**Research Article**

# Ultrasonographic Evaluation of Scrotal Swelling

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**ABSTRACT**

Asymptomatic painless testicular swellings are not uncommon. The differential diagnosis of scrotal mass includes cysts, lipomas, hydrocele, varicocele, benign and malignant testicular masses. Prompt clinical examination followed by appropriate imaging is the key to early diagnosis and appropriate management. Our case is that of a self-neglected, long standing partially ruptured benign epidermal inclusion cyst masquerading as a massive painless scrotal mass. Magnetic resonance imaging not only displays the size and margins of these lesions, but also shows characteristic internal features that may suggest the preoperative diagnosis. We studied unusually large cystic scrotal extratesticular epidermal inclusion cyst, illustrate the imaging characteristics and discuss the differential diagnoses.

**Keywords:** Testes; Epidermal inclusion cyst; Scrotum

## INTRODUCTION

The extratesticular scrotal structures consist of the epididymis, spermatic cord, and enveloping fascia, derived as the testis descends during its embryologic development through the abdominal wall into the scrotal sac[1-3]. The epididymis is a crescent-shaped structure that lies along the posterior border of the testis, connecting the efferent seminiferous tubules in the testis to the vas deferens. The efferent ductules pierce through the tunica albuginea of the testis and coalesce to form the head of the epididymis. The ductules then merge as they travel along the edge of the testis, forming the body and the tail of the epididymis, which is attached to the lower pole of the testes by loose areolar tissue. The tail continues onward as the vas deferens. The vas deferens loops superiorly in the spermatic cord to meet the duct from seminal vesicle and forms the ejaculatory duct, which connects to the urethra[4,5] Knowledge of this anatomic course is valuable in understanding the retrograde progression of infection along the same pathway, which occurs in epididymoorchitis. The spermatic cord contains blood vessels (including the interconnected network of small veins, the pampiniform plexus), nerves, lymphatics, and connective tissue apart from the vas deferens. High-resolution ultrasonography with color or power Doppler is the imaging modality of choice for patients with scrotal abnormalities. It has also demonstrated good reliability in differentiating between intratesticular and extratesticular lesions.[6-9]

Furthermore, ultrasonography is helpful in characterizing extratesticular lesions as cystic or solid, which is an important feature to consider when evaluating these lesions. Most extratesticular lesions are benign, although approximately 5% are malignant.

Clinical examination is often elucidative in scrotal diseases and therefore imaging is not frequently required. When necessary, ultrasonography (US) is the first option and, often, the only imaging method required to make a reliable diagnosis,[10-14] because of its good accuracy and availability and the anatomic details provided by high frequency, linear transducers.[15] The ability of color Doppler to study blood flow[16] makes US an excellent imaging method in acute scrotal diseases,[17] when excluding torsion is crucial. In certain situations, a definitive diagnosis is not possible on the basis of the clinical and US findings. Magnetic resonance imaging (MRI) has been tested,[18-20] with good results in different scrotal diseases because of the superb anatomic details, great tissue contrast, and images on different planes. However, since the first report,[21] almost all studies have been merely descriptive, reporting typical MRI findings for every scrotal disease. Only a few investigators have tried to define in which clinical situations MRI could increase accuracy.[22-24] The exceptions were mostly related to the value of MRI in the diagnosis of the undescended testis.[4-8]

The aim of our study was to determine the utility of MRI after inconclusive US in patients referred for US examinations for any type of clinical complaint.

## METHODOLOGY

We conducted a retrospective study of 33 patients who came to our institution for scrotal blunt trauma between January 1996 and December 2006. All patients in our series underwent US of the scrotal content before systematic surgical exploration. The mean age at the time

of the accident was 30.2 years (14 to 86 years). The mean and the median time between the urologic consultation and the initial trauma were 2.6 and 0 days (0 to 52), respectively. All patients were examined by a faculty staff urologist. US was performed by the radiologist on call using high resolution linear transducers (7.5 or 10 MHz). Results were reviewed by urologist, before surgical exploration. The ultrasonographic criteria for severe injuries of the scrotal contents were as follows: hematocele, loss of the contour definition, breach in the tunica albuginea, hypoechogenic and heterogeneous testis parenchyma, important testicular hematoma, epididymis injuries, and testis avulsion. Radiologists were asked for suspicion of testis fracture, based on all ultrasonographic findings. Surgical exploration was then performed in emergent basis (4 to 12 hours) after analgesia administration and anesthesia preparation. It consisted usually in a unilateral transverse scrotal or median longitudinal access, allowing for the exploration of the contralateral testis. Salvage management with necrotic testicular parenchyma ablation and tunica albuginea closure was performed each time it was possible. When not possible, orchiectomy was performed in informed patients. All the patients were evaluated in the outpatient clinic within a month after surgery. Further visits depended on the presence of complications. We compared clinical, ultrasonographic, and surgical findings for all patients and calculated the sensitivity and specificity of US for each type of injuries. Moreover, we analyzed the accuracy of US for the diagnosis of testis fracture.

