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Imaging in scrotal trauma: a European Society of Urogenital Radiology Scrotal and Penile Imaging Working Group (ESUR-SPIWG) position statement

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Abstract

Imaging plays a crucial role in the evaluation of scrotal trauma. Among the imaging modalities, greyscale ultrasound and Colour Doppler ultrasound (CDUS) are the primary techniques with the selective utilisation of advanced techniques such as contrast-enhanced ultrasound (CEUS) and elastography. Despite ultrasound being the mainstay of imaging scrotal trauma, its diagnostic performance is not fully established. Considering these difficulties and their impact on clinical practice, the Scrotal and Penile Imaging Working Group of the European Society of Urogenital Radiology (ESUR-SPIWG) established an expert task force to review the current literature and consolidate their expertise on examination standards and imaging appearances of various entities in scrotal trauma. This paper provides the position statements agreed on by the task force with the aim of providing guidance for the use of imaging especially multiparametric US in scrotal trauma.

Key Points

- *Greyscale and Colour Doppler ultrasound are the mainstay of imaging in patients with scrotal trauma.*
- *Contrast-enhanced ultrasound and elastography are the advanced techniques useful as a problem-solving modality in equivocal cases.*
- *This paper summarises the position statements of the ESUR-SPIWG on the appropriate utilisation of multiparametric ultrasound and other imaging modalities in the evaluation of scrotal trauma.*

Keywords Scrotum · Trauma · Doppler · Ultrasonography · Testis

Abbreviations

CDUS	Colour Doppler ultrasound
CEUS	Contrast-enhanced ultrasound
EFSUMB	European Federation of Societies for Ultrasound in Medicine and Biology
ESUR	European Society of Urogenital Radiology
MPUS	Multiparametric ultrasound
SPIWG	Scrotal and Penile Imaging Working Group

Introduction

In patients with scrotal trauma, a variety of injuries should be differentiated to decide the appropriate treatment strategy. This strategy will range from a conservative approach to orchiectomy, and furthermore to complex and staged reconstructive procedures [1]. Imaging has a key role in this management task, with greyscale ultrasound and Colour Doppler ultrasound (CDUS) being the mainstay [2]. The combination of greyscale and CDUS with adjuvant techniques like contrast-enhanced ultrasound (CEUS) and elastography is described as multiparametric ultrasound (MPUS). The diagnostic performance of MPUS in trauma patients is not established. For example, the differentiation between testicular fracture and haematoma is essential in order to decide between a surgical and a

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conservative approach, but studies vary from reporting no false negatives [3], to a negative predictive value of only 58% [4]. CEUS has been found to be useful in identifying testicular viability when CDUS is equivocal. Elastography can be useful in differentiating haematomas from incidental testicular tumours. Along with CDUS, power Doppler and recently introduced superb microvascular imaging (SMI) can be used to confidently assess testicular vascularity in difficult cases. Differences in the diagnostic performance of multiparametric US are in part a consequence of the different quality of the US equipment used, but other factors have to be considered. Importantly, the study is essentially an emergency imaging procedure and frequently performed by sonologists or emergency physicians, possibly not fully trained in ultrasound (US) imaging. This has a detrimental effect on the performance of the technique, and would explain the distrust by urologists on using US for imaging scrotal trauma.

Currently, the guidelines of the European Association of Urology (EAU) recommend use of US in patients with scrotal trauma, but also underline that it is mandatory to surgically explore the patients with equivocal US findings or with findings inconsistent with the clinical presentation [1].

Methodology

The Scrotal and Penile Imaging Working Group of the European Society of Urogenital Radiology (ESUR-SPIWG) is aware of these difficulties and of their impact in clinical practice. It fully recognises the need to establish examination standards, required skills and competences of the sonologists, and to illustrate both the potential and the pitfalls of multiparametric US and of other imaging techniques in the setting of scrotal trauma.

This Working Group established an expert task force to review the currently available literature on this topic, identified accumulated knowledge and limitations in order to establish the current position paper. The aim is to provide guidance for the use of various imaging techniques in scrotal trauma. The lead authors (S.R., M.B., V.D.) formulated a series of position statements based on the available literature, existing guidelines from the European Association of Urology (EAU), American Urological Association (AUA), European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) and British Association of Urological Surgeons (BAUS). The position statements were then sent to the members of SPIWG for feedback and approval. The position statements were then modified based on this feedback and final approval obtained from SPIWG of ESUR.

