

SONOGRAPHIC FINDINGS IN NON-NEOPLASTIC TESTICULAR LESIONS*

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Abstract Pathological processes of the testis are very frequently found, and include non-tumoral and tumoral lesions. Ultra-sonography performed with a high-frequency transducer has become the imaging modality of choice for examination of these organs. This method is of help to improve intratesticular lesions characterization, and in many instances the findings suggest a more specific diagnosis, especially in the presence of similar clinical manifestations such as pain, swelling and local increase in volume. Color Doppler is an invaluable tool for demonstrating anomalous patterns of testicular perfusion and aids in the diagnosis of acute clinical conditions. In the present iconographic essay, the authors summarize the most frequent clinical, pathological findings as well as the main diagnostic features of benign intratesticular lesions such as microlithiasis, simple cysts, spermatocele, varicocele, tubular ectasia of the *rete testis*, orchitis, hematomas and more rare conditions. Familiarity with clinical and sonographic features is essential for the correct diagnosis and starting of the most effective therapy, as necessary.

Keywords: Testis; Benign testicular lesions; Ultrasonography; Color Doppler.

Resumo Aspectos ultra-sonográficos das alterações não-neoplásicas do testículo.

Processos patológicos dos testículos são muito comuns, incluindo-se lesões tumorais e não-tumorais neste contexto. A ultra-sonografia com transdutor de alta frequência tornou-se a modalidade de imagem de escolha para a avaliação desses órgãos. Este método ajuda a melhor caracterizar lesões intratesticulares e em muitas situações sugere um diagnóstico mais específico, principalmente nos casos em que há manifestações clínicas similares, tais como dor, inchaço e aumento volumétrico locais. O mapeamento com Doppler colorido é importantíssimo para demonstrar padrões anormais de perfusão testicular e auxilia no diagnóstico de condições clínicas agudas. Neste ensaio iconográfico os autores resumem os mais comuns achados clínicos, patológicos e as principais características diagnósticas de lesões testiculares, tais como microlitíase, cisto simples, espermatocelo, varicocele, ectasia tubular da *rete testis*, orquite, hematomas e condições mais raras. A familiaridade com as características ecográficas e clínicas destas alterações é essencial para o estabelecimento do diagnóstico correto e início da terapêutica mais eficaz, quando necessária.

Unitermos: Testículos; Afecções testiculares benignas; Ultra-sonografia; Color Doppler.

TESTICULAR MICROLITHIASIS

Microlithiasis has been recently described and is a relatively rare entity, reported to be incidentally observed in 0.6% to 0.75% of patients submitted to testicular ultrasound⁽¹⁻⁴⁾. Frequently, both testicles

are affected, however there are reports on unilaterality in patients from 10 months to 70 years of age^(4,5).

The disease is clinically asymptomatic⁽²⁾ and its cause remains unknown. The incidental diagnosis should indicate a complete clinical evaluation for detecting subfertility/infertility or systemic diseases.

Histologically, microliths represent scattered laminated calcium deposits in the lumen of the seminiferous tubules, called *calcospherites*⁽⁶⁾.

It may be associated with other pathological entities like Klinefelter's syndrome, cryptorchism, Down syndrome, male pseudohermaphroditism, pulmonary alveolar microlithiasis, previous radiotherapy and infertility conditions⁽⁷⁾.

Initially, testicular microlithiasis was thought to be a benign process not requiring follow-up⁽⁷⁾. However, a strong asso-

ciation has been seen with the presence of germ cell tumors, particularly seminomas⁽⁵⁾, and intratubular germ cell neoplasms which progress to carcinoma 50% of times (Figure 3).

At ultrasound, the most characteristic aspect of microlithiasis is of multiple, small, hyperechogenic foci ranging between 1 mm and 3 mm in diameter, which typically do not shadow^(2,8). Calcifications appear diffusely scattered throughout the testicular parenchyma, but may be segmented or distributed peripherally (Figures 1 and 2). Although not presenting posterior acoustic shadowing, occasionally they might generate comet-tail artifacts or a scintillating pattern at color Doppler⁽²⁾.