## RESULTS

### Nonseminomatous Germ Cell Tumours

They are uncommon before puberty and after the age of 50. They more likely occur as mixture of two or more of the individual components. Seminomatous elements may also present but do not influence the prognosis.

### Pure Embryonal Carcinoma

Pure embryonal carcinoma is a rare tumor accounting only 2-3 % of testicular germ cell neoplasm. Sonographic feature of pure embryonal cell carcinoma are similar to those of mixed NSGCT, cystic areas are present in one third of cases representing areas of hemorrhage with clot resolution. They may be aggressive and invade the tunica, distorting the testicular contour.

Recardo Drut (2003) demonstrated case of 2 year old boy with testicular embryonal carcinoma and presence of testicular microlithiasis (TM) in the adjacent still recognizable testicular tissue is reported. The combination of prepubertal embryonal carcinoma and bilateral TM has not been reported previously.

### Teratomas

Teratomas constitute 5-10 % of primary testicular neoplasm usually developing in children between 3 months to 5 yrs. Sonologically the teratoma is commonly a well defined markedly inhomogenous mass containing cystic and solid areas of various sizes and appears similar to other NSGCT. Dense echogenic foci causing acoustic shadow are common resulting from focal calcification cartilage, immature bone, fibrosis and non calcific scarring, and adipose tissue components the latter sonologically appearing echogenic foci without posterior shadowing.

### Choriocarcinoma

Pure choriocarcinoma is the rarest type of germ cell tumor, accounting for less than 5% of malignant primary testicular tumors. Peak incidence is in $2^{nd}$ and $3^{rd}$ decade. Sonographic appearance is similar to the other NSGCT.

### Stromal Tumors

Gonadal stromal tumors account for 3-6 % of all testicular neoplasm. Approximately 20 % of the tumors occur in children. The tumors may contain single or multiple cell types because of totipotentiality of gonadal stroma.

Majority of stromal tumors are of leydig cell tumors which account for 1-3 % of all testicular neoplasm and occur predominantly in patients between 20 and 50 yrs. They are homogenous, but foci of hemorrhage and necrosis may be seen, hypoechoic small, solid. Cystic spaces resulting from hemorrhage and necrosis are seen with larger lesions. It is not possible sonographically to differentiate among either the various types of stromal tumors.

### Sertoli Cell Tumors

These are usually small, homogenous and hypoechoic masses. Occasional hemorrhage and necrosis may give a more heterogenous appearance. The large cell calcified sertoil cell tumor is a sub type with distinctive clinical, histological and sonographic character, may be bilateral and totally calcified.

### Tunica Albuginea Cysts

The pathogensis of tunica albuginea cysts is not known but believed to be mesothelial. The cysts range from 2-5 mm in diameter and are brought to medical attention when a patient presents himself for treatment with a palpable lump (Martinez-1998). The mean age at presentation is 40 years, and cysts can even be seen in the $5^{th}$ and $6^{th}$ decades. At US, tunica albuginea cysts meet all the criteria of a simple cyst. They characteristically are located at the upper anterior or lateral aspect of the testicle. They can be uni-or multilocular. Their origin is uncertain, but they are thought to arise from mesothelial cells. Sometimes the differentiation of a tunica vaginalis cyst is difficult. Most testicular malignant tumors are palpable, whereas the majority of intratesticular cysts are not palpable except when they are at the periphery of the testis. Larger lesions may compress the testicular parenchyma and simulate an intratesticular mass. Less commonly, these

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lesions have internal echoes and raise concern for a neoplasm.

