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%

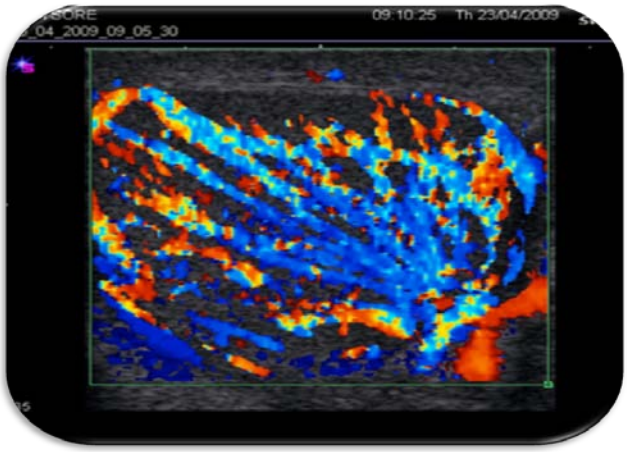

Figure 1: Pulse Doppler Showing Low Resistance Flow In Acute Epididymo-Orchitis

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

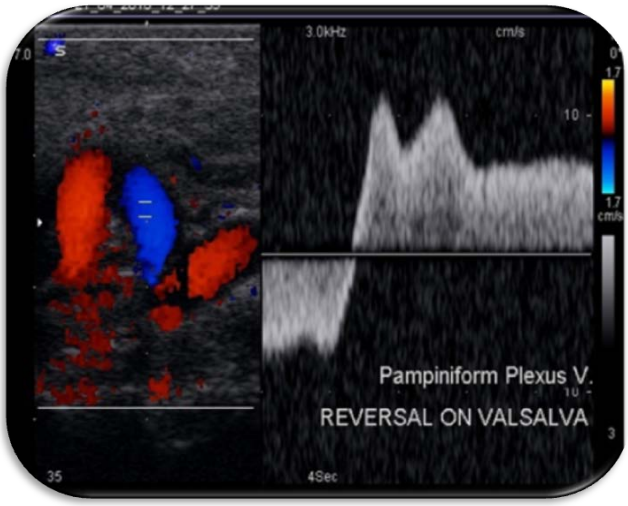

Figure 3: Reversal Of Flow On Valsalva Manouvre In Varicocele

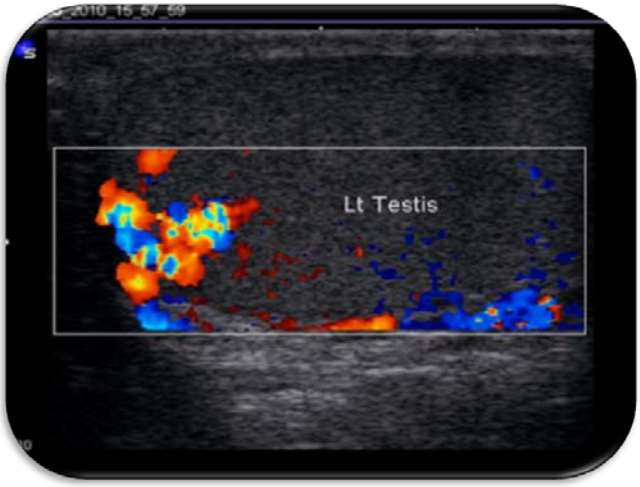

Figure 4: Intratesticular Varicocele Showing Subcapsular Varices

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