For the ultrasound diagnosis, the identification of a minimum of five microcalcifications per imaging field is the most accepted criterion⁽⁹⁾.

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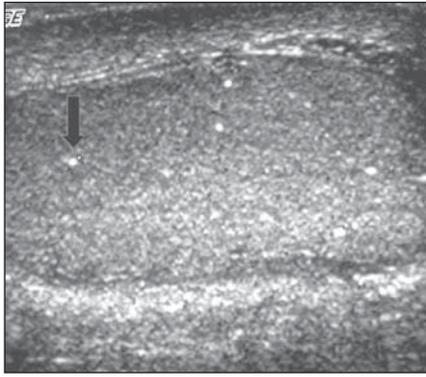


Figure 1. Mild presentation of testicular microlithiasis. Sparse, small echogenic spots (arrow) distributed in the parenchyma (calcospherites).

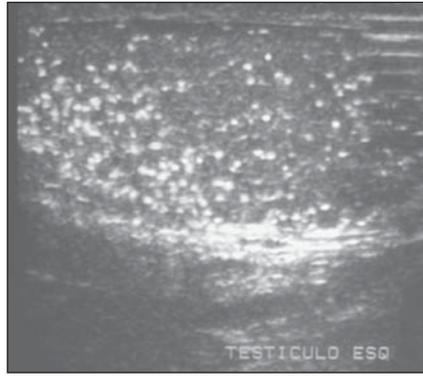


Figure 2. A more accentuated pattern of microlithiasis. The calcospherites appear in higher number and diffusely scattered.

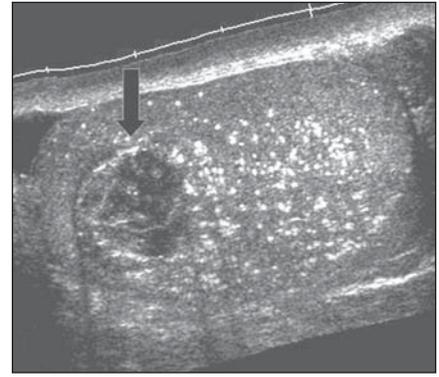


Figure 3. Association of microlithiasis with testicular tumor. Note a partially cystic, round-shaped, heterogeneous and hypoechoic lesion (arrow), with lobulated margins (teratoma) in testicular parenchyma with abundant calcospherites.

There are scientific evidences justifying the ultrasound follow-up of patients with microlithiasis, aiming at the early diagnosis of testicular tumors. Some authors have recommended an annual ultrasound follow-up, and that self-examination is encouraged for all patients affected^(2,4,10).

SIMPLE INTRATESTICULAR CYST

Intratesticular cysts are incidentally detected lesions in men with 40 or more years of age, measuring from 2 mm to 2 cm in diameter. They may be uni- or multiloculated⁽²⁾, usually are single and non-palpable, and may be multiple and bilateral^(11,12).

The pathogenesis is still to be completely known; three theories have been proposed: a) congenital, where simple intratesticular cysts would be a result from an increase in epithelial cells secretion or cystic distention from remnants of Müllerian and Wolffian ducts; b) post-traumatic; c) post-inflammatory.

Microscopically, they are lined by flat or cuboid epithelium, surrounded by testicular parenchyma, with serous content⁽²⁾.

They may be found in any portion of the testes, but are more frequently seen near the mediastinum testis and adjacent to the tunica albuginea, associated with extratesticular spermatocele.

At ultrasound, the simple cyst present as an anechoic, well-defined lesion, with imperceptible walls and posterior acoustic shadowing, localized inside the testicular parenchyma⁽¹¹⁾ (Figure 4).

When complicated with hemorrhage and infection, these cysts lose their

anechoic feature, and start showing internal suspended echoes, resulting in differential diagnosis with epidermoid cyst and teratoma⁽²⁾.

Simple intratesticular cysts may be associated with other congenital anomalies like Von Hippel-Lindau syndrome and cystic dysplasias⁽¹³⁾.

INTRATESTICULAR SPERMATOCELE

Spermatocele refers to an intraparenchymatous cystic lesion adjacent to the mediastinum testis, in the area of rete testis, and may be septate and communicating with seminiferous tubules.

