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High frequency & color doppler ultrasound evaluation of scrotal and testicular pathologies

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Abstract

Introduction: The superficial location of the scrotal contents makes them ideally suited for sonographic examination. The development of high-frequency, real-time scanners along with color Doppler have enhanced the diagnostic accuracy of scrotal sonographic examinations. Sonography played a vital role in the evaluation of testes obscured from palpation by large hydrocele and accurately separated intra testicular from extra testicular masses, even when the location is equivocal on physical examination. **Materials & Methods**: A prospective study of 108 patients who presented with complaints of scrotal pathology. Gray scale sonography and color Doppler examination was carried out with linear array high frequency (6-7-9 MHz) for evaluation of patients. During ultrasound scan, on a routine basis patient history, clinical examination were evaluated. Observations were collected in a prescribed Performa for analysis. **Results**: Out of 108 cases, 19 had pathologies bilaterally and 89 had unilateral involvement. Inflammatory /infective pathologies were noted in largest number of cases – 56 cases (51.8%), followed by Inguino scrotal hernias – 13 cases (12%), congenital and infertility related pathologies in – 09 cases (8.3%) each, neoplastic lesions in – 07 cases (6.4%). Miscellaneous conditions like trauma, torsion and epididymal cyst were noted in 14 cases (12.9%). **Conclusions**: High frequency ultrasonography with color Doppler is highly accurate and sensitive primary imaging modality for investigation of scrotal pathology in appropriate clinical setting, with adequate history and physical examination.

Keywords: Epididymoorchitis, Pyocele, Scrotum, Testicular neoplasm, Ultrasound

Introduction

Sonography is simple to perform, rapid, non-invasive relatively inexpensive, easily reproducible, widely available investigation and does not involve irradiation of gonads.

Until mid 1970, clinical evaluation of scrotal contents was confined to palpation, transillumination, supplemented by investigative modalities like, thermography and venography, when in 1974 Miskin and Bain first published report about using diagnostic ultrasound as a modality of investigating scrotal pathologies [1].

The scrotum is a superficial structure separated by a midline septum, with each half of the scrotum containing testis, the epididymis and the lower part of the spermatic cord. 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 tunica albuginea, covered by tunica vaginalis, consists of visceral and parietal layers normally separated by a few milliliters of fluid. 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. The parietal and visceral layers of the tunica join at the posterolateral aspect of the testis, where the tunica attaches to the scrotal wall. The tunica vaginalis covers the testis and epididymis except for a small posterior area.

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. 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. Sonography played a vital role in the evaluation of testes obscured from palpation by large hydrocele and accurately separated intra testicular from extra testicular masses, even when the location is equivocal on physical examination [2].

The development of high-frequency, real-time scanners have enhanced the diagnostic accuracy of scrotal sonographic examinations. The scrotum and its contents are best evaluated by using high-resolution transducers with frequencies of 5-10 MHz with a linear-array transducer. In addition, Doppler sonography, both duplex and color, can be used to evaluate blood flow in the scrotum in normal and pathologic states.

When a surgeon faces a problem of scrotum, the essential questions requiring elucidations are:-

a. Is it normal or pathological?

b. If pathological, is it testicular or extra testicular?

c. Is it cystic or solid?

d. Is it benign or malignant?

e. Does it require surgery or conservative management?

In comparison to clinical examination, high frequency ultrasound is admirably accurate in solving the surgeon's dilemma. Ultrasound, effectively guide in determining the course of management and the approach to be used in surgery. The normal scan is equally important, as it provides great relief from anxiety for both the patient and the treating doctor.

Aims and Objectives

To assess role of high frequency gray scale and color Doppler ultrasonography in diagnosis of scrotal diseases.

To evaluate sensitivity, specificity and accuracy of high frequency and color Doppler ultrasonography in comparison with clinical and surgical diagnosis.

