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Role of Ultrasound and Colour Doppler in Scrotal Pain

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Abstract: ***100 patients coming to JSS with scrotal pain between November 2011 and August 2014 were studied. Each patient was examined in multiple planes using 7.5MHz-10MHz variable frequencies with colour and pulse Doppler 5MHz frequency probe was used in a few cases who had large scrotal mass. Most of the patients in our study belong to age group between 20-40 years (68%).In our study, Inflammatory conditions were noted in 40 patients, non inflammatory causes were seen in 51 patients ,traumatic lesions noted in 5 patients. In our study, of 51 patients of non-inflammatory causes of scrotal pain, 5 patients had neoplastic lesions; remaining 46 patients had non-neoplastic lesions.Among the 12 cases of varicocele we observed 2 cases of the rare entity of intravascular varicocele. High-frequency ultrasonography enables in clear demonstration of morphological alterations associated with acute scrotal inflammatory diseases, and colour Doppler sonography is highly sensitive in diagnosing acute scrotal pathology. In addition, Colour Doppler sonography accurately differentiates between testicular ischemia and torsion from acute inflammatory diseases in acute painful scrotal conditions. High frequency ultrasonography is highly sensitive in differentiating solid from cystic scrotal masses, detecting intratesticular microlithiasis, demonstrating normalcy of testes and epididymis in presence of large hydroceles and is highly sensitive in demonstrating the varicoceles. The advantages of High frequency US and colour Doppler includes non-invasiveness, lack of ionizing radiation, simplicity, wide availability, cost effectiveness and repeatability. We conclude that High-frequency ultrasonography and colour Doppler sonography is an extremely valuable tool in evaluation of scrotal and testicular pathologies***

Keywords: Ultrasonography, colour doppler, testis, scrotum, inflammatory, non-inflammatory

1. Introduction

Scrotum is a cutaneous bag containing right and left testis, the epididymis and the lower part of the spermatic cord. Externally, scrotum is divided into right and left parts by a ridge or median raphe, which is continued forwards on to the under surface 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.

Consequently one would suppose that clinical diagnosis of a scrotal swelling would be straightforward. On the contrary, certain testicular swellings are most difficult to diagnose with confidence based on physical examination alone. It is often difficult to decide whether a palpable scrotal mass is arising from the testes itself or from the extra testicular elements. In addition, the normal examination may over look significant pathology and physical signs elicited may be improperly interpreted.

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 armamentarium includes gray scale Ultrasonography, Doppler studies, Magnetic Resonance Imaging, in addition to radioisotope studies and testicular angiography**.**

Since Miskin and Bain[1] and Murray Miskin, Martin Buckspan and Jerald Bain[2] first published report about using diagnostic ultrasound as a modality of investigating scrotal pathologies, advances in instrumentation and transducer design have progressed to the point where high frequency

Ultrasonography is the modality of choice in investigating scrotal and testicular pathology. While CT and MRI have dominated imaging of other regions of the body, they have certain limitations in evaluation of scrotal diseases[4]. 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 colour doppler study in evaluation of various scrotal pathologies.

2. Review of Literature

Miskin and Bain (1974), using B–mode static scanner with 2.5MHz transducer, first performed sonography of the testes [1].

Murray Miskin(1976), Martin Buckspan and Jerald Bain[2], presented details of B-mode as well as grey scale images obtained with a high frequency 5 MHz transducer. Longitudinal scans more performed and three planes with the testes in neutral position internally rotated and externally rotated. Transverse scanning was attempted early in the study but the authors stated that reproducible sonograms

were not practical when scanning in this plane. Normal appearances of testes, as well as sonographic appearances of testicular neoplasm, abscess, trauma, hydrocele, varicocele, spermatocele, and epididymitis were presented. Conventional B-mode scanning produced images that consisted of multiple dots on the oscilloscope screen. However, with gray scale modification, echoes of varying intensity can be projected as shades of gray on a television screen. By this means, more detail of internal testicular structure can be obtained.

Thomas H Shawker(1976) [3], reported details of 14 patients scanned with the Picker Echo View VI B-scanner and a 2.25 MHz transducer and concluded that ultrasound B-scanning of the scrotum is a feasible diagnostic study. However static imaging was only possible and the author presented only images of longitudinal images of longitudinal scans, since immobilization of testis for a transverse scan was technically more difficult. Images were recorded on an oscilloscope screen and Polaroid photographs obtained for permanent record.