At histological evaluation, they present a fibromuscular wall surrounded by cuboid epithelium, pseudostratified or ciliated epithelium being rarely observed⁽¹⁴⁾.

Ultrasound usually demonstrates anechoic lesions measuring between 1 cm and 2 cm, and that may reach more than 15 cm, with posterior acoustic enhancement. Spermatoceles might be confused with simple cysts, although its walls use to be more irregular^(11,15,16).

INTRATESTICULAR VARICOCELE

While extratesticular varicocele is a common clinical condition, its intratesticular form is a rare entity which is seen in less than 2% of a population affected by scrotal symptoms^(1,17). Intratesticular varicoceles usually are left-sided, in association with ipsilateral extratesticular

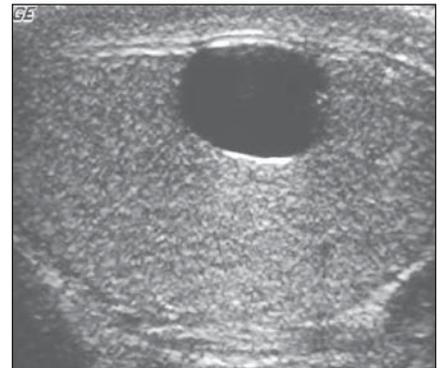


Figure 4. Intratesticular cyst. Regular thin-walled cystic lesion filled with anechoic contents, adjacent to the tunica albuginea.

varicoceles, but their independent existence is more common.

The most frequent claim of patients is local pain, while infertility, edema or scrotal mass also present as typical symptoms.

Its sonographic appearance consists of multiple serpiginous tubular and anechoic structures, varying in sizes, usually larger than 3 mm in diameter, localized around the mediastinum testis⁽¹⁸⁾. These vessels are more frequently found at left, during Valsalva maneuver, preferably in the orthostatic position.

At the mapping with color Doppler, the venous reflux is seen at the Valsalva maneuver, which is pathognomonic^(1,19). The differential diagnosis includes testicular cysts, tubular ectasia of the rete testis, hematoma, focal orchitis and cystic intratesticular neoplasms⁽¹⁷⁾.

There is a great controversy about which would be the most reliable sonog-

raphic diagnostic characteristic of initial/mild varicocele. A consensus is still to be reached about this matter, but most of urologists, in our practical experience, consider the venous reflux as a more reliable feature than the venous dilatation.

TUBULAR ECTASIA OF THE RETE TESTIS

Tubular ectasia of the rete testis is a relatively rare benign entity resulting from a partial or complete obstruction of efferent ducts⁽¹⁶⁾. This obstruction may occur at different levels, and may be classified into intra- or extratesticular.

In testicular lesions, the obstruction is situated in the seminiferous tubules or in the rete testis, generally resulting from severe inflammatory episodes like orchitis. In extratesticular lesions, the proximal obstructions result from luxation or traumatic tearing of epididymis, testicular varicoceles and cystic dysplasia. Middle obstructions are due to typical epididymal conditions like epididymitis, spermatoceles and tunica albuginea cysts. On the other hand, distal obstructions occur post-vasectomy or after scrotal surgery^(8,20). Usually, these lesions affect patients above 55 years of age, and frequently are bilateral (45%) and asymptomatic^(2,21).

The typical presentation of the rete testis consists of a serpiginous, hypoechoic structure communicating the mediastinum testis with the epididymis head usually localized in the posterolateral region of the testes⁽²⁰⁾.

In cases of ectasia, ultrasound depicts numerous small tubular and cystic structures with fluid and hypoechoic contents in the region of the rete testis, proximal to the mediastinum testis. At the mapping with color Doppler no flow is detected within the rete testis⁽¹⁶⁾, differentiating it from the intratesticular varicoceles. Occasionally, a pseudocystic pattern may be identified⁽²⁾ (Figures 5 and 6).

It is important to differentiate tubular ectasia of the rete testis from testicular tumors such as adenocarcinoma of the rete testis, epididymal cystadenoma, teratoma, non-Hodgkin lymphoma, and seminiferous tubules dilatation secondary to testicular neoplasms^(16,22).

In dubious cases, magnetic resonance might be of help, showing non-enhanceable tubular structures after intravenous gadolinium injection, with homogeneous low-intensity signal in T1-weighted images, and high-intensity or intermediary signal on T2-weighted images⁽²²⁾.

TESTICULAR TRAUMA

Testicular traumas usually result from car accidents, or contact sports, and may lead to contusion, hematoma, fracture or even testicular rupture which is considered as a surgical emergency⁽²¹⁾. In closed traumas, there is a formal indication for ultrasound to evaluate the testicular viability, vascularization, and to serve as a basis for follow-up⁽⁶⁾.

Hematomas are identified at ultrasound as heterogeneous testicular lesions, and may become complex, with cystic components. Considering the frequency of post-traumatic atrophy, the ultrasound follow-up is essential until the complete resolution of

testicular alterations. This atrophy occurs as a result of ischemia caused by increased pressure inside the tunica albuginea secondary to hematoma formation⁽²³⁾ (Figures 7 and 8).

Tunica albuginea fracture is another condition characterized by a fault (interruption) on the organ borders, an even external protrusion of the testicular pulp due to the segmental interruption of the echogenic testicular coat (tunica albuginea)⁽¹⁾.

On the other hand the diagnosis of testicular fracture is made when there is a linear, irregular, hypoechoic intratesticular abnormality, dividing the testis into two or more parts. The differential diagnosis with a transmediastinal artery is not easy. Fractures with severe testicular injury present with a heterogeneous echotexture⁽¹⁾.

TESTICULAR INFARCTION

Testicular infarction is associated with episodes of subacute torsion or infectious phenomenon determining zones of is-

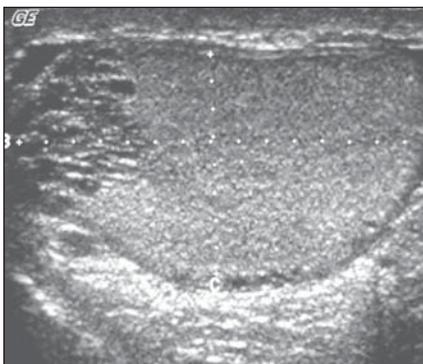


Figure 5. Ectasia of the rete testis. There is a network of anechoic, thin tubular structures in the testicular hilar region.

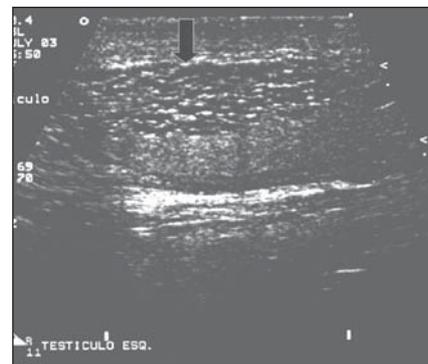


Figure 6. Ectasia of the rete testis. Other more extensive case demonstrating clustered anechoic tubular structures (arrow) in the testis anterior region.



Figure 7. Testicular hematoma. Anechoic parenchymal collection surrounded by irregular hypoechoic areas.

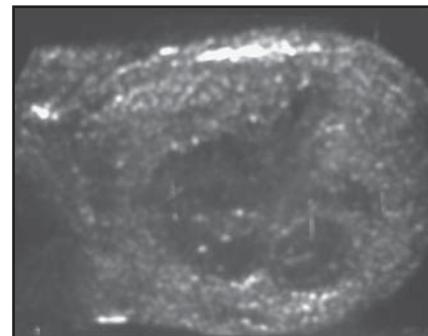


Figure 8. Testicular hematoma. Heterogeneous collection with thick and hypoechoic contents inside the testis.

chemia in the testicular parenchyma⁽²⁾. More rarely, segmental infarcts are disclosed during a picture of accentuated pain due to several etiologies such as trauma, arterial embolism, venous thromboses and various angiopathies⁽²⁾. Other iatrogenic origin is the resection or connection of the spermatic cord vascular elements in an inguinal hernioplasty.

Its sonographic appearance depends on the patient's age and severity of the injury⁽²³⁾. In an early phase, ultrasound does not demonstrate any change in echogenicity. Posteriorly, ischemic zones may be single or multiple, and appear round-shaped and hypoechoic on a plane, and in a more triangular shape with poorly defined borders on the perpendicular plane (Figure 9).

The mapping with color Doppler shows perfusion of hypervascularized perilesional regions and/or absent flow in the lesions⁽²⁾. With the clinical progression, lesions tend to decrease in size, calcify, and increase its echogenicity as a result of fibrosis⁽²³⁾. Small, more frequent infarction zones are hardly differentiated from small tumors (which may be equally avascular), however the triangular-shaped infarction is a discriminative semiological element⁽²⁾.

Amongst the differential diagnosis, one should consider testicular tumor and abscess which present a diverse clinical history⁽¹¹⁾. In dubious cases, magnetic resonance imaging shows the gadolinium enhancement in tumor processes, and absent enhancement in infarction⁽²⁾.

Hemorrhagic infarcts may rarely occur as a complication of inguinal hernioplasty. The anatomopathological substrate is the

venous flow interruption, generating local congestion and hemorrhagic necrosis.

At ultrasound, an increase in testis is observed with diffuse heterogeneity associated with permeated hyperechogenic areas, suggesting zones of liquefaction looking like a thick fluid.

At magnetic resonance imaging, T1-weighted sequences demonstrate an increased signal typical of hemorrhagic collections, because of products from hemoglobin degradation⁽²⁾.

ACUTE ORCHITIS

Usually orchitis results from a direct extension of epididymis inflammation to testis, which becomes acutely edematous and painful^(1,23). Primary orchitis is frequently viral and associated with parotiditis. Contrarily to bacterial orchiepididymitis, the viral infections usually are bilateral⁽¹⁾.

In adolescents, most common causing agents are those sexually transmitted like *Chlamydia trachomatis* and *Neisseria gonorrhoeae*. In prepubertal boys and men aged above 35 years, most frequently the disease is caused by *Escherichia coli* and *Proteus mirabilis*⁽²⁴⁾.

Ultrasound shows indirect signs of inflammation such as hydrocele or pyocele associated with scrotal wall thickening, these forms being present in most of cases. The diffuse testicular involvement is confirmed by increase in parenchymal volume as a result of testicular edema, presenting a heterogeneous echotexture⁽²¹⁾. In focal processes, presentation is characterized by

multiple hypoechoic lesions scattered throughout the parenchyma⁽²¹⁾ (Figure 10). In viral orchitis there is a diffuse increase in volume, and homogeneous or heterogeneous hypoechogenicity with peripheral hypoechoic zones⁽¹⁾ (Figure 11).

Since these findings are not specific of orchitis, they must be correlated with clinical history and laboratory tests. The patient should be followed-up until complete resolution. Additionally, findings must be documented by ultrasound aiming at ruling out tumor, infarction and metastasis.

At color Doppler-mapping, one observes an increase in the blood flow into epididymis and testis, characterized by increased number of vascular structures identifiable per view field which must always be compared with the contralateral testis. The analysis of the resistivity index and spectral pattern may bring useful information, since in these cases there is a decrease in the vascular resistance in relation to healthy individuals⁽²⁵⁾ (Figure 12).

In this context, ultrasound also becomes essential for researching the process severity, the complications, and elements of differential diagnosis like a subacute testicular torsion⁽¹⁾.

A relatively frequent infectious complication is the abscess, corresponding to a hypoechogenic fluid collection with poorly defined contours and a hypo/hyperechogenic halo, sometimes associated with echogenic debris.

The color Doppler-mapping shows an increase in the perilesional vascularization and absent blood flow inside the abscess. Rarely, gas bubbles can be observed, ap-

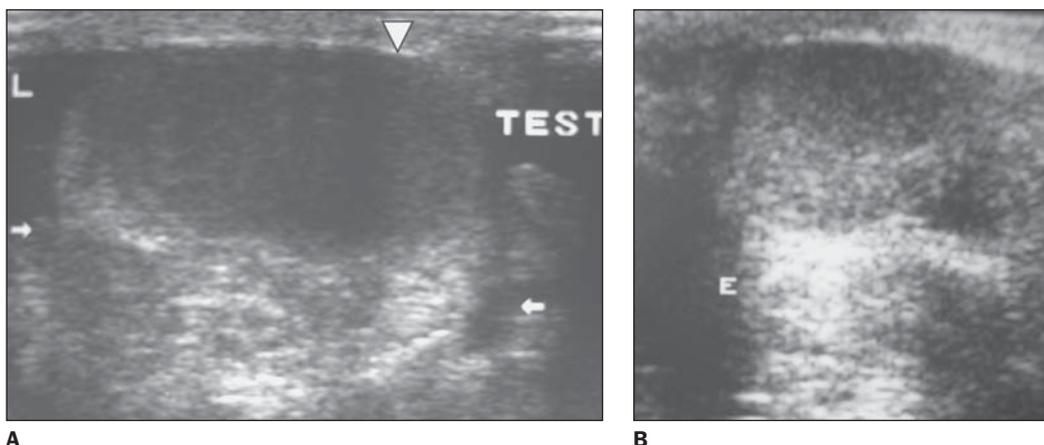


Figure 9. Testicular infarction. **A:** Hypoechoic, homogeneous, round-shaped focus (arrowhead), with precise contours, occupying a great part of the organ (between arrows). **B:** Other case showing two hypoechoic foci similar to that on Figure 9A, but with smaller dimensions, corresponding to the infarction area.

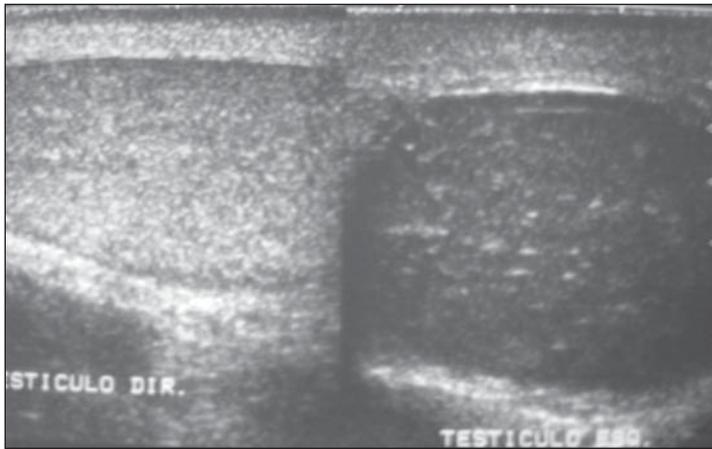


Figure 10. Unilateral acute orchitis. Note hypoechogenicity and diffuse increase in volume of the left testis in relation to its contralateral.

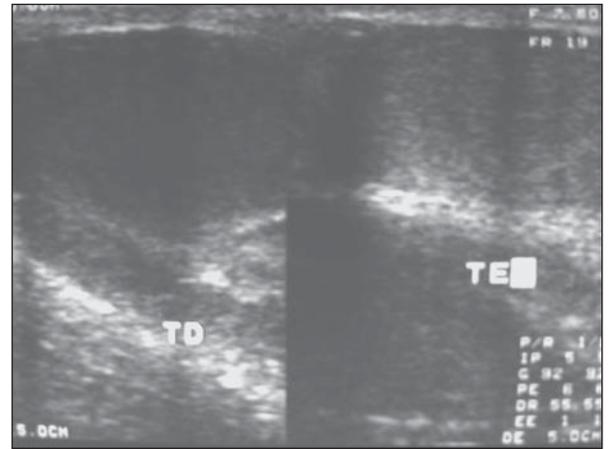


Figure 11. Bilateral acute orchitis. Diffusely hypoechoic testes presenting increased volume in higher proportion at left (patient affected by viral parotiditis). (TD, right testis; TE, left testis).

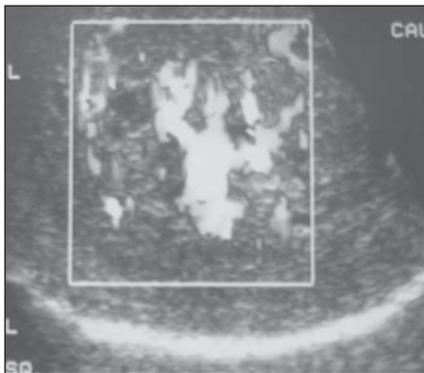


Figure 12. Acute orchitis. At color Doppler-mapping (although under black and white photo-documentation) an increase in caliber and quantity of intratesticular vessels is observed, characterizing a pattern of intraparenchymal vascularization.

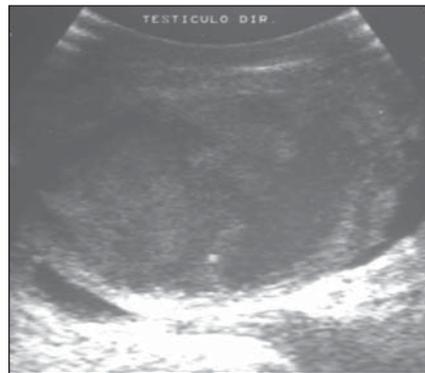


Figure 13. Testicular abscess. Orchitis complication. Heterogeneous parenchymal collection with irregular limits, occupying practically the whole testis.



Figure 14. Testicular abscess. Orchitis complication. In this case, the patient had already presented purulent secretion on the skin. The testes presented enlarged, heterogeneous and hypoechoic (edema), in association with thickening of the tunica vaginalis.

pearing like hyperechoic, supernatant punctate foci⁽¹⁾ (Figures 13, 14 and 15).

Another complication is the acute ischemia generated by compression of the vascular pedicle of the spermatic cord with the resulting formation of intratesticular venous thrombi. At the color Doppler-mapping, decreased or absent vascularization is observed, in contrast to the adjacent epididymis hypervascularization⁽¹⁾. With the clinical progression, the affected testis atrophy is observed (Figure 16).

CRYPTORCHISM AND ECTOPIA

The frequency of cryptorchism in the population ranges between 0.5% and 0.8%. The undescended testis may be situated

from the renal hilus to the inguinal canal. In one-third of cases is bilateral, but in cases of unilaterality the right side is most frequently affected. Most common localization is in the inguinal canal (72% of cases), followed by the prescrotal (20%) and abdominal or pelvic topography (8%)⁽¹⁾.

Testicular ectopia is a quite rare condition, and the most frequent localization is the subcutaneous region situated between the internal and external inguinal fossas⁽²¹⁾.

All cases of cryptorchism must be surgically treated (orchidopexy or rudimentary testis ablation) to avoid future complications such as infertility, tumor process, torsion and incarceration of intestinal loops. The risk for malignant degeneration is 48 times superior to that in the normal testis,



Figure 15. Bilateral testicular necrosis. Orchitis complication in a diabetic patient. Bilateral testes parenchymal destruction with interspersed necrotic debris in the scrotal sac (a bilateral orchiectomy was performed). (TD, right testis; TE, left testis).

seminoma and embryonic carcinoma being the most frequent types of tumors⁽¹⁾.

At ultrasound, the cryptorchidic testis appears atrophic, hypoechoic, homogeneous or heterogeneous (Figure 17). In its most frequent localization, the external inguinal canal opening is identifiable by echography. In the cases where this opening is localized in the deep opening of the inguinal canal, the presence of gas reverberation artifacts from the digestive apparatus complicate the visualization of a small testis; so in these cases magnetic resonance imaging is the indicated modality⁽¹⁾.

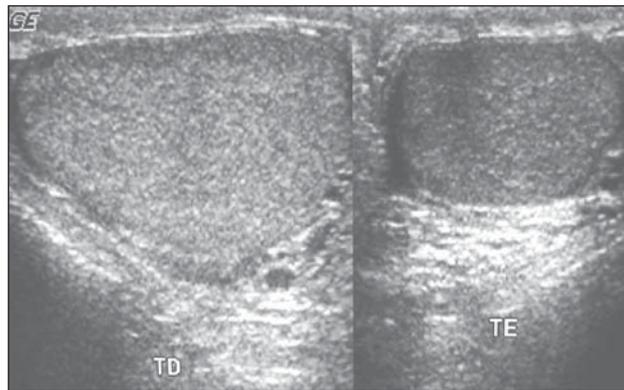
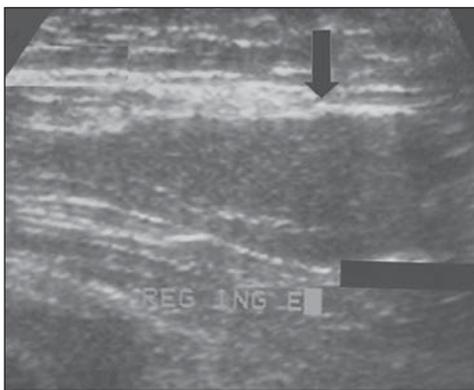
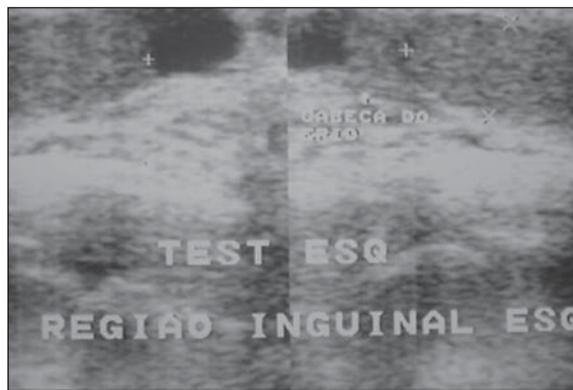


Figure 16. Testicular atrophy at left resulting from chronic orchitis. Impaired vascular supply of the left testis has generated a significant volumetric decrease and diffuse hypoechogenicity. (TD, right testis; TE, left testis).



A



B

Figure 17. Cryptorchism. **A:** Testis in left inguinal region, above the spermatic cord, with elongated shape and reduced dimensions (arrow). **B:** Other case shows testis in the inguinal region (between markers), surrounded by a discrete halo of anechoic fluid.

RARE TESTICULAR DISEASES

Ectopic rests of adrenal tissue

During the embryonal development, some adrenocortical cells may remain in the testicular parenchyma, and, unless they receive sufficient hormonal stimulation, remain undetectable. In children with congenital adrenal hyperplasia, there is a defect in the glucocorticoid synthesis and possible intratesticular adrenal rests are abnormally stimulates, suffering from hypertrophy. The lesions tend to be detected by ultrasound as multiple, round-shaped and hypoechoic^(6,16). These lesions are not considered as potentially malignant⁽²³⁾.

Sarcoidosis

Sarcoidosis rarely affects the testis, with genital involvement occurring in only 1% of patients with systemic involvement. Usually, it causes a painless enlargement of the testis, and at ultrasound irregular, solid, hypoechoic and potentially calcifying lesions are identified^(2,23).

Tuberculosis and syphilis may present similar sonographic manifestations, and should be considered as differential diagnosis⁽²³⁾. When this disease presents with a focal pattern, the differential diagnosis with other tumor-like lesions is not feasible with ultrasound⁽²⁾.

Splenogonadal fusion

The testicular fusion with splenic tissue is an unusual finding, and may be discontinuous (intratesticular ectopic splenic tissue), or continuous (direct connection between the spleen and gonad by a fibrous cord)⁽²⁶⁾. Clinically, the patients present with an inguinal or scrotal mass; lesions larger than 5 cm have already been described. Frequent associated findings are: hernia, cryptorchism and micrognathia⁽¹⁶⁾.

Intratesticular arteriovenous malformation

An intratesticular arteriovenous malformation is a rare entity, and the differential diagnosis is hemangioma. This condition usually presents like a hypoechoic nodule,

and at color Doppler demonstrates a blood flow pattern with low impedance, high diastolic peak velocity, and presence of a drainage vein⁽²⁷⁾.

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