## Cystic Dysplasia

Cystic dysplasia is a congenital malformation usually occurring in infants and children. One case was reported in a 30 years old man. They result from an embryological defect that prevents connection of tubules of rete testis and the efferent ductili. Sonographically the appearance is similar to acquired cystic dilatation of rete testis. Renal agenesis and dysplasia frequently coexists.

## Cystic Transformation of the Rete Testis

This benign condition, also known as tubular ectasia, results from partial or complete obliteration of the efferent ductules, which causes ectasia and, eventually, cystic transformation. These cysts can be identified at US as fluid-filled tubular structures. Most occur in men older than 55 years, and the process is frequently bilateral (Tartar MV 1993) but is often asymmetric. The diagnosis can still be made with confidence when the process is unilateral.

The location of the lesion in or adjacent to the mediastinum testis and the presence of epididymal cysts are characteristic. The key to the diagnosis of this condition is the elongated shape that replaces the mediastinum. These features aid in distinguishing cystic transformation of the rete testis from cystic malignant testicular tumors (which can occur anywhere in testicular parenchyma) (Bree RI 1996).

Teratomas are the most frequent to manifest as cystic masses; however, a cystic tumor is rare, and when present, cystic tumors do not meet all the criteria of a simple cyst. Usually, an abnormal rind of parenchyma with increased echogenicity surrounds cystic malignant tumors. The age of the patient, clinical presentation. And tumor marker status allows diagnosis of a tumor with fair certainty.

## Epidermoid Cyst

The most common benign intratesticular neoplasm is an epidermoid inclusion cyst. This relatively uncommon benign tumor is of germ cell origin but contains only ectodermal tissue. It typically manifests in younger men and adolescents as a painless, palpable mass and is most commonly 1-3 cm at discovery.

A cystic lesion filled with keratinized debris with a well defined wall lined by squamous cells. These were thought to represent approximately 1% of testicular tumors. Most epidermoid cysts are derived from epithelial rests or inclusions and have no malignant potential.

Manivel and others recognized that carcinoma in situ was observed in 85% to 100% of adult invasive germ cell tumors but was never observed in epidermoid cysts at any age. A series of over 100 ultrasonographically detected testicular masses found that 5% were epidermoid cyst (eissenmenger).

Price identified 5 criteria that define an epidermoid cyst:

(1) it must be a cyst and within the parenchyma of the testicle;

(2) the lumen is filled with keratinized debris or amorphous material with cleft like spaces;

(3) the wall of the cyst is comprised of fibrous tissue with complete or incomplete inner lining of squamous epithelium with or without ossification;

(4) there are no teratomatous elements or dermal adnexal elements such as sebaceous glands or hair follicles in the cyst wall or elsewhere in the testicle;

(5) the remaining testicular parenchyma may be atropic with or without relative hyperplasia of the interstitial cells and must not contain scars. Sonographically these are well defined, avascular masses that may be multiple and bilateral. They have a characteristic whorled appearance due to alternating layers of compacted keratin and desquamated squamous cells.

Another typical appearance is a well defined hypoechoic mass with an echogenic capsule that may be calcified. There may be central calcification giving a bull's eye or target appearance. They may have an appearance resembling germ cell tumors and a vascularity may be the clue to the diagnosis. Distinguishing dermoid cyst from teratoma requires careful pathological examination of the cyst wall.

## Leydig Cell Hyperplasia

Leydig cell hyperplasia is a rare, benign condition characterized by multiple small testicular nodules, frequently bilateral. Various conditions have been associated with leydig cell hyperplasia, including cryptorchidism, congenital adrenal hyperplasia, human chorionic gonadotropin (hCG)-producing germ cell tumors, Klinefelter syndrome, and exogenous hCG therapy. The sonographic appearances have been described.

## Intratesticular Varicocele

The pathogenesis and clinical implications of this newly defined entity are not yet well established. Intratesticular varicoceles can occur in association with extratesticular varicoceles, but their independent existence is more common (Das Km 1999). Patients with this condition may have pain related to passive congestion of the testis, which eventually stretches the tunica albuginea.

The US findings of intratesticular varicocele are similar to those of extratesticular varicocele and include multiple anechoic, serpiginous, tubular structures of varying sizes.

Color flow and duplex Doppler US show a venous flow pattern with a characteristic venous spectral waveform, which increases with the Valsalva maneuver (Mehta AL, Dogra 1998). The main differential diagnosis is a pseudoaneurysm, which has a characteristic yin-and-yang

flow pattern (Dee KEI 2000) distinct from the venous flow of a varicocele.