Sample et al(1978)[4], evaluated a large series of patients with scrotal masses using 5.0 MHz, 7-mm diameter transducer with short internal focus, produced high quality images of scrotal contents. This study, for the first time enabled confident separation of testicular and extra testicular abnormality. The great majority of patients with testicular neoplasms in their series presented with areas of decreased echogenicity.

Leopold et al (1979) [5] studied 22 patients referred with a strong clinical suspicion of intra scrotal pathology. The used a high-resolution real-time ultrasononic scanner developed at the Stanford research institute. They employed a single 13 mm, 10 MHz water bath transducer, focused at approximately 1.5 cms beneath the skin surface. They concluded that utilizing 10 MHz, high resolution, real-time system could permit an improved examination of the scrotal contents. Recognition of the normal epididymis and physiological amounts of extra testicular fluid is possible. The real-time feature of the instrument proved to be helpful in rapid screening of the entire scrotum quickly.

Sample (1980) published ultrasound images in the textbook. “Diagnostic ultrasound text and patients”, Edited by Sarti DA and Sample WF.

Peter H Arger et al(1981)[6] examined 69 consecutive patients with suspected testicular abnormalities prior to surgery. They scanned the patients with 5 or 7.5 MHz, short focus (2-6 cms) transducer using an articulated arm B-scanner. Their study established the testis itself as echogenically normal or abnormal. Antero posterior and longitudinal measurements were made on both testes for size comparison.

Evaluation of the epididymal area clearly defined epididymis as a separate structure. Extra testicular masses were characterized as solid, cystic or complex. The amount of peri testicular fluid was classified as normal or as minimally, moderately or excessively increased.

John M Bockrath et al (1982)[7] described an ultrasound technique that accurately detected an occult testicular primary in a young man with a large retroperitoneal seminoma. In their study, they used a 5 MHz mechanical sector scanner and an 8 MHz small part scanner with an internal water bath system. The testicles which remained normal to palpation on repeated physical examination showed a 1 cm sharply marginated, hypoechoic mass in the upper pole of left testis. Microscopic examination revealed pure seminoma.

Bala R Subramanyam et al (1983)[8] evaluated 65 patients with clinical diagnosis of primary scrotal mass. They concluded that Sonography is effective in evaluation of primary scrotal masses, in the differentiation of scrotal hernia from other extra testicular or testicular masses by scanning the inguinal region in addition to the scrotum. They also established sonographic criteria to reliably differentiate between scrotal hernias from primary scrotal pathology.

Barbara A Carroll and David M Gross(1983)[9], conducted scrotal scans in 48 patients using 5 MHz static B-scanner and 7.5 MHz real time sector scanner. They showed that development of high-frequency real-time scanners has enhanced the diagnostic accuracy of scrotal sonographic examinations. They demonstrated that the real time scanner generated superior quality images that could be obtained in a more rapid and thorough fashion than those obtained with the static scanner. They concluded that high-frequency sonography of the scrotum readily distinguishes testicular tumours from extra testicular masses. Sonography is particularly useful in the evaluation of the testis, which is obscured by a large hydrocele. Small non-palpable lesions that may assist in the search for the primary tumour can be detected in the patient with metastatic germ cell tumour of unknown origin.

Michael K Wolverson et al (1983)[10], conducted real-time sonography of the scrotal veins in a group of patients who are clinically suspected patients of varicocele. They used a high-resolution real-time scanner (Bio Sound) with a midrange frequency of 8 MHz transducer. They confirmed the vascular nature of varicoceles by direct visualization of blood flow within the dilated veins. They demonstrated sudden acceleration of flow in the dilated veins on Valsalva manoeuvre or abdominal compression.

Monica L Leung, et al(1984)[11], evaluated 40 men who had no known scrotal or testicular symptoms, using a real-time, dedicated superficial-parts scanner (Picker Micro view) 10 MHz transducer. They described the normal anatomy of testis, epididymis and other scrotal structures.

Gregory D Linkowski et al (1985)[12] described ultrasonic appearance of scrotal calculi. They used a sector real-time scanner with a 10 MHz transducer.

Michael K Wolverson et al (1988)[13] did a comparative study of CT and High-resolution ultrasound in localization of impalpable undescended testis. They recommended high-resolution ultrasound as the modality of choice, because it is simple, accurate, and avoids ionizing radiation.

William D Middleton et al (1989)[14] performed Colour Doppler ultrasound with spectral analysis of scrotum. The study showed that Colour Doppler sonography allows for simultaneous real-time display of morphology and the temporospatial characteristics of blood flow.