Materials and Methods

Prior to subjecting patients for ultrasound examination, detailed clinical history was obtained along with physical examination. The verbal informed consent was also taken before the examination. Patients were examined on – LOGIQ 500 MD MR 3 WIPRO GE SONOGRAPHY MACHINE. Gray scale sonography and color Doppler examination was carried out with linear array high frequency (6-7-9 MHz) probe

The time gain compensation and overall gain was adjusted to provide optimal gray scale information. The contra lateral normal testis was used as control for gain settings and comparison. For color Doppler ultrasonography color gain maximize for optimal sensitivity and Doppler scale decreased to its lowest value to maximize the sensitivity to slow flow. Patient lied in supine position with penis draped over anterior abdominal wall. Scrotum was supported by towel draped beneath it or cradle in the examiners glove hand [3]. A minimum of pressure was applied in a patient with scrotal tenderness. For gray scale and color Doppler sonography standard longitudinal and transverse views of each testis and epididymis was obtained. A transverse view of both testes on same image permit direct comparison of subtle echo texture changes. In addition oblique view was obtained in vascular plane of testis.

Scanning was also done with patient in lying down and upright position and with or without performing Valsalva maneuver in cases of

varicocele. Additional scans of spermatic cord in region of scrotal neck and inguinal canal region were obtained in special circumstances like undescended testis, torsion of testis, Inguino scrotal hernia, and varicocele.

Abdominal sonography was done in selected cases which included cases of testicular neoplasm, undescended testes and varicocele.

Results

In this study, we have examined 108 patients with high frequency ultrasound scan, and color Doppler study was done in relevant cases, for detection of scrotal and testicular pathology.

Out of 108 cases, 19 had pathologies bilaterally and 89 had unilateral involvement. Inflammatory pathologies were noted in largest number of cases – 56 cases (51.8%), followed by Inguino scrotal hernias – 13 cases (12%), congenital and infertility related pathologies in – 09 cases (8.3%) each, neoplastic lesions in – 07 cases (6.4%). Miscellaneous conditions like trauma, torsion and epididymal cyst were noted in 14 cases.

The age distributions of cases varied from 1 Year to 80 Years. Highest number of cases presented were in the age group of 21- 40 years (41 cases – 38%), The minimum cases were in the age group 71 – 80 years (02 cases – 1.8 %).

The patients presented with varied complaints depending on pathology ranging from fever, scrotal pain, scrotal swelling, trauma, infertility, inguinoscotal hernia, burning micturition, swelling after inguinal operation and absence of testis in hemiscrotum, however the commonest clinical presentation were consisted of combination of scrotal swelling, pain & fever in 49 cases (45.2%). The nature of pain was acute ([Duration few hours to 5 days] to insidious [Duration – 15 days to 6 months].

The histopathology was correlated in 10 patients. Of these 10 cases 06 were testicular tumors, 01 was scrotal wall malignancy, 02 were granulomatous lesion of the cord and 01 was benign epididymal cyst. The tumor markers (alpha feto protein, beta hCG) were positive in 02 cases of testicular tumors.

Out of 108 cases, 56 cases (51.8%) were detected to have inflammatory/infective scrotal pathology. Acute Epididymo orchitis and pyocele were the commonest pathology detected, noted in 15 cases (26.7%). Next most frequent inflammatory pathology detected was hydrocele, noted in 11 cases (19.6%). Other detected inflammatory pathology included, Funiculitis, cord filariasis, scrotal wall abscess and inguinal abscess 2 cases (3.6%) and 01 case of acute Epididymitis.

The incidence of inflammatory disease is comparable to other studies. Middleton et al in their study of 16 patients, found acute Epididymo-orchitis in 15 cases (93 %), scrotal wall abscess in 1 case (07 %) [4]. Lerner et al, in their limited series of 5 cases of acute inflammatory diseases of scrotum, found acute Epididymitis in 3 patients (60%), acute Epididymo orchitis in 2 patients (40%) [5]. Horstman et al, in their study of 50 patients, found acute Epididymitis in 25 (56%) cases, acute Epididymo orchitis in 20 patients (44%), and complication of acute Epididymo orchitis in 5 patients (11%) [6].

