory diseases like, Cellulitis of scrotal wall, Fournier's gangrene, Idiopathic scrotal edema.

**C. Non-inflammatory swellings of scrotum.**

**I Neoplastic:** Testicular, Epididymal, Spermatic cord.

**II Non-Neoplastic:** Hydroceles, Lymphoceles, Spermatocele, Epididymal cyst, Testicular cyst, dilated rete testis, Varicoceles, Complete hernia.

**D. Scrotal and testicular trauma.**

Testicular contusion, Testicular hematoma, Testicular rupture, Testicular laceration, Testicular disruption, Hematocele, Scrotal wall hematoma

**CONGENITAL LESIONS**

**Congenital hydroceles:** The processus vaginalis communicates with the peritoneal cavity. Usually the communicating orifice is too small for development of hernia. When the patient is horizontal, e.g. at night, the fluid in tunical pouch disappears into the general abdominal cavity, and returns to the scrotum, when erect posture is resumed.

On High frequency US, acute epididymitis manifests as: Reduced echogenicity of the epididymis, Increase in size of epididymis, Secondary hydrocele and Scrotal wall thickening.

Epididymitis may be diffuse /global with involvement of head, body, and tail. The normal values for epididymal head is 7 – 14 mm, 4 mm for epididymal body.

**Acute orchitis:** Isolated testicular involvement occurs in 21 % of cases of scrotal inflammatory disorders. The most frequent cause of orchitis is direct extension of infection from adjacent inflamed epididymis. On High frequency ultrasound scan, acute orchitis appears as poorly defined, focal, peripherally situated hypoechoic intratesticular lesions. The testis will be diffusely enlarged and ultrasonic probe tenderness may be present. Color Doppler study shows increased blood flow.

**Non-inflammatory swelling of scrotum:** It is of 2 types: Neoplastic and Non-neoplastic

**I Neoplastic swellings of scrotum**

**Testicular neoplasms:** 95% of Primary testicular neoplasms are of germ cell origin. The incidence of testicular germ cell neoplasm is 2 per 100 000. These are seminoma (40-50%), embryonal carcinoma (15-20%), teratoma (5-10%), choriocarcinoma (rare). Remaining 5% neoplasms arise from Sertoli cells, Leydig cells, or mesenchymal tissues.

**Seminoma:** Seminoma occurs in the age group 30-40 years. Pure seminomas are characterized by smooth or irregular marginated, homogeneously hypoechoic lesions without calcification. Cystic areas are rare and if present, small multifocal involvement may be seen.

**II Epididymal neoplasms:** Primary extra testicular neoplasms are rare, majority (70 %) of them arises in spermatic cord and are benign. Epididymal neoplasms include Adenomatoid tumors (Mesothelioma), Mesenchymal neoplasms, Cystadenoma of epididymis, and Metastasis.

Adenomatoid tumors are rare, slowly growing benign neoplasm, which represents 30 % of all extra testicular neoplasms; most are epididymal. They arise after the age of 20 years, are usually unilateral, and show presence of associated hydroceles in 15 – 20 % cases. Clinically they are usually asymptomatic, but 30 % of cases present with scrotal pain. They are bilateral in 33 % of cases. On High frequency US they appear hyperechoic, homogenous and well circumscribed.

**III Spermatic cord neoplasms:** Includes Lipoma, Leiomyoma, Neurofibroma, Embryonal rhabdomyosarcoma. Lipoma of the cord is the most common tumor. Leiomyoma and neurofibroma occurs less frequently. Malignant tumors are chiefly sarcomas, in first three decades of life, these are almost invariably embryonal rhabdomyosarcoma. On High frequency US the Lipoma appear as a well-circumscribed lesion with medium to low intensity echoes, confined to the cord and discrete from both testes and epididymis.

**Secondary neoplasms**

**Reticulo endothelial tumors**

**Testicular lymphoma and leukemia:** Testicular lymphoma is the most common primary and secondary testicular neoplasm in men aged 60 to 80 years. Testicular lymphoma constitutes 1-7 % of all testicular tumors. The primary lymphoma in which the tumor mass is confined to testis at time of clinical onset is rare. On High frequency US imaging, both lymphoma and leukemia appear either as, diffuse homogeneously hypoechoic testis or Focal hypoechoic areas with an enlarged testis.