Anatomy

The testis is surrounded by the tunica albuginea, a fibrous capsule which projects septa in the parenchyma converging into the mediastinum testis. The septa divide the testicular parenchyma into lobules. On US, the testis has homogeneous echotexture with uniformly distributed medium-level echoes [5]. The testicular artery arises from the abdominal aorta just below the origin of the renal arteries, enters the spermatic cord and reaches the upper pole of the testis. The cremasteric and the deferential arteries run in the spermatic cord beside the testicular artery. They are connected by anastomoses, but the testicular artery primarily supplies the testis, the deferential artery the epididymis and vas deferens, and the cremasteric artery the peritesticular tissues and the scrotal wall [6].

The testicular artery supplies the capsular arteries which run within the tunica vasculosa, a loose connective layer beneath the tunica albuginea. Testicular parenchyma is supplied by the centripetal and by the recurrent arteries, the former branch at the right angle from the capsular arteries. As they approach the mediastinum, centripetal arteries give rise to recurrent branches that run back in the opposite direction. A transmediastinal artery is often seen. Venous drainage is through paired testicular veins which form the pampiniform plexus and drain into the inferior vena cava on the right side and left renal vein on the left side [7] (Fig. 1).

Position statement 1

Knowledge of testicular anatomy and vascularisation is necessary to investigate patients with scrotal trauma.

Mechanism and type of trauma

Scrotal trauma can result from blunt, penetrating and degloving injuries. Blunt trauma is the most common type (80%), usually unilateral, most often seen in sports injuries [1, 8]. Other causes include motor vehicle collisions, assault, straddle injuries and falls [9]. The right testis is more often injured as it tends to lie in a higher position and is therefore more likely to be trapped against the pubis or inner thigh [10]. The most common cause of penetrating trauma is a gunshot wound [11]. Degloving injuries are rare, most commonly encountered following the use of heavy machinery.

Penetrating trauma is usually apparent from clinical history and examination and usually requires surgical exploration to assess the severity. The most common cause of penetrating trauma is a gunshot wound [11] with other causes including stab wounds, animal bites and self-mutilation. Degloving injuries are rare, most commonly encountered following the use of heavy machinery such as farming or industrial equipment (Table 1).

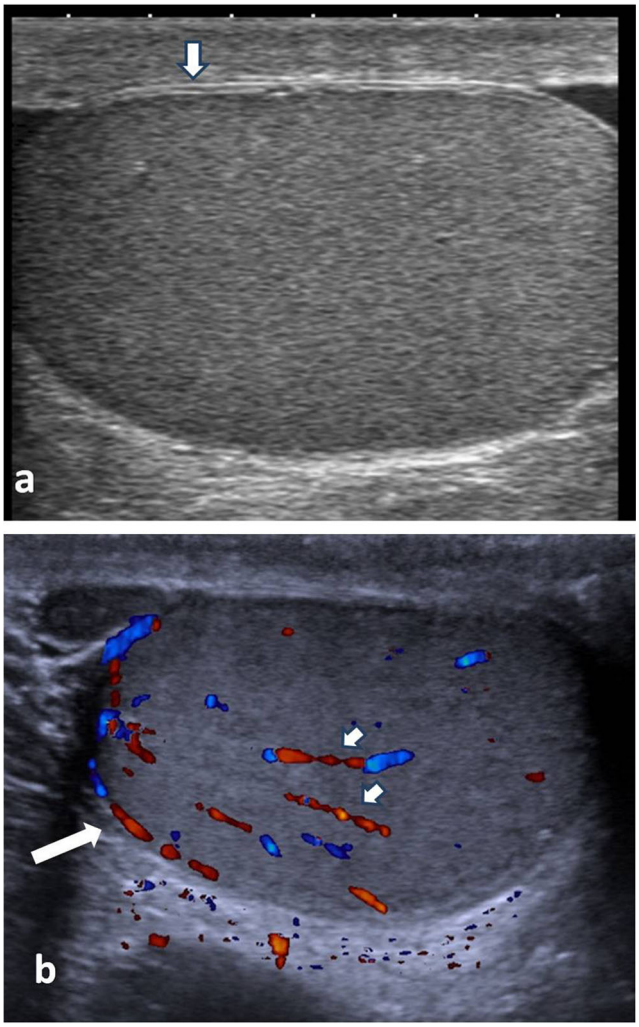

Fig. 1 Sonographic anatomy of the testis. **a** The testis is bound by a fibrous tissue called tunica albuginea (arrow) seen as a bright double line on high-frequency greyscale US. Assessing the integrity of this tunica albuginea on US is vital in the evaluation of testicular trauma. **b** Colour Doppler ultrasound (CDUS)

Position statement 2

When performing an US investigation for scrotal trauma, the sonologists should have adequate knowledge and understanding of the mechanism and type of trauma.

Greyscale and Colour Doppler US

US is the mainstay for imaging scrotal trauma and is commonly performed as an emergency procedure. A standard US investigation should include both evaluation of the scrotal content on greyscale US with high-frequency broadband transducer (lower frequencies may be used with marked scrotal enlargement), and assessment of testicular vascularity with Colour Doppler US (CDUS) and spectral US analysis.