Intratesticular varicocele is a rare and relatively recently recognized entity. The condition is characterized by dilatation of intratesticular veins. It was first described by Weiss in 1992. Since then 50 cases of intratesticular varicocele is made on identification of a tubular or oval structure within the testicle with venous flow and a positive response to the Valsalvs's maneuver in color Doppler sonography. We describe two cases of this entity and review previously reported cases.

## Testicular Abscesses

Testicular complications are usually abscesses of epididymoorchitis, undiagnosed testicular torsion or primary pyogenic orchitis. A very rare cause is scrotal collection as presentation of acute appendicitis, with less than 25 cases reported in literature. Most patients who develop acute scrotal signs due to appendicular pathology have a patent processes us vaginalis. Less than one-third of these patients have a clinical hernia before presentation. Sonography shows enlarged testicle containing a predominantly fluid filled mass with hypoechoic or mixed echogenic areas. An atypical appearance has been described in which the testicular architecture is disrupted with echogenic striations separating hypoechoic areas. These striations are thought to be fibrous septa in hypoechoic necrotic testicular parenchyma.

## Testicular Infarction

sonographic appearance depends on age of infarct. Initially seen as peripherally located hypoechoic areas with absent vascularity. Differentiation from a testicular tumor may be difficult sonologically. Infarcts decrease in size with time but tumors enlarge in size.

## Sarcoidosis

Clinically presents as recurrent or acute epidydimitis or painless enlargement of testis or epidydimitis. Sonologically sarcoid lesions are irregular hypoechoic solid masses in testis or epididymis. Occasionally hyperechoic calcific foci with acoustic shadow may be seen. Distinguishing from neoplasm is difficult sonographically.

## Adrenal Rests

Adrenal Rests arise from aberrant adrenal cortical cells that migrate with gonad tissue in the foetus. Sonographically appears as multifocal hypoechoic lesions occasionally posterior acoustic shadow seen. Colour Doppler shows typical spoke wheel pattern of multiple peripheral vessels radiating towards a central point.

## Extra Testicular Pathologic Lesions

### Inguinal-Scrotal Hernia

Inguinal scrotal hernia is defined as the passage of intestinal loops and/or omentum into the scrotal cavity.

The prevalence of inguinal hernia is higher in preterm neonates, especially at 32 weeks gestation (ship TD 1995). The hernia is more frequently located on the right side, since the right processus vafinalis closes later than the left (siegel MJ1997). Physical examination is sufficient to enable diagnosis in most cases. Nevertheless, US examination (which has replaced plain radiography) is indicated in patients with inconclusive physical findings, in patients with acute scrotum, and to investigate contralateral involvement in patients in whom only a unilateral hernia is clinically evident (chou Ty 1996). At gray scale US, the scrotum is partially occupied by one or more round structures containing air bubbles or fluid. The diagnosis of hernia is achieved by visualization of air bubble movement and/or interstinal peristalsis during the real time examination.

The herniated omentum is seen as a highly echogenic structure. US examination should include both inguinal canals, since a clinically inapparent contralateral hernia can be found in 88% of cases (Moss RI 1991). Inguinal rings larger than 4 mm are an indication for prophylactic herniorrhaphy.

### Hydrocele

Hydrocele, an abnormal collection of fluid between the visceral and parietal layers of the tunica vaginalis and/or along the spermatic cord, is the most common cause of painless scrotal swelling in children. In the normal scrotum, 1-2 ml of serous fluid may be observed in the potential tunica vaginalis cavity and should not be mistaken for hydrocele. Virtually all hydroceles are congenital in neonates and infants and associated with a patent processus vaginalis, which allows peritoneal fluid to enter the scrotal sac (Martin LC, 1996). In older children and adolescents, hydroceles are usually acquired and are the result of an inflammatory process, testicular torsion, trauma, or a tumor.

At sonography, congenital hydrocele appears as an anechoic fluid collection surrounding the anterolateral aspects of the testis and sometimes extending to the inguinal canal or as a fluid collection with low level swirling echoes, which are related to protein aggregation or above the testis and below the internal inguinal ring leads to a less common type of hydrocele also known as spermatic cord cyst, which appears as fluid collection in the spermatic cord (martin lcl 1996).

Another type, referred to as abdomino scrotal hydrocele, is a highly uncommon entity, with only some 80 reported pediatric cases (Avolio L 2000). These are large inguinoscrotal hydroceles that protrude through the internal inguinal ring into the abdominal cavity and manifest clinically as a communicating abdominal-scrotal mass. The exact mechanism by which peritoneal fluid is forced into the abdominal cavity remains speculative (ferroF, 1995).

Most congenital hydroceles (80%) resolve spontaneously before the age of 2 years. However, surgical treatment is

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usually applied in spermatic cord and abdominoscrotal hydroceles.

### Varicocele

Varicocele involves abnormal dilatation of veins in the pampiniform plexus of the spermatic cord and is relatively common, accounting for 20.5% of cases. Most cases are idiopathic; varicoceles are found mainly in adolescents and young adults and are more frequent on the left side. At sonography, the dilated veins appear as tortuous, anechoic, tubular structures along the spermatic cord. Two mm is widely used cut off level between normal and abnormal vein. Other studies shows 2.7mm for sub clinical and 3.6mm for clinical varicocele. On color and pulsed-wave Doppler images, venous flow is better demonstrated during the Valsalva maneuver. Varicocele may affect testicular growth; hence, testicular volumes should be systematically measured and asymmetries assessed with US.

### Hematocele and Pyocele

Less common than simple hydrocele. Hematocele results from trauma, surgery, diabetes, neoplasm, torsion and atherosclerotic disease. Pyocele results from rupture of an abscess in to the TVT sac. Both contains loculations and internal septations. Thickening of scrotal skin or calcification noted in chronic cases.

### Sperm Granuloma

Sperm granulomas, inflammatory masses resulting from a foreign body giant cell reaction to extravassated sperm. Sperm granulomas are present in up to 42% of men who have had vasectomy but only 2.5% of the general population. A study conducted by shermanj silber in which ninety two consecutive patients who had undergone bilateral vasectomy 1 month to 28 years earlier were studied at the time of vasectomy reversal for sperm output, dilatation of the vas deferens lumen, and sperm granuloma. Thirty nine men had unilateral or bilateral sperm granuloma. The presence of a sperm granuloma virtually assured normal sperm in the vas fluid no matter how long ago the vasectomy was performed. These may have associated pain and are often well defined hypoechoic solid masses. Chronic sperm granuloma may contain calcification (oh c, Nissenbaum Hl langer J).

### Fibrous Pseudotumors

Fibrous pseudotumors are rare non neoplastic mass of reactive fibrous tissue that may involve tunica vaginalis or epididymis. On sonography appears as hypoechoic or heterogenous paratesticular mass.

### Cystic Lesions

Epididymal cysts, although not true tumors, usually manifest as a palpable mass and are of lymphatic system origin. Epididymal cysts cannot be differentiated from spermatoceles, which are secondary to obstruction and dilatation of the efferent ductule. Spermatoceles are more common than epididymal cysts. Both were seen in 20% to 40% of asymptomatic patients studied by leung and 30% were multiple cysts.

Pathologically epididymal cysts contain clear fluid where as spermatoceles are filled with spermatozoa and sedimentation containing lymphocytes, fat-globules and cellular debris giving the circumscribed anechoic masses with no or few internal echoes. Loculation and septations are commonly seen. Rarely a spermatocele may be hyperechoic. Spermatoceles most commonly occur in head of the epididymis where as epididymal cysts arises throughout the length of the epididymis.

### Adenomatoid Tumors

Constituted 22% of the solid epididymal neoplasms. The malignancy rate for all solid masses was 6% beccia previously described a 25% malignancy rate for epididymis is metastasis. Previous reports have described solid epididymal masses as a result of metastasis from the prostate, stomach, colon and kidney in addition to leukemia. According to another study adenomatoid tumors represent 30% of all paratesticular neoplasms is rare in children and arises from the poles of the epididymis. At US this tumor is seen as smooth, round, well circumscribed echogenic mass. However the appearance is not specific and it should be differentiated from granulomatous epididymitis a chronic form of epididymitis that manifests as a painful palpable mass. At color Doppler imaging, vessels are observed within the adenomatous tumor, whereas usually no vessels are seen in granulomatous epididymitis. No metastases or recurrence have been reported after excision.