**Color Doppler US findings in testicular tumors**

Color Doppler US has a limited role in the evaluation of testicular tumors. Findings at color Doppler US scanning depend on the size of the lesion. Tumors, which are of size more than 1.6 cms diameter, show hypervascularity. The cell type of the tumor has no correlation with the visible vascularity at color Doppler US scanning. However, hypervas

cularity of these neoplastic lesions cannot be differentiated from that of inflammatory lesions.

Non-inflammatory, Non-Neoplastic swellings of scrotum includes, Hydrocele, Lymphocele, Spermatocele, Epididymal cyst, Testicular cyst, Varicocele, Complete hernia.

**Hydrocele:** A Hydrocele is a collection of serous fluid in the scrotum between the visceral and parietal layers of the tunica vaginalis. It may be Congenital or Acquired (primary / idiopathic and secondary).

Causes of secondary hydroceles are acute Epididymo orchitis, Chronic epididymis / Chronic Epididymoorchitis, testicular neoplasms, Filariasis, Post-operative, Following radiotherapy for testicular malignancy, Trauma., Acute septic peritonitis in children with patent processes vaginalis.

On High frequency US, a hydrocele is seen as anechoic collection in the tunical sac. At high gain settings, low-level echoes are seen. These internal echoes are thought to be due to cholesterol crystals. Scrotal calculi and parietal wall calcification may be seen. Other types of hydroceles are Infantile hydrocele and Lymphocele

**Scrotal and testicular diseases:** The conditions described are: Scrotal calculi and calcifications, Testicular microlithiasis, Testicular atrophy and Scrotal Filariasis.

**Scrotal Filariasis**

The "Filarial dance sign" (FDS) is described on HRUS shown as linear echogenic structures with persistent, random, almost tireless twirling movements of live adult filarial worms in the lymphatic vessels. Pulse Wave Doppler reveals worm nests, in enlarged lymphatic vessels by the characteristic pattern of irregular worm movements, in color Doppler visualized in form of an irregular red color signal. US shows dilatation in the lymphatic vessels, early and advanced stages of hydrocoele, and the number of worm nests over time. On follow-up US, after the treatment with DEC, Complete absence of worm movements was taken as a positive response.

**RESULTS:**

Totally 112 cases presented with clinical symptoms were studied in HRCD sonography. Largest numbers of patients were in age group of 11 to 30 years, which constituted 48% all cases. Commonest clinical presentation was scrotal swelling in combination with pain. Most common pathology was hydrocele followed by epididymo orchitis. HRCD is an accurate method for assessment of scrotal pathology. HRCD accurately differentiates between testicular torsion from acute epididymo-orchitis in acute painful scrotal conditions. High frequency ultrasonography is also highly sensitive in differentiating intratesticular from extra testicular origin of scrotal masses, differentiating solid from cystic scrotal masses & in diagnosis of sub clinical varicoceles.

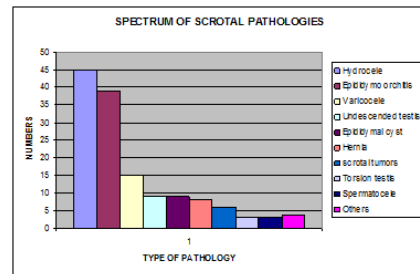
**Table No. 1: Showing side Involvement**

Type of pathology	Numbers
1. Hydrocele	45
2. Epididymo orchitis	39
3. Varicocele	15
4. Undescended testis	9
5. Epididymal cyst	9
6. Hernia	8
7. scrotal tumors	6
8. Torsion testis	3
9. Spermatocele	3
10. Others	4
Total	141

