Chapter One

1.1 Introduction

The testes have two main functions of spermatogenesis (an endocrine function), and male hormone (androgen) secretion as well as exocrine function. Both functions are dependent on a good blood supply and healthy tissues. Ischemia of only 1-3 hours, for example, results in decreased spermatogenesis and irreversible changes occur in only 6-8 hours, this makes twisting of the testicles due to trauma is a surgical emergency **(Joseph et al, 2013)**. Understanding the importance of male reproduction system abnormalities is also important; considering that testicular cancer is the most commonly occurring malignancy in men between the ages of fifteen and thirty-five. The incidence for mixed germ cell tumors alone is two to three cases per 100,000 males per year (in the United States). Testicular cancer makes up about 1 percent of all cancers in men in the United States. About 8,000 new cases are discovered annually and approximately 390 men die of testicular cancer each year**(Joseph et al,2013)**.Testicular cancer most often occurs in white males between ages 20 and 39 and doubled in white males over the last decade**(Daniel etal,2013**). This disease is particularly hard on males emotionally because of the young age of its victims, and is the most common cancer in males between ages 15 and 35 (in the United States). Racially testicular cancer does not affect black people asexist in white ones and represents 5 times more in white with unknown reasons. However in Saudi Arabia El-Senoussi et al, (2006) introduced study related to epidemiology and clinical characteristics of testicular tumors in Saudi during the period of January 1977 and June 1983, in which they showed that: among 62 patients with germinal testicular tumors the epidemiologic and clinical characteristics dependant on geographic distribution of population which analyzed as follows: Testicular seminomas (TS) and

non-seminomatous testicular tumors (NSTT) comprised 50% each. The mean age was 41 and 27.8 years for TS and NSTT, respectively. Fifteen patients had cryptorchidism of the involved testicle. Three patients with NSTT had a history of trauma to the involved testicle. The most common presentations were painless testicular swelling (51.6%), painful swelling (16%), and abdominal or inguinal swelling (21%). The delay between the onset of symptoms and referral (mean 15 months) was considerable. Eighty percent of patients with NSTT and 45 % of those with TS had advanced disease at referral **(Senoussi et al, 2006).** The risk factors for testicular cancer include: Cryptochidism (Uu-descended testicles in scrotum), prior testicular cancer, age, race, and some occupations, the risk of developing testicular cancer is increased by a factor of 10-20 with cryptorchism. About 10% of testicular cancers seem to have a genetic basis, so a father or sibling having testicular cancer should be an early warning to screen other males of the family. Klinefelter's Syndrome (A condition of a male having an extra X chromosome can be a cause of sterility), abnormal testicular development, and risk of developing germ cell tumors. Pesticide workers, leather workers, miners, and oil workers have slightly increased risk as well as the persons with human immunodeficiency virus (HIV) **(Joseph et al, 2013).** It is a that vasectomy is a cause of testicular cancer in males. Males have little knowledge of testicular self exam, making this a poorly practiced screening tool at best. Many of these cancers present as painless masses so symptoms do not reach clinical significance early in the disease. Furthermore, many laypersons are not aware that ultrasound and blood markers can be used to detect disease and manage treatments. Ultrasound is a sensitive and accurate technique for the evaluation of testicular abnormalities, and is widely accepted as the first-line imaging technique for many common and uncommon testicular diseases. Ultrasoundis effectively the sole scrotal

imaging technique that apatient will undergo prior to surgery **(Huang et al,2012)** .Traditionally, Bmode (B-mode stands for brightness)ultrasound is extremely sensitive in the detection of testicular masses, however doesn'to provide histological evidence to differentiate between benign and malignant tissues which has been a challenging for ultrasound unit facility; although some ultrasound techniques such as Color Doppler ultrasound(CDUS, defined as: color Doppler ultrasound), Contrast-Enhanced Ultrasound (CEUS) and Tissue Elastography (TE, defined as: is an ultrasound measure of the stiffness of tissue.) are available to provide a more detailed interrogation of focal testicular lesions.Color Doppler ultrasound is an important ultrasound technique for the evaluation of a focal in determinate testicular lesion **(Horstman et al, 1992).** With rare exception, any solid intra-testicular lesion with an increase in color Doppler flow should be considered suspicious for malignancy. However, this is not without limitations, as small testicular tumors may appear a-vascular on the CDUS examination. The use of CEUS improves characterization of testicular lesions, with more detailed evaluation of intra-testicular vascular flow **(Lock et al, 2011).** More importantly, CEUS allows conclusive demonstration of lack of vascularity that is likely to be encountered in benign lesions **(Hedayati etal, 2012).** Demonstration of an avascular abnormality, which is likely to be benign in nature and may resolve, would allow the option of ''watchful waiting'' with ultrasound, without subjecting the patient to unnecessary surgery **(Shah et al, 2010).** Tissue elastography is an ultrasound measure of the stiffness of tissue. Given that most solid focal tumors differ in their consistency from the surrounding tissue, TE is a further technique that allows better differentiation between benign and malignant testicular lesions **(Goddi et al, 2012).** The ''hard'' lesions are more likely to be malignant, and the''soft'' area suggest benignity.

1.2 Problem of the study:

The increasing incidence of testicular tumors nationally and internationally in addition to vague, silenceconfuse characteristics and differentiations of testicular tumors are considered as main problems.

1.3 Objectives of the study:

1.3.1 General objectives:

To characterize the testicular tumors in view of benign and malignant dedending on B-mode with applied Dopplar in such diseases.

1.3.2 Specific objectives:

- To differentiate between benign and malignant testicular tumors depending on B-mode (characteristics).
- To determinethe properties of Dopplar in benign and malignant tumors of testicles.
- To correlate between alpha feto protein level with cancer types.
- To differentiate between testicular from paratesticular lesions,
- To determine the location of palpable\unpalpable lesions
- To determine the incidence of malignant testicular tumors in percent
- To determine the sonographic appearance of general testicular pathologies

1.4 Thesis outline:

The following study will be laid out in five chapters. Chapter one will deals the introduction, problem of the study, objectives and thesis outlines. Chapter two will shows literature review (section one) and previous studies in section two. Chapter three will deal with methodology. Chapter four will highlight the results and discussion. Chapter five will show the conclusion and recommendation.

Chapter Two-Section One
Literature Review
Anatomical, Physiological and Pathological

2.1 Anatomical review:

The male gonads are called testes. These are paired organs that lie within the scrotal sac and are responsible for producing spermatozoa, the male gametes, and male hormones. The scrotum contains the two testicles, epididymides, part of the two ducts deferens, and some residual embryonic tissues surrounded by the visceral tunica vaginalis. The scrotal sac also contains the tunica albuginea and the dartos muscle, and a portion of the cremaster muscles within the spermatic cord. Each testicle has a duct system to convey spermatozoa, which consists of the proximal ductuli efferentes, epididymis, ductus deferens and ejaculatory ducts. The duct system is important in that it stores spermatozoa, and release them into the urethra during copulation. Spermatozoa require a fluid environment to facilitate movement through the duct system as they self propel in the female reproductive system to reach an ovum (female gamete). Three of the five glands of the male reproductive system supply the liquid moiety, which lubricates sperm, and support their nutritional energy need. These glands are the two seminal vesicles and the prostate glands. They are exocrine glands having ducts through which to secrete their products. Two accessory glands, the bulbo-urethral glands (also called Cowper's glands), add a liquid substance that prepares the urethra to transport semen. The right and left testicular arteries are the main blood supply to the testes. They arise from the aorta just below the renal arteries. They pass into the inguinal canal within the spermatic cord. Each testicular artery pierces the tunica abuginea along the posterosuperior testis to supply the testes, iliac lymph nodes, a portion of each ureter, and a portion of the cremaster muscle. The cremasteric artery accompanies the spermatic cord and supplies it. The cremaster

muscle is also supplied by it. The differential and cremasteric arteries anastomose with the testicular artery as shown in (Figure 2.1).

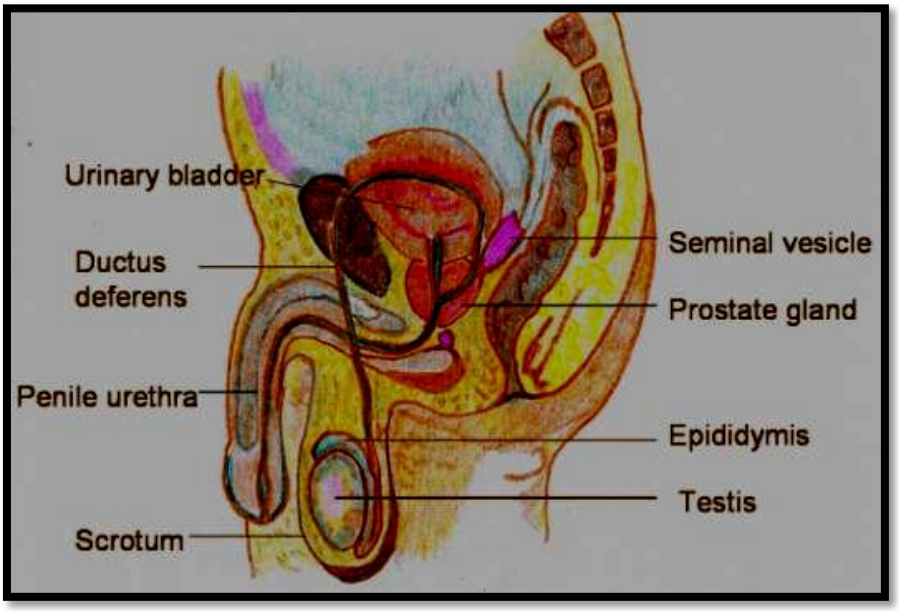

Figure (2.1) shows the parts of a male reproductive system (Joseph et al, 2013).

The adult testes are paired reproductive organs weighing about 10-14 grams each and measuring about 4 cm in length and 2.5 cm in diameter. Each embryonic testis must descend from its posterior abdomen location through the inguinal canals located in the anterior abdomen. The testes begin their migration to the scrotum at about the twenty-eighth week lasting 2 or 3 days. About week 32 the testes are fully descended into the scrotum in 97 percent of males and shortly after birth for the remainder three percent.For the 3 percent of full-term males who may have an undescended testis, the testis should complete migration in the first year post gestation. Cryptorchidism, the medical term for undescended testis, is a pathological condition in newborns and requires medical or surgical attention when it persists. If both testes are undescended spermatogenesis fails and the individual will be sterile. The main function of the testes is production of male gametes (spermatogenesis) and their development into motile sperm (spermiogenesis). The tunica albuginea extends into the testis and

partitioning it into about 250 lobules. Each lobule has 2-3 convoluted seminiferous tubules where sperm are produced. Within the packed coiled seminiferous tubules gametes in different developmental stages which can be seen on a histological thin section (Figure 2.2).

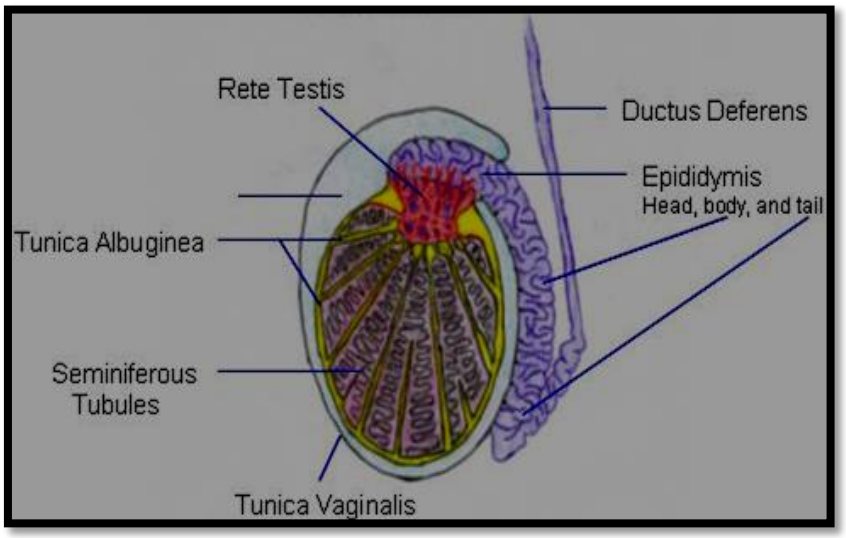

Figure (2.2) demonstrates the histological structure of the human male testis (Joseph et al, 2013).

The seminiferous tubules congregate on the mediastinum testis and are continuous with the efferent ductules that connect the testis to the head of the epididymis.Flagellums that line the interior of the rete testis help conduct spermatozoa towards the epididymis where they are stored. The epididymides are paired tubular organs described as a “comma-shaped” structure along the superior and posterolateral surface of each testicle; it is uncoiled and about twenty feet long **(Joseph et al, 2013).** It has been stated that, the ductus deferens lies within the spermatic cord. Its function is to conduct spermatozoa from the epididymis to the urethra. As the testes descend, it becomes surrounded by a serous cavity that pushes the visceral layer of the tunica vaginalis against the tunica albuginea and testis. The outer layer of the newly formed cavity becomes the parietal layer of the tunica vaginalis. The visceral tunica vaginalis surrounds the testis. The tunica vaginalis is a fluid filled sac surrounding the testis.

The seminiferous tubules are also demonstrated; they produce sperm through a process called spermatogenesis. Within the seminiferous tubules spermatozoa are produced. This is where gametogenesis takes place through a process of meiosis. This process is unique to germ cells that reduce the genetic complement of the spermatozoa to haploid. Germ cells called spermatogonia produce haploid gametes through meiotic divisions. Meiosis results in the production of four haploid gametes called spermatid, which takes about three weeks in males. These gametes are subsequently developed in a process called spermiogenesis (lasting about 5 weeks) in which spermatids become motile. Within the seminiferous tubules gametes can be found in different stages of spermatogenesis. The rete testis propels maturing sperm into the epididymis where they acquire their tails for full motility. Approximately 12 ducts called the ductus efferentes conduct spermatozoa from the rete testes to the head of the epididymis. Because the spermatozoa still have not acquired their tails and therefore are not mobile the pathway is lined with cilia and flagella to brush them distally into the epididymis. The epididymis is a long comma shaped tubular structure arising from the posterolateral aspect of the testis and runs along the testes length. It consists of head that lies some what on the superior surface of the testes. The head of the epididymis receives spermatozoa from the simininferous tubules. The parts of the epididymis are the proximal head, the body (consisting of many convoluted ducts where spermatids are stored), and the tail, which is continuous with the ductus deferens. The ductus deferens conducts sperms to the ejaculatory duct where they are expelled into the urethra during copulation.The spermatic cord is a term referring to the covering that encloses those structures that pass through the inguinal ring with the testes during their descent. These structures are: the ductus deferens, testicular artery, cremasteric artery, lymph vessels, veins, artery of the ductus deferens, and remnants

of the processus vaginalis. These structures can present symptoms of torsion when the cord is tangled or twisted. The spermatic cord suspends the testicles within the scrotum; it contains many structures of the male reproductive system. Structures found within the spermatic cord include the ductus deferens, artery of the ductus deferens, testicular artery, cremasteric artery, pampiniform plexus, sympathetic and parasympathetic nerves, motor nerves, and lymphatic vessels. The testicular artery provides the main supply of blood to the testicles and epididymis, whereas its own artery supplies the ductus deferens. The cremasteric artery joins the testicular artery just before it enters the testis, but first it supplies the cremaster muscle and coverings of the spermatic cord (Figure2.3). About 12 veins drain the testicles by forming an anastomotic network called the pampiniform plexus. The plexus is found along the posterior surface of the testicles. It is the major portion of the spermatic cord forming a spiralingvine-like plexus covering the ductus deferens and arteries within the cord. It terminates in the testicular vein. These veins can become blocked causing a painful varicocele of the testes **(Anderson et al, 1983).**

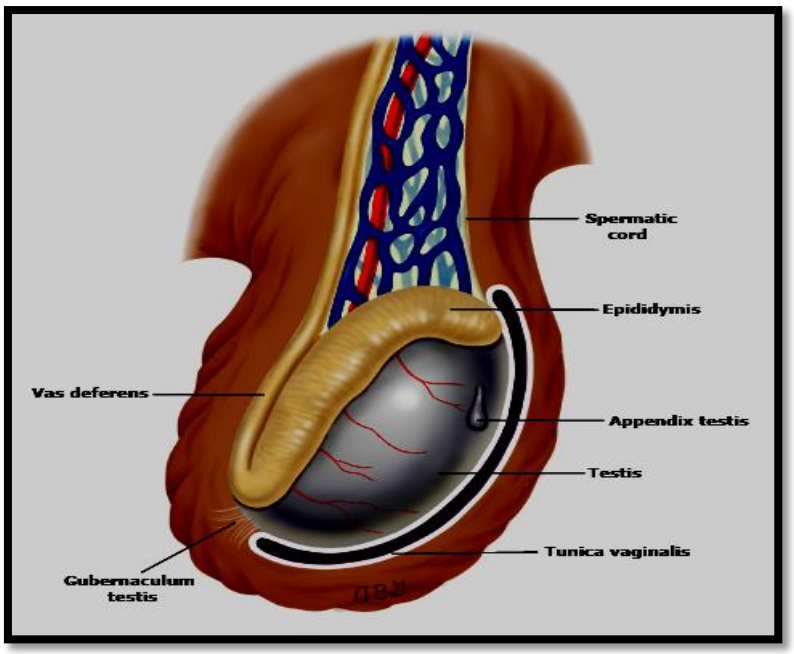

Figure (2.3) shows the testicle in vertical aspects and its anterior portion is surrounded by the tunica vaginalishttp://www.uptodate.com(access 20\5 \2013).

2.2 The pathology and ultrasonic appearance:

- **Cryptorchidism:**

Cryptorchidism is failure of descent of the testes into the scrotum during fetal development. The defect may result in the testes being located within the abdomen, inguinal canal, or some ectopic location. Both unilateral and bilateral cryptorchidism are associated with impaired spermatogenesis and an increased risk of testicular tumors; testes that remain in an intra-abdominal location are believed to have a 40-fold increased risk of developing testicular carcinoma (making the risk 1 per 1000 to 2500) **(Pillai and Besner, 1998)** (Figure2.4).