In this study out of 108 cases, 07 cases (6.48%) were detected to have neoplastic pathology on high frequency US and Color Doppler study. Types of neoplastic pathologies detected were as follows– 04 cases (57.3%) – Non seminomatous germ cell tumor, 02 (28.5 %) – Seminomas and 01 case (14.2%) of scrotal wall malignancy. All cases were histologically confirmed. Wolf et al, in their series of 51 patients, found 20 cases (39.2%) of seminomas, 31 cases (60.8%) of Non seminomatous germ cell tumor [7]. Grantham et al in their series of 28 patients, found 07 cases (25%) of seminomas, 09 cases (32.1%) of Non seminomatous germ cell tumor, 07 cases (25%) of regressed germ cell tumors, 03 cases (10.7%) of lymphoid and leukemic involvement of testis and 02 (07.1%) cases of Leydig cell tumors.(change location) [8]. The discrepancy from ours study is likely to be due to larger series of patient

The next common condition which was encountered in this study was Inguino scrotal hernias. Out of 108 cases there were 13 cases (12%) of Inguino scrotal hernias. The ultrasound is highly sensitive in comparison to clinical examination in detecting the content of hernia. Out of 13 cases, 09 cases (69.2%) had bowel loops as hernial content and 04 cases (30.8%) had omentum as hernial content.

In this study there were 09 cases of congenital anomalies of testis. The 07 cases (77.7%) were of undescended testes and 02 (32.3%) cases were of absent testis. Out of 7 cases of undescended testis 6 cases were unilateral and 1 case was of bilateral undescended testis. All were present in the inguinal canal except one which was present in pelvis at the level of internal inguinal ring.

The next common lesion detected was varicocele, which was noted in 09 cases (8.3%) out of 108. There were total 13 patients who presented with complaint of infertility. Out of these 13 patients

09 cases (69.2%) had varicocele. Out of 09 cases 08 (88.8%) had unilateral and 01 (11.2%) case had bilateral varicocele. Of unilateral cases 07 cases (87.5%) were on left side and 01 (12.5%) case was on right side. The dilated veins measured more than 2 mm.

There were 4 cases (3.7%) of testicular torsion. Out of these 3 cases (75%) were acute in onset and 1 case (25%) was sub acute in onset. The all three acute cases underwent surgery and detorsion was done and testis was salvaged. The subacute case was followed which on follow up showed testicular atrophy.

Finally there were 2 cases of traumatic pathology. In one case there was history of trauma to scrotum which was followed by scrotal swelling. There was another patient who presented with history of Non Scalp vein Vasectomy followed by swelling in the cord region after 10 days. The diagnosis of cord hematoma was kept which was confirmed on FNAC and further by surgery and histopathologically examination.

In present study the sensitivity, specificity, positive predictive value and negative predictive value of High frequency ultrasound is compared with clinical examination in diagnosing scrotal and testicular pathologies. (Tab. 1)

Table 1: Comparison of ultrasound and clinical examination in diagnosis of scrotal pathologies

ULTRASOUND

Ultrasound diagnosis	Final diagnosis		Total
	Positive	Negative	
Positive	98	00	98
Negative	02	08	10
Total	100	08	108

CLINICAL EXAMINATION

Clinical examination	Final diagnosis		Total
	Positive	Negative	
Positive	76	05	81
Negative	24	03	27
Total	100	08	108

Present study shows a low sensitivity (76%) very low specificity (37%) and lower negative predictive value (11.1%) of clinical examination, where as high frequency ultrasound is highly sensitive (98%) and specific (100%) with high positive predictive value (98%) and negative predictive value (80%) in diagnosing scrotal and testicular pathologies. The ultrasound was highly accurate in differentiating testicular from extra testicular pathologies, while the clinical examination was inconclusive.

The ultrasound findings influenced the course of management (Surgical or Conservative), surgical approach (Inguinal or Scrotal) in patients presenting with scrotal pathologies. It evolved as a highly reliable tool for diagnosing scrotal and testicular pathologies.

Discussion

The enigmatic nature of scrotum and its content dates back to historic era when Castration was undertaken in earlier times because of the powerful, magical association with the genitalia [9]. John Hunter (1728-1793) performed deliberate testicular transplantation, transferring the testis of a cock into the abdominal cavity of a hen. The testis adhered to the intestine or peritoneum but produced no noticeable systemic change in the recipient [10].

Cooper had a major interest in testicular disease and contributed what may well be the first book of substance on the topic, 'Observations on the Structure and Diseases of the Testis', published in 1830 [11].

High-frequency and color Doppler ultrasonography is a simple, painless, rapid and easily reproducible method of evaluation of intrascrotal masses and comparison to the usually normal contralateral side offers rapid identification of abnormal architecture. It can be used even in acute scrotal conditions and huge scrotal masses, when clinical examination is difficult.

