

Patterns Of Scrotal Doppler Sonographic Findings And Its Association With Clinical Diagnostic Outcome

Kashish Garg¹, Disha Gupta²

¹Department of Radi-diagnosis, SGT medical college and research institute, Gurgaon, India

²Department of Radi-diagnosis, SGT medical college and research institute, Gurgaon, India

Abstract:

Background: The scrotum is a cutaneous sac located under the penis containing both testis, the epididymis, and the spermatic cord. All patients with Scrotal pain must be carefully evaluated with a complete clinical history and physical examination. Certain testicular swellings are difficult to diagnose with certainty, based solely on clinical examination because clinical signs/symptoms (pain, swelling and scrotal mass) are usually overlapping. Gray scale ultrasonography superimposed with Doppler is an advancement in imaging, and it provides simultaneous display of tissue morphology in gray scale, blood flow direction and flow characteristics.

Materials and Methods: Data for this descriptive study was collected from patients coming to the Department of Radiology, in a tertiary care hospital for evaluation of scrotal pathology. 53 cases of scrotal pain and swelling were studied with High frequency Ultrasonography and Color Doppler Sonography by using High frequency transducers.i.e. linear array transducer of 5-12 MHz.

Results: The commonest indication for scrotal Ultrasonography in clinical practice are inflammatory scrotal disorders. High frequency gray scale US with Doppler Ultrasonography accurately differentiates testicular torsion from acute inflammatory diseases. It is highly sensitive in differentiating solid from cystic scrotal masses. In this study, ultrasonography had 100% sensitivity and 94.74% specificity for inflammatory conditions, 100% sensitivity and 97.06% specificity for hydrocele, 100% sensitivity and 100% specificity for testicular torsions and segmental infarcts, 85.71% sensitivity and 100% specificity for Varicocele and 100% sensitivity and 97.87% specificity for cryptorchidism, when correlated with clinical diagnostic outcome.

Conclusion: High frequency Ultrasonography superimposed with Doppler study is an extremely valuable tool in evaluation of scrotal and testicular pathology. High frequency ultrasound is also highly sensitive in differentiating intra- testicular pathology from extra-testicular pathology.

Key Word: Scrotal pain, Scrotal swelling, Ultrasonography-Scrotum.

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I. Introduction

Physical examination of scrotal sac is easy accessible, as examining fingers are separated from scrotum by only a thin layer of loose fibro muscular tissue and skin. Skin changes, scrotal wall edema and pain involving the dependent portion of scrotum may hinder in complete physical examination. Scrotal sonography does not involve irradiation to gonads; and is easy, non-invasive, rapid and relatively inexpensive. Dominant imaging like CT and MRI has witnessed certain limitations in scrotal imaging due to radiation exposure to gonads in CT, while MRI imaging is expensive and not readily available everywhere¹.

Accurate identification of the origin, nature and extent of the scrotal lesions is required for proper management of scrotal pathology². USG provides not only fine anatomical details of the testis and surrounding structures, but also assess the vascular perfusion in real time. Color Doppler can help distinguish between epididymo-orchitis and testicular torsion because they have similar clinical presentations and help in avoiding unnecessary exploration of scrotum.

In this descriptive study, Gray scale ultrasound findings were supplemented with spectral Doppler to make a diagnosis, when color flow imaging findings were indeterminate for various scrotal pathologies.

II. Material And Methods

This prospective descriptive study was carried out on patients of Department of Radio-diagnosis at tertiary care hospital. A total of 53 adult subjects participated in this study. Patients were selected with consecutive sampling technique.

Study Design: prospective descriptive study

Study Location: This was a tertiary care teaching hospital based study done in Department of Radio-Diagnosis. (10)

Study Duration: June 2022 to June 2023.

Sample size: 53 patients.

Sample size calculation: The sample size was estimated on the basis of a single proportion design.