### Epididymal Cystadenoma

Papillary cystadenoma of the epididymis is a benign epithelia neoplasm. It is seen in up to 60% of men with von Hippel-Lindau disease. Although the sporadic variety is usually seen in middle aged men, it occurs earlier in patients with few cystic space. Alternatively, it can appear as a multiloculated cystic lesion with small papillary projections. In patients with von hippel Lindau disease sonographic criteria for diagnosis of epididymal cystadenoma consist of a predominantly solid epididymal mass larger than 10-14 mm and slow growth. Most are treated conservatively with serial US to monitor lesion growth.

### Lipoma

It is the most common benign tumor of the spermatic cord and can occur at any age. At US, it is a well defined, homogeneous hyperechoic paratesticular lesion of varying size.

**Fibrous pseudotumor** is a benign reactive fibrous proliferation of paratesticular tissue. It can grow up to 8 cm in diameter and therefore can mimic a neoplasm. It most commonly arises from the tunica vaginalis. The sonographic appearance is nonspecific and calcification is common. The lesion can dislodge and become freely

mobile within the scrotal sac such a lesion is known as a scrotal pearl.

**Paratesticular rhabdomyosarcoma** is the most frequent extratesticular tumor in paediatric age which originates in the spermatic cord or scrotal tunics. The majority occurs in the first two decades of life and belong to the embryonal histopathologic subtype. At US, paratesticular rhabdomyosarcoma is seen as a hypo or hyperechoic solid mass that may envelop or invade the epididymis and testis, with hypervascularity at color Doppler imaging.

CT is recommended in the initial work up to determine tumor spread, and MR imaging can be performed to delimit the borders of the mass relative to the epididymis and testis. Long term survival is expected in patients under 10 years of age with disease confined to the scrotum.

### Acute Scrotum

The term acute scrotum refers to a clinical picture of sudden onset scrotal pain, redness, and swelling, most frequently caused by acute epididymo-orchitis, torsion of the testicular appendages or testicular torsion. Since scrotal involvement is usually unilateral, we start the examination on the asymptomatic side to have a basis for comparison. Color flow imaging, adjusted to visualize low flow velocities, or power Doppler imaging should always be added to the gray scale study. Pulsed wave Doppler imaging is not absolutely necessary. Comparable transverse Doppler scans of both testers are essential to study testicular perfusion discrepancies. Patients with absent or clearly decreased blood flow signal should be treated surgically. In cases with inconclusive Doppler perfusion findings, nuclear medicine or MR imaging can assist in the diagnosis and management decision.

### Testicular Torsion

Testicular torsion or twisting of the spermatic cord implies first venous and later arterial flow obstruction. The extent of testicular ischemia will depend on the degree of twisting ($180°–720°$) and the duration of the torsion. Testicular salvage is more likely in patients treated within 4-6 hours. Testicular salvage is more likely in patients treated within 4-6 hours after the onset of torsion. On the basis of the surgical findings, two types of testicular torsion are recognized: extravaginal and intravaginal. Extravaginal torsion is seen mainly in newborns and occurs prenatally in most cases. The testis is usually necrotic at birth and the hemiscrotum is swollen and discolored.US findings vary but complex hydrocele and calcification of the tunica albuginea are common. Intravaginal torsion can occur at any age but is more common in adolescents. A predisposing factor is the "bell clapper" deformity, in which the tunica vaginalis joins high on the spermatic cord leaving the testis free to rotate. Differentiation between testicular torsion and epididymo-orchitis is a clinical challenge since scrotal pain swelling and redness or tenderness are clinical symptoms common to these two entities. The usual teaching is that

pain in testicular torsion has a sudden onset whereas in orchitis have sudden onset of pain and only 50% of patients with testicular torsion have an acute attack.

### Torsion of the Testicular Appendages

The testicular appendages are remnants of the embryonic mesonephric and paramesonephric ducts and consist of vascularized connective tissue. The appendages are sessile structures which predisposes them to torsion and the appendix testis is most often affected. Torsion of the appendix testis occurs mainly in prepubertal boys are more frequent on the left side and is a common cause of acute scrotum in his age group. Affected patients typically present with gradual or sudden intense pain usually localized in the upper pole of the testis. In approximately one third of patients a nodule of the upper scrotum with bluish skin discoloration (blue dot sign) is palpated. This is a pathognomonic feature of this entity and US examination is not necessarily required for the diagnosis when it is present. At the twisted appendage is seen as a round extratesticular mass with high or mixed echogenicity depending on the evolution time. Associated findings include enlarged epididymal head reactive hydrocele and scrotal skin thickening. There is no Doppler signal in the twisted appendage and the epididymis and scrotal tunics are hypervascularized. Management consists of bed rest and nonsteroidal anti inflammatory agents. Within days the twisted appendix may calcify and become detached leaving a scrotal calcification as a scrotolith.