Out of ten cases of acute Epididymo-orchitis, we observed diffuse hypoechogenicity with increase in size of testis and epididymis and diffuse increase in vascularity (fig. 1) in 5 cases. The 5 cases had normal echo texture and size with diffuse increase in vascularity.

There were 15 cases (26.7%) of pyocele. Of these 15 cases of pyocele there was free fluid in the scrotum with multiple septations within. The free fluid was also having multiple moving internal echoes within (fig 2). The nature of fluid was confirmed with the surgery. There were total 11 cases (19.6) of hydrocele. Out of 11 cases hydrocele was noted unilaterally in 09 cases and bilaterally in 02 cases. The hydrocele fluid collection appeared as clear fluid collections between two layers of tunica vaginalis (fig 3). Of two cases of Funiculitis (fig 4) and scrotal wall abscess (fig 5) each, there was hypoechoic area within the wall of scrotum and the cord with increased in the vascularity of surrounding

areas. The findings were same as described by other authors [4-6,12].

Out of 02 cases of seminomas both showed increased size of testis, with homogenously hypoechoic echo texture and raised vascularity (fig 6). The echogenic component was visible in one case.

Of 04 cases of non seminomatous germ cell tumors, there was increased size of testis in all four cases. All four cases showed inhomogeneous hyperechoic echotexture with increased vascularity. 2 cases were well marginated and the other two were ill defined. There were echogenic foci and cystic structures noted in one case each (fig 7).

There was one case of scrotal wall malignancy. The patient presented in an advanced stage and it was difficult on ultrasound to state that whether it is arising from scrotal wall or the testis. On ultrasound the diagnosis of testicular tumor was kept. It showed inhomogeneous hyper echoic echo texture with increased vascularity. The diagnosis of myxofibrosarcoma of scrotal wall was given on histopathology. However on surgical resection also the tumor was not differentiated from the testis.

In Inguino scrotal hernias on high frequency ultrasound, the bowel loops are clearly depicted on examination and can be differentiated from the omentum. As described by Bala R Subramanyam et al [13] . In case of small bowel hernia, it appeared as anechoic mass surrounding normal testicular elements with recognition of valvulae conniventes, detection of peristalsis on real time sonography. On the other hand omentum appeared as highly echogenic, non mobile mass separate from the testis in the scrotum. The diagnosis of obstructive hernia was also given in one patient having non peristaltic, dilated, edematous bowel loop and surrounding free fluid in the scrotum (fig 8).

In Congenital anomalies, the Undescended testes presented as oval hypoechoic structure with maintained vascularity (fig 9). The Undescended testis which presented later in life had smaller size in comparison to cases which presented earlier in life. Both the cases of absent testis had unilateral left absent testes and these cases were further evaluated by CT scan and explorative laparotomy, however the testes could not be identified even after these procedures and the final diagnosis of absent testis was kept in both patients. The findings presented in this study are comparable to the study done by Wolverson et al [14]. In their study the patients with undescended testis underwent both sonography and CT abdomen for localization of undescended testis and exploratory laparotomy was done in cases of testes not visualized on both as well as ultrasound.

A varicocele was considered to be present by high-frequency grey scale ultrasonography, if 2 or more veins could be identified, with at least 1 vein having diameter greater than 2 mm. On color doppler examination there was accentuation and reversal of flow on valsalva maneuver (fig 10). The high frequency gray scale findings were similar to that of study done by other authors [15,16]. In comparison to study done by Gonda et al [17], he had only one false negative case of subclinical varicocele, however in the present study there was no case of subclinical varicocele; it may be due to late presentation of patient in our study then in their study.

In testicular torsion, the involved testis in acute torsion appeared hypoechoic and enlarged with complete absent of flow on color Doppler ultrasound (fig 11). This finding was comparable to other studies [4,5,18]. On clinical examination only 1 case was suspected to have testicular torsion, the rest of cases were false positively diagnosed as Epididymoorchitis.

Hematocele on ultrasound examination shows free fluid in the scrotal sac with dense moving internal echoes. On basis of history of trauma the diagnosis of Hematocele was given and it was confirmed post operatively. Cord hematoma presented as heteroechoic lesion with no vascularity (fig 12).