John N Krieger, Keith Wang and Lawrence Mack (1990)[15], conducted scrotal US study in a group of asymptomatic patients, using both real-time, high-resolution gray-scale ultrasound and also Pulsed Doppler ultrasound. They concluded that, colour doppler ultrasound is a promising method that may prove to be useful for assessment of selected patients with intrascrotal pathological conditions.

William D Middleton et al(1990)[16], conducted colour doppler study on patients who presented with acute scrotal pain, swelling or both, using 7.5 MHz linear phased array transducer. They concluded that colour doppler can be used for the initial evaluation of patients with acute scrotal pain and equivocal clinical findings. The sensitivity and specificity for diagnosing or excluding testicular torsion is as good as that of testicular scintigraphy and colour doppler US should become the method of choice in evaluating patients with acute scrotal disorders and equivocal clinical findings.

William G Horstman et al (1991)[17], in their study of 51 patients of hemi scrotal inflammatory disease, using 7.5 MHz real-time gray scale and colour doppler , concluded that colour doppler study could demonstrate the hyperaemic response to scrotal inflammatory disease; it can supplement the gray scale findings and increase the diagnostic confidence.

George O Atkinson et al (1992)[18], Studied 32 children with scrotal pain or swelling using 7.5 MHz linear transducer. They conclude that colour doppler sonography is helpful in the initial evaluation of paediatric Testes, provides accurate evaluation of the involved hemiscrotum.

Sanjeev Agarwal et al (1997)[19], conducted study on 40 patients who were referred for intrascrotal imaging. They concluded that Colour doppler sonography could rapidly and reliably differentiate epididymitis and orchitis from testicular torsion. It also enhances visualization of varicocele.

Victoria Garriga Farriol, et al (2000) [20], described 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.

There has been a wealth of publications material detailing high-resolution ultrasound and Colour doppler scan appearances in various testicular and extra testicular scrotal pathologies.

Woojin kim et al (2007)[21] did a study on 'US–MR Imaging Correlation in Pathologic Conditions of the Scrotum' and he concluded that although the primary modality for scrotal imaging is ultrasonography, MR imaging is a useful adjunct in many cases. MR imaging is effective in characterization of intra- versus extra testicular masses and can depict various tissue types, including cysts or fluid, solid masses, fat, and fibrosis. MR imaging may add specific value when the location of a scrotal mass is uncertain or when sonography does not allow clear differentiation between a solid mass and an inflammatory or vascular abnormality.

At present juncture, high-resolution ultrasound scan, judiciously supplemented with Colour doppler imaging is the modality of choice in evaluating scrotal pain.

3. Aims and Objectives

Evaluation of scrotum with reference to

- Role of High frequency real time ultrasonography in accurately diagnosing causes of scrotal pain.
- Role of Colour Doppler sonography in evaluation of scrotal pain.

Sonographic Anatomy of Scrotum[22,23]:

The normal adult testis is ovoid, measuring 3 to 5 cm in length and 2 to 3 cm in both transverse and anteroposterior dimensions. Its echo texture is homogeneous, and echogenicity is intermediate.

The epididymal head is rhomboid to triangular in shape, measures less than 1 cm, and is similar in echo texture and echogenicity to the testis. The epididymal head is positioned superolaterally to the testis with the body of the epididymis aligned along the long axis posteriorly. Occasionally, testicular appendages such as the appendix testis, a mullerian duct remnant found at the superior aspect of the testis, and the appendix epididymis, a mesonephric remnant located at the epididymal head, can also be seen.

4. Materials and Methods

This study was performed at JSS medical college hospital, Mysore, from November 2008 to August 2010. Hundred patients of scrotal pain were examined using high frequency real time ultrasonography and colour doppler.

The study was performed using high-resolution real time gray scale ultrasonography and doppler study of scrotum .The study was carried out using 7.5 to 10 MHz linear transducer, abdominal ultrasonography was done using 3.5 to 5.0 MHz convex curved array transducer of Seimens G60 ultrasound and doppler machine

The patients were referred to our department for scrotal ultrasonography and doppler study by department of Urology and department of surgery from JSS hospital**.**

Prior to subjecting the patients for ultrasound examination, patient details, detailed clinical history was obtained along with thorough physical examination. The colour doppler sonography was routinely performed in all these patients. Subsequently these patients were followed up and correlated with histopathology report, surgical findings& response to treatment as per individual patient. Follow up scans were done in patients when clinically indicated. Abdominal ultrasonography was performed in conjunction with the

scrotal scans in patients of tubercular epididymo orchitis, patients to look for abdominal tuberculosis, in patients of testicular malignancy to look for associated pathology, in patients of varicoceles to look for any cause of testicular vein obstruction and in patients where no scrotal abnormality was localised.

Scanning technique: - Scanning was routinely performed in supine position, after elevating scrotum using a towel draped over thighs, and the penis was placed on the patient's abdomen and covered with a towel. The hemi scrota were examined in transverse, saggital and oblique planes. Scanning was also performed with the patient in upright position and during performing Valsalva manoeuvre. Additional scans of spermatic cord in region of scrotal neck and inguinal canal region were obtained in special circumstances: Encysted hydrocele of cord, and varicocele.

5. Data Analysis

Chi-square test

The chi-square test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

6. Conclusion

One hundred patients of scrotal pain were studied with real time High frequency ultrasonography and Colour doppler sonography.

Largest number of patients with scrotal pain presented in this study belongs to the age group of 21 to 40 years, which constituted 68% of patients. Among the 100 patients of scrotal pain examined 53 patients presented with only scrotal pain, the rest had additional symptoms referable to scrotum.

In our study, inflammatory conditions were noted in 40 patients, non inflammatory causes in 51 patients, traumatic lesions noted in 5 patients and miscellaneous conditions like, testicular microlithiasis, scrotal pearls noted in 4 patients.

Among the conditions having inflammatory scrotal pathology - Acute epididymo orchitis was the commonest inflammatory pathology detected in 12 patients (30%). Next most frequent inflammatory pathology was chronic epididymo orchitis detected in 8 patients (20%) followed by acute orchitis which was seen in 6 patients (15%).

The bulk of scrotal and testicular pathologies were unilateral with regard to side of involvement. High-resolution ultrasonography enabled in clear demonstration of morphological alterations associated with acute scrotal inflammatory diseases, but has the limitations, because it does not enable assessment of perfusion of scrotum and its contents.

When colour doppler sonography is supplemented with High frequency grey scale US, the sensitivity of diagnosing acute scrotal pathology will be increased. In addition, Colour doppler sonography accurately differentiates between testicular ischemia and torsion from acute inflammatory diseases in acute painful scrotal conditions.

In our study of 40 patients of inflammatory pathologies we found that majority of the lesions were hypoechoic & few were hyperechoic and almost all patients had increased vascularity on colour doppler.

On pulse doppler examination we observed low resistance values in acute inflammatory conditions with mean RI value of 0.63 in epididymal arteries, in patients with epididymitis & Epididymo-orchitis and mean RI value of 0.46 in intratesticular arteries, in patients having acute orchitis and acute epididymo-orchitis.

The bulk of chronic inflammatory diseases were due to tubercular aetiology. The most notable sonographic findings of tuberculous epididymitis were enlarged epididymis, marked heterogeneity of echo texture of involved epididymis, cysts in epididymis and calcification. On colour doppler sonography diffuse increase in vascularity was noted. Hydrocele was the most common cause for non-inflammatory scrotal pain.

Out of 19 patients of hydrocele in our study, 18 patients had primary vaginal hydrocele (95%), 1 patient had encysted hydrocele of cord (5%).

High frequency ultrasonography was invaluable in demonstrating normalcy of testes and epididymis in presence of large hydroceles.

On pulsed doppler examination, we observed high resistance type of flow with a mean RI of 0.63 in the intratesticular arteries in these patients of hydrocele.

High frequency ultrasonography is a useful means of evaluating the testis for presence of a tumour. The most useful sonographic features in tumour detection are mass and diffuse parenchymal echotexture change. Seminoma was the most common testicular tumour. Patients with lymphoma can have multiple site involvement, as in our patient with splenic lesions and lymphadenopathy. This study also showed that most of extra testicular scrotal masses are benign and most of intratesticular scrotal masses are malignant.

A high incidence of unilateral varicocele was noted in present study. High frequency ultrasonography with doppler was highly sensitive in demonstrating the dilated, tortuous veins of pampiniform plexus and flow reversal on Valsalva manoeuvre. The rare entity of intratesticular varicoceles was detected in 2 patients in association with extra testicular varicoceles. Literature review reveals less than 50 case reports of intratesticular varicocele worldwide.

Our study demonstrated that colour doppler sonography is having high sensitivity (100%) and positive predictive value (72%), compared to physical examination.