### Epididymo Orchitis

Epididymitis and epididymo orchitis are common causes of acute scrotal pain in young males. Most cases are caused by sexually transmitted disease or retrograde spread of bacterial infections from the urinary bladder. The infection usually begins in the tail of the epididymis and spreads to the body and head. Approximately 20-40% of cases of epididymitis are associated with orchitis which is thought to be due to direct extension of infection into the testicular parenchyma. At US the findings of acute epididymitis include low echogenicity or rarely high echogenicity (if there is coexisting hemorrhage) with enlargement and hypervascularity of the entire epididymis or a focal region. Similarly diffuse inflammation of the testis causes enlargement heterogeneous echogenicity and hypervascularity. Hypervascularity on color Doppler images is well established diagnostic criterion and may be the only imaging finding of epididymo orchitis in some men. Associated findings such as reactive hydrocele or pyocele and scrotal wall edema can further support the diagnosis scrotal trauma also results in enlargement and hyperemia of the epididymis and should be considered in the differential diagnosis. Diffuse heterogeneous echogenicity of the testis is not specific for orchitis and can be seen with leukemia lymphoma metastasis and infarction. Leukemia lymphoma metastasis and mumps usually demonstrate bilateral involvement while other infectious

conditions usually have unilateral involvement. However given the difficulty in differentiating between these entities with imaging findings alone follow up to resolution is recommended if the diagnosis is uncertain.

### Tuberculous Epididymo-Orchitis

The genitourinary tract is the most common site of extrapulmonary involvement by tuberculosis. At US there is enlargement of the epididymis with variable echogenicity. The presence of caseation necrosis, granulomas, fibrosis and calcifications can cause heterogeneous echogenicity. Orchitis has a similar appearance but the presence of multiple small hypoechoic nodules has also been described.

### Sarcoidosis

Sarcoidosis can rarely involve the genitourinary tract. In general it affects the epididymis more commonly than the testis. While it can manifest as solitary lesion it is more commonly seen as multiple small bilateral lesions. At US testicular lesions are hypoechoic Epididymal involvement by sarcoidosis results in enlargement.

### DISCUSSION

Imaging is not extensively used to evaluate scrotal diseases because the history and physical examination are often elucidative. When required, US is the primary choice. The low percentage of cases considered inconclusive in our series (5.02%) corroborates the findings of previous studies. In a few cases, the clinical and US findings are inconclusive, mainly because the specificity of US is not the ideal,[15] and additional information is necessary to reach a confident diagnosis. MRI can provide those details. However, the role of MRI in scrotal diseases is not well defined.[16,17] Most studies are descriptive, with a few exceptions. Thurnher[12] compared the two modalities using 0.35-T MRI equipment and selecting only patients with palpable masses. They reported a low specificity for both methods, but noticed that MRI better revealed infiltrative lesions. Their poor results might be explained by the limitations of a low-field scanner and inherent low signal-to-noise ratio and low contrast between lesions and normal tissue. Cramer[10] compared MRI and US, initially for every patient referred for US examination. Subsequently, they selected only those suspected to have neoplasia. Their conclusion was a significantly better specificity and high sensitivity for MRI. They were concerned about other situations in which MRI could be complementary to US. The study of Serra[11] was very similar to ours. They compared US and MRI in different clinical settings, with an emphasis on costs. They concluded that MRI significantly improved the approach to scrotal diseases, permitting an expressive reduction of costs based on a reduction of the surgical explorations and days of hospitalization. However, they did not mention which characteristic of MRI or details of the imaging studies provided better results. In our series, the classic protocol described in the literature was used, without contrast agents.[18] The diagnosis of testis rupture