Conclusion

High frequency ultrasonography with color 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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Source of Conflict- Nil

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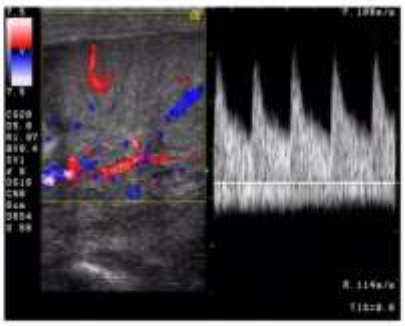
GRAY SCALE - EPIDIDYMO ORCHITIS

ENLARGED MILDLY HYPOECHOIC TESTIS AND EPIDIDYMIS

COLOR DOPPLER - EPIDIDYMO ORCHITIS

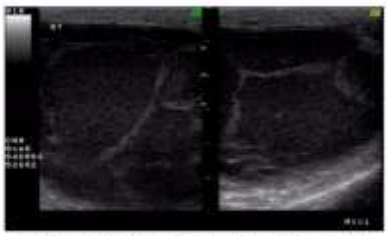


RAISED VASCULARITY AND INCREASED FLOW

Figure 1:

PYOCELE

MULTIPLE HYPERECHOIC SEPTAE WITH DENSE INTERNAL ECHOES IN HEMISCROTUM



FREE FLUID WITH INTERNAL ECHOES AND SEPTATIONS

Figure 2:

GRAY SCALE - FUNICULITIS

THICKENED HYPOECHOIC CORD

COLOR DOPPLER - FUNICULITIS

INCREASED VASCULARITY OF THE CORD

Figure 4:

HYDROCELE

CLEAR FREE FLUID IN THE HEMISCROTUM

HYDROCELE

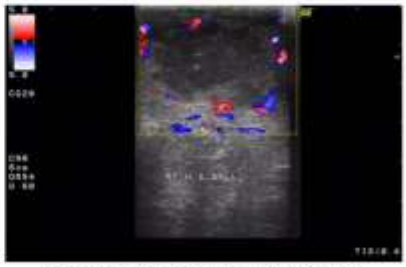
CLEAR FREE FLUID IN THE HEMISCROTUM

Figure 3:

GRAY SCALE - SCROTAL WALL ABSCESS

HYPOECHOIC AREA WITH ILL DEFINED MARGINS IN THE SCROTAL WALL

COLOR DOPPLER - SCROTAL WALL ABSCESS



LESION SHOWING PERIPHERAL RAISED VASCULARITY

Figure 5:

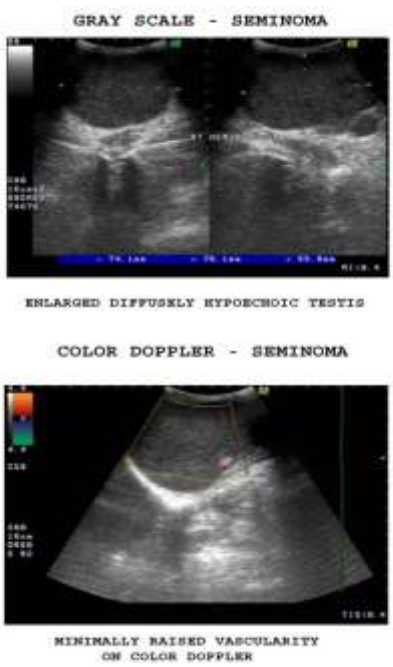
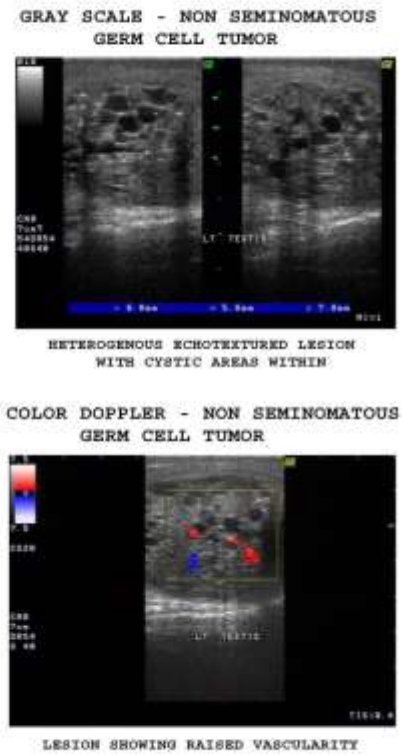