Haematocele & hematoma were the most commonly detected traumatic causes of pain

Table 1: Inflammatory scrotal pathology distribution:

	Pathology	*NO OF PTS*	*% OF PTS*
1	Acute Epididymitis	4	10 %
2	Acute Epididymo Orchitis	12	30 %
3	Acute Orchitis	6	15 %
4	Chronic Epididymitis	2	5 %
5	Chronic Epididymo Orchitis	8	20%
6	Scrotal Wall Inflammation	3	7.5 %
7	Testicular Abscess	3	7.5%
8	Fournier's Gangrene	1	2.5 %
TOTAL		**40**	**100 %**

Table 2: Non Inflammatory Non Neoplastic Causes of Scrotal Pain

		No of patients	*% of non inflammatory non neoplastic causes*
1	Hydrocele	19	41%
2	Epididymal Cyst	6	13%
3	Spermatocele	3	7%
4	Torsion Testis	5	11%
5	Varicoceles	12	26%
6	Complete Hernia.	1	2%

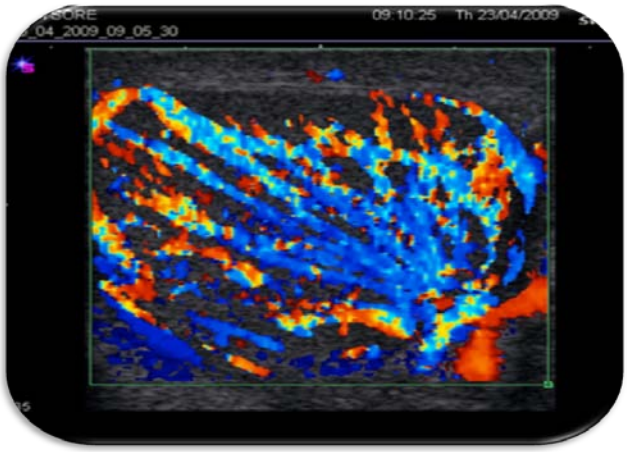

Figure 1: Pulse Doppler Showing Low Resistance Flow In Acute Epididymo-Orchitis

Figure 2: Hydrocele Showing Anechoic Fluid & Appendix Of Testis:

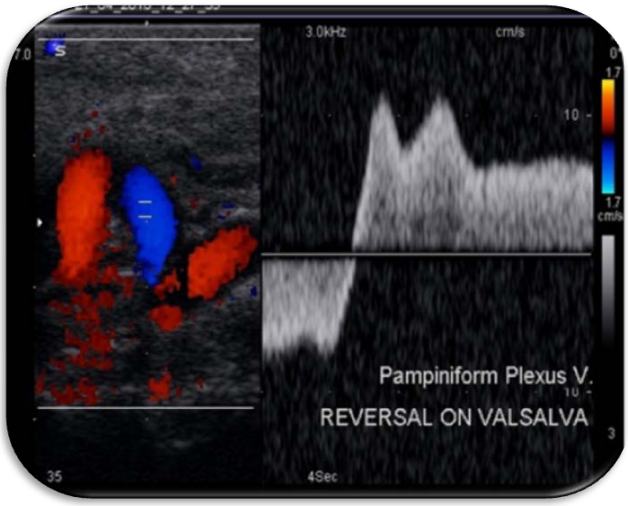

Figure 3: Reversal Of Flow On Valsalva Manouvre In Varicocele

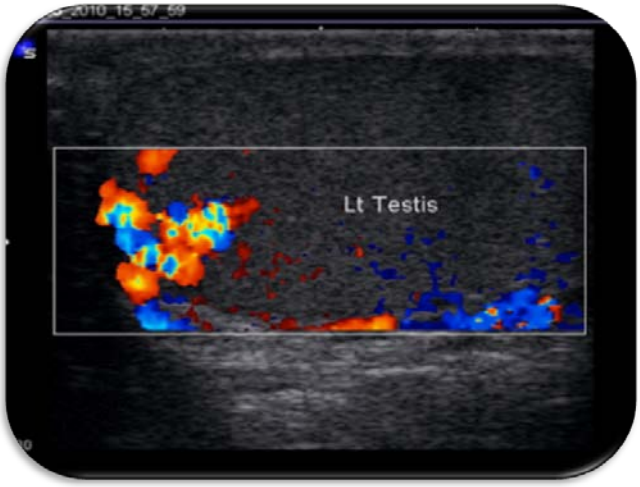

Figure 4: Intratesticular Varicocele Showing Subcapsular Varices

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