by US is made by indirect signs, since the albuginea is not defined in US.[17] A discontinuity or irregularity of the testis is highly suggestive, but not specific. The high tissue contrast, multiplanar imaging, and ability to depict hemorrhage at different stages[18] was extremely helpful for evaluation of scrotal blunt trauma at MRI. The low signal from the albuginea is a remarkable sign, ensuring testicular integrity. Also, the extension of the hematoma to the inguinal canal is nicely demonstrated. The differentiation between benign and malignant was the main utility of MRI in our study. Several conditions mimic neoplasia at US. The most frequent are inflammation, hematoma, infarct, fibrosis, and tubular ectasia. Others are rare, such as adrenal gland rests.[17-19] The criteria used to characterize a benign lesion by MRI were accurate differentiation between intra and extratesticular areas, absence of hemorrhage and extratesticular extension, preservation of testicular architecture, and a more homogeneous signal. Hemorrhagic components, extension to albuginea and/or epididymis, and a heterogeneous signal were the features used to define a malignant lesion. Although hemorrhage may occur in inflammatory diseases, it is extremely rare, occurring sporadically, and associated with granulomatous disease that induces vasculitis, such as seen in Wegener's disease and periarteritis nodosa. We found MRI to be extremely accurate in predicting benign lesions. In fact, no lesion defined as benign by MRI proved to be malignant (negative predictive value 100%), although two pseudotumoral inflammatory lesions were mistaken as malignant (positive predictive value 71.4%). Rosenfeld[18] clearly demonstrated how scrotal inflammatory disease might mimic neoplasia in all phases of evolution. However, it is especially problematic in chronic stages, when it sometimes has a sonographic appearance identical to that of tumors; it is still the most common cause of false positive scrotal explorations.[19,20] Although fibrosis can occur in neoplastic diseases, mainly in seminomas, this is quite rare. Fibrosis, either after inflammation or trauma, can be very worrisome at US, but the low signal in T1 and T2-weighted images, sometimes radiating from the mediastinum, is indicative of a benign lesion. Dilation of the seminiferous tubules is a relatively common condition that occurs mostly during the fifth and sixth decade. In most cases, the diagnosis is easily made by US, but atypical ones can mimic neoplasia at sonography. However, the typical appearance at MRI, with an isointense/hypointense signal in T1-weighted images and an isointense signal in T2-weighted images, allows a very specific diagnosis.[21]

An epidermoid cyst is a very rare benign lesion of the testis.[22] Sometimes, the so-called onion appearance at US is pathognomonic. However, this is not the most frequent appearance, and sometimes MRI can be helpful to characterize the fatty component.[23] We considered the discontinuity of interlobular septa a malignant feature, as described by Cramer.[10] However, this sign was not reliable, since two pseudotumoral inflammatory lesions

were misdiagnosed as neoplastic diseases on the basis of it. Also nonseminomatous lesions were more heterogeneous compared with seminomas, but a reliable differentiation was not possible, as previously described in published reports.[24] Calcifications are still a drawback for MRI, particularly the tiny ones from microlithiasis,[25] as shown in one of our cases. This study has some limitations. Regarding the cases of trauma, in about 20% (n _ 116) of those evaluated at one institution (HCRP), we did not have MRI equipment available promptly. So, perhaps, more cases could have been added to our study. Some of the sonograms were performed in machines built in 1992 or 1993[26]. However, as those were "state-of-the-art" equipment at that time, and as some of them are still being used with good performance, we believe our results are valid. In addition, none of the recent advances in US, such as contrast agents and harmonics, are currently used in scrotal US. We had surgical and pathologic confirmation in only about 50% of cases, but the other one half was only included after a confident clinical diagnosis and follow-up long enough to confirm diagnosis by showing regression or stabilization of the lesion[27-29]. Another limitation of our study was that MRI was not used to evaluate all patients with scrotal complaints, only a small subset, and perhaps there would be other limitations of the method not described here. We believe that the constellation of findings in MRI can reliably exclude neoplasm in some lesions when US is not specific. Because this method is new and not sufficiently tested in clinical situations and, as with any other imaging method, does not provide a specific histologic diagnosis, an alternative would be a conservative approach, based on serial sonograms to follow-up "probably benign" lesions, and thereby avoiding unnecessary surgical exploration. Therefore, the high cost of MRI examination would be justified by the savings provided by low-cost sonographic follow-up instead of surgical intervention, as shown by Serra.[30]

## CONCLUSION

The results of our study confirm US as the primary choice in scrotal disease imaging. MRI dramatically improves the diagnostic reliability in certain conditions, such as scrotal blunt trauma, nonpalpable lesions with an inconclusive sonographic appearance, patients with chronic scrotal pain with nonspecific sonograms, and when the US and clinical findings are discrepant.

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