

TO DETERMINE THE VALIDITY OF HIGH RESOLUTION B-SCAN AND POWER DOPPLER ULTRASOUND IN DETECTION OF SCROTAL MASSES

Naveed Iqbal¹, Nadeemullah², Mohammad Uzair², Tahira Nishtar¹

¹Department of Radiology, Hayatabad Medical Complex Peshawar Pakistan

²Department of Radiology, Lady Reading Hospital Peshawar Pakistan.

ABSTRACT

Objectives: To determine the accuracy of high resolution grey scale (B-Scan) and Doppler ultrasound in detection of scrotal masses.

Material and Methods: This is descriptive cross-sectional study, which was conducted at the Radiology Department of Hayatabad Medical Complex, Peshawar over a period of twelve months i.e. from October 2009 to October 2010. Patients referred to Radiology Department with scrotal swelling (painless or painful) were scanned with 7.5 to 11 MHz linear transducer on NEMIO 20 scanner in supine position and erect posture when needed. Gray scale ultrasound was first conducted to determine the size, location and echogenicity of the lesion. Doppler ultrasound was done to assess and document the blood flow, spectrum, and velocity of flow and indices in the testes, epididymis, as well as in the lesion. Accuracy of Doppler scan was determined against histopathology of the respected specimen in case of tumors and against surgical findings in the benign lesions. Sample size was 112, using 100% sensitivity, 90% specificity, 86% prevalence, 95% confidence level and 6% margin of error. Sample technique was non-probability convenience sampling.

Results: In this study, 112 male patients with scrotal swelling / mass (both painful and painless) had ultrasound examination. Benign masses were found in 89(79.46%) of the patients, while 23(20.54%) had a malignant testicular tumor. The study included age ranges from 1 up to 59 years. Average age was 29.48 years + 11.36SD. Most of the masses were found unilateral 54.5% on right side. On left side it was 41.1% while 4.5% were found on both sides. Age wise distribution of biopsy results shows that majority of the malignant masses (39.1%) were found in less than 29 years of age while 3.4% patients who were above 49 years of age had benign masses.

Conclusion: Gray scale ultrasound in combination with Doppler ultrasound is a good imaging technique in patients presenting with scrotal masses. Benign masses are more accurately diagnosed than tumors that require histopathology for exact tissue characterization.

Key Words: Scrotum, testis, Ultrasonography, Color Doppler.

INTRODUCTION

The desire to explore the living human anatomy goes back to many centuries. A great achievement was the discovery of X-Rays in 1895 A.D. The first ultrasound image was taken by Australian Bussik brothers in 1937¹. Scrotal ultrasound started with static B-mode imaging in 1974 by Miskin & Bain². Now with the availability of real time high frequency transducers and color Doppler has made Sonography as the primary diagnostic tool for diagnosing disorders of scrotum. Ultrasonography (US) performed with a high-frequency transducer and the use of pulsed and

color Doppler modes is the imaging modality of choice for evaluating acute and nonacute scrotal disease. US with a high-frequency transducer helps to better characterize intrascrotal lesions, and in many instances the findings suggest more specific diagnoses. High-frequency US in its present state can help identify certain benign intratesticular lesions, resulting in testes-sparing surgery. Familiarity with US characteristics and the examination pitfalls of scrotal US is essential for establishing the correct diagnosis and initiating treatment. In patients at risk for a testicular tumors, ultrasound is the best imaging modality for follow up³. Ultrasound pattern of scrotal pathologies may be classified as; calcified, cystic, solid, nodular lesions and diffuse lesions². In pediatrics age groups (1-16 years) intratesticular masses accounts for 86% of all cases. Lifelong probability of testicular tumor in all childhood is 0.5-1% while in adults it is 0.5-10% for non-germ cell tumours and germ cell

Address for Correspondence:

Dr. Naveed Iqbal

Department of Radiology

Hayatabad Medical Complex Peshawar Pakistan.