Subjects & selection method: Patients were selected with consecutive sampling technique. All consecutive cases irrespective of age with scrotal pathologies like epididymitis, orchitis, hydrocele, testicular torsion, testicular tumor and others were included in the study.

Inclusion criteria:

1. All consecutive cases irrespective of age referred from various departments for Ultrasound of scrotum were included in the study.

Exclusion criteria:

1. Patients with extensive necrosis and gangrene involving the scrotum and perineal region.
2. Patients with known inguinal-scrotal hernia.
3. Patients who do not consent for the study.

Procedure methodology

After written informed consent was obtained, US examination of the scrotum was performed using GE S7 ultra sound machine. The asymptomatic hemi scrotum was scanned first to obtain accurate doppler settings using a high-resolution, near-focused, linear-array transducer with a frequency of 5-12 MHz. For instance- the wall filter and scale was adjusted to pick up the blood flow without artifact. Testicular perfusion and blood flow pattern to epididymis was evaluated using color and spectral doppler.

The imaging parameters such as PRF 0.6, low wall filters ranging from 25 to 50 Hz, color gain maximized for optimal sensitivity while avoiding excessive color noise, color vs. echo priority ranging from 70 to 90% and color persistence adjusted to high values were set to increase the detection of low-velocity, low volume flows within the small testicular vessels.

Spectral Doppler was used after the gray-scale with Color Ultrasonography examination of the scrotum was complete. Resistive index was calculated in intra-testicular artery in cases of testicular torsion.

Statistical analysis

All data was entered into a Data collection Performa sheet and entered into MS Excel 2011. Privacy and confidentiality was maintained.

III. Result

The age distributions of cases varied from day one of life to 80 Years. Highest number of cases presented were in the age group of 31- 40 years (12 cases – 22.64%), The minimum number of cases were in the age group 11–20 years (03 cases – 5.66 %).

Out of 53 cases, 13(24.53%) had bilateral pathologies and 37(69.81%) had unilateral; among unilateral, left sided (43.40%) involvement was more common than right side (26.41%).

Scrotal pathology due to inflammatory etiology were – 17 cases (32.07%), followed by primary hydrocele – 9 cases (16.98%), cryptorchidism and Varicocele – 06 cases (11.32%) each and testicular torsion– 04 cases (7.54%). Miscellaneous conditions like Spermatocele, Testicular segmental infarct, Testicular atrophy, Testicular appendage with calculi, Scrotal wall cellulitis, Tunica albuginea cyst and epididymal cyst were noted in rest of the cases.

The patients presented with varied complaints depending on pathology ranging from fever, scrotal pain, scrotal swelling, trauma, infertility and erythematous scrotum; in different combination of symptoms. The commonest clinical presentation was scrotal pain in 33 cases (62.26%). Second most common symptom being scrotal swelling in 27 cases (50.90%). Combined presentation of scrotal pain and swelling remain the most prominent combination in 23 cases.

Out of 53 cases, 17 cases (32.07%) were detected to have inflammatory/infective scrotal pathology- including epididymo-orchitis, epididymitis, orchitis and funiculitis. Ultrasonographic findings of epididymitis include an enlarged and hypervascular epididymis with heterogenous echopattern, predominantly hypoechoic. Color Doppler evaluation shows increased vascularity. Spectral evaluation of intratesticular artery in cases of epididymo-orchitis shows RI of <0.5.

Hydrocele present as anechoic fluid collections with increased acoustic transmission that surround the testicle. Internal echoes can be noted within.

In this study there were 07 cases (13.21%) of congenital anomalies of testis. All cases were of undescended testes. In 04 cases (57.14%), testes were present in the inguinal canal, in 02 cases (28.57%) it was present in abdomen and in 01 case testis was found to be ectopic in location, so could not be found on Ultrasonography. Out of 07 cases of undescended testis, in 4 cases (57.14%) testes was decreased in size and hypoechoic in echopattern and in 2 cases (33.33%) testes was normal in size and echo pattern.

Varicocele was noted in 06 cases (11.32%) out of 53 patients. The dilated veins showed tortuosity in 06 cases (100%) and measured 2-3 mm in 2 cases, 3-4 mm in 1 case and >4 mm in 3 cases.

There were 4 cases (7.54%) of testicular torsion. Out of these 4 cases, 3 cases (75%) were acute in onset and 1 case (25%) was subacute in onset. All acute cases of testicular torsion showed RI of >0.7 in intratesticular artery with enlarged edematous hypoechoic testes with decreased flow on color Doppler.

In our study of 53 cases of scrotal pathologies, we noted incidental finding like epididymal cysts. Most of the epididymal cysts are uniloculated, situated in the head of epididymis, thin walled and anechoic. Whereas, spermatocele appeared as cystic structure with fluid-fluid level or fluid-debris level. In 01 case there was history of trauma to scrotum. The sonological diagnosis of hematocele was made which was confirmed on FNAC and histopathological examination.

In study we calculated sensitivity, specificity, positive predictive value and negative predictive value by high frequency Ultrasound in diagnosing various scrotal and testicular pathologies. The ultrasound was highly accurate in differentiating testicular from extra testicular pathologies. The ultrasound findings influenced the course of management either -Surgical or Conservative .

Table no 1: Sonological diagnosis and their frequency and percentage

S. No.	Final diagnosis	No. of cases (N=53)	Percentage
1	Epididymitis	7	13.21
2	Epididymo-orchitis	7	13.21
3	Spermatocele	1	1.89
4	Orchitis	2	3.77
5	Undecended testes	7	13.21
6	Testicular torsion	4	7.54
7	Testicular segmental infarct	1	1.89
8	Testicular appendagewith calculi	1	1.89
9	Primary Hydrocele	9	16.98
10	Hematocele	1	1.89
11	Varicocele	6	11.32
12	Scrotal wall cellulitis	2	3.77
13	Funiculitis	1	1.89
14	Tunica albuginea cyst	1	1.89
15	Normal	3	5.66

Image 2: Calculated sensitivity and specificity for various Ultrasound diagnosis.

S.No.	Ultrasound Diagnosis	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
1.	Inflammatory conditions	100.00%	94.74%	88.24%	100.00%	96.23%
2.	Hydrocele	100.00%	97.06%	95.00%	100.00%	98.11%
3.	Testicular torsion and segmental infarct	100.00%	100.00%	100.00%	100.00%	100.00%
4.	Varicocele	85.71%	100.00%	100.00%	97.87%	98.11%
5.	Undescended testis	100.00%	97.87%	85.71%	100.00%	98.11%

Image 3: USG image of right hemi scrotum (in view of trauma) showing multiple septations and free floating internal echos- Suggestive of hematocele.

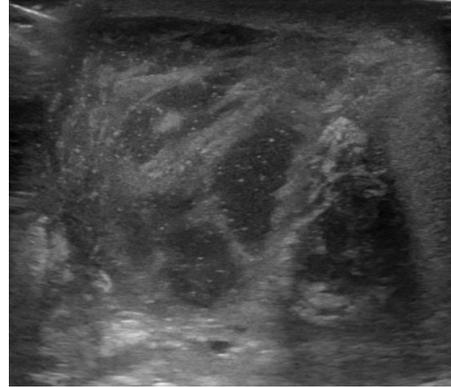


Image 4: A well defined predominantly anechoic cystic lesion is seen superior to the left testis with few linear echogenic septations are noted within. No significant internal echos are seen.- suggestive of Spermatocele.

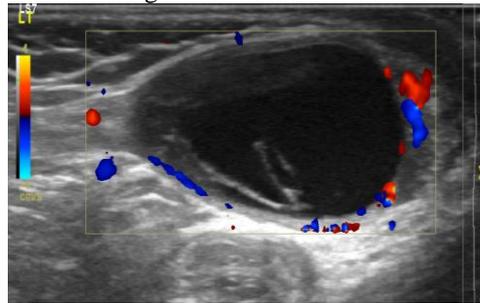


Image 5: 25 years old male with complaint of fever and pain located at right hemiscrotum. Gray scale image with Color Doppler image showing enlarged heterogeneous right Epididymis (yellow arrow) with increased vascularity on Color Doppler- Suggestive of right Epididymitis.

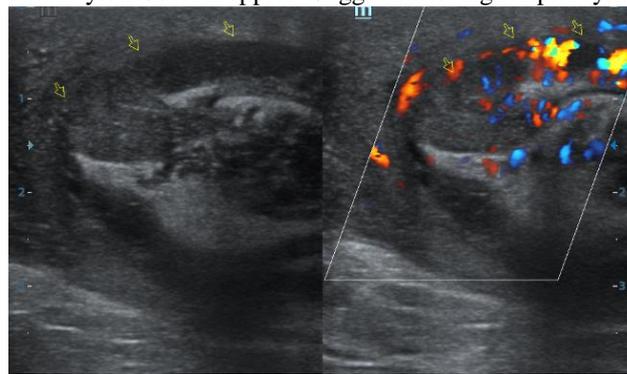


Image 6: 31 years old male with complaint of acute scrotal pain and swelling located to right hemiscrotum. Color Doppler image showing Unilateral enlarged hyperechoic testes and epididymis with increased vascularity on color Doppler- Suggestive of Epididymo-orchitis.

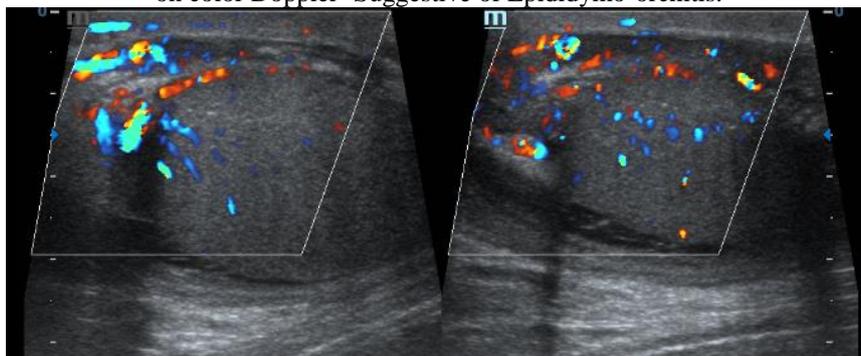


Image 7: 44 years old male with complaint of painless scrotal swelling since one month. Gray scale image with Color Doppler showing anechoic fluid collection between two layers of tunica vaginalis, surrounding the testes with no evidence of free floating internal echoes- suggestive of hydrocele.

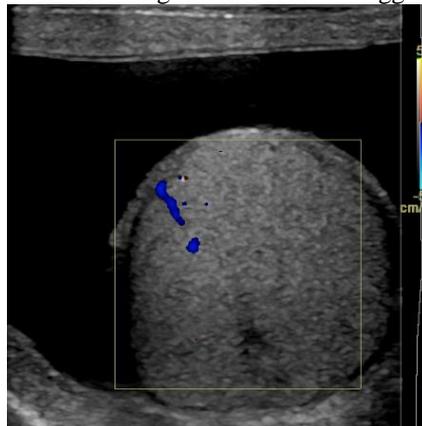


Image 8: 30 years old male with complaint of multiple palpable abnormal structures within the scrotal sac. Gray scale image with color doppler showing dilated pampiniform plexus of veins measuring ~4 mm noted at upper pole of right testes which shows reversal on Valsalva maneuver- Suggestive of Grade II Varicocele.

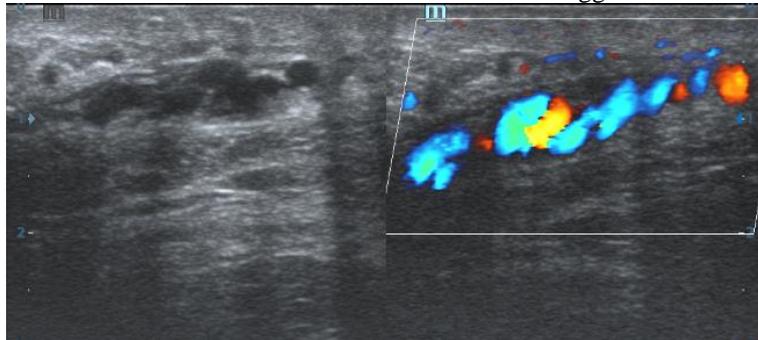
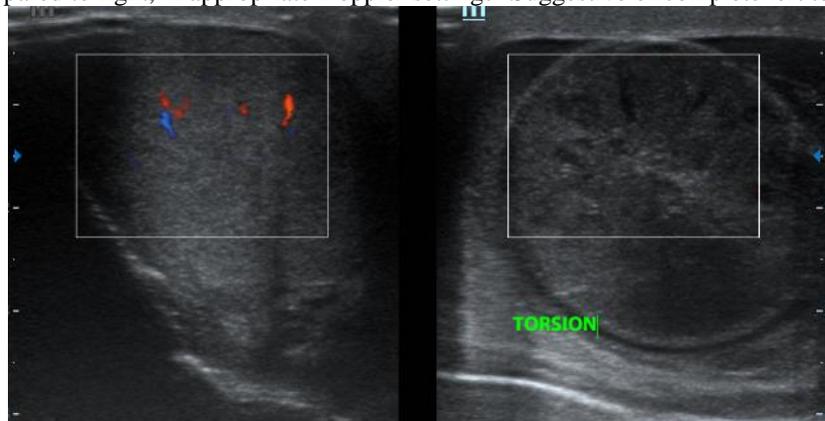


Image 9: 32 years old male present with acute onset scrotal pain in left hemiscrotum. Gray scale image showing heterogeneous echo pattern and enlarged right testes, Color Doppler showing absence of blood supply to left testicle as compared to right, in appropriate Doppler settings- Suggestive of complete left testicular torsion.



IV. Discussion

High-frequency Ultrasonography supplemented with Doppler evaluation is a simple, painless, rapid and easily reproducible method for evaluation of intra-scrotal masses . It can be used even in acute scrotal conditions and huge scrotal masses, when making a diagnosis through clinical examination is difficult.

In this study, we have examined 53 patients with high frequency ultrasound scan and Doppler in all cases, for detection of scrotal and testicular pathology.

Types of scrotal and testicular pathology detected:

In our study, the bulk of pathology detected by high-resolution US were divided into two groups: Inflammatory pathologies and non-inflammatory swellings, which correlates with findings documented in previous studies³⁻⁶.

Inflammatory diseases of scrotum and its contents:

The incidence of inflammatory disease is comparable to other studies as done by Narra et al⁷, Horstman et al⁸, Fonseca et al⁹, Horstman, Middleton and Melson¹⁰.

In this study the most common finding is heterogeneous echo-pattern of testis and epididymis in acute epididymo-orchitis. In acute epididymitis, we observed diffuse hetero-echogenicity with diffuse increase in vascularity on color Doppler and increase in size of epididymis. These findings are similar to the findings of Farriol et al¹¹ and Kim et al¹².

On clinical follow-up of 53 patients, 15 patients were found to have inflammatory etiology. The study demonstrated 94.74% specificity and 100% sensitivity of ultrasound in diagnosing inflammatory conditions of scrotum. PPV and NPV was found to be 88.24% and 100% respectively.

Out of 17 positive diagnosis made by US, two cases diagnosed as funiculitis were found to be false positive on clinical follow-up, as one case being diagnosed as Varicocele limited to inguinal region, which was misdiagnosed as funiculitis; Hence, valsalva maneuver should be done to differentiate funiculitis from varicocele in cases of doubt. While another case came out to be omental hernia which was misdiagnosed to be funiculitis due to hyperechoic echo pattern of both.

Non-inflammatory swellings of scrotum:

In our study, we examined 27 cases of non-inflammatory scrotal swellings. Among non-neoplastic scrotal swellings, hydrocele was the commonest pathology noted in 20 cases, out of which secondary hydrocele was commonest (11 cases), followed by 6 cases of primary hydrocele and 3 case of encysted hydrocele of cord. Most of the cases of hydrocele showed clear anechoic collections. These findings are in similarity to previous studies of Micallef¹³ et al, Doherty et al¹⁴ and Dewbury et al¹⁵.

One case diagnosed as primary hydrocele turned out to be a large epididymal cyst on clinical follow up. Epididymal cysts cause mass effect on testes, pushing the testes against scrotal wall whereas hydrocele encircles the testes.

The next common lesion detected was Varicocele, which was noted in 06 cases (11.32%). Varicocele was diagnosed on US, if 2 or more veins could be identified, with atleast 1 vein having diameter of 2 mm or greater. A varicocele was considered to be present by color Doppler US, if retrograde flow was found in the pampiniform plexus either spontaneously and/or after asking the patient to perform Valsalva maneuver. Findings were consistent with study done by Narra et al⁷.

In this study there were 07 cases (13.21%) of congenital anomalies of testis. Out of 07 cases of undescended testis, in 4 cases (57.14%) testes was decreased in size and hypoechoic in echopattern with maintained vascularity and in 2 cases (33.33%) testes was normal in size and echopattern. In our study sensitivity 100%, specificity 97.87%, positive predictive value 85.71% and negative predictive value of 100% was calculated after surgical management. In one case diagnosis of ectopic testes was made, which was found to be false, as testicular nodule was noted at superficial inguinal ring during exploration. The present study shows that high frequency US is sensitive in detecting clinically palpable cases, and is less reliable diagnostic modality in detecting abdominal ectopic testes. However, high frequency US is sensitive in differentiating clearly between testes and lymph nodes on a textural basis.

There were 4 cases (7.54%) of testicular torsion. Grey scale showed hypoechoic edematous testes. On color Doppler showed decreased color flow in 3 cases and absent color flow in 1 case. 03 acute cases of testicular torsion showed RI of >0.7 in intra-testicular artery on Spectral Doppler with enlarged hypoechoic testis. It showed torsion knot on gray scale at the root of scrotum, where epididymis wound around the cord to form torsion knot complex. The color Doppler confirmation showed whirl pool sign appearance of spermatic cord in transverse section. Clinically suspected torsion was diagnosed as acute epididymo-orchitis in 2 cases on US, which avoided unnecessary surgical intervention. Results were similar to study conducted by Boopathy Vijayaraghavan¹⁶

Examination of the acute scrotum should always be assessed with Doppler because perfusion evaluation of testicular parenchyma is an important part not only for testicular torsion diagnosis but also for orchitis, epididymitis, trauma and neoplasm. Prompt diagnosis is necessary because torsion requires immediate surgery to preserve the testis. The testicular salvage rate is 80% to 100% if surgery is performed within 5 to 6 hours of the onset of pain.

This study also showed that most of extra testicular scrotal masses are benign. Present study proved to be most accurate for detection of testicular torsion and segmental infarcts as there are no false positive and false

negative cases so; calculated sensitivity, specificity, positive predictive value and negative predictive value is 100% each.

V. Conclusion

High frequency Ultrasonography with Doppler is highly accurate and sensitive primary imaging modality for investigation of scrotal pathology. Hence, in appropriate clinical setting, with adequate history and physical examination, it offers specific diagnosis which is helpful in deciding the management of the patients. Therefore every patient with Inguino scrotal disorders should undergo ultrasonographic examination.

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