**Table No. 2: Showing Spectrum of Scrotal Pathologies**

Side affected	No	%
Bilateral	24	22.5
Right	43	40
Left	40	37.5

Bilateral	24	22.5
Right	43	40
Left	40	37.5



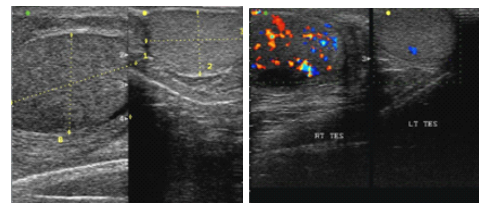
**GRAPH 1: SHOWING SPECTRUM OF SCROTAL PATHOLOGIES.**

**Table 3: Spectrum of Hydrocele with sidedness**

TYPE OF HYDROCELE	RT	LT	B/L	TOTAL
1. PRIMARY	2	3	3	9
2. SECONDARY	30	11	7	34
3. CONGENITAL	1	0	0	23

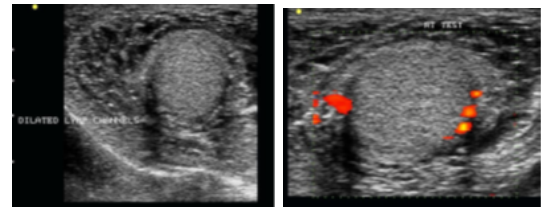
- Among non-neoplastic scrotal swellings, hydrocele is the commonest pathology noted 45 cases. The incidence of non-neoplastic scrotal swellings is very much high compared to neoplastic swellings.
- Among 6 Neoplastic scrotal swelling cases, lymphoma is seen in 2 cases and seminoma is seen in 4 cases.

**IMAGES: ACUTE ORCHITIS**



**(A) Transverse section of both testis showing enlarged hypoechoic right testis (B) with increased vascularity**

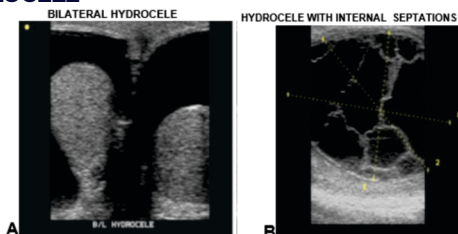
**SCROTAL FILARIASIS**



**(A) (B)**

**(A) Grey scale, (B) Colour Doppler, Transverse section of right testis shows thickening of the scrotal wall with multiple, hypoechoic tubular channels in the scrotum suggest lymphedema of the scrotal wall following filariasis.**

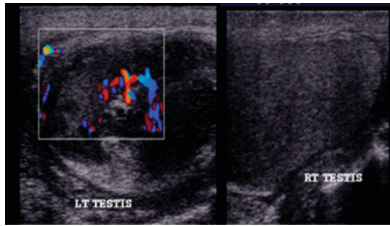
**HYDROCELE**



**(A) Showing anechoic collection in bilateral scrotal sac. (B) Shows collection in the scrotal sac with multiple**

internal septations.

**SEMINOMA**



**Undescended left testis seen in left iliac fossa with irregular marginated, homogenously hypoechoic lesions within it. Right testis shows normal echotexture.**

**DISCUSSION**

The clinical presentation is non-specific and clinical examination alone is not sufficient for diagnosis and management. Because of superficial location of the scrotal contents makes them ideally suited for sonographic examination. The development of high frequency, real time with colour doppler scanners has enhanced the diagnostic accuracy of scrotal sonographic examinations. Scrotal ultrasound has reached a level of maturity that allows the technique to be the first and only imaging examination necessary to evaluate the scrotal contents.

In this study, we have examined 112 patients with high frequency ultrasound scan and color Doppler study was done in all cases, for detection of scrotal and testicular pathology.

**Clinical background:**

Cases were referred from department of Surgery, with strong clinical suspicion of intrascrotal pathology. The age distributions of cases in this study are varied from 1 Years to 80 Years. Highest number of cases presented were in the age group of 21 to 30 (31 cases – 28%), followed by 11 to 20 years (20 cases – 18%). Therefore age group of 11 to 30 years constitutes 48% of our cases. Least number of cases was in the age group 71 to 80 years (1 case – 3%).

**Types of scrotal and testicular pathology detected:**

Out of 112 cases of study, the pathological process were detected in 107 cases and 5 cases showed normal study. The distribution pattern is depicted in Table-2. More than one pathology is noted in many patients, which led to diagnose the total pathologies of 141, in 107 patients.

The sidewise distribution depicted in table No. 1. Out of 107 cases, 24 cases had pathology bilaterally, unilaterally in 83 cases. Out of 83 cases of unilateral side involvement, 43 cases of involvement were on right side, 40 cases involvement was on left side. Totally, pathology was noted in 107 hemiscrotum out of 112 patients studied. Hydrocele was the most common pathology noted 45 cases (42%), followed by epididymorchitis noted in 39 cases, varicoceles were noted in 13 cases, undescended testis in 9 cases, inguinal hernia was 9 cases, epididymal cysts 9 cases, scrotal neoplastic lesions noted in 6 cases. Spermatoceles 3 cases, Miscellaneous conditions like, testicular microlithiasis 2 cases, scrotal filariasis 3 cases, torsion testis 3 cases.