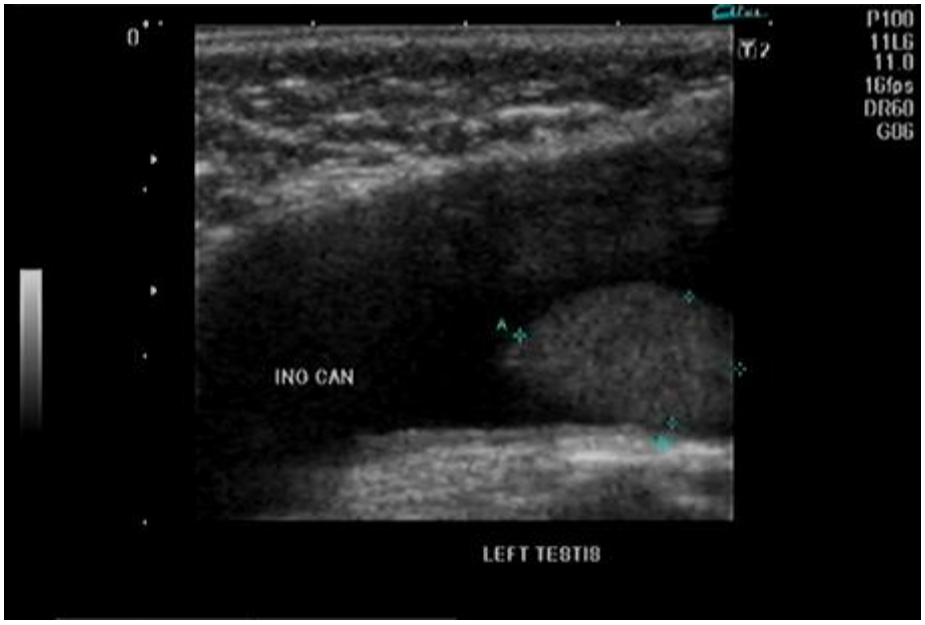

Figure (2.4) shows, the left inguinal testis (see ultrasound images of left inguinal testis below). In this infant, aged two months, the baby has normal rights testis located within the scrotal sac. However, the left testis is located low down within the left inguinal Canal suggesting left cryptorchidism or left undescended testes. Also evident is communicating hydrocele of the left side. Normal vascularity is present in the left testes suggesting that this testis is viable.

- **Varicocele:**

A varicocele is caused by dilatation of the pampiniform plexus of spermatic veins as shown in (Figure2.5).It is present in 15 to 20 percent of post-pubertal males, occurring in the left hemiscrotum in the vast majority of cases. The reason for the left-sided predominance may be explained anatomically. The left spermatic (gonadal) vein is one of the longest veins in the body, entering the left renal vein at a perpendicular angle. The intravascular pressure in the leftrenal vein is higher than on the right because it is compressed between the aorta and the superior mesenteric artery coming off the aortaabove the renal vein, thereby producing a"nutcracker effect." This phenomenon causes increased pressure in the left gonadal vein, which can dilate and cause incompetence of the valve leaflets, leading to retrograde flow of blood toward

the testis in the erect position (**Henry et al, 2009)**. The Varicoceles are graded as I, II, or III, according to size as shown in table (2.1) (**(Pillai and Besner, 1998).**

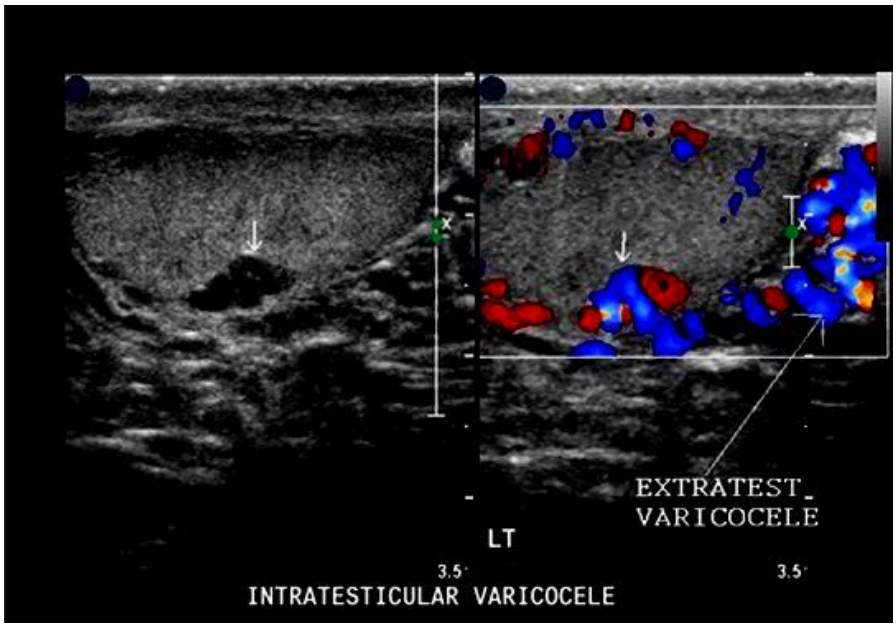

Figure (2.5) shows, the left scrotum shows a large extratesticular varicocele (long arrow in image on left). Also present are a few dilated vessels (more than 2 mm. each) in the subcapsular part of the left testes (small arrow in color Doppler image). Spectral Doppler trace of the vessels show typical low resistance venous flow pattern. These Color Doppler and spectral Doppler ultrasound images are diagnostic of intratesticular varicocele of left testes. This appears to communicate with the Extratesticular varicocele. Color Doppler helps to rule out other lesions like tubular ectasia of rete testes and Testicular neoplasia which can cause similar appearances on sonography. Both above images are courtesy of Ravi Kadasne, MD, UAE

Table (2.1) shows the Grading of varicoceles disease (Pillai and Besner, 1998).

`Grade	**Size**	**Clinical description**
I	Small	Palpable only with valsalva maneuver
II	Moderate	Nonvisible on inspection, but palpable upon standing
III	Large	Visible on gross inspection

Varicoceles may be asymptomatic or may cause any or all of the following:Dull, aching left scrotal pain, typically noticeable when standing and relieved by recumbency.Testicular atrophy, believed to be secondary to loss of germ cell mass by induction of apoptosis (programmed cell death) initiated by the associated slightly

increased scrotal temperature. Possibly compromised fertility on physical examination, the spermatic cord has a "bag of worms" appearance that increases with standing or the Valsalvamaneuver.

- **Epididymal cysts and spermatoceles**

Epididymal cysts are commonly palpated in the head (caput) of the epididymis and are generally asymptomatic. They occur with increased frequency in male offspring of mothers who used diethylstilbestrol during pregnancy. In addition, epididymal cystadenomas are seen in more than one-half of patients with Von Hippel-Lindau disease and are often bilateral **(Choyke et al, 1997)**. The cystic scrotal mass appears as a fluid accumulation between the parietal and visceral layers of the tunica vaginalis as shown in (Figure2.6).

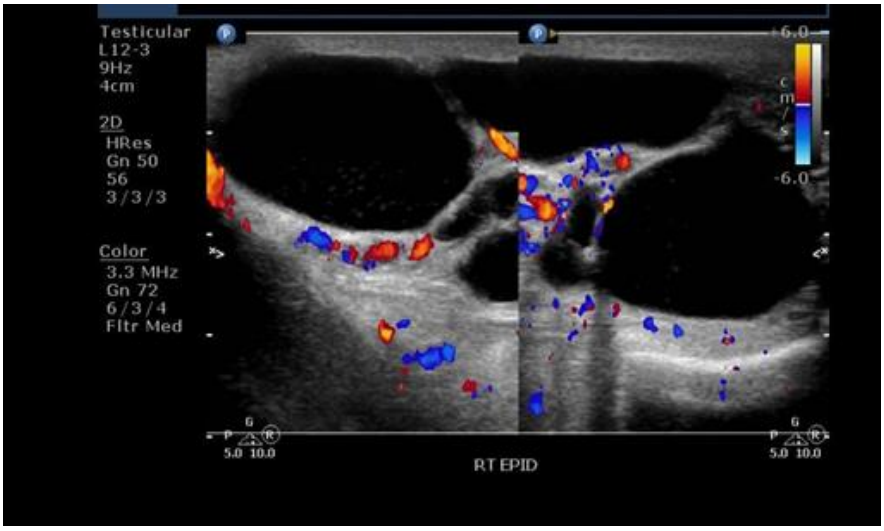

Figure (2.6) -Shown above are 2D B-mode and color Doppler ultrasound images of multiple right epididymal cysts in the head of the right epididymis. Surprisingly the septae show remarkable vascularity.

- **Simple testicular cyst with debris**

Simple cysts are detected incidentally and usually occur in men over 40 years of age, with a size range from2mm to 2cm in diameter (Figure 2.7). The cysts are usually

solitary, and may be associated with spermatoceles. On B-mode ultrasound, a simple cyst would appear an anechoic centre surrounded by a thin wall, with a degree of posterior acoustic enhancement **(Dogra et al, 2001).**

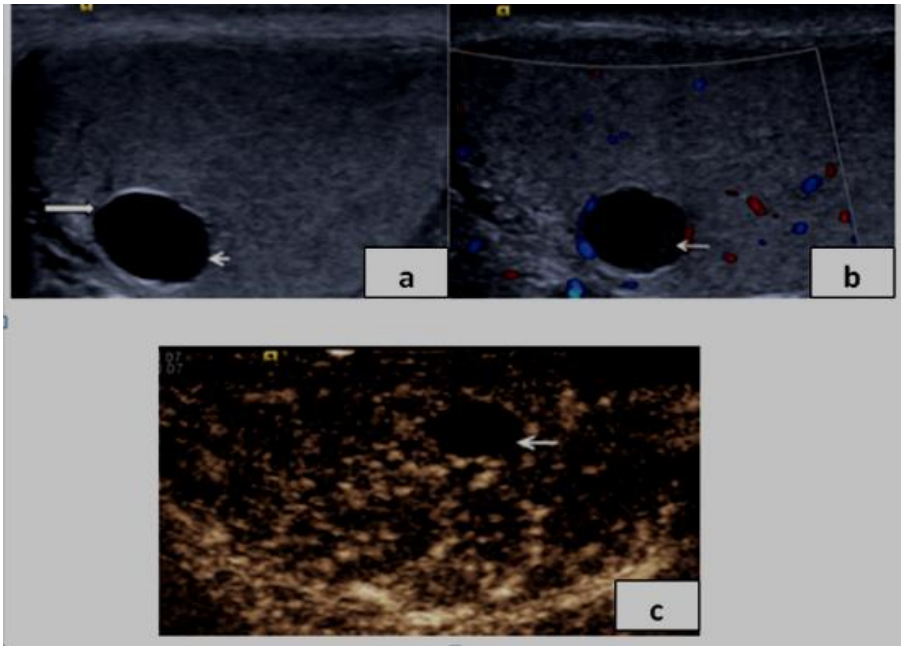

Figure (2.7) shows the Cyst with debris. (a) A 6-mm anechoic lesion (long arrow) is noted in the testicle with a thin clear demonstrated. A‘‘fluid-debris’’ level is noted (short arrow). (b) No internal color Doppler signal is demonstrated within the debris present in the lower aspect of the cyst (arrow). (c) On contrast-enhanced ultrasound, there is clear absence of enhancement in the debrispresent in the lower aspect of the cyst (arrow), and a cystic tumor is unlikely.

- **Adenomatoid lesion**

Extratesticular lesions, although almost always benign, may cause a diagnostic challenge clinically and significant patient anxiety. An adenomatoid tumor (Figure 2.8) is the second most common extratesticular tumor (cysts are the most common), followed by a lipoma. The ultrasound appearances of an adenomatoid tumor consist of a hyperechoic rounded tumor most commonly at the epidydimal tail.FollowingCEUS the focal epididymal lesion demonstrates enhancement and early washout of microbubble contrast.

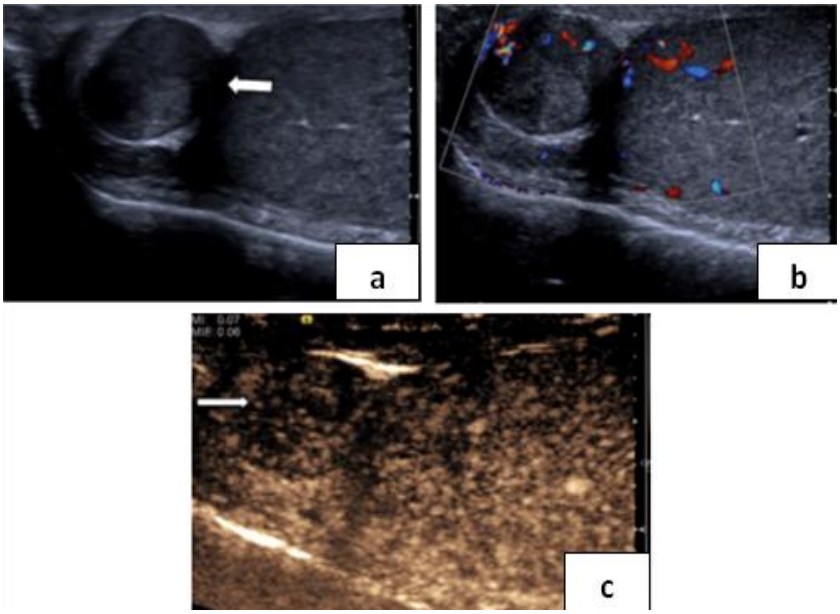

Figure (2.8) shows the extratesticular adenomatoid lesion. (a) A heterogeneous lesion (arrow) measuring 12mm is noted within the right epididymal head. (b) Color Doppler signal is demonstrated within the lesion. (c) Following contrast administration the focal epididymal lesion demonstrates enhancement and early washout (arrow).

- **Hydroceles**

A hydrocele is a collection of peritoneal fluid between the parietal and visceral layers of the tunica vaginalis (the investing layer that directly surrounds the testis and spermatic cord) which shown in (Figure2.9&10). It is the same layer that forms the peritoneal lining of the abdomen. Hydroceles are believed to arise from an imbalance of secretion and reabsorption of fluid from the tunica vaginalis **(Choyke et al, 1997).**

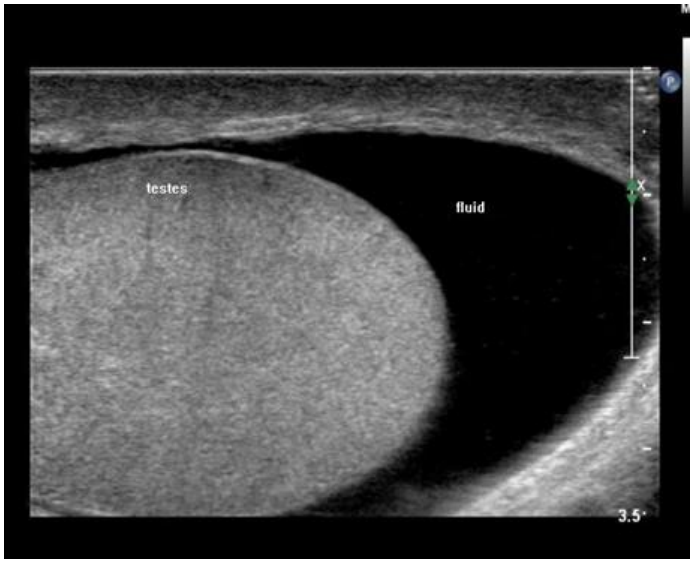

Figure (2.9) -shows, **hydrocele is the pathological collection of fluid within the tunica vaginalis of the scrotum. Here, the serous fluid collection is seen within the tunica vaginalis around the left testes. Observe the detail seen in the 3-D (or 3 dimensional) ultrasound image on the right side. 3-D ultrasound image of hydrocele, courtesy of Dr. Ravi Kadasne, MD, UAE, who used a Philips IU 22 machine for it**

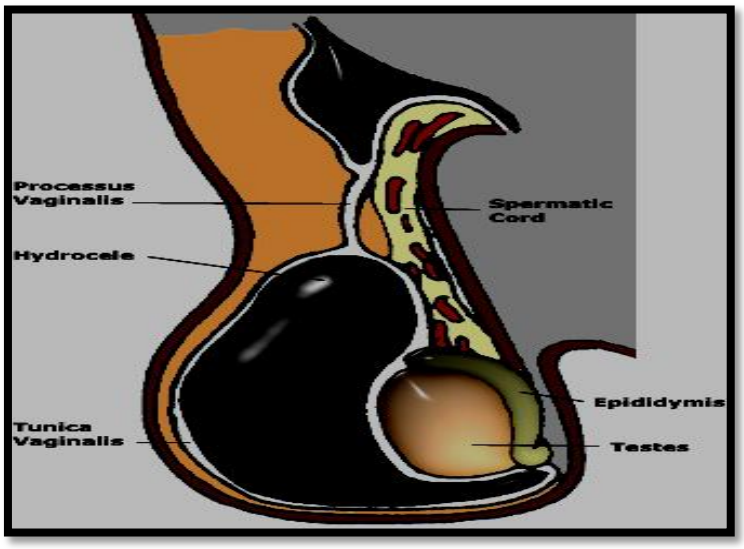

Figure (2.10) shows the hydrocele appears as a fluid accumulation between the parietal and visceral layers of the tunica vaginalis (Sandlow et al, 2007).