Figure 6:

Figure 8:



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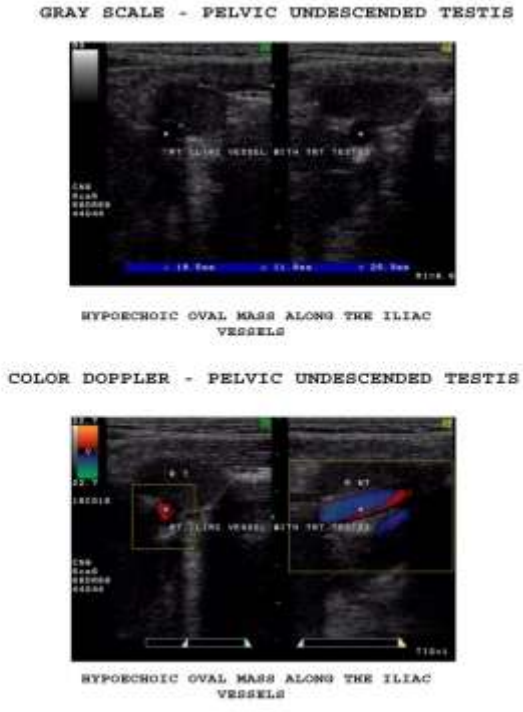

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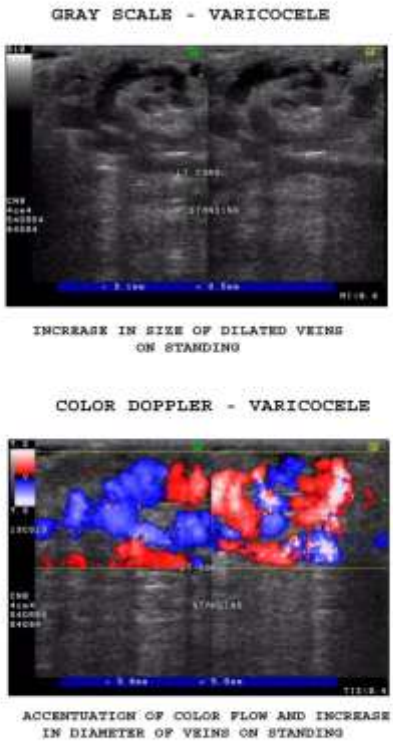

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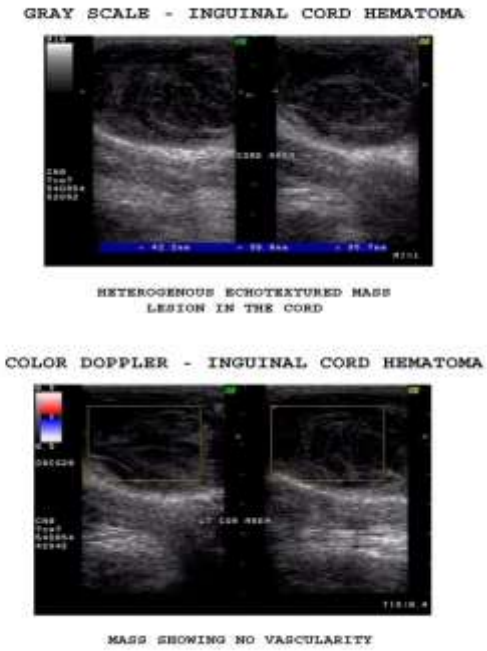

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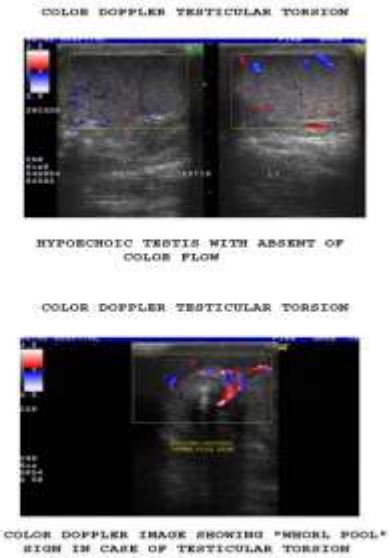

Figure 11: