The vital role of ultrasonographic evaluation in acute scrotal pain

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Learning objectives

To demonstrate the relevance of ultrasonography (US) combined with color flow Doppler in the diagnosis and therapeutical orientation of acute painful scrotum. To highline the optimal scanning technique in the before mentioned clinical setting. To describe the advantages and limitations of the described imaging approach. To exemplify the technique as the modality of choice in evaluating 15 cases of acute scrotum observed in our institution.
Background

The timely evaluation of patients presenting with acute scrotal pain is of critical importance in differentiating those who require emergent surgical treatment, as in spermatic cord torsion presentations, from the ones for whom conservative management suffices, as in most epididymo-orchitis clinical settings.

High frequency US with a linear-array transducer (7- to 14-MHz) complemented with color flow Doppler sonography is unsurpassed by any other imaging modality in diagnosing the pathogenesis of acute scrotum and guiding subsequent therapy.

The scanning is performed with the patient lying supine and the scrotum supported by a towel between the thighs. The testes are evaluated in transverse and longitudinal planes, optimally with transverse images of both testes recorded in the same image to allow direct comparison, and the asymptomatic side being evaluated first to set the gray scale and color Doppler gains. Color Doppler and pulsed Doppler should be optimized to display low flow velocities and the valsalva or ortostatic position should be used to evaluate venous engorgement.

Knowledge of the ultrasonographic appearance of normal and pathological scrotum and familiarity with optimal US scanning technique are essential facilitators of both correct diagnosis and successful treatment of a patient presenting with acute scrotal pain.

Epididymo-orchitis and spermatic cord torsion are the two main etiologies of acute scrotal pain.

The most frequent cause of acute scrotum in adults is epididymo-orchitis, commonly by *E. coli*, *Proteus mirabilis*, *Neisseria gonorrhoea* and *Chlamydia trachomatis*. The process can affect firstly only the tail of the epididymis but if the infection progresses it can spread to involve the body and head of the epididymis an ultimately orchitis develops in 20% to 40% of the cases.

In comparison with acute spermatic cord torsion, pain associated with epididymo-orchitis as usually a more gradual onset, is accompanied by urinary symptoms and fever, and can be relieved when the testes are elevated above the pubic symphysis (*Prehn’s sign*).

On gray scale evaluation the most frequent signs are enlarged and hypoechoic testes and epididymis due to edema and inflammation with accompanying hidrocele or pyocele and scrotal wall thickening. On later stages the testes and epididymis may appear markedly heterogeneous, reflecting simultaneous areas of edema, hemorrhage and necrosis.

Hyperaemia on color Doppler examination is a positive criterion for the sonographic establishment of epididymo-orchitis, and results in an evident high flow/low resistance pattern of the capsular and centripetal arteries of testes and arterial flow of the epididymis,
with high peak systolic and diastolic velocities and a resistive index commonly below 0.5 on spectral evaluation.

Spermatic cord torsion is associated with the highest morbidity rate within acute scrotum presentations, consisting in a surgical emergency in most cases. The salvage rate depends on time elapsed since onset of symptoms and on the degree of torsion, being it almost 100% within the first 6 hours of the clinical presentation and diminishing to 20% in 12 to 24 hours if the torsion is superior to 180 degrees (the rotation required to occlude the testicular artery).

It occurs most frequently between 12 and 18 years old, normally after action that requires strong cremasteric contraction (e.g.: vigorous exercise, trauma or sexual activity) and it rarely presents bilaterally (only in 2% of the cases). The patient usually presents with acute pain, nausea, vomiting, and the affected hemiscrotum appears swollen and abnormally high in location, most often with a transverse orientation and the epididymis in an anterior position related to the testis. The cremasteric reflex and the Prehn sign are normally absent.

Intravaginal torsion is the most common cause for acute spermatic cord rotation, in which the intrascrotal content can freely move within the tunica vaginalis, that is abnormally redundant and circles the testis rather than being attached to its postero-lateral region. This Bell-Clapper deformity is bilateral in 80% of the cases and surgical fixation should therefore also be bilateral whether the torsion occurs on one or both sides.

Extravaginal torsion is less common, derives from a pathological fixation of the testes to the gubernaculum, exclusively occurs in newborns and frequently presents as scrotal necrosis at birth.

Gray scale findings include increase scrotal content volume due to venous engorgement distal to the torsion point, homogenously hypoechoic structure within the first 6 hours, with increased heterogeneous appearance within 24 hours of onset, reflecting areas of edema, hemorrhage and infarction, and marked reduction (if rotation angle is inferior to 90 degrees) or complete absence (if torsion is superior to 180 degrees) of flow in the centripetal and capsular arteries of the testes. Color Doppler evaluation has a 86% sensitivity and 100% specificity for the diagnosis of cord torsion and when the investigations relies only on clinical and laboratorial data, there is a false positive rate as high as 50%, with frequent unnecessary surgical exploration.

Apparent peritesticular flow within the capsular arteries can sometimes reflect reactive peripheral hyperemia due to the mechanical trauma and therefore should be carefully evaluated to prevent false negative results.

On spectral analysis the resistive index for testicular arteries is usually well above normal (mean of 0.62) and reversal of the diastolic flow may be seen.
Besides the two most frequent etiologies mentioned above, there may be other common causes of acute scrotal pain, such as testicular trauma, testicular tumor, indirect inguinal hernia and idiopathic varicocele.

Trauma to the testis can be divided between testicular fracture, commonly seen as a linear hypoechoic band extending through the parenquima with preservation of the tunica albuginea integrity, and rupture, in which there is interruption of the tunica albuginea with exteriorization of intratesticular content, associated with areas of heterogeneous echogenicity, corresponding to hemorrhagic and infarcted testicular parenquima, and reduced or absent blood flow. The combination of heterogeneous parenquima and loss of integrity of testicular contour has been demonstrated to have a sensitivity of 100% and a specificity of 93.5% for the diagnosis of rupture caused by blunt scrotal trauma.

Testicular tumors can, in approximately 10% of patients, due to hemorrhage and infarction, be associated with acute pain, simulating cord torsion or epididymo-orchitis. Most intratesticular solid masses are malignant, normally unilateral and can be primary (the majority of them being germ cell tumors, as the infantile embryonal cell carcinoma, or non-germ cell tumors, that account for approximately 30% of primary tumors, as the Leydig cell neoplasms) or non-primary (e.g.: leukemia). Their ultrasound appearance is usually focal, most presenting as well defined, solid, hypoechoic masses, some with hyperechoic areas representing calcification or fat and usually with adjacent areas of healthy parenquima.

An intestinal hernia may also result in an acute scrotum presentation with painful swelling, normally due to bowel strangulation after an indirect inguinal hernia travelling through the inguinal canal until the scrotal sac. Gray scale findings of an akinetic, hyperemiated, air or fluid filled loop of bowel within the scrotum are usually diagnosis.

Idiopathic varicocele, owing to impaired venous drainage of the pampiniform complex, usually due to incompetent valves in the internal spermatic vein can cause acute scrotal pain. The patient should be evaluated in supine an ortostatic position, and findings evidencing multiple serpigenous venous structures of the pampiniform complex, with maximum diameter superior to 2mm, slow flow pattern and retrograde filling with the Valsalva maneuver are diagnostic.
The authors discuss the imaging findings in both gray-scale and color flow with duplex Doppler US in 15 patients presenting with different settings of acute scrotal pain, namely acute spermatic cord torsion (4), epididymo-orchitis (4), testicular trauma (2), idiopathic varicocele (2), testicular tumor (1) and indirect inguinal hernia (2), diagnosed in our department.

The radiological diagnoses were confirmed by reviewing clinical and surgical records.

**Fig. 1**: Spermatic cord torsion: Increased testicular volume on the left caused by venous outflow impairment, with heterogeneous echogenicity due to oedema, hemorrhage and infarction, and inflammatory thickening of the ipsilateral scrotal wall.

**References**: - Beja/PT
**Fig. 2:** Spermatic cord torsion: Heterogeneous echogenicity due to oedema, hemorrhage and infarction, and reactive hyperemia of the tunica vaginalis, caused by mechanical trauma, simulating presence of capsular flow. Complete absence of intratesticular flow on the affected side.

**References:** - Beja/PT
Fig. 3: Spermatic cord torsion: Heterogeneous echogenicity and complete absence of intratesticular flow on the affected side, including on power Doppler interrogation.  

References: - Beja/PT
Fig. 4: Spermatic cord torsion: increased testicular volume on the right, with heterogeneous echogenicity and complete absence of intratesticular flow on the affected side, on color Doppler.

References: - Beja/PT
Fig. 5: Epididymo-orchitis: enlarged and heterogeneous hypoechoic right testis due to oedema and inflammation with accompanying scrotal wall thickening.

References: - Beja/PT
Fig. 6: Epididymo-orchitis: Evident hypereremia on color Doppler examination in the affected side.

References: - Beja/PT
Fig. 7: Classic seminoma presenting as two well defined solid, hypoechoic foci, with intratumoral calcifications and with adjacent areas of healthy parenquima.

References: - Beja/PT
Fig. 8: Classic seminoma presenting as two well defined, hypervascular, solid, hypoechoic foci, with adjacent areas of healthy parenquima.

References: - Beja/PT
**Fig. 9:** Trauma to the testis: evident testicular fracture, seen as a linear hypoechoic band extending through the parenquima combined with rupture, in which there is interruption of the tunica albuginea with exteriorization of intratesticular content, associated with areas of heterogeneous echogenicity, corresponding to hemorrhagic and infarcted testicular parenquima.

**References:** - Beja/PT
Fig. 10: Trauma to the testis: evident testicular fracture combined with rupture and reduced or absent blood flow, with exception of the epididymis, which presents with increased vascular flow, due to traumatic epididymitis.

References: - Beja/PT
**Fig. 11**: Hyperemiated akinetic omental fat in the scrotal sac representing an incarcerated indirect inguinal hernia.

References: - Beja/PT
Fig. 12: Dilation of the pampiniform complex in bilateral idiopathic varicocele.

References: - Beja/PT
Conclusion

Ultrasound with color Doppler is the diagnosis modality of choice in acute scrotum presentation and directs successful treatment outcomes.
Personal Information

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References

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