The hydrocele depicted above is non-communicating (there is no connection between the hydrocele and the peritoneum; the fluid comes from the mesothelial lining of the tunica vaginalis).Hydroceles range in size from small, soft collections that still allow palpation of the scrotal contents to massive, tense collections of several liters that

make examination impossible. Symptoms of pain and disability generally increase with the size of the mass. The fluid of hydrocele in the scrotal sac usually illuminates well which differentiates the process from a possible hematocele, hernia, or solid mass. A scrotal ultrasound should be considered if the diagnosis is in question since a reactive hydrocele can occur in the presence of a testicular neoplasm or with acute inflammatory scrotal conditions. Idiopathic hydroceles usually arise over a long period of time and are most common. Inflammatory conditions of the scrotal contents (epididymitis, torsion, appendiceal torsion) can produce an acute reactive hydrocele, which often resolves with treatment of the underlying condition. Idiopathic hydroceles are often asymptomatic, despite considerable scrotal enlargement. Thus, treatment is necessary only for symptomatic complaints or for the rare situation of compromised scrotal skin integrity from chronic irritation, pressure, etc. The most common treatment is surgical excision of the hydrocele sac or a simple aspiration is generally unsuccessful due to rapid re-accumulationof fluid. On the other hand, percutaneous aspiration of the hydrocele fluid may be successful if combined with instillation of a sclerosing agent into the sac. The potential risks of the latter approach are a low incidence of reactive orchitis/epididymitis and a higher rate of recurrence, which may then make open surgery more difficult because of the development of inflammatory adhesions between the hydrocele sac and the scrotal contents. Hydroceles discovered in infancy are usually "communicating," sincethey areassociated with a patent processus vaginalis, which allows flow ofperitoneal fluidinto the scrotal sac. They usually disappear in the recumbent position and are often associated with herniation of abdominal contents (indirect hernia) through the processus vaginalis. Surgical repair is advised in these cases **(Choyke et al, 1997).**

- **Testicular cancer:**

Testicular cancer is the most common solid malignancy affecting males between the ages of 15 and 35, although it accounts for about 1 percent of all cancers in men. Germ cell tumors (GCTs) account for 95 percent of testicular cancers table (2.2). They may consist of one predominant histologic pattern, or represent a mix of multiple histologic types. For treatment purposes, two broad categories of testis tumors are recognized: pure seminoma (no nonseminomatous elements present), and all others, which together are termed nonseminomatous germ cell tumors (NSGCTs). In most series, the ratio of seminoma to NSGCT is about one. Testicular cancer has become one of the most curable of solid neoplasms because of remarkable treatment advances beginning in the late 1970s. Prior to that time, testicular cancer accounted for 11 percent of all cancer deaths in men between the ages of 25 to 34, and the five-year survival rate was 64 percent. In 2011, about 350 deaths from testicular cancer are expected in the United States. The five-year survival rate is over 95 percent **(Ercan et al, 2007).**

Table (2.2) shows the classification of testicular tumors (Who-Lyon, 2004).

Germ cell tumors
Seminoma
Seminoma with syncytiotrophoblastic cells
Spermatocytic seminoma
Spermatocytic seminoma with sarcoma
Nonseminomatous germ cell tumors
Embryonal carcinoma
Teratoma
Dermoid cyst
Monodermal teratoma
Teratoma with somatic type malignancy
Trophoblastic tumors (choriocarcinoma)
Yolk sac tumor (endodermal sinus tumor)
Mixed germ cell tumors
Sex cord-stromal tumors
Sertoli cell tumor
Leydig cell tumor
Granulosa cell tumor
Mixed types (eg, Sertoli-Leydig cell tumor)
Unclassified

The clinical manifestations, diagnosis, and staging of testicular cancer will be presented here. Optimal therapy, which varies with the stage of disease, is discussed separately. On B-mode images these tumors may be inhomogeneous, with areas of increased echogenicity, calcification and cyst formation. Increased vascularity may or may not be demonstrated, and therefore may be mistaken for a benign avascular abnormality, such as a segmental infarction of focal scarring (Figure2.11&12).

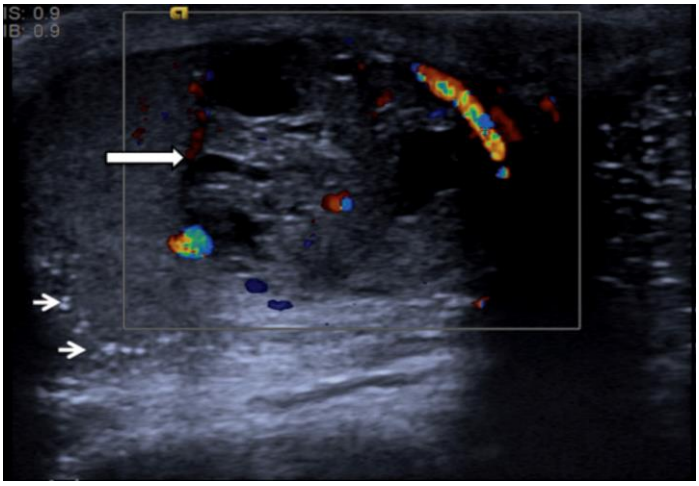

Figure (2.11) shows the mixed germ cell tumor appears as focal lesion with heterogeneous reflectivity and cystic components (long arrow). Color Doppler demonstrates distortion of the normal vascular pattern by the lesion. Note is also made of background testicular microlithiasis (short arrows).

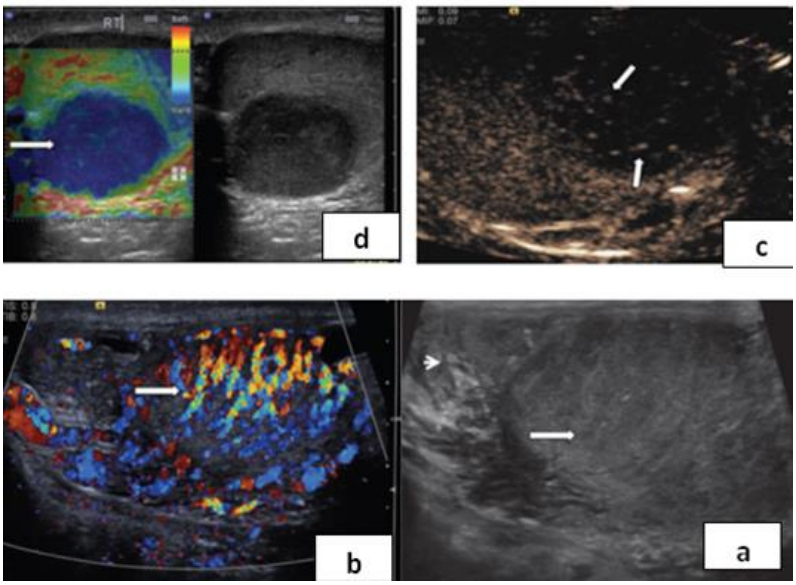

Figure (2.12), shows the embryonal cell tumor (a) B-Mode ultrasound demonstrates a focal lesion with aslightlyheterogeneous reflectivity (arrow). (b)Color Doppler ultrasound demonstrates loss of normal parenchymal vascular pattern, replaced by an abnormal vascularity (the ‘‘crisscross’’vascular pattern; arrow). Color Doppler flow is demonstrated in the large vessels only. (c) Tissue elastography demonstrates a‘‘blue’’ lesion, therefore clearly a ‘‘hard’’ lesion (arrow) (d) in contrast-enhanced ultrasound, particulatemovement of contrast (arrows) are seen throughout the lesion in a haphazard pattern, confirming the vascularity is present within all components of the lesion.

- **Clinical manifestations**

Testicular tumors usually present as a nodule or painless swelling of one testicle, which may be noted incidentally by the patient or by his sexual partner **(Bosl et al, 1997)**. Occasionally, a man with a previously small atrophic testis wills noteenlargement. Approximately 30 to 40 percent of patients complain of a dull ache or heavy sensation in the lower abdomen, perianal area, or scrotum, while acute pain is the presenting symptom in 10 percent. The presenting manifestations of testicular cancer are attributable to metastatic disease in approximately 10 percent of patients. Symptoms vary with the site of metastasis: as for the neck mass (supraclavicular lymph node metastasis), cough or dyspnea (pulmonary metastasis), Anorexia, nausea, vomiting, or gastrointestinal hemorrhage (retroduodenal metastasis), Lumbar back pain (bulky retroperitoneal disease involving the psoas muscle or nerve roots).Bone pain (skeletal metastasis), central or peripheral nervous system symptoms (cerebral, spinal cord, or peripheral root involvement), unilateral or bilateral lower extremity swelling (iliac or caval venous obstruction or thrombosis), gynecomastia, which occurs in about 5 percent of men with testicularneoplasms. GCTs, is a systemic endocrine manifestation of these neoplasms (**Tseng et al, 1985)**. It also occurs in 20 to 30 percent of patients with the less common (2 percent of testicular tumors) Leydig cell tumors of the testes. These tumors are found in 6 to 10 year old boys who present with precociouspuberty, and in 26 to 35 year old men who present with a testicular mass, gynecomastia, impotence, and loss of libido. Gynecomastia is usually associated with production of human chorionic gonadotropin (HCG) by foci of choriocarcinoma or trophoblastic cells in the tumor. However, the relationship between gynecomastia, testicular tumor morphology, and endocrine abnormalities remains incompletely defined. In individual patients, gynecomastia may or may not

occure. Non-primary tumors (Figure 2-13) such as lymphoma and metastasis can all manifest as an indeterminate testicular mass. Testicular lymphoma occurs in a much older population than those affected by primary germ cell tumors, and is the most common testicular neoplasm in men over 60 years of age. The epididymis and spermatic cord are commonly involved. Primary leukaemia of the testis is rare; secondary testicular involvement is more common. Sonographic findings in both lymphoma and leukaemia may be represented by focal or multifocal hypoechoic lesions, and may be indistinguishable from germ cell tumors. Correlation to relevant clinical history would be required in reaching correct diagnosis. Other metastases to the testes, which are rarely the presenting complaint, are most commonly seen in cases of widespread primary prostate and lung malignancies **(Ulbright et al, 1999).**

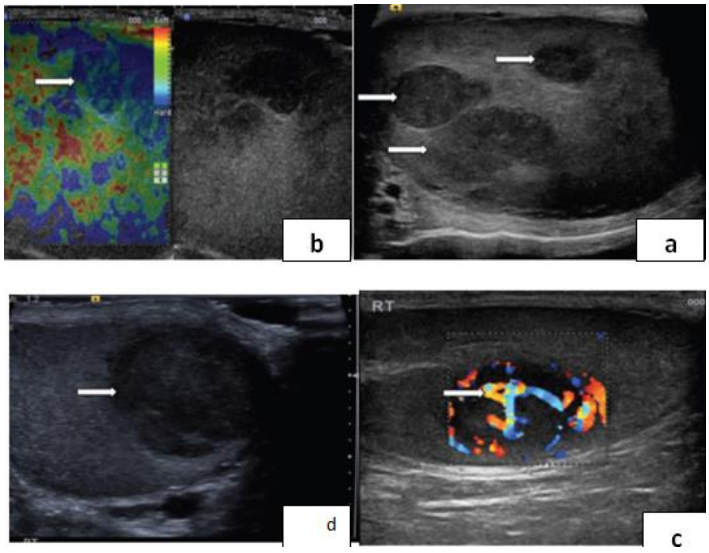

Figure (2.13) shows the Prostatic metastasis. (a) B-mode ultrasound demonstrates multifocal hypoechoeic lesions (arrows). (b) Color Doppler ultrasound demonstrates internal vascularity within the lesions (arrows). (c) The lesions appear ‘‘hard’’ on elastography (blue area arrow). (d) Enhancement is noted within the lesion, confirming internal vascularity and peripheral contrast enhancement (arrow) wall.

They are one of the few intratesticular masses that demonstrate no malignant potential. Four ultrasound appearances have been described N Type 1 classic ‘‘onion-ring’’ appearance with alternating hyper-echoic and hypo-echoic layers,N Type 2

densely calcified mass with an echogenic rim,N Type 3 cyst with a rim and either peripheral or central calcification andN Type 4 mixed pattern, heterogeneous and poorly defined. Although the sonographic appearances of epidermoid cysts are characteristic, it is not pathognomonic. The combination of absence of color Doppler flow, absence of vascular flow on CEUS and ‘‘hardness’’ on real-time elastography help further characterize these lesions **(Patel et al, 2012).**Negative tumor markerswith the above ultrasoundfindings increase diagnostic confidence. The treatment for epidermoid cyst is either enucleation or orchidectomy, which is usually performed when malignancy cannot be completelyexcluded. Segmental testicular infarction is an infrequent finding in patients with acute testicular pain. Predisposing factors to segmental infarction include epididymo-orchitis trauma, hypersensitivity angiitis, and intimal fibroplasia of the testicular artery, previous surgery polycythaemia and sickle cell disease.Ultrasound examination demonstrates an area of mixed or low reflectivity, which may be wedge- or round shaped. There is poor or absent colorDoppler flow.CEUS will demonstrate any avascular testicular parenchyma.In the subacute stage, CEUS may show avascular lobules and in some cases perilesional rim enhancement **(Bertolotto et al, 2011).** Rim enhancement observed may be due to perilesional inflammatory changes around the infarcted areas, or mass effect secondary to intralesional oedema in the infarcted area that displaces the surrounding testicular tissue and causes bundling of the perilesional parenchymavessels. After 1 month or more, CEUS may depict reduced size of the lesion, with intralesional vascular ‘‘spots’’ in areas of infarction. The ultrasound appearances, the absence of tumor markers and a change in the size or shape of the abnormality during follow-up will often establish the benign nature of the abnormality.

- **Orchitis**

Primary orchitis (Figure 2.14) is rare without associated epididymo-orchitis, but may be caused by human immunodeficiency virus or mumps virus. The process may be seen as diffuse or focal. Orchitis may manifest as multiple hypo-echoic abnormalities within the testicular parenchyma, with septal accentuation with foci of low reflectivity conforming to the lobular anatomy **(Cook and Dewbury, 2000).** As the condition progresses, areas of venous infarctionoccur with associatedhaemorrhage, givingriseto areas of mixed or increased reflectivity. Increased blood flow to the epididymis and testis at CDUS and CEUS examination is a well-established criterion for thediagnosis of epididymo-orchitis. After treatment and healing, changes may resolve completely, or often there is loss of volume of the testis with fibrosis giving a heterogeneous pattern on ultrasound. The great variability in ultrasound appearances can cause diagnostic confusion, but awareness of the changes and progression may allow a more confident diagnosis to be made in theappropriate clinical setting.

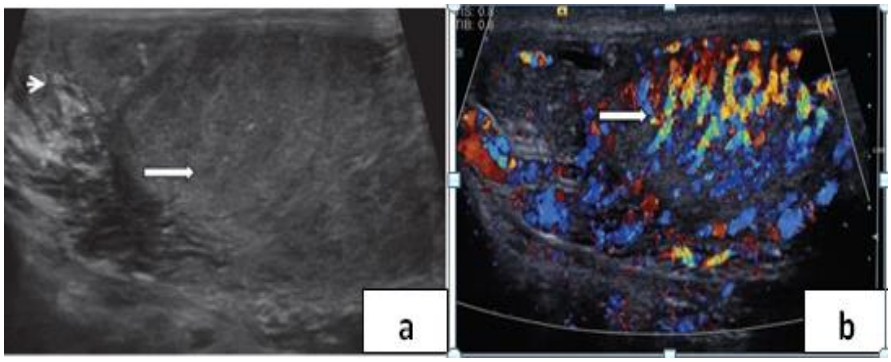

Figure (2.14), shows the Orchitis. (a) Longitudinal ultrasound of the testis demonstrates patchy heterogeneous reflectivity within the testis (long arrow) and enlargement of the epididymis (short arrow). (b) There is marked increase in vascularity within the testis on color Doppler ultrasound (arrow).

- **Venous infarction**

Venous infarction (Figure 2.15) of the testis may occur in cases of severe epididymo-orchitis where local swelling occludes the venous drainage of portions of the testis or the entire testis. Venous infarction may also occur in patients with hypercoagulable states. Onultrasound the testis is of low or mixed echo reflectivity. There is an absence of color Doppler flow and contrast enhancement. The diagnosis should also be suspected when reversal of intratesticular arterial flow in diastole is observed with an associated focal abnormality. CEUS demonstrates clear demarcation of avascular areas to allow for appropriate clinical management **(Lung et al, 2012).**

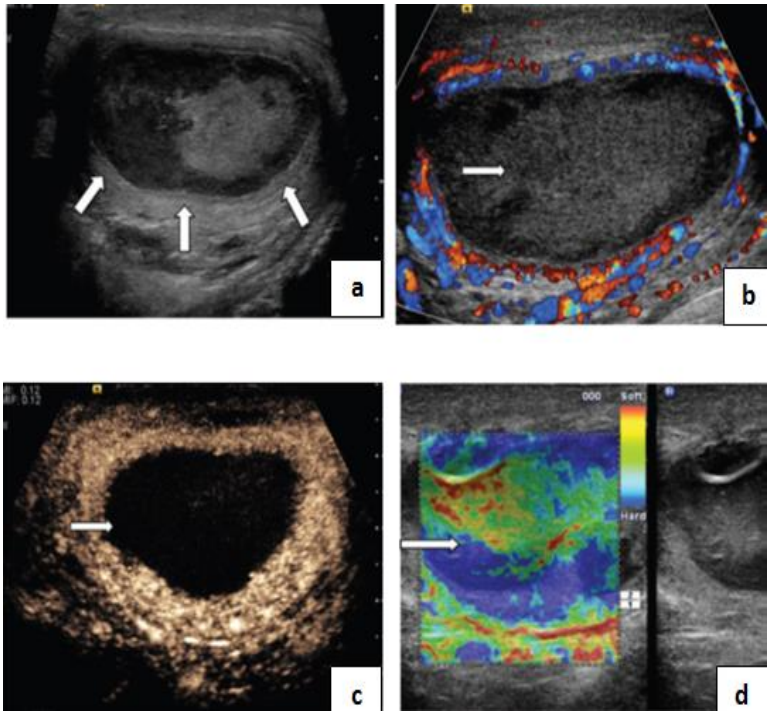

Figure (2.15), shows the venous infarction of the testis. (a) A focal testicular abnormality with mixed reflectivity (arrows) is noted on B-modeultrasound. (b) No color Doppler signal is seen in the focal testicular abnormality (arrow). (c) Following the administration of microbubble contrast, contrast flow is present in the normal testicular parenchymal, clearly absent from the infarcted portion of the testis (arrow). (d) Tissue elastography demonstrates no focal ‘‘hard’’ lesions, and the area of abnormality appears ‘‘soft’’ (green on color scale, arrow).

- **Intratesticular haematoma**

A history of trauma should raise the suspicion of the differential of an intratesticular haematoma (Figure 2.16).Acutely; the haematoma appears as patchy increased reflectivity. On follow-up it may appear as an area of low reflectivity, with size reduction as the haematoma retracts. The most important differential diagnosis ismalignancy, and therefore an accurate history, lack of vascularity on both CDUS and CEUS, absence of tumor markers, and reduction in the size of the abnormality onsequential scans is indicative of a benign entity **(Purushothaman et al, 2007).**

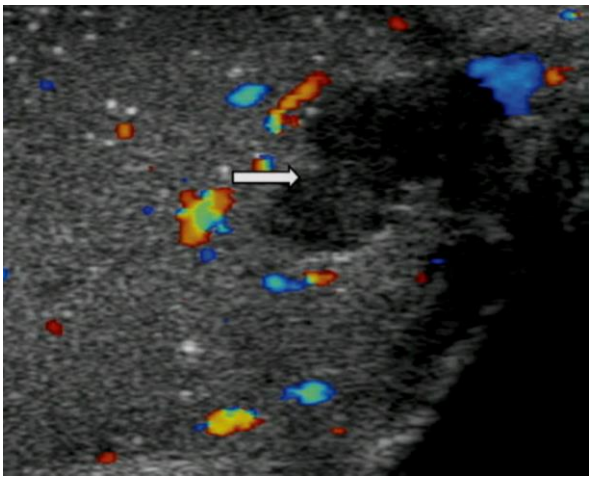

Figure (2.16) shows the Intratesticular haematoma. A well-circumscribed (arrow) focal area of low reflectivity with internal echoes is noted in the testis of a patient involved in a motorcycle accident. The lesion demonstrates low reflectivity. Color Doppler ultrasound confirms absence of vascularity, in keeping with the diagnosis of traumatic intratesticular haematoma. At 4 weeks there was reduction in size of the lesion. Incidental microlithiasis is present.

- **Intratesticular abscess**

Intratesticular abscesses (Figure 2.17) are unusual and are associated with severe epididymo-orchitis. It may also arise secondary to mumps, trauma or infarction. The ultrasound appearances are of a lesion of low reflectivity with irregular borders. Hyper-vascular rims may be visible surrounding a testicular abscess on CEUS and CDUS but no internal vascularity is present. The abnormality observed in testicular

abscess does not conform to lobular distribution which may help to differentiate this from a segmental infarction **(Stewart and Sidhu 2007).**

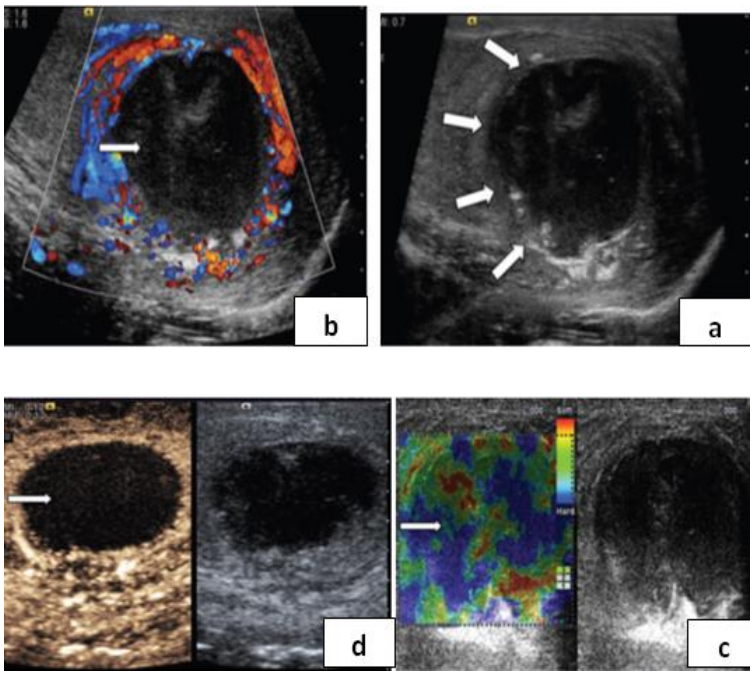

Figure (2.17) shows the testicular abscess (a) On B-mode ultrasound a focal lesion with low internal echoes (arrows) is seen in a patient with history of resolving epididymo-orchitis. (b) On color Doppler ultrasound there is increased vascularity at the periphery of the lesion but none within the lesion (arrow). (c) Contrast-enhanced ultrasound image demonstrating increased absence of vascularity in the abscess (arrow) with some rim enhancement. (d) Tissue elastography demonstrates a heterogeneous pattern of firmness but no focal ‘‘hard’’ lesion is demonstrated (arrow).

- **Rete testis:**

The rete testis (Figure 2.18) is a system of numerous seminiferous tubules located at mediastinum testis, which drain to the epididymal head. On ultrasound the rete testis has a spectrum of appearances ranging from a faintly visible ill-defined area of decreased reflectivity to a coarse tubular appearance with finger-like projection into the parenchyma **(Sellars and Sidhu, 2001).**No vascular flow is demonstrated within retetestis. They may resemble a hypoechoic mass when viewed in cross-section. As long as ultrasound appearances remain typical with no softtissue component orabnormal color Doppler signal or enhancement on CEUS, no further investigation is

usually required. Although this is a benign entity, it may be of significance in a patient suffering fromazospermia as this implies there is obstruction of the ipsilateral spermatic ducts.

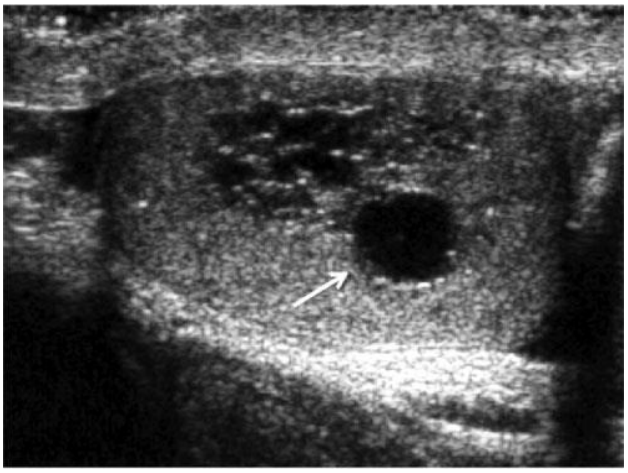

Figure (2.18), shows the Rete testis as localized area of tubular ectasia of the rete testis, with a further testicular cyst (arrow). No soft tissue component or internal color Doppler signal (not shown) is demonstrated to suggest the presence of an underlying tumor.

- **Testicular sarcoidosis**

Involvement of the genital system by sarcoidosis is rare (Figure 2.19). It more commonly affects the epididymis but can also involve the testis. Onultrasound the lesions of sarcoidosis are typically multiple, small, bilateral low-reflectivity masses. Differentiation from malignancy may be difficult, and clinical evidence of sarcoidosis elsewhere is required for diagnosis to be made more confidently **(Stewart and Sidhu 2007).** If there are no associated symptoms or features, then ultimately tissue biopsy for pathological evaluation may be requiring.

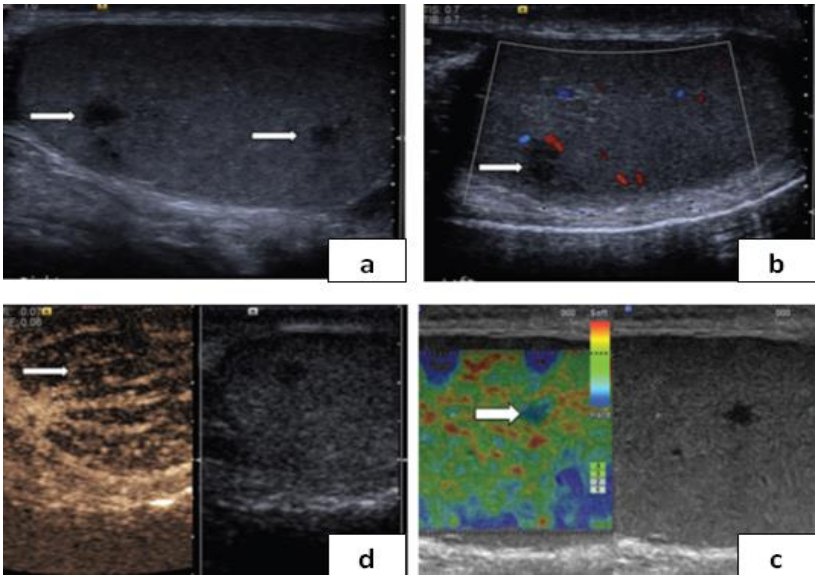

Figure (2.19), shows the testicular sarcoidosis. (a) B-mode ultrasound demonstrates multiple low-reflectivity focal testicular lesions (arrows) in a patient with a recent clinical diagnosis of sarcoidosis. (b) On the color Doppler study the focal lesions do not clearly demonstrate vascular flow, but it is difficult to be certain due to size of the lesions. (c) Contrast-enhanced ultrasound clearly confirms some vascularity within the lesion (arrow). (d) Tissue elastography demonstrates a moderate degree of ‘‘hardness’’ of these lesions (blue on color scale, arrow).

- **Post-trauma testicular devascularisation**

Devascularisation of the testis may occur following significant traumatic injury to the scrotum (Figure 2.20). On B-mode images the testis may appear heterogeneous and may not assume the normal testicular configuration. An associated haematocele may be present. On CDUS little vascular flow will be appreciated within the devascularised segment. The extent of the abnormality, however, is best appreciated with CEUS, where there may be a sharply demarcated non-enhancing area in contrast to the normally vascularised testicular tissue **(Stewart and Sidhu2007).**

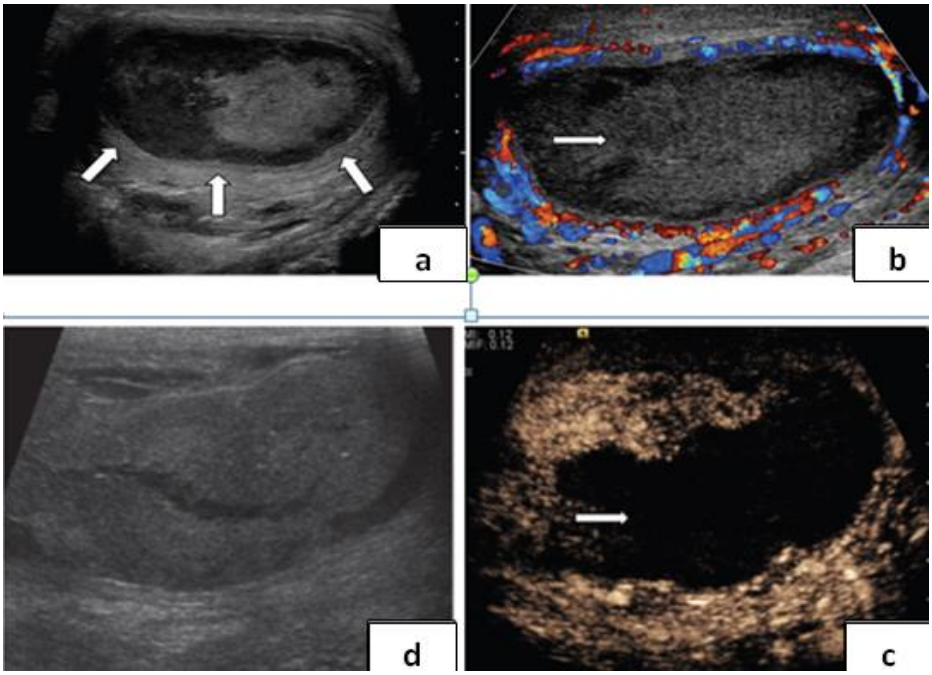

Figure (2.20), shows the Post-traumatic testicular devascularisation. (a) On B-mode images demonstrates the testis appears very heterogeneous and appears to be ‘‘shattered’’. (b) There is no clear evidence of color Doppler flow to the affected testis. (c) Following administration of microbubble contrast, the testis is seen to be predominantly devascularised. The abnormality is much better demarcated on contrast-enhanced ultrasound (arrow).

Chapter Two-Section Two
Literature Review Previous studies

In the realm of previous studies related to characterization of testicular tumors by ultrasound, there have been considerable scholars wrote about. For instance: **Zeev et al, (2004)** have determined the gray scale and color Doppler sonographic features of Leydig cell tumors of the testis in a series of patients, they have retrospectively analyzed the sonographic appearance of 10 proven Leydig cell tumors in 9 patients aged 26 to 47 years. The sonographic features that were reviewed included the size and echogenicity of the tumors, presence of cystic areas or calcifications, and distribution pattern of detectable blood flow on color or power Doppler imaging. The results were as follows: the tumors ranged from 0.4 to 3.0 cm in diameter, but most were less than 1.0 cm in diameter. In 1 testis, 2 discrete Leydig cell tumors were found. Nine (90%) of the 10 tumors were homogeneously hypoechoic. Only 1 tumor was isoechoic with the testis .None of the tumors contained calcifications. In 8tumors with color Doppler imaging, 7 (88%) showed a characteristic pattern of increased peripheral blood flow, which was either circumferential or punctate. Only 1 tumor was found with internal hypervascularity. Peripheral hypervascularity in a hypoechoic testicular tumor that has little or no internal color Doppler flow should suggest the possibility of a Leydig cell tumor and table (2.3).

Table (2.3) Summary of Patient Data, Clinical Findings, and Sonographic Appearance of Leydig Cell Tumors (NA = not available)

Patient	Age, y	Reason for Referral	Gyneco mastia	Palpable Mass	Tumor Size, cm	Echogenicity	Color Doppler Flow	
							Peripheral	Central
1	47	mpotence, decreased libido	+	+	3.0	Hypoechoic	+	_
2	26	Infertility	+	+	1.5	Hypoechoic	NA	_
3	38	Infertility	_	+	1.0	Hypoechoic	+	_
4	32	mpotence, decreased libido	_	_	0.6	Hypoechoic	NA	_
5	27	Testicular discomfort	_	_	0.8	Hypoechoic	+	_
6	35	Contralateral epididymitis	_	+	2.4	Isoechoic + cystic area	+	_
7	26	Infertility, Klinefelter syndrome	_	_	0.7	Hypoechoic	_	+
8	29	Contralateral epididymitis	_	_	0.6	Hypoechoic	+	_
9	29	Contralatera epididymitis	_	_	0.8 0.4	Hypoechoic Hypoechoic	+	_ _

One tumor, 2.4 cm in diameter, was isoechoic with the surrounding testicular tissue and contained a small central hypoechoic area . In 1 patient (patient 9), there were 2 discrete focal masses in the same testis .The sizes of the tumors ranged from 0.4 to 3.0cm (mean, 1.2 cm) in diameter, but only 2 tumors were greater than 1.5 cm, and most were less than 1.0 cm in diameter. All 4 palpable masses measured 1.0 cm or greater in diameter. Neither intratumoral calcification nor testicular microlithiasis was observed in any of the cases. Color or power Doppler sonography or a combination was available for review in 8 of the 10 tumors. Of these, a remarkable pattern of peripheral flow but little or no intrinsic Doppler signal was seen in 7 (88%) of the cases. In some, the flow was circumferential, creating a color halo around the tumor . In others, there were prominent peritumoral punctate foci of blood flow .Intrinsic hypervascularity was seen in only 1 case, a patient with Klinefelter syndrome and a 0.7-cm lesion .The histologic slides that were available for review correlated well

with the sonographic appearance of the tumors by showing an intratumoral paucity of blood vessels but prominent vascularity surrounding the lesion.Other previous study of Intratesticular haematoma is well described by **Purushothaman et al, (2007);** they have found that, the ultrasound literature may be mistaken for a primary testicular malignancy if a detailed clinical history and careful ultrasound examination are not performed. They reported two cases of intratesticular haematoma (one complicated by the presence of microlithiasis), described the ultrasound appearances and document the natural history of the haematomas. Aclinical history coupled with Doppler ultrasound features is crucial for conservative management.A 55-year-old man was referred to the ultrasound department by his general practitioner with symptoms of left scrotal pain of 2 weeks' duration. He had not offered a precipitating reason for the pain. An ultrasound examination was performed using a high-frequency linear array transducer (15L8w) on a Siemens Acuson Sequoia machine (Siemens, Mountain View, CA), revealing two well-defined areas of low reflectivity within the left testis measuring 1.96-0.9 cm and 1.26-0.4 cm .The abnormal areas did not demonstrate any internal colour Doppler signal.The right testis was normal. Appearances were thought to represent two poorly vascularized primary intratesticular tumours. On direct questioning the patient gave a history of being ''bitten'' on the scrotum during sexual activity 2weeks previously. With this information and the lack of vascularity within the lesions a diagnosis of an intratesticular haematoma was raised, with follow-up examination arranged. At the 1 month follow-up examination, the two lesions had altered, with only a single 0.9 cm diameter low reflective abnormality with central echoes present, without any internal Colour Doppler signal.3 months later, an ultrasound demonstrated further retraction of the lesion to 0.6 cm, again appearing as an ill-defined area of low reflectivity.Tumour markers (alpha-fetoprotein, lactate

dehydrogenase and human chorionic gonadotrophin) remained within normal limits. These consecutive features together with the history were in keeping with intratesticular haematomas and the patient had remained in good health throughout.A healthy 35-year-old man was referred to the ultrasound department by his general practitioner with left-sided scrotal pain of several weeks duration. An ultrasound examination performed using a high frequency linear array transducer (15L8w) on a Siemens Acuson Sequoia machine (Siemens, MountainView, CA) demonstrated florid unilateral microlithiasis in the left testis with an ill-defined low reflective lesion measuring 2.062.0 cm without internal colour Doppler signal detected.The lesion was thought to represent a poorly vascularized intratesticular tumour, known to occur with a higher frequency in the presence of microlithiasis. The right testis was normal. Further patient questioning revealed that during sexual activity several weeks ago an object (a shoe) thrown by the patient's partner had hit the groin region. With this history, the possibility of an intratesticular haematoma was raised, and follow-up ultrasound examination was arranged for 4 weeks. At 4weeks the lesion had reduced in size, measuring 0.56-0.2 mm. Tumour markers (alpha-fetoprotein, lactate dehydrogenase and human chorionic gonadotrophin) remained within normal limits. At 1 year follow-up, ultrasound demonstrated complete resolution of the previous low reflective lesion in the left testis.These cases highlight the clinical utility of high resolution ultrasound with colour Doppler in providing valuable information for the differential diagnosis of testicular lesions. More importantly, the cases demonstrate the necessity of a thorough clinical history as an adjunct to the ultrasound findings, particularly when the clinical history may be a source of awkwardness for the patient. The environment of the ultrasound examination room is often conducive to patient–operator interaction with pertinent points of the clinical history more forthcoming

than in the clinical consultation room. Ultrasound is highly sensitive in detecting testicular tumours with the specificity of ultrasound depending on the clinical referral pattern **(Sidhu et al, 2006)**. Many intratesticular lesions mimic malignant tumours including intratesticular haematomas **(Megremis et al, 2005),** segmental infarction **(Sriprasad et al, 2001)**, focal orchitis **(Karmazyn et al, 2005)**, abscesses **(Horstman et al, 1991)**, spleno-gonadal fusion **(Stewart et al, 2004)** and the presence of adrenal rest tissue **(Dogra et al, 2004).**Many non malignant lesions do not demonstrate internal vascularity and therefore have no colour Doppler flow signal. Although there is an association of increased colour Doppler signal with primary malignant tumours of the testis above 1.0 cm in diameter, below this size the colour Doppler signal is thought to be variable **(Horstman et al, 1992)**. However, the testicular tumour size criteria for the detection of colour Doppler flow signal may well be less than the figure of 1.0 cm quoted with the introduction of newer high-frequency colour Doppler sensitive transducers.Nevertheless, the reliability of the absence of colour Doppler signal from an intratesticular solid lesion is not adequate to confidently exclude a malignant lesion **(Bushby et al, 2001) .**There is strong evidence for an increased prevalence of testicular tumours with the presence of testicular microlithiasis **(Bach et al, 2001) ,** a condition seen in one of our patients, further increasing the possibility of the presence of a malignant tumour. Penetrating scrotal injury requires immediate surgical exploration without the need for ultrasound imaging.Blunt testicular trauma may be a result of obvious injury or iatrogenic as in the case of testicular sperm extraction **(Strauss et al, 2001)**; ultrasound imaging is useful. The clinical history is invaluable in establishing the correct underlying diagnosis.Blunt testicular trauma may produce an array of ultrasound findings, depending on the severity of the injury, which include haematoma, fracture or rupture of the testis. The most important

ultrasound feature to determine is whether the tunica albuginea is confluent.The ultrasound features of testicular rupture include an irregular testicular outline together with associated heterogeneous echo-texture of the testis. A testicular fracture appears as a discrete cleavage line within the tunica albuginea, but is present in 17% of cases of testicular trauma **(Jeffrey et al, 1983) .**The appearances of intratesticular haematomas, like haematomas elsewhere, may vary and evolve with time and this important feature validates the need for serial ultrasound imaging if this diagnosis is suspected. Initially, acute haematomas appear of increased reflectivity and with temporal progression the haematomas become more complex and cystic in nature with evidence of septation, finally becoming lower flective as haematoma retraction occurs **(Dogra et al, 2003) .**During this transition, haematomas need to be distinguished from other similar appearing lesions. Both cases illustrated demonstrated complete absence of colour Doppler flow within the lesions and early formation of internal echoes, features that are useful for the diagnosis of a haematoma. Furthermore, clot retraction occurred with complete resolution of ultrasound findings in 1 year in one of the patients (Case 2), although other authors have suggested that the resolution may be seen within 6–10 weeks or by 6 months .These two cases illustrate the need for a clear clinical history despite patient awkwardness, combined with the salient ultrasound features of a resolving low reflective focal intratesticular lesion with absent colour Doppler signal, to prevent unnecessary surgical exploration for the possibility of a malignant tumour. Confidence in the diagnosis will allow for ultrasound surveillance until resolution of imaging findings **(Strauss et al, 2000).**An other study was done on Cystic lesions in the testis of children by **Liniger et al (2012)** .They said that ,Cystic lesions in the testis of children are rare and in most cases benign tumors. However, apreoperative

diagnostic work-up could contribute to planning the surgical procedure: orchiectomy in the case of potential malignancy or otherwise a testis-sparing approach. In this study we reviewed our recent cases of benign cystic testicular tumors and the corresponding literature. The different entities are presented with details of the diagnostic work-up, pathology and treatment of these lesions. In all presented cases, organ-preserving treatment was performed. This practice is to be recommended in the case of all prepubertal cystic testicular lesions.

- **Simple testicular cyst**

An otherwise healthy 5-week-old boy was brought to our institution because of a testicular swelling that caused no pain upon palpation. The right testicle measured about 14 ml, could be outlined from all sides, and showed no signs of inflammation, hydrocele or hernia. An ultrasound examination revealed a 1.8 _ 1.2 cm intratesticular cystic formation, anechoic and with sharply defined walls and enhanced posterior sound transmission. The alphafetoprotein level was within the normal range. The child was operated by a scrotal approach. The cyst was punctured and then excised in to. A biopsy of the testicular parenchyma was obtained and 8 ml serous fluid sent for cytological examination. Four weeks after the surgery, the treated testicle was the same size as the contralateral. The histological examination showed that the mesothelial inclusion cyst was lined with cuboidal epithelium.

- **Prepubertal teratoma**

A 7-month-old boy was referred because of a constant painless swelling in the right testis. The child was in excellent general condition and there was no loss of weight or appetite. Upon clinical examination, the right testis was enlarged, had an increased consistence and a smooth surface. There was no pain during the examination and no

adherence between the tumor and the scrotal skin; no pathologic lymph nodes or enlargement of the liver or spleen was found. Alpha-fetoprotein and beta-HCG were Normal. On ultrasound examination a multicystic space occupying mass with some small solid parts, prominent perfusion and exact demarcation was found. The testis was explored by a scrotal approach. After incision of the lower pole, a cystic tumor 8e9 mm in diameter could be seen and easily shelled out. The frozen section analysis confirmed the diagnosis of a testicular teratoma, bordered by a pseudo-capsule and containing bone, cartilage and several epithelial parts of different differentiation, as well as some immature portions. The postoperative course was uneventful. A close follow-up with repeated ultrasound examinations was performed. At the last consultation, 12years after the operation, we found symmetric normal testes in the clinical examination and also normal ultrasound findings.

- **Cystic dysplasia of the rete testis**

A 12-year-old boy presented with increasing swelling of the right scrotum over a period of 3 years. Clinically we found a distinctly swollen, bulky and indolent right testicle with a volume of 35 ml. The left testicle was normal on palpation and had a volume of 10 ml which is according to age. The transillumination was positive on the right side. The ultrasound examination showed an expanded (2.5 _ 3 cm) multicystic lesion in the center of the right testicle with intact displaced testicular parenchyma in the periphery.In addition, a so far undetected agenesia of the right kidney with compensatory hypertrophy of the left kidney was diagnosed. Alpha-fetoprotein and beta-HCG were in the normal range. With all this, the existence of a cystic dysplasia of the rete testis was assumed and, considering the recent recommendations, a testicle-sparing operation was performed via a scrotal approach. During the intervention we found multiple cysts in the rete testis. These lesions could be resected, preserving the

continuity between testis and epididymis and the perfusion of both organs .The histological analysis confirmed the suspected diagnosis, showing multiple anastomosing, irregularly shaped cystic spaces lined by cuboidal or flatted epithelium and separated by cell-poor connective tissue.The postoperative course was uneventful. The patient underwent regular clinical and ultrasound follow-up examinations. Forty-five months after the resection, the ultrasound examination showed homogeneous testicular parenchyma with a regular perfusion. There was no sign of a relapse and both testes developed normally according to age.

- **Epidermoid cyst**

An 8-year-old patient presented in our emergency ward with a scrotal swelling on the right side. On clinical examination, torsion of a hydatid of Morgagni was suspected, which was confirmed by ultrasound examination. Incidentally, during this investigation, a well circumscribed, cystic, hyperechoic lesion of 4 mm in diameter was found in the left testis.This tumor could not be palpated and both testes showed an identical size of 3 ml, normal according to age. There was no swelling, redness or pain on palpation, and the cremaster reflex was normal on both sides. Alpha-fetoprotein and beta-HCG were in a normal range. We performed an elective exploration of the left testis via scrotal incision. Intraoperatively we found a well encapsulated cystic lesion, containing soft, yellow material with a concentric pattern. The tumor was enucleated and sent for frozen section analysis, which confirmed the diagnosis of an epidermoid cyst of the testis and removal in to. The postoperative course was uneventful. The patient was discharged the day after surgery and showed normal clinical and ultrasound findings 4 weeks and 3 months later.

- **Dermoid cyst**

A 13-year-old boy presented with a scrotal swelling on the left side which he had observed over 8 months. There was no pain, dysuria or other complaints. The ultrasound examination indicated a varicocele. As coincidental finding, a cystic lesion in the left testis was shown, meeting the typical features of testicular dermoid cysts

By a scrotal approach, the left testis was exposed. There was a superficial spherical tumor near the upper pole of the testicle, bulging out the surface. The lesion was excised.The frozen section analysis revealed a testicular dermoid cyst. The varicocele was ligated in the same session. After an uneventful postoperative course, a clinical and ultrasound examination was performed after 6 months and found no recurrence of the tumor. However, the varicocele reappeared and a laparoscopic ligature of the testicular veins was performed. Today, 3 years after the first operation, there are similar sized, inconspicuous testicles on both sides on the clinical and ultrasound follow-up examination .Testicular tumors are 10 times less frequent in children than in postpubertal males, with a reported incidence of 0.5e1 per 100,000 children compared to 5.4 per 100,000 adults .In contrast to testicular tumors in men, prepubertal testicular tumors contain usually only one histological type.According to tumor registries, the majority of them have been considered malignant. However, recent observations suggest that pediatric testicular tumors are usually benign, but under reported. In particular, intratesticular cystic masses in children are benign in more than 95% of cases. Furthermore, malignant prepubertal testicular tumors are less likely to metastasize. With all this, a less aggressive approach in the surgical treatment of testicular tumors in children is justified, particularly in younger boys. In older patients, a careful evaluation of pubertal development is required. Testis-sparing

surgery is becoming the standard of care for a variety of benign cystic testicular lesions, such as prepubertal teratomas, epidermoid cysts and simple tesicular cysts.

But,Luca Carmignani et al (2003) in their study ,said that : the clinical and histological significance of incidental ultrasonographic focal testicular lesions and assessed whether a conservative surgical approach may put the patient at higher oncological risk due to insufficient surgical eradication. From October 2000 to May 2002 all patients with infertility, scrotal swelling, scrotal pain, varicocele, scrotal trauma or erectile dysfunction underwent scrotal ultrasonography. A total of 1,320 patients were investigated. Focal testicular lesions were foundin 27 patients (2%), palpable nodules were present in 17 (63%) and nonpalpable incidental lesions were diagnosed in 10. Nodule diameter was 3 to 24 mm. All patients underwent explorative surgery via inguinotomy and preventive clamping of the spermatic cord. The nodules were completely removed with biopsy of the resection margins. Non palpable lesions were removed under ultrasonographic guidance. The testicle was only preserved when frozen section revealed abenign lesion and margins were negative. Of the 17 cases of palpable lesions (diameter 3 to 24 mm) conservative surgery was performed in 8 (47%). Definitive histological diagnosis showed Leydig cell tumor in 2 (25%), and large cell calcifying Sertoli's cell tumor, adenomatoid tumor, pseudofibrotic tumor of the tunica albuginea, epidermoid cyst, tubular fibrosis and nonHodgkin's lymphoma in each 1 (12.5%). The remaining 9 patients (53%) underwent orchidectomy. Definitive histological examination revealed pure seminoma in 4 patients (44%), embryonal carcinoma in 4 (44%) and diffuse Leydig cell hyperplasia in 1 (12%). Seven of the 10 pts (70%) with nonpalpable nodules (diameter 4 to 16 mm) underwent conservative surgery. Histological study revealed focal Leydig cell hyperplasia in1 case (10%), fibrosis in 3 (30%), infarction in 2 (20%) and mesothelial

hyperplasia in 1 (10%).Orchiectomy was performed in the remaining 3 pts. Histology showed diffuse Leydig cell tumorin 2 pts (20%) and adenomatoid tumor with abscessed areas in 1 (10%). Neither atrophy nor local relapse was observed in pts who underwent conservative treatment during followup (mean: 1month, range 19 to 9). The incidental diagnosis of testicular ultrasound alterations is increasing and 80% show a benign histology. In these cases a conservative surgical approach is the best option and it does not expose the patient to the risk of relapse.From October 2000 to May 2002 all patients with infertility, scrotal swelling, testicular pain, varicocele, , scrotal trauma, erectile dysfunction and premature ejaculation underwent clinical evaluation and scrotal ultrasonography at our departmentTable (2.4) .lists indications and percent of scrotal ultrasound for all patients.Scrotal ultrasonography and duplex ultrasonography examination were performed with a 7.5 MHz B mode linear.

Table (2. 4)-Indications for scrotal ultrasonography.

Indications	% Pts
Infertility	35
Scrotal swelling	14
Varicocele	12
Testicular pain	12
Scrotal trauma	2
Erectile dysfunction	15

A total of 1,320 patients were investigated and 27 (2%) with focal testicular lesions on ultrasound were diagnosed.Of the lesions 16 were hypoechoic nodules, including 9 palpable (33.3%) and 7 nonpalpable (26%) lesions, 2 were palpable hyperechoic areas (7.4%) and 9 had a mixed echotexture, including 6 palpable (22.2%) and 3 nonpalpable (11.1%) lesions. Palpable nodules with focal ultrasonographic alterations

were diagnosed in 17 patients (63%), while nonpalpable ultrasonographic incidental lesions were diagnosed in 10 (37%). One of the 17 patients (5.8%) had a palpable nodule in a solitary testicle after orchiectomy performed at a young age due to atrophic cryptorchism. Of the 462 patients who underwent scrotal ultrasound for infertility 7 (1.5%) had ahypoechoic palpable nodule **(Horstman et al, 1994),**

Hypoechoic nonpalpable lesions **(Montie et al, 1994)** or a palpable lesion with mixed echotexture **(Horstman et al, 1994)**.Average patient age was 41.2 years (range 5 to 76). The_-fetoprotein level was high in 5 of the 27 cases (25.3 to 84.4 U/ml), while _-human chorionic gonadotropin was increased in 4 (14 to 73 mU/ml).In the 17 cases of palpable lesions (diameter 3 to 24 mm) conservative surgery was performed in 8 (47%) after intraoperative negative histological examination for malignant neoplasm **(Dogra et al, 2001)** and an outcome suspicious for lymphoproliferative pathology **(Simon et al, 2001).**Definitive histological diagnosis in this group showed Leydig cell tumor in 2 patients (25%), and large cell calcifying Sertoli's cell tumor, adenomatoid tumor, pseudofibrotic tumor of the tunica albuginea, epidermoid cyst, tubular fibrosis and nonHodgkin's lymphoma in each (12.5%). The remaining 9 patients (53%) underwent radical orchiectomy based on frozen section evidence of malignant neoplasm **(Micallef et al, 2000)** or diffused Leydig cell hyperplasia with cryptorchidism. Definitive histological examination revealed pure seminoma in 4 patients (44%), embryonal carcinoma in 4 (44%) and diffused Leydig cell hyperplasia in the midst of diffused tubular atrophy and aplasia of the germinal cells in 1 (12%). Conservative surgery was performed in the monoorchid case after an intraoperative diagnosis of benign Leydig cell proliferation, which proved to be a Leydig cell tumor on definitive examinationTable (2.5) .lists the characteristics of this group of patients.

In the group of nonpalpable nodules (diameter 4 to 16 mm) 7 of the 10 patients (70%) with negative FSE underwent conservative surgery.

Table (2.5) - ultrasonographic and histological characteristics of patients with palpable nodules

Characteristics	**No. Pts (%)**	**Comments**
Echostructure:	17 (100)	
Hypoechoic focal area	9 (53)	
Hyperechoic nodule	2 (11.8)	
Mixed focal area	6 (35.2)	
Doppler investigation:Pos	2 (11.7)	
Neg- Histology:	15 (88.3)	
Pure seminoma	4 (23.4)	Orchiectomy
Embryonal Ca	4 (23.4)	Orchiectomy
Diffuse Leydig cell hyperplasia	1 (5.9)	Orchiectomy, cryptorchid, diffused tubular atrophy, germinal cell line aplasia
Focal Leydig cell tumor	2 (11.7)	Conservative surgery, monorchid (1)
Large calcifying Sertoli's cell tumor	1 (5.9)	Conservative surgery
Epidermoid cyst	1 (5.9)	Conservative surgery
Fibrosis	1 (5.9)	Conservative surgery
Pseudofibrotic tumor	1 (5.9)	Conservative surgery
Adenomatoid tumor	1 (5.9)	Conservative surgery
NonHodgkin's lymphoma	1 (5.9)	Conservative surgery

The definite histological report was showed focal Leydig cell hyperplasia in 1 patient (10%), fibrosis in 3 (30%), infarction in 2 (20%) and mesothelial hyperplasia in 1 (10%). Radical orchidectomy was performed in the remaining 3 patients after the histological diagnosis of adenomatoid tumor with multifocal abscesses (1 or 10%) and Leydig cell tumor with positive FSE on resection margins (2 or 20%). Definitive histological analysis confirmed multifocal, diffused Leydig cell tumor. Table (2.6) lists the characteristics of this group of patients.

Table (2.6)-Ultrasonographic and histological characteristics of patients with nonpalpable nodules

Characteristics	No. Pts (%)	Comments
Echostructure:	10 (100)	
Hypoechoic focal area	7 (70)	
Mixed focal area	3 (30)	
Doppler investigation: Pos	2 (20)	
Neg - Histology	8 (80)	
Diffused multifocal Leydig cell tumor	2 (20)	Orchiectomy, positive FSE on resection margins
Adenomatoid tumor with multifocal abscesses	1 (10)	Orchiectomy
Focal Leydig cell hyperplasia	3 (30)	Conservative surgery
Fibrosis	3 (30)	Conservative surgery
Infarction	1 (10)	Conservative surgery
Mesothelial hyperplasia	1 (10)	Conservative surgery

Patients who presented for observation for infertility showed the histological outcomes of Leydig cell tumor **(Montie et al, 1994)**.Leydig cell nodular hyperplasia **(Horstman et al, 1994),** classic seminoma (1 35- year-old man) and embryonal carcinoma **(Simon et al, 2001)**.The latter 35-year-old patient had a cryptorchid testicle. Table (2.7) lists the characteristics of this subgroup. In all patients there was correspondence between the intraoperative and definitive histological evaluations in relation to the benign or malignant nature of the disease. During followup scrotal hematoma appeared in 1 of the 15 patients (6.6%) who underwent conservative surgery.

Table (2.7) Characteristics of infertile patients

Characteristics	No. Pts (%)	Comments
Echostructure	7 (100)	
Hypoechoic focal area	5 (71.5)	
Mixed focal area	2 (28.5)	
Doppler investigation: Pos	1 (14.3)	
Neg - Histology:	6 (85.7)	
Leydig cell tumor	3 (42.8)	Conservative surgery, microsurgery (1)
Diffused Leydig cell hyperplasia	1 (14.3)	Orchiectomy, criptorchid, diffused tubular atrophy, germinal cell line aplasia
Focal Leydig cell hyperplasia	1 (14.3)	Conservative microsurgery
Embryonal Ca	1 (14.3)	Orchiectomy, palpable nodule
Seminoma	1 (14.3)	Orchiectomy, palpable nodule

Patients diagnosed with malignant neoplasm and Leydig cell tumors underwent followup according to established guidelines with complete abdominal computerized tomography, chest x-rays and serum markers every 3 months for the first 2 years and every 6 months there after3 During the average 9-month followup (range 1 to 19) of patients who underwent conservative surgery for benign lesions each patient under-

went clinical evaluation, hormonal assessment and scrotal ultrasound after 1 month, every 3 months for the first year and every 6 months after the first year. Patients of fertile age were monitored for semen parameters every 6 months. No testicular atrophy or worsening of semen parameters was observed after surgery. There was no clinical evidence of local relapse. Only 2 of the 5 patients (40%) diagnosed with fibrosis had a persistent nonhomogeneous hypoechogenic area with irregular margins that did not change in size during follow-up.Preveous study of **Shweta Bhatt et al (2011)**, they have stated that the use of high-frequency ultrasound is increasing for the treatment of cystic, vascular, and solid non-neoplastic intratesticular masses. Cystic lesions examined include simple testicular cysts, tunica albuginea cysts, epidermoid cysts, tubular ectasia of rete testis, and intratesticular abscesses. Vascular lesions examined include intratesticular varicocele and intratesticular arteriovenous malformations. Solid lesions examined include fibrous pseudotumor of the testis, focal or segmental testicular infarct, fibrosis of the testis, testicular hematoma, congenital testicular adrenal rests, tuberculoma, and sarcoidosis. Gray-scale and color-flow Doppler sonography facilitate the visualization of the benign characteristics of the lesions. Magnetic resonance imaging can also help as a problem-solving modality in some cases.Sonographically; the mediastinum testis appears as an echogenic band of variable thickness that extends across the testis in the longitudinal axis . Multiple fibrous septa extend from the mediastinum into the testis, dividing it into 250 to 400 lobules. Spermatogenesis occurs within the seminiferous tubules contained within these lobules. The seminiferous tubules openinto dilated spaces called the rete testis within the mediastinum via the tubuli recti. The normal rete testis can be seen on high-frequency US in18% of patients. The rete testis drains into the epididymis via 10 to 15 efferent ductules.There are four testicular appendages

(remnants of the mesonephric and paramesonephric ducts): the appendix testis (hydatid of Morgagni), the appendix epididymis, the vas aberrans, and the paradidymis. The appendix testis and the appendix epididymis are commonly seen on scrotal US. The appendix testis is a small ovoid structure usually at the upper pole of the testis in the groove between the testis and the epididymis, better seen by the presence of fluid around the testis.The testes are supplied by testicular arteries that arise from the abdominal aorta. The testicular arteries enter the spermatic cord at the deep inguinal ring and continue along the posterior surface of the testis, penetrating the tunica albuginea and forming the capsular arteries that course through the tunica vasculosa, which underlies the tunica Albuginea. Branches from the capsular arteries carry blood toward the mediastinum and divide to form the recurrent rami that then carry blood from the mediastinum into the testis. A transmediastinal branch of the testicular artery is present in approximately one-half of normal testes. It traverses through the mediastinum to supply the capsular arteries and is usually accompanied by a large vein. The testicular veins exit from the mediastinum and drain into the pampiniform plexus, which also receives venous drainage from the epididymis and scrotal wall.These vessels join together as they pass, through the inguinal canal and form single testicular veins on each side, ultimately draining into the vena cava on the right side and the left renal vein on the left side of the body.

- **Cystic lesions**

Simple testicular cysts .Testicular cysts occur in approximately 8% to 10% of patients **(Gooding et al, 1987)**.Benign cysts are often incidentally found and are generally not palpable **(Hamm et al, 1988) .**They usually occur near the mediastinum testis and are associated with extratesticular spermatoceles **(Woodward et al, 2002).**Onultrasound,

simple cysts have an imperceptible wall, an anechoic center, and through transmission, with sizes ranging from 2 mm to 2 cm in diameter.

- **Tunica albuginea cysts**

Tunica albuginea cysts are benign and arise from within the leaves of the tunica albuginea. By virtue of their location, these cysts are almost always palpable despite being very small in size, ranging from 2 to 7 mm (Fig. 3a) **(Dogra et al, 2001).**These cysts meet the criteria for a simple cyst by ultrasound but sometimesmay be calcified or even contain milk of calcium .Four sonographic appearances of epidermoid cysts have been described, but the classic onion ring appearance is considered characteristic (Figure 2. 41) and corresponds with the natural evolution of the epidermoid cyst **(Dogra et al, 2001) .**There is only one report in the literature that has suggested that this so-called "classic appearance of epidermoid cysts" can be seen in teratomas **(Maizlin et al, 2005) .**An epidermoid cyst of less than 3cm in size with negative tumor markers can be managed conservatively by enucleation provided that frozen sections are obtained to confirm the diagnosis and that two biopsies of the surrounding parenchyma show no testicular involvement **(Loya et al, 2004).**

- **Tubular ectasia of rete testis**

Tubular ectasia, also known as cystic transformation of rete testis, is a dilatation of the rete testes as a result of partial or complete obliteration of the efferent ductules **(Dogra et al, 2001).**It usually affects men over the age of 50, It is often bilateral and asymmetric, and it is identified by its typical location in or around the mediastinum testis. On ultrasound, it is seen as multiple anechoic, avascular structures within the mediastinum and is often associated with ipsilateral spermatoceles **(Dogra et al, 2001)**.

- **Intratesticular abscess**

An intratesticular abscess most frequently results from epididymo-orchitis and less commonly from a superadded infection in post-traumatic testicular hematomas and testicular infarcts **(Dogra et al, 2003) .**Patients with an intratesticular abscess present with an acutely painful scrotum and associated fever. Ultrasonography is the imaging modality of choice and demonstrates a hypoechoic lesion within the testis marked by low-level echoes and shaggy margins.Color flow Doppler demonstrates absent internal vascularity with increased peripheral hyperemia.

- **Vascular lesions**

Intratesticular varicocele Intratesticular varicocele is a rare and relatively new entity, reported in fewer than 2% of symptomatic men undergoing testicular sonography as opposed to extratesticular varicoceles, which are present in 15% to 20% of men **(Das et al, 1999) .**Patients with intratesticular varicocele may have testicular pain secondary to venous congestion, resulting in stretch-ing of the tunica albuginea. Intratesticular varicoceles are usually associated with extratesticular varicoceles and their location may be subcapsular (under the tunica albuginea) or adjacent to mediastinum testis **(Kessler et al, 2005) .**The sonographic features of intratesticular varicoceles are similar to those of extratesticular varicoceles. Gray-scale sonography demonstrates tubular or serpentine structures more than 2 mm in diameter with a positive Valsalva maneuver, confirming the venous origin (**Weiss et al ,1992).**

Color flow Doppler also facilitates the visualization intratesticular varicoceles. A Valsalva maneuver is very important as some of the vessels may not show spontaneous flow. Intratesticular varicoceles adjacent to the mediastinum testis may mimic tubular ectasia; however, color flow Doppler helps to differentiate between the two **(Dogra et al, 2004) .**Intratesticular arteriovenous malformation (AVM)

Intratesticular AVM is a rare benign entity **(Dogra et al, 2004) .**Its pathogenesis may be congenital or post-traumatic **(Dogra et al, 2004) .**Its sonographic appearance on gray scale is hypoechoic with a characteristic arterialized venous spectral waveform **(Kutlu et al, 2003).** The arteriovenous type of an intratesticular hemangioma should be considered in the differential diagnosis **(Ricci et al, 2000).**

- **Solid lesions**

Fibrous pseudotumor of the testis .A fibrous pseudotumor is a painless tumor of the tunica that clinically mimics testicular and paratesticular neoplasms. Almost three-fourths of these pseudotumors arise from the tunica vaginalis, and the remainder arises from the epididymis, spermatic cord, or tunica albuginea **(Akbar et al, 2003).**

Patients are usually in the third decade of life, but these lesions have been observed over a wide age range (7–95 years) **(Ulbright et al, 1999) .**Fibrous pseudotumor of the testis is not a neoplasm but rather a benign fibroinflammatory reaction that results in the formation of one or more nodules, diffuse thickening,or a plaque-like process of the testicular capsule **(Woodward et al, 2003) .**Patients typically present with a painless scrotal lump of widely varying size or unilateral scrotal swelling **(Seethala et al, 2003) .**Pseudotumors are usually associated with hydrocele, history of trauma, or infection, particularly with the bacterium schistosoma hematobium **(Parker et al, 2006) .**The sonographic appearance of fibrous pseudotumors is widely variable and depends upon the fibrous and cellular tissue present. The proliferation of fibrous and cellular tissue can appear as a well-defined hyperechoic or hypoechoic mass on ultrasound, and there is no other specific appearance (**Germaine et al, 2007).**

Because of the fibrous pseudotumor's sonographic similarity to malignant neoplasms, patients with these tumors usually undergo a radical orchiectomy.

- **Focalsegmental testicular infarct**

Focal or segmental testicular infarction is rare. It typically occurs duringthe third decade of life, and patients may present with an acute scrotum. Itis most commonly idiopathic in origin **(Jordan et al, 1987)**but may also occur secondary to other etiologies such as acute epididymo- orchitis, which can cause obstruction of the adjacent testicular blood supply **(Bird et al, 1984) .** It has also been reported secondary to surgery for inguinal hernia repair **(Nistal et al, 1986),**vasectomy **(Pellice et al, 1995)**, or varicocelectomy **(Secil et al 2006).** Other less common predisposing factors for segmental infarction include polycythemia **(Jordan et al, 1987)** ,intimal fibroplasia of the spermatic artery **(Brehmer et al, 1985),** sickle cell disease **(Holmes et al, 1998)**or sickle cell trait **(Beck et al, 2006) ,** hypersensitivity angiitis **(Baer et al, 1989) ,** and trauma. A bell clapper deformity leading to repeated torsion-detorsion episodes is also a predisposing factor for segmental testicular infarct **(Dogra et al, 2003).**The ultrasound appearance of a segmental infarct is that of a focal mixed echogenic or hypoechoic lesion that simulates a testicular tumor **(Flanagan et al, 1995) .**In an acute presentation, the testis may appear enlarged, but it subsequently shrinks in size and, as a chronic presentation, will present as a unilaterally smaller testis. Color flow Doppler examination demonstrates absent vascularity within the region, thus distinguishing it from a tumor.

- **Fibrosis of testis**

Testicular fibrosis can occur secondary to trauma, inflammation, or incomplete testicular torsion. Most testes with fibrosis are either small or normalsized. Other causes of testicular fibrosis include radiation therapy **(Aguado et a, l 2005)** and post-biopsy changes **(Yagan et al, 2000) .**Sonographic features of fibrosis include a

striated pattern, diffuse heterogeneity (not otherwise specified), focal hypoechoic masses, and unilateral or bilateral focal hyperechoic masses **(Yagan et al, 2000).**

- **Testicular hematoma**

Testicular hematomas are commonly seen secondary to trauma but can also be seen secondary to testicular biopsy. Other less common etiologies include bleeding diatheses, vascular pathology, thrombosis, vasculitides, and spontaneous testicular hemorrhage **(Sinclair et al, 2003) .**Hematomas are most often acute in onset. Their appearance depends on the age of the hematoma; acute hematomas appear hyperechoic and subsequently become complex with cystic components. Hematomas appear avascular on color Doppler US **(Dogra et al, 2003).**

- **Testicular hamartomas in Cowden's disease**

Cowden's disease is also referred to as multiple hamartoma syndromes because of the associated occurrence of hamartomas. Hamartomas may arise from any of the germ cell layers and can occur anywhere in the body. Patients with Cowden's disease may also have testicular hamartomas (testicular lipomatosis) **(Woodhouse et al, 2006).**

Lindsay et al. first described sonographic and MRI features of testicular hamartomas in Cowden disease **(Lindsay et al, 2003) .**These lesions have no effect on fertility or testicular function .Sonographic features include the presence of multiple, discrete, hyperechoic foci in both testes, varying in size from 1 to 6 mm. These are usually non-shadow ingand demonstrate absent vascularity on color flow Doppler imaging **(Woodhouse et al, 2006).** On MRI examination they demonstrate a high signal on a T1 weighted sequence, confirming the presence of fat **(Lindsay et al, 2003) .**The main differential consideration on ultrasound examination is testicular microlithiasis, which also presents as multiple, bilateral, non-shadowing hyperechoic lesions **(Dogra et al, 2003).**However, testicular microlithiasis lesions are clearly differentiated from

testicular hamartomas by their size. Testicular microlithiasis is most often punctate, varies from 1 to 3mm in size **(Woodhouse et al, 2006)** and may not be visibleon MRI **(Heinemann et al, 2003).**

- **Congenital testicular adrenal rests**

Congenital testicular adrenal rests are seen in about 29% of patients with congenital adrenal hyperplasia (CAH) **(Dogra et al, 2004).**CAH is an autosomal recessive disease characterized by a deficiency of adrenocortical enzymes, particularly 21-hydroxylase. An increase in adrenocorticotropichormone (ACTH) levels causes hyperplasia of adrenal remnants in the testes in patients with CAH and results in the development of intratesticular masses. Sonographically, these masses appear as hypoechoic intratesticular masses in both testes, with or without posterior acoustic shadowing, depending on the degree of fibrosis (**Dogra et al, 2004).** Intratesticular masses are typically located in the region of the mediastinum testis (in 86%) **(Proto et al, 2001) .**Ultrasound is the modality of choicefor their diagnosis; however, MRI can also assist as a problem-solving modality in some cases. Testicular adrenal rests appear isointense on T1- and hypointense on T2-weighted images witha diffuse enhancement pattern after gadolinium administration **(Dogra et al, 2004) .**Bilateral, synchronous testicular tumors are extremely rare (about 1%) **(Dieckmann et al, 1986)** and are the main differential considerationin bilateral testicular masses. Therefore, congenital adrenal rests must be considered in patients withCAH and clinically followed by ultrasound to demonstrate stability over time.

- **Tuberculoma**

There is an overall increase in the incidence of tuberculosis (TB) worldwide that is associated with a resultant increase in extra-pulmonary TB. The genitourinary tract is the most common site of extra-pulmonary TB which includes involvement of the

kidneys, ureters, bladder, testes, and epididymides. The incidence of tuberculous epididymo-orchitis secondary to intravesical Bacillus Calmette- Guerin (BCG) therapy for bladder cancer has been reported **(Muttarak et al, 2002) .**The testis and epididymis are usually affected concomitantly, but several recent reports indicate isolated epididymal involvement as well **(Viswaroop et al, 2005).** The most common finding in TB is an enlarged epididymis with calcification **(Woodward et al, 2003) .**Tuberculous involvement of the testis is variable. It may involve the whole (figure **(Kessler et al, 2005).**Detected incidentally while the patient is worked up for pulmonary sarcoidosis **(Naseem et al, 2001).**Testicular sarcoidosis is particularly common in the African-American population **(Woodward et al,2002).**Sonographically, sarcoid granulomas appear as single or multiple hypoechoic nodules within the testes and epididymis, mimicking testicular tumors .Recently, testicular sarcoidosis appearing as testicular appendices have been described**(Obinata et al, 2007).** It may also present as epididymoorchitis **(Dogra et al, 2003).**Although differentiation of sarcoidosis from tumors may be difficult, the presence of multiple bilateral lesions with the simultaneous involvement of the epididymis and testes, in conjunction with other systemic presentations such as pulmonary or abdominal involvement, should raise the suspicion of sarcoidosis.The patient should be worked up for either diagnosis before proceeding with an orchiectomy.High-frequency ultrasound is the imaging modality of choice for the evaluation of testicular masses. Although most intratesticular masses are malignant, many benign lesions can also occur within the testes. Appropriate clinical history and sonographic features (gray-scale and color Doppler) almostalways allow the correct diagnosis, thus helping to salvage the testis.Additionally, if ultrasound findings are indeterminate, MRI might aid in the diagnosis.In the realm of previous studies related

to prospective observational study (case series), done by**Rizvi et al, (2011).**Was carried out over a period of 16 months on 122 patients in the age range of 13 to 70 years old, who presented with scrotal swellings. After adequate history taking and examination, CDUS was performed. The diagnosis of the surgeon and that of radiologist were compared with final outcome, which was based on course and outcome of the disease, fine needle aspiration cytology results, and operative findings.The final diagnoses were epididymitis or epididymo-orchitis, hydrocele, varicocele, testicular malignancy, orchitis, testicular torsion, spermatic cord injury, hematocele, and pyocele. Color Doppler ultrasonography accurately diagnosed all cases of epididymitis or epididymo-orchitis, spermatic cord injury, testicular torsion, varicocele, and hydrocele (sensitivity 100% and specificity 100%). Of 16 subjects diagnosed as testicular malignancy on CDUS, only 14 were subsequently found to have malignancy. Two cases of orchitis were wrongly diagnosed as malignancy. Similarly, of 6 patients diagnosed as orchitis, 1 was found to have seminoma (sensitivity 87.5% and specificity 66.7%). Overall sensitivity of CDUS in diagnosing scrotal diseases was 98% while specificity was 66.7%.Color Doppler ultrasonography is an excellent, a safe, and reliable method for evaluating patients with scrotal diseases. It aids in diagnosis of testicular tumors and reduces the number of unnecessary exploratory operations. It is especially important in conditions like testicular torsion where immediate diagnosis is required.This prospective observational study (case series) was conducted in the Jawaharlal Nehru Medical College Hospital (JNMCH), AMU Aligarh over a span of 16 months from September 2008 to January 2010. The study was approved by the ethical committee of the hospital and a written informed consent was taken from each patient. Inguinoscrotal hernia and undescended testis were the exclusion criteria. A total of 122 patients in

the age range of 13 to 70 years old, with scrotal pathologies were included in the study. Two subjects were lost in the follow-up period. After adequate history taking and physical examination, CDUS was performed. The patients were scanned with the linear color Doppler multi-frequency (7 to 9 MHz) transducer using LOGIQ 500 (GE Wipro) ultrasound machine and sagittal and transverse images were obtained. Additional views were also obtained in coronal and oblique planes, with the patient being upright .The majority of the patients with acute scrotal condition were in their 2nd and 3rd decades of life whereas those presenting with testicular masses were in their 5th and 6th decades. With the help of CDUS, the diagnoses of epididymitis and epididymo-orchitis were made in 46 out of 52 patients who presented with clinical suspicion.All of these 46 patients were conservatively managed and follow-up CDUS revealed resolution of findings.All patients with symptoms of varicocele were in their 2nd and 3rd decades of life. Of 14 patients, 10 were clinically diagnosed with unilateral and 4 with bilateral varicoceles. These patients were subjected to CDUS, which showed multiple serpiginous anechoic structures adjacent to upper pole of the testis and head of the epididymis with venous flow that accentuated on performing Valsalva maneuver or making the patient upright.Doppler ultrasonography confirmed the presence of unilateral varicocele in 8 patients ,But detected bilateral varicocele in 2 subjects that were clinically diagnosed as unilateral varicocele.It also confirmed bilaterallity of varicocele in 4 patients. Further, 2 patients who presented with infertility and had normal scrotum clinically were diagnosed as case of varicocele on CDUS.Twenty-six patients with clinical suspicion of hydrocele were also subjected to CDUS, which supported the diagnosis. Color Doppler ultrasonography also found hydrocele in 4 clinically unsuspected subjects. On aspiration, only 26 were found to have hydrocele while hematocele and pyocele were found in 2 others. Four patients

were clinically diagnosed as cases of testicular torsion. Color Doppler ultrasonography showed absent intratesticular blood flow confirming the diagnosis. Surgery was done, which supported the diagnosis. Two patients who presented with history of trauma to the scrotum were also diagnosed as a case of traumatic spermatic cord injury. The patients were managed with antibiotics, and follow-up examination showed complete resolution of inflammatory changes in all the patients. Fine needle aspiration cytology was not required. Therefore, we found that CDUS was 100% sensitive and 100% specific for diagnosing scrotal diseases other than testicular masses .Twenty-two patients who presented with enlargement of the scrotum were clinically labeled as cases of testicular mass. The size of the lesion ranged from 1.1 cm to 5.5 cm. They were subjected to CDUS, which showed localized involvement in 36.6% and diffuse involvement in 63.4%. Increased vascularity was revealed in all the subjects, and diagnoses of testicular mass and orchitis were made in 16 and 6 patients, respectively. Subsequently, all 16 subjects with diagnosis of testicular mass were subjected to FNAC. Fourteen out of 16 patients turned out to be seminoma.

While 2 mis diagnosed subjects turned out to be orchitis. Six out of 22 clinically diagnosed cases of testicular mass were labeled as orchitis on CDUS.However, FNAC results showed one of them to be seminoma.Color Doppler ultrasonography was 87.5% sensitive and 66.7% specific in diagnosing testicular masses Tables (2.8).

Table (2.8).Sensitivity and specificity of color Doppler ultrasonography in diagnosis of testicular masses

Doppler Diagnosis	**FNAC diagnosis***		**Total**
	Positive	**Negative**	
Tumor	14	2	16
Non tumor	2	4	6
	16	6	22

***FNAC indicates fine needle aspiration cytology. †Sensitivity: 14/14 + 2 × 100 = 87.5% Specificity: 4/4 + 2 × 100 = 66.7%**

In all confirmed cases of seminoma, orchidectomy was performed and FNAC diagnoses were comparable to final histopathological examination.Overall sensitivity of CDUS in the diagnosis of scrotal diseases was 98% while specificity was66.7% Table (2.9).

Table (2.9) Overall sensitivity and specificity of color Doppler ultrasonography in diagnosis of scrotal diseases.

Doppler Diagnosis	**Final outcome**		**Total**
	Disease present	**Disease absent**	
Disease present	112	2	114
Disease absent	2	4	6
	114	6	120

***Sensitivity: 112/112 + 2 × 100 = 98.0% Specificity: 4/4 + 2 × 100 = 66.7%**

Grey scale ultrasonography is a well-establishe modality for diagnosis of scrotal diseases; however, the major limitation of conventionalgrey scale ultrasonography is lack of specificity for parenchymal changes. Also benign and malignant lesions cannot be distinguished on the basis of ultrasonography alone **(Mishkin, 1977).**

Furthermore, in painful scrotum, grey scale ultrasonography cannot accurately differentiate testicular torsionfrom epididymo-orchitis. William and colleagues studied 5 patients in whom no intratesticular blood flow was identified on symptomatic side while normal flow was detected on the opposite side. However, on grey scale ultrasonography, no abnormality could be detected in 3 patients while2 subjects had non-specific findings **(Middleton et al, 1989)** Color Doppler ultrasonography has many advantages over conventional ultrasonography. In addition to detecting non-specific grey scale changes that can occur with testicular ischemia, it also shows blood flow in testicular arteries. Till recently, radionuclide scanning has played an important role in evaluation of equivocal cases of acute scrotal diseases. It has provided useful information regarding scrotal blood flow **(Lutzker and Zuckier, 1990).** However, it cannot accurately depict theanatomy **(Riley et al, 1976) .**Middleton and associates evaluated 28 patients with acute scrotal pain by CDUS and scintigraphy. While CDUS correctly diagnosed all the subjects, scintigraphy failed to reach the diagnosis in one **(Middleton et al, 1990).**Also CDUS was more rapid, non-invasive, and at least as accurate as scintigraphy**(Fitzgerald et al, 1992) .**Accurate clinical diagnoses of scrotal diseases are difficult as most patients present with similar signs and symptoms**(Pavlica and Barozzi, 2001).**Color Doppler ultrasonography is currently the most important imaging modality available for diagnosis of scrotal pathologies. It allows accurate evaluation ofscrotal conditions as well as normal anatomy. Becker and coworkers concluded a sensitivity of 90.5% and specificity of 98.3% in diagnosis of testicular torsion **(Becker et al, 1997).**Suzer and colleagues found CDUS to be 100% sensitive and 100% specific in diagnosis of acute scrotal conditions **(Süzer et al, 1997).**In our study, of 26 patients who had acute presentation, 23 were diagnosed with epididymitis or epididymo-orchitis. In all the patients, the

epididymis was enlarged, hypoechoic, and hyperemic. In 5 patients, in addition to the epididymis, the testis was also hypoechoic and hyperemic.Two patients were diagnosed as cases of testicular torsion. Both patients showed mild enlargement, hypoechoic echotexture, and markedly decreased vascularity. Color Doppler ultrasonography showed sensitivity and specificity of 100%, respectively, in diagnosesof inflammatory scrotal diseases and testicular torsion. Thus, our observations are comparable to previous studies. However, CDUS is notwithout pitfalls. Zoller and associates concluded that detection of intratesticular blood flow cannot exclude testicular torsion. **(Zoller et al, 1997).**Derouet and coworkers observed ultrasonography to be 90% sensitive and 55% specific in detection of testicular neoplasms **(Derouet et al, 1993).**whereas Gallardo, Agromayor and colleagues reported sensitivity of 100% for ultrsonography in diagnosing testicular neoplasm **(Gallardo et al, 1996).** In the present study, CDUS showed a sensitivity of 87.5% and specificity of 66.7% in detection of testicular neoplasms, which is compatible with the study carried out by Derouetand associates. In our series, 90% of seminomas appeared as solid, homogenous, hypoechoic, and hypervascular lesions compared to normaltesticular tissue. In our study, all cases of varicocele were accurately diagnosed and also one patient, who presented with infertility and had nofindings on clinical examination, was diagnosed with varicocele. Other investigations like magnetic resonance imaging can be applied when ultrasonography proves inconclusive. Its use in scrotal diseases isincreasing **(Nagler et al, 1995).**However; it is more expensive and not always available. Nuclear scintigraphy, which has high sensitivity and specificity in differentiating ischemia from infarction, cannot accurately distinguish ischemia from conditions such as hydrocele, spermatocele, and inguinalhernia and is uncommon due to high accuracyof

CDUS**(Lutzker and Zuckier, 1990) .** Therefore, CDUS with its high sensitivity and specificity is the most important investigation for diagnosis of scrotal diseases, presenting especially in emergency clinical setting.We conclude that CDUS, which can simultaneously display scrotal anatomy and perfusion, is an excellent, a safe, and reliable method for evaluating patients with scrotal diseases, whether acute or chronic. It helps toimprove patient's management, especially by preventing unnecessary surgical exploration. It is also convenient and easy to perform. But ithas its own limitations, including difficulty in detecting intratesticular flow in small children and requiring adequate expertise and experience. Its results are also equipment dependent.**Other study** carried by**Henry Oscar et al, (2012)** Ultrasonography (US) is the imaging modality of choice for evaluating scrotal abnormalities. Scrotal swellings are frequently seen in children and adolescents and narrowing differential diagnosis is important in assisting the referring clinicians and enhancing their efficiency in coming to a diagnosis. The spectrum ranges from incidental to pathological findings and can be divided into chronic (or at least subacute) and acute; painless and painful. Familiarity with US is essential for establishing the correct diagnosis. The objective of this pictorial review is to provide current information on common and unusual scrotal abnormalities. Most common causes of painless scrotal swelling in children and adolescents include hydrocele and non-incarcerated inguinal hernia. Less common causes are varicocele, spermatocele, localized edema, and testicular tumors. Painful scrotal swelling in children are usually require urgent diagnosis and intervention and include but not limited to abscess, testicular torsion, torsed appendix of epididymis/testis, and epidydmitis/orchitis **(Pavlica et al, 2001)**.

- **Abscess**

Scrotal abscess can be a complication of epididymo-orchitis, trauma, or surgery. The clinical history and physical examination of a painful hyperemic scrotum is essential in making the diagnosis. On US, this lesion can have a variety of appearances such as a heterogenous hypoechoic mass, thickened wall, and internal debris.Areas of infection are generally hyperemic and heterogeneous in echotexture. If organized, an abscess may have a well-defined hyperemic wall. If there is gas within the collection, hyperechoic foci with "dirty" shadowing are seen.

- **Testicular torsion**

Testicular torsion leads to ischemia and possibly death of the testis. There are two peak incidences for testicular torsion – one is during puberty and the other is during the neonatal period. There are two types of testicular torsion: extra and intra vaginal. Extra vaginal testicular torsion occurs in neonates, due to the loose attachment of testes and the spermatic cord to the scrotum thus the entire cord above the level of the scrotum can undergo torsion. Intra vaginaltesticular torsion occurs more frequently in boys undergoing puberty. This is due to the abnormal development of the tunica vaginalis, where the tunica vaginalis completely covers the epididymis and testis, thus the testis is not fixed to the scrotal walls and is allowed to rotate freely. This deformity is usually seen on both sides, and would require surgical fixation. Usually, these children present with acute onset of severe testicular pain. The ischemia can lead to testicular necrosis if not corrected within 5-6 hours of the onset of pain **(Waldert et al, 2010)**. Torsion can be intermittent and can undergo spontaneous de-torsion.US is the modality of choice and shows an enlarged hypoechoic testes, showing minimal or no internal vascularity.

- **Torsion of testicular appendix**

The appendix epididymis and appendix testis are embryologic remnants of the mesonephric (wolffian) duct and paramesonephric (müllerian) duct, respectively. Torsion of these appendages causes acute scrotal pain and a focal bluish discoloration beneath the skin (so-called “blue-dot” sign) in about one third of the cases; as well as a tender nodule is commonly palpated on physical examination **(Frush andSheldon, 1998) .**UStypically shows a nonvascular hyperechoic small oval mass adjacent to the testis or epididymis, which may be associated with epididymal inflammation and hydrocele.In a child with an acute scrotum, torsion of testicular appendices represents the more common cause of scrotal pain rather than testicular torsion. Typically, torsion of testicular appendices has more gradual onset thantesticular torsion and patients may endure pain for several days before seeking medical attention.

- **Epididymitis and orchitis**

Epididymitis is the most common inflammatory process involving the scrotum and more common in adults but can occur in children. Children usually present with fever, dysuria and a painful scrotum. With the acute and sometimes excruciating scrotal pain presentation associated with a severe orchitis, the clinicians do often encounter difficulties in differentiating an orchitis with a testicular torsion or torsionof the testicular appendix. On conventional ultrasound both orchitis and torsion may result in an enlarged diffusely or heterogeneously hypoechoic testes. US doppler is useful in such a setting, as orchitis usually demonstrates an increased vascular flow in the testicular parenchyma; while the torsedtestes will show decreased or absent vascularity with increased flow at the testicular capsule.Orchitis is characterized by focal, peripheral, hypoechoic lesions that is poorly defined. Orchitis may also exhibit testicular hyperemia on color Doppler US images, and is usually follows an

underlying epididymitis **(Cook and Bewbury, 2000)**.Areactive hydrocele may also be associated with epididymoorchitis. Focal testicular infarction can also occur as a complication of epididymitis when swelling of the epididymis is severe enough to constrict the testicular blood supply. This appears as a hypoechoic intratesticular mass devoid of blood flow.

- **Hydrocele, encysted hydrocele of the spermatic cord**

A hydrocele is a collection of fluid in the scrotal sac between the layers of the tunica vaginalis; and is usually painless. A reactive hydrocele occurs when there is an underlying pathology of the testes or its epididymis for example reactive hydrocele can occur in trauma, infection, torsion and tumors. Encysted hydrocele of the spermatic cord is a fluid along the spermatic cord, separated from and located above the testicle and the epididymis. This is due to abnormal closure of the processus vaginalis. There are two types of hydrocele of spermatic cord - encysted hydrocele of the cord, and funicular hydrocele. Encysted hydrocele of the spermatic cord is when the fluid does not communicate with the peritoneum or the tunica vaginalis and the latter is where fluid is seen communicating with the peritoneum at the internal ring. US shows well demarcated anechoic lesion in the inguinal region, with no color flow on the Doppler. Most importantly, the underlying testes and epididymis are normal **(Martin et al, 1996).**US features of a simple hydrocele include anechoiec well demarcated fluid collection outlining the testis, with posterioracoustic enhancement. Presence of internal echoes/septae may suggest a complex hydrocele, which could be secondary to trauma or infection.

- **Microlithiasis**

Testicular microlithiasis appears as tiny nonshadowing hyperechoic foci ranging in diameter from 1-2 mm. They are usually intraparenchyma but can be seen distributed

peripherally or segmentally; and maybe unilateral or bilateral. Common consensus for the number of microliths required to define testicular microlithiasis is five **(Janze et al, 1992).**Several associations have been reported with testicular microlithiasis including Klinefelter's syndrome, cryptorchidism, Down's syndrome, mal pseudohermaphroditism, pulmonary alveolar microlithiasis, previous radiotherapy, and subfertility states. The most important association is with testicular neoplasms. These are, however, only associations, and no cause-and-effect relationship has been established. Associations aside, the increased risk appears to be real, as there are now several case reports documenting the interval development of germ cell tumors of the testis in patients with previously identified isolated microlithiasis **(Frush et al, 1996).** As these patients with microlithiasis are usually found on incidental US investigation for other scrotal abnormality and are mostly asymptomatic, the current recommendation in management of microlithiasis is for annual US follow-up and patient education about self-examination **(Cast et al, 2000).**

- **Testicular tumor**

Pediatric testicular tumors are uncommon occurrences. Teratomas and yolk sac tumors are most commonly testicular tumors before puberty and after puberty, embryonal carcinoma occurs more frequently. A painless testicular mass is the most common finding in a child with a testicular tumor. There are no sonographic features that can reliably distinguish benign and malignant tumors. Size of the lesion is not a factor in determining if the lesion maybe benign or malignant. US features of testicular malignancy may include enlarged testis, with ill-defined heterogenous hypoechoic areas. Color Doppler US has also been reported to be more effective than gray-scale sonography in detecting intratesticular neoplasms in the pediatric population **(Luker et al, 1994).**If surgery is warranted, US can also assess whether

there is enough normal testis parenchyma remaining for testis sparing surgery **(Valla et al, 2001).**US can also be used to aid in image guided biopsies. Testicular tumor markers are important tools in theevaluation of testicular tumors in children. Alpha fetal protein (AFP) is more reliable because it is secreted by 90% of yolk sac tumors in children. Pointer in using AFP in these patients is to remember that serum AFP level is normally very high in infancy. It measures in the tens of thousands innewborns and does not decrease to normal adult levels until nearly 1 year of age **(Wu et al, 1981).**Therefore, although elevated AFP in a child older than 1 year with a testicular tumor almost always reflects the presence of a yolk sac tumor, an "elevated" level in infants can also occur in the case of benign tumors.

- **Scrotal wall edema**

Edema of the scrotum can be due to a multitude of reasons, such as ascites, nephrotic syndrome, or even insect bites. It is sometimes clinically difficult to assess the underlying testes due to the overt overlying swelling, and thus US can provided valuable tool in assessing the testes in such conditions. On US, features include marked thickening of the scrotal wall with normal appearing testis and epidydmis . Normal to slightly increased flow to the scrotal wall on Doppler is sometimes seen.

- **Inguinal hernia**

Hernias in children are more common in premature infants. If the hernia is filled with bowel, it is usually easier to detect, but sometimes the hernia maybe filled with soft tissue such as omental fat. On US, the testis and epididymis are normal. Fluid or air containing loops in the scrotum or echogenicareas representing herniated omentum are seen . Clinical examination of the inguinal canal to distinguish from primary scrotal pathology is essential.

- **Hematoma**

US play a vital role in patients with penetrating or blunt trauma. Blunt trauma to the scrotum can lead to damage of the testicle and adjacent structures. Injuries to scrotum include laceration, hemorrhage, or contusion of the testicle. The goal of scrotal US in patients with acute trauma to the scrotum are to evaluate injury to the testicle. Acute intratesticularhematomas appear hyperechoic at US and maysimulate a focal mass. After 1–2 weeks, the hematoma undergoes liquefaction and may appear cystic. The sonographic appearance can vary depending on the age of the hematoma, and at times it may be difficult to differentiate between this entity and neoplastic lesions **(Langer 1993).**US usually shows an avascular mass, variable echogenicity (with age of hematoma) . Associated findings of scrotal hemaotma, hematocele and wall thickening sometimes may give a clue.

- **Varicocele**

Varicocele is abnormal dilatation of the pampiniform plexus. Varicocele is mass of painless enlarged testicular veins like a bag of worms and usually occurs on the left due to the left spermatic vein entering the left renal vein at a perpendicular angle (where else on the right, it enters the inferior vena cavaobliquely which may have protective element). Retrograde flow into the spermatic vein causes dilatation and tortuous pampinifrom plexus. There are other more sinister causes of varicocele, such as mass effect or thrombosis of the renal veins, or the internal vena cava. As such, if an asymmetric right sided varicocele is found it is necessary to exclude other causes of abdominal compression secondary effects **(Beddy et al, 2005) .**On US, serpentine, anechoic structures greater than 2mm areseen with flow on the Doppler imaging; and shows venous waveform on the pulsed Doppler imaging .Augmentation of Doppler flow on valsalva and upright position are usually seen.US plays a major role in the

diagnosis, follow up and management of scrotal abnormality in pediatric age group. It is readily available, and usually the first and usually only investigation required for assessment of the scrotum and provides an accurate insight into the underlying process. It isable to easily distinguish causes of acute scrotal swelling suchas testicular torsion and epidiymo-orchitis from not so acute ones such as hematomas, hydrocele and testicular tumors.The authors declared no conflicts of interest.Wadeet, al (2008) also introduced review study of all patients who had solid epididymal masses evaluated by scrotal sonography at their institution between 1996 and 2004. They evaluated multiple clinical and sonographic variables, including lesion size, location, echogenicity, color Doppler characteristics,and calcifications. Of the 85 patients included in the study, 25 (29%) underwent surgical intervention, and 5 (6%) had malignant disease. A mass size of greater than 1.5 cm and the presence of color Doppler flow were statistically significant markers for malignancy ($P < .05$). Combining these 2 variables as a test for malignancy yielded sensitivity of 100%, specificity of 80%, a positive predictive value of 24%, and a negative predictive value of 100%.Most solid epididymal masses (94%) are benign. A size of greater than 1.5 cm and the presence of color Doppler flow may help identify possible malignant masses.High-resolution real-time sonography with color Doppler imaging is the technique of choice for imaging the epididymis. Although only 3% of all solid extratesticular masses are malignant, 1–3 previous studies focusing specifically on the epididymis have shown the malignancy rate for solid epididymal masses to be as high as 16% and the rate for neoplastic processes within the epididymis to be as high as 25%.5 These studies excluded masses followed clinically without pathologic evaluation. An accurate assessment of the true malignancy rate for solid epididymal masses would provide important information for current clinical practice. Recent

studies have suggested that scrotal sonography can play an important role in distinguishing benign solid masses from solid inflammatory masses of the epididymis. A small size, the presence of a hyperechoic or hypoechoic rim circumscribing the lesion, and little orabsent blood flow are distinguishing factors when com-paring benign neoplastic lesions with inflammatory lesions. However, because of the very low prevalence of epididymal malignancies, the sonographic characteristics of malignant epididymal lesions have not yet been adequately studied. The purpose of this study was to determine whether benign and malignant masses of the epididymis can be distinguished on the basis of the clinical history and sonographic appearance. We correlated sonographic data with the pathologic diagnosis and clinical history and determined the incidence of benign and malignant solid epididymal masses in our patient population.This was a retrospective study approved by the Mayo Clinic Institutional Review Board. The institutional sonography database was queried for all sonograms of the scrotum from April 1996 to January 2004. All sonographic evaluations interpreted at our institution are given location and diagnosis numeric codes; all codes for solid, complex, and indeterminate masses in the epididymis or paratesticular tissue were included in our search. A solid mass (or lesion with a solid component) of the epididymis seen on scrotal sonography was required for inclusion. Additionally, 1 of the following was mandatory: a pathologic diagnosis, at least 1 year of clinical follow-up, or at least 6 months of clinical follow-up with sonography. Clinical follow-up was defined as a subsequent visit and physical examination with the original referring physician or a complete medical history and physical examination with another institutional physician. Although many of the patients had follow-up scrotal sonography, this was required for inclusion only if the duration of clinical follow-up was between 6 and 12 months. If any patient had more than 1 mass,

only the largest mass was considered in this study. We reviewed each patient's clinical history for age, the duration of clinical follow-up, the presence of pain, a history of antibiotic treatment, and prior vasectomy. The histologic diagnosis was obtained from the pathologic report if available. Other information gathered from the history included clinical changes before surgery,growth of the mass according to patient reports or physical examinations, and the clinical reasoning for pursuing surgery. One genitourinary radiologist (B.F.K.) blinded to the patient information reviewed all scrotal sonograms for the following features: location (right or left), location in the epididymis (head, body, tail, or multiple sites), 2 largest diameters, echogenicity compared with the surrounding epididymal tissue, presence of color Doppler flow, calcifications, and definitions of borders (well circumscribed or poorly defined borders). Pathologic diagnoses for all available specimens were reviewed by a genitourinary pathologist (J.C.C.) and categorized as inflammatory or neoplastic processes. Neoplastic masses were subclassified as benign or malignant. Statistical analysis was performed for malignant versus benign lesions and for masses treated with surgical excision versus observation. Lesions that were unchanged on clinical followup were considered benign. Quantitative data were analyzed with rank sum tests and logistic regression. Qualitative variables were analyzedwith $\chi 2$ tests. When necessary and appropriate, the Fisher exact test was used to account for thesmall sample size of malignant cases and to ensure statistical accuracy. $P < .05$ was considered statistically significant. Finally, specific sonographic findings were analyzed to determine whether they had predictive value for malignant disease. Receivers operating characteristic curves were used to determine appropriate cutoff values for sonographic characteristics astest statistics.The query of the database yielded 131 cases with solid epididymal masses; of these, 25 wereexcluded because of

lack of clinical follow-up. Although some of these patients had clinical follow-up at outside institutions, to maintain consistency in clinical review, these cases were withdrawn. Eighteen cases were excluded after additional review of the images showed no distinct epididymal mass or a mass located outside of the epididymis. Three additional cases were excluded because the original hard copy films were no longer available for additional review.The final group included 85 cases of solid epididymal masses. Of the 85 patients included in the study, 59 had clinical follow-up of more than 1 year (mean, 40 months; median [range], 37 [12–85] months). One patient had 10 months of clinical followup and subsequent negative scrotal sonographic findings. The remaining 25 patients (29%) underwent surgical intervention, 5 (6%) of whom had malignant disease. A complete analysis of the 25 pathologic specimens obtained at surgery. Of these 25 pathologic specimens, 16 (64%) had inflammatory etiologies, and 9 (36%) were due to neoplastic processes. The most common type of inflammatory mass was the nonspecific category of paratesticular fibrosis, which included reactive changes and chronic epididymal inflammation. Five of the 9 neoplastic masses were malignant.Of note, 2 of the patients with neoplastic masses (seminoma metastasis and T-cell acute lymphocytic leukemia) had concurrent masses in the testicle at the time of original diagnosis.One of the malignant masses was diagnosed pathologically as an adenocarcinoma, although it remained unclear whether the mass was a primary epididymal adenocarcinoma or a metastasis from a lung adenocarcinoma.Examples of the benign neoplasms found are shown in Figure 5. Characteristics found to be significantly increased for malignant masses compared with benign masses included the diameter (largest single-plane dimension; P = .007), volume (according to the equation for elliptical volume: V = [d1] · [d2]2 · [π/6]; P = .008), and presence of vascularity as

shown by Doppler sonography (P = .02; Table 1). Well-circumscribed masses, a mass location in the epididymis, a history of vasectomy, calcifications on sonography, the side of the tumor location, the presence of pain, patient age, and mass echogenicity were not significantly associated with malignancy Table (2.10). None of the variables we examined from patient histories were significantly more common in patients with malignant lesions. Of note, no patient in our study with an epididymal malignancy had undergone prior vasectomy.

Table (2.10).Patient and Sonographic Characteristics: Association with Epididymal Malignancy.

Characteristic	Results			
	Benign	**Malignant**	**Malignant, %**	***P***
Mean patient age, y	56.3	47	NA	.35
Mean mass diameter (range), cm	1.3 (0.4–2.8)	2.4 (1.6–4.1)	NA	.007
Mean mass volume (range), cm3	1.4 (0.02–8.5)	3.4 (2.1–4.8)	NA	.008
Doppler flow Present (n = 41)	36	5	12	.02
Absent (n = 44)	44	0	0	.08
Well-circumscribed mass Yes (n = 20)	17	3	15	.26
No (n = 65)	63	2	3	
Mass echogenicity Hypoechoic (n = 56)	53	3	5	
Isoechoic (n = 10)	9	1	10	
Hyperechoic (n = 14)	14	0	0	
Mixed (n = 5)	4	1	20	
Calcifications Yes (n = 29)	29	0	0	.16
No (n = 56)	51	5	9	
Mass location in epididymis Head (n = 14)	12	2	14	.14
Body (n = 2)	2	0	0	
Tail (n = 63)	61	2	3	
Multiple (n = 6)	5	1	17	
Mass location Right (n = 37)	36	1	3	.39
Left (n = 48)	44	4	8	
History of vasectomy Yes (n = 34)	34	0	0	.15
No (n = 51)	46	5	10	
Associated pain Yes (n = 35)	32	3	9	.65
No (n = 45)	43	2	4	

We next wanted to determine whether the significant sonographic characteristics could beused to predict malignancy of epididymal lesions. Receiver operating characteristic curveswere developed for 2 different indicators of lesion size, the largest single-plane diameter andthe calculated volume, both of which were significantly associated with malignancy. Because nosignificant difference was seen between the receiver operating characteristic curves for these2 variables and because the diameter is the more practical and clinically reproducible factor, thediameter was selected as the preferable clinical parameter for the lesion size. A diameter ofgreater than 1.5 cm and the presence of color Doppler flow were considered positive values. Bycombining the diameter and Doppler flow as test statistics, the test yielded sensitivity of 100%, specificity of 80%, a positive predictive value of 24%, and a negative predictive value of 100% forpatients with positive values for both factors.

Consistent with previous reports, 2, 3 most of the epididymal lesions in our study were benign.The malignancy rate for all solid masses was 6%. If only cases with a pathologic diagnosis are included, 5 of 25 masses (20%) showed malignant disease. This percentage is similar to those inprevious studies that excluded clinical diagnoses, and the results under score the importance ofincluding clinically benign masses in a discussion of malignancy rates for solid epididymal masses**(Frates et al, 1997).**The malignancy rate for true neoplasms of the epididymis was surprisingly high in our population(56%). Beccia et al1 previously described a 25% malignancy rate for epididymis neoplasms.Primary epididymal adenocarcinomas are very rare **(Ganem et al, 1998)**; only 1 possible case was seen in our population.The most common cause of solid malignant neoplasms of the epididymis is metastasis.Previous reports have described solid epididymal masses as a result of metastasis from theprostate, stomach, colon, and kidney8–10 in addition to leukemias. Three of the 5 malignantlesions in

our sample were metastases: 1 seminoma and 2 leukemias. The pathologic findings in our patient population were similar to those in previous reports **(Holden and List 1994).**Solid masses secondary to chronic inflammatory processes were the most common (64%). These masses are most likely due to granulomatous inflammatory reactions **(Woodward et al, 2003).**Sperm granulomas, inflammatory masses resulting from a foreign body giant cell reaction to extravasated sperm, were common. These may have associated painand are often well-defined hypoechoic solid masses **(Dogra et al, 2003).**Sperm granulomas are present in up to 42% of men who have had vasectomy but only 2.5% of the general population **(Greek 2000)**of interest. The inflammatory masses was diagnosed pathologically as "smooth muscle hyperplasia,"an inflammatory reaction previously described in the literature as a mass that mimics neoplastic processes.16 Adenomatoid tumors represent 30% of all paratesticular neoplasms**(Krone and Carroll 1984),**and constituted 22% of the solid epididymal neoplasms in our study . Adenomatoid tumors are of mesothelial origin; no metastases or recurrence have been reported after excision. **(Srigley and Hartwick 1990) .**Often presenting as painless scrotal masses, adenomatoid tumors are smooth, round, well circumscribed, and highly variable in size and echogenicity.**(Woodward et al, 2003).**Scrotal sonography is the imaging technique ofchoice in the analysis of scrotal lesions and a crucial tool in determining a clinical course of treatment.Currently, no guidelines are established for delineating when epididymal masses shouldbe surgically excised or followed clinically. A critical step in instituting such guide lines will be to establish sonographic characteristics that aid in distinguishing malignant from benign disease.Although previous studies have shown sonographic characteristics that aid in distinguishing inflammatory from neoplastic disease, to our knowledge no previous study has shown statistically significant

sonographic characteristics of malignant disease **(Frates et al, 1997) .** Benign neoplasms tend to have a smaller size and less vascularity on color Doppler sonography when compared with inflammatory masses.Our data suggest that these same characteristics can be used to help distinguish benign from malignant processes. The epididymal lesion size and vascularity on color Doppler sonography weresignificant markers for malignant epididymal neoplasms in this study. Independently, sonographic information is insufficient to establish a diagnosis. However, sonographic findings combined with the clinical history can help a clinician establish a short differential diagnosis and subsequent plan of care.For example, all of the malignant lesions included in this study had not only an increased volumeand the presence of color Doppler flow but also clinical features suggestive of possible malignancy.Two patients had a concurrent diagnosis of leukemia; the patient with seminoma had a concurrent mass in the testicle; the patient with epididymal .Epididymal adenocarcinoma had a concurrent lung mass; and in the patient with embryonal rhabdomyosarcoma, the mass was removed when it increased in size on follow-up sonography.Other variables that were different but not statistically significant between the benign and malignant masses also may be important. For example, the borders of the mass could be cluesto its nature. Yang et al6 found that neoplastic masses were more likely to have a hypoechoic or hyperechoic ring than inflammatory masses. Inflammatory processes are irregular or infiltrative in nature, without a capsule or pseudocapsule; neoplasms are often well defined in their borders. The presence of a mass in multiple locations wasdid not see a statistically significant difference in age between those with malignant and benign disease. The ages of the patients with malignant disease in this study were evenly distributed, with 1 patient 16 years old, 2 in their 40s, 1 in his 50s, and 1 in his 70s. Even so, our clinical experience

suggests that solid epididymal masses in teenaged patients warrant detailed evaluation.Pain was not a reliable predictor of malignancy in our study; only 3 of 5 patients with malignancy reported pain. At our institution, the first step in the evaluation of solid epididymal masses is scrotal sonography. If the mass is smaller than 1.5 cm and Doppler flow is absent, a follow-up clinical evaluation is scheduled, with or without follow-up scrotal sonography, depending on the history and physical examination. If the size of a solid epididymal mass is 1.5 cm or greater or Doppler flow is present, surgical exploration is considered. Our study had several limitations. We grouped all malignant lesions into 1 category for statistical analysis, although different malignancies could have different characteristics. Ideally, sonographic characteristics could be delineated for each malignant and benign etiology. However, the difficulty in obtaining a sufficiently large sample size makes this impractical. Additionally, although 1 pathologist organized all of the pathologic specimens into categories, multiple pathologists originally reviewed each specimen. The variability of the pathologic diagnoses is likely most evident for the inflammatory lesions in deciding whether to designate a mass as a "fibrous pseudotumor," "chronic inflammation," or "fibrosis." Although the evaluation of all scrotal sonograms by 1 genitourinary radiologist provided a level of consistency, we could not assess interobserver variability in the interpretation of the sonographic findings. Finally, because of the small number of malignant cases, the ability to draw broad conclusions was restricted. Although statistical methods such as the Fisher exact test were used to compensate for the small sample size, the power of the study would have been greatly increased if more malignant cases had been available. In summary, most solid epididymal masses (94% in our study) are benign.