Cell: +92-333-3940198

E-mail: iqbaldrnaveed@gmail.com

tumours accounts for 90-95% of all primary malignant tumours⁴. Testicular cancer is the most common solid malignancy in male aged 18-35 years and currently represents 1% of all tumours in adults⁵. Ultrasound is the first imaging performed in patients with acute scrotum⁶ and Color Doppler sonography (CDS) is an indispensable imaging modality for acute scrotum such as epididymo-orchitis, or torsion of testes^{7,8}.

Other modalities available are Nuclear imaging, C.T scan, MRI and to lesser degree venous angiography. The radionuclide scanning is primarily used to differentiate acute testicular torsion from acute inflammatory condition of the testes. The CT abdomen and chest is done for staging of testicular tumors. MRI may have a role in the diagnosis of diffuse infiltrative disease and torsion³³ but it is much expensive and not available everywhere. On the other hand, ultrasound has the advantage of general availability, portability, non-invasiveness, high resolution, functional information (blood flow) and relatively low cost. Ultrasound depends on the quality of equipment and the expertise of the operator. Although the sensitivity and specificity have not been reported, general consensus exists that ultrasound finding of a solid or mixed cystic and solid intratesticular¹⁴ masses is an indication for surgery^{9,10}.

Intermittent testicular torsion is a challenging clinical condition with a spectrum of clinical and sonographic features. The sonographic real-time whirlpool sign is the most specific and sensitive sign of torsion. In the presence of testicular torsion ultrasound when combined with color Doppler is 95.5% sensitive and 86% specific¹¹. Diagnosis of Varicocele is also made by clinical examination and scrotal Sonography. The high resolution B-Scan /color Doppler ultrasound showed a sensitivity and specificity of 100% and 90% respectively for diagnosis of varicocele¹². Familiarity with US characteristics and the examination pitfalls of scrotal ultrasound are essential for establishing the correct diagnosis and initiating appropriate treatment.

MATERIAL AND METHODS

This cross sectional study was carried out at Radiology Department, Hayatabad Medical Complex, Peshawar over a period of one year (from October 2009 to October 2010). The study was conducted on 112 patients through Non-probability convenience sampling. Patient of all ages referred from in and outpatient departments were included while those patient which were diagnosed cases of testicular carcinoma were excluded from the study. Approval from PGMI ethics and research committee was taken. Informed consent from patient was obtained. Standard protocol for Ultrasound of scrotum (High resolution gray scale and Color Doppler) was adopted. Accuracy of Doppler scan was determined against

histopathology of the respected specimen in case of tumors and against surgical findings in the benign lesions. Data was analyzed using SPSS version 10.

RESULTS

In this study, 112 male patients with scrotal swelling/ mass (both painful and painless) had scrotal ultrasound examination and underwent biopsy for confirmation. Benign masses were found in 89(79.46%) of the patients, while 23(20.54%) had a malignant testicular tumor. (Fig. 1) The study included patients of age ranges from 1 up to 59 years out of which most presented in young age i-e less than 30 years which was 50(44.6%). Average age was 29.48 years \pm 11.36SD (Table 1). Most of the masses were found unilateral 61(54.5%) on right side while on left side it was 46(41.1%) while 5(4.5%) were found on both sides. Age wise distribution of biopsy results shows that majority 9(39.1%) of the malignant masses were found in less than 29 years of age (Figure 2). Epididymo orchitis was the most common finding (31.25%) accounting for all scrotal lesions. The sensitivity and specificity of ultrasound in diagnosis of scrotal

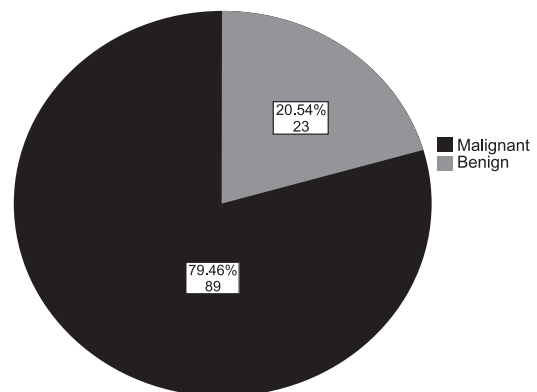


Fig. 1: Biopsy Results

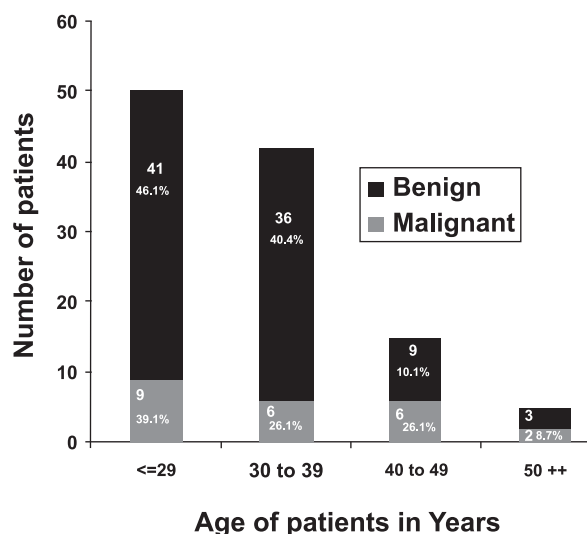


Fig. 2: Age wise distribution of biopsy results

Table 1: Age (in years)

Age	Frequency	Percent	Cumulative percent
<= 29.00	50	44.6	44.6
30.00 - 39.00	42	37.5	82.1
40.00 - 49.00	15	13.4	95.5
50.00+	5	4.5	100.0
Total	112	100.0	

Table 2: Diagnostic Test Evaluation

	Positive	Negative	Total
Ultrasound results	16	1	17
	7	88	95
Total	23	89	112
Parameter	Estimate		
Sensitivity	69.57%		
Specificity	98.88%		
Positive Predictive Value	94.12%		
Negative Predictive Value	92.63%		
Diagnostic Accuracy	92.86%		

swelling are 70% and 98.88% respectively while it has positive predictive value of 94.12% and negative predictive value is 92.12%. Over all the diagnostic accuracy of ultrasound in scrotal swelling is 92.86%. (Table 2)

DISCUSSION

Ultrasonography (US) with high-frequency transducer and the use of pulsed and color Doppler modes is the imaging modality of choice for evaluating of scrotal masses (benign and malignant). Many of these disease processes, including testicular torsion, epididymo-orchitis, and intratesticular tumor, produce the common symptom of pain at presentation, and differentiation of these conditions and disorders is important for determining the appropriate treatment. US with a high-frequency transducer (7.5 -11MHz) helps to better characterize intrascrotal lesions resulting in testes-sparing surgery.

This review was carried out for several reasons:

- No study on this topic is available in our province.
- to determine the frequency of various lesions, both benign and malignant, in our own populations.

- to provide the importance of role of US in diagnosis of scrotal masses because it is easily available, cost effective, free of radiations and very accurate.
- requires no preparation and no sedation.
- to provide insights into the US diagnosis of scrotal disorder in order to provide clue for proper treatment and avoiding unnecessary interventions.

On US scrotal swellings were first classified in to intra or extra testicular and then into benign or malignant lesions. Extra testicular lesions were further categorized into scrotal wall lesions, tunica vaginalis lesions, epididymal lesions, and spermatic cord and inguinoscrotal lesions.

In our study Acute Epididymo orchitis were the most common accounting 31.25% for all scrotal lesions and 39.32% for benign lesions and were common cause of acute scrotal pain in adolescents and adults. This was comparable with international study conducted by Seigel MJ¹². Appearance of Epididymitis has been typical in our cases of acute epididymus. There was diffuse enlargement of epididymus with decreased or heterogeneous echogenicity¹² and showing increased vascularity with reactive hydrocele or Pyocele and scrotal wall thickening. In our study Epididymitis was found associated with orchitis in 31.25% cases which is also noted in international study developing in 20-40 case¹³. There was focal or diffuse enlargement of testis with inhomogeneous echogenicity in orchitis along clinical signs of tenderness, fever and raised leucocytes count. Ferriol et al³² reported 11 of 25 cases with enlargement and heterogamous echogenicity of epididymis, testis or both. Similar focal or diffuse hypo-echogenicity of testis was seen in testicular tumors, lymphoma and leukemia but following differences were noted:

Scrotal swelling was painless and non-tender,

- Testicular tumor marker level in serum was usually raised,
- Leukocytes count was normal and
- Epididymis was always normal in testicular tumors.
- Bilateral involvement in lymphoma and leukemia.

Two cases noted in our study in which focal orchitis were given on us findings. Later on biopsy which was taken when pts were not responding to medications, revealed seminoma. So it is concluded when testis show heterogeneous echogenicity, the condition should be followed. Clinical, lab and Us correlation should be carried out to rule out tumor, infarction or metastasis. At color and power Doppler, the hall mark of scrotal infections is hyperemia of epididymus, testis or both¹⁴. Study conducted by Burks

DD and Markey BJ¹⁵ showed CDS to be 100% sensitive in inflammation. In our study CDS with grey scale came out be 94.21% sensitive in epididymo orchitis. Focal or diffuse enlargement with hypoechogenicity of testis or epididymus with an evidence of UTI or raised TLC in a patient with painful scrotum usually indicates inflammatory nature of the lesion. However testicular tumors also appear as hypoechoic lesions but in most of the cases it causes painless swelling. Such lesions to be taken malignant unless proved otherwise.

Torsion usually affected young males in their 2nd or 3rd decades with sudden onset of pain and swelling. Because grey scale findings are often normal in early phase of torsion¹⁷, CDS and power Doppler study is essential. The absence of flow on CDS and power Doppler is considered diagnostic of ischemia^{14,15}.

In our study, we found 6 cases of torsion showing lack of flow on CDS and power Doppler. Grey scale findings vary with degree and duration of torsion¹⁷. Rounded shape of an enlarged testis with focal or diffuse hypoechoic appearance was the usual picture in sub-acute torsion in the study with no vascularity. Another important finding has been the loss of normal granular parenchymal echo pattern. Although spermatic cord twist insufficient to cause acute torsion, can ultimately cause ischemic necrosis of testis, but in early stages Doppler will be false positive (will show blood flow). Not only this but spontaneous detorsion can increase testicular flow (post ischemic hyperemia) and differential from orchitis is not always easy.

Among various benign testicular lesions (cyst of tunica albugenia, simple cyst, Epidermoid cyst, tubular ectasia of rete testes, intra testicular Spermatocele, varicocele and abscess) only intratesticular abscess noted in one case secondary to epididymo orchitis. The US features includes shaggy irregular wall, low level echoes and occasionally hyper vascular margins¹⁸. Testicular abscess easily distinguished from testicular tumors because liquefied pus usually revealed flowing echoes and no blood internal flow pattern with increased vascularity in the periphery.

The principle role of US examination in diagnosis of testicular cancer is to help distinguish intratesticular from extra testicular lesions because majority of extra testicular lesion are benign and intratesticular lesion are most likely malignant²⁰. Grey scale is nearly 100% sensitive in detection of testicular tumors^{19,20}; however it does not provide histologic and morphologic diagnosis. There are other variety of benign intratesticular process like hematoma, orchitis, abscess, infarction and Granuloma that mimic malignancy and therefore should be considered in differentials.

In our study 23 cases found to be malignant. US gave suspicion of malignancy in 17 cases while in 6 case orchitis were given. Later on these 6 cases also turned out to be malignant when biopsy is taken as the patients gave no response to medication. Color and power Doppler US demonstrates increased vascularity in majority of malignant tumors and help to better define testicular involvement²¹. The presence of hypervascularity is not specific enough for the diagnosis of malignancy and it may be difficult to demonstrates increased blood flow in small tumors.

A hydrocele is usually idiopathic but may develop due to a variety of reasons including trauma, infection, torsion and tumors (called secondary hydrocele). In our study idiopathic hydrocele noted were¹² in number, PPV or Congenital hydrocele in 2 cases and septated hydrocele in 12 cases. In septated hydrocele 8cases comes out to be hematocele and 2 cases to be Pyocele. On US Idiopathic hydrocele appears as anechoic fluid collection showing good thorough transmission^{22,23}. Septated hydrocele including hematocele and Pyocele at US appear as complex cystic lesion with internal Septations. Skin thickening noted in both cases while increased vascularity of thickened skin was evident in Pyocele; however correlation with clinical history whether trauma or infection is very much important. Value of Color Doppler ultrasound in case of hydrocele is mainly to exclude any testicular abnormality.

In this study Varicocele (idiopathic or primary) were present in 11.23% cases between age of 15-30 years while in one of the international study conducted by Meacham RB and Towensend RR²⁴, this was reported in 15% cases between age group of 15-25 years. Spermatic veins were dilated approximately measuring 4-6mm in this study while Metin A, Bulut O and Temizkin M in their study¹⁵ showed diameter of spermatic vein in Varicocele to be 5-6mm.

The US appearance of Varicocele consists of multiple hypoechoic, serpiginous, tubular structures of varying sizes larger than 2mm in diameter, usually seen superior or lateral to testes³⁰. CDS and duplex Doppler help confirm venous flow pattern. The sensitivity and specificity of Varicocele detection approaches 100% with CDS. No single case of secondary Varicoceles noted in this study. Also neither benign nor malignant tumors of spermatic cord seen.

Spermatocele, a common type of extra testicular cyst, are usually unilocular but can be multilocular and at US appear as well defined hypoechoic lesions usually measuring 1-2cm and demonstrating posterior acoustic enhancement. They often show proteinous fluid and spermatozoa³¹. In our study two cases of Spermatocele identified. Epididymal cyst are less common than Spermatocele and indistinguishable from latter on US. Epididymal

cyst contains serous fluid and may arise throughout the epididymis while Spermatocele almost always from epididymal head. No malignant lesion of epididymis noted in our study.

Two cases in our study presented with inguinoscrotal swelling. They turned out to be inguinal hernia extending into scrotal sac. Inguinal hernia is a clinical diagnosis. US is usually suggested in equivocal cases or in those presenting with acute inguinoscrotal swelling²¹.

Inguinal hernia is classified into direct or indirect, depending on its relation with inferior epigastric artery. Konekov et al²⁹ were able to demonstrate inferior epigastric artery in 100% case of small hernia using CDS. We noted two cases of inguino scrotal swelling which turned to be inguinal hernia extending to scrotal sac, but we were unable to identify their relation with inferior epigastric artery. The main reason was that the swellings were very large. Grey scale US findings were air filled loops of bowel in the scrotal sac showing real time peristalsis which was diagnostic. Akinetic dilated bowel loops at US in hernial sac with hyperemia on CDS is reported to have high sensitivity (90%) and specificity (93%) for recognition of bowel strangulation. It is important to recognize this condition because pre-operative delay leads to high post-operative morbidity.

Hematoma can involve the testis, epididymis, or scrotal wall. Their US appearance varies with time. Acute hematoma appear hyperechoic and subsequently become complex with cystic components. Hematoma appear avascular on Doppler US study^{25,14}. Three cases of scrotal wall hematoma and one case of intratesticular hematoma with history of trauma are recognized in our study. No fracture of testes or rupture of tunica vaginalis noted.

CONCLUSION

Gray scale ultrasound in combination with Doppler ultra sound is a good imaging technique in patients presenting with scrotal masses. Benign masses are more accurately diagnosed than tumors that require histopathology for exact tissue characterization. Familiarity with US characteristics and the examination pitfalls of scrotal ultrasound are essential for establishing the correct diagnosis and initiating appropriate treatment.

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