In our study, hydrocele was commonest pathology noted in which secondary hydrocele 33 cases (72%), of which majority related to epididymorchitis was noted, followed by epididymorchitis is the next most common.

**Hydrocele:**

The spectrum of hydrocele is shown in table No.3, totally 45 cases of hydroceles found in 141 cases of total scrotal pathologies, out of which secondary hydrocele was commonest (34 cases, 74%), followed by 9 cases of primary hydroceles, followed by 3 cases of congenital hydrocele. The secondary hydroceles were majority seen secondary to

Epididymorchitis, followed by hernia, torsion and scrotal tumors and scrotal wall cellulitis.

Most of the hydroceles show clear anechoic collections, majority of secondary showed internal echoes and few with septations and a few primary hydroceles showed internal echoes. Three cases of congenital and one case of funicular type of hydrocele showed intra-abdominal communication. One case of encysted hydrocele showed neither communication with tunica or intra abdomen.

**Epididymorchitis:**

In our study, out of 112 cases, 39 cases were detected have epididymorchitis. Acute epididymo-orchitis was the commonest inflammatory pathology detected, noted in 19 cases (49%), followed by chronic epididymorchitis, noted in 6 cases (15%), followed by T.B. Epididymorchitis 5 cases (19%) Other detected inflammatory pathology include, scrotal filariasis 3 cases, Acute orchitis 2 cases, chronic epididymitis, 1 cases, scrotal wall inflammation 1 case, acute epididymitis 4 cases (5%), and Funiculitis are noted in 1 cases each (2.5%).

In our study, acute epididymorchitis is more in common which is comparable to other studies followed by chronic epididymorchitis. The T.B. epididymorchitis is more, because of Indian set of patients.

**High frequency US and color Doppler appearance of inflammatory scrotal pathology:**

Of 3 cases of acute orchitis, one case showed focal involvement, two cases showed diffuse involvement. On high frequency US sonography, focal involvement appeared as focal area of hypoechoogenicity, two cases of diffuse involvement showed diffuse enlargement with diffuse hypoechoogenicity. On color Doppler sonography, all three cases showed increased vascularity in the areas of areas of hypoechoogenicity.

**Non neoplastic scrotal swellings:**

In our study of 141 cases of scrotal pathologies, we noted 9 cases of epididymal cysts, 3 cases of Spermatoceles. Out of 9 cases of epididymal cysts, 6 were unilateral, one was bilateral and 3 cases showed multiple cysts. Most of the epididymal cysts are uniloculated, situated in the head of epididymis, thin walled anechoic. Associated ipsilateral hydrocele was noted in 2 cases. In present study, we detected 3 cases of spermatocele, which appeared on high frequency US scan as cystic structure with fluid level or fluid-debris level.

**Scrotal neoplasms:**

In our study 6 scrotal neoplasms diagnosed. The testicular tumors include most frequently seminoma, 4 cases (60%), which could be diagnosed ultrasound by its classical solid and cystic components. All 5 tumors were accurately diagnosed by ultra sound. One case of testicular lymphoma which was falsely diagnosed by ultrasound as epididymorchitis later proved by histopathology as lymphoma. It is also found that the features of seminoma on ultrasound as, homogenous, hypoechoic, oval shaped or round, sharp demarcation, possible multifocal involvement.

**CONCLUSION**

In our study about 112 cases of scrotal pathologies were studied with real time High frequency ultrasonography and Color Doppler sonography.

- Largest number of patients belongs to the age group of 11 to 30 years (48 %).
- Hydrocele was the most common diagnosis followed by Epididymorchitis.
- This study also showed that most of extra testicular scrotal masses were cystic and benign; most of intratesticular scrotal masses were solid and malignant.

- Ultrasound helps in differentiating different types of hydrocele and hence proper management.

Therefore HRCD is a non-invasive easily available, relatively cheap, rapid, repeatable and involves no ionizing radiation, is an accurate diagnostic imaging modality, suitable for both diagnosis and follow up of various scrotal pathologies. HRCD is highly sensitive in differentiating intratesticular from extra testicular origin of scrotal masses and solid from cystic lesions and in demonstrating the varicoceles. Gray scale enables in demonstration of morphological alterations, Doppler helps in functional assessment by perfusion. The advantages of HRCD include easy operating, non-invasiveness, lack of ionizing radiation, accurate, wide availability, cost effectiveness and repeatability.

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