Table 1 Mechanism of trauma

Mechanism of trauma	Causes
Blunt trauma	Sport injuries Assault Motor vehicle collisions Straddle injury Fall
Penetrating trauma	Gunshot wound Stab wound Animal bite Self-mutilation
Degloving	Operating heavy machinery

US is performed with the patient supine, and the penis placed superiorly against the abdomen, and with a supportive towel between the patient's thighs to elevate the scrotum, keeping the testes in a parallel position, helping comparative views. In a degloving injury, if the clinical situation indicates that preoperative assessment of the testes is essential, a careful US investigation using sterile gel and transducer covers is essential.

Scanning is performed using linear high-frequency (7.5–12.0 MHz) transducer with the selective use of lower frequency transducers in marked scrotal enlargement. Asymptomatic side should be scanned first to appropriately set the flow/gain parameters. Scanning of both testes and epididymis is performed in sagittal and transverse planes with size measurements. Longitudinal images of each testis in the medial, mid and lateral portions and transverse images of the upper, mid and lower poles of each testis should be taken. An extended field-of-view transverse image including both testicles on the same image should be acquired to allow side-to-side comparison of echotexture and vascularity.

Spectral waveforms of both arterial and venous flow should be documented. Doppler parameters are adjusted to evaluate slow flow, with high colour gain settings. Smallest colour sampling box should be used in the region of interest before reporting no vascularity. Wall filter and pulse repetition frequency are kept low. Flow should be identified in normal testis and compared with the injured testis. Intratesticular arteries show high-velocity low-resistance pattern with resistive index (RI) ranging from 0.5 to 0.7. Absent or reversed diastolic flow and RI > 0.7 indicate testicular ischemia. Power Doppler can be useful as an alternative in low flow states and paediatric patients. Power Doppler identified flow in 97% testes, whereas CDUS in 88% testes. Combined techniques depicted blood flow in 100% testes. Superb microvascular imaging (SMI) is a newer technique to detect low-velocity blood flow in small vessels. It has been shown to be more sensitive than conventional techniques due to its higher frame rate (thereby reducing motion artefacts) and no filters enabling it to capture microvascular flow [12].

Extratesticular findings also should be assessed, including hydrocele, haematocele and traumatic injuries of the scrotal wall. Approximate volume of the extratesticular scrotal collections need to be measured as it helps in deciding the management as discussed in the later sections.

Position statement 3

A standard US examination for scrotal trauma should include greyscale US, Colour Doppler and spectral US analysis.

Position statement 4

Transverse images including both testes should be acquired when anatomy permits, to allow side-to-side comparison of echotexture and vascularity.

Testicular rupture

Assessing the integrity of the tunica albuginea is the key factor to decide whether the patient should be surgically managed. A prompt diagnosis is essential since > 80% of ruptured testes are salvageable if surgery is performed within 72 h [13]: the reason for an emergent US in scrotal trauma. Specific findings are discontinuity of the tunica albuginea and testis contour abnormality. Associated findings include heterogeneous echotexture, related intra- and extratesticular haematomas and absent/reduced vascularity which may also be seen, with an intact tunica albuginea.

Interruption of the echogenic line of the tunica albuginea is the most specific sign and can be seen most of the times with the current high-resolution greyscale US. However, it can also be inferred indirectly by observing contour abnormality which denotes irregularity in the normally smooth testicular surface due to parenchymal protrusion through the tunical defect. A study reports that combination of contour abnormality and heterogeneous echotexture is 100% sensitive and 93.5% specific for the diagnosis of testicular rupture [3], but other studies report less favourable results [4]. A change in the normal echotexture of the testis is a nonspecific finding, but may indicate an injured parenchyma. Although discontinuity in the tunica albuginea warrants surgical exploration, there are reports that delayed presentation of testicular rupture with preserved vascularity can be managed conservatively [14].

Evaluation of testicular vascularity with CDUS is essential both to predict viability of the parenchyma and to help the surgeon to plan the extent of testicular debridement. The testicular parenchyma is fed by centripetal arteries branching at the right angle from capsular vessels, and this anatomical arrangement makes these arteries susceptible to disruption at their origin (Fig. 2). In some cases, a linear avascular band running across the testicular parenchyma can be seen with or without tunica albuginea disruption. On imaging, it has been described as 'testicular fracture' and is rare reported only in 17% of cases [2, 15] (Fig. 2). CEUS can be used to demonstrate the fracture line in suspected cases and reported to be more sensitive than CDUS [16]. Management depends on the status of tunical albuginea and testicular vascularity.

Position statement 5

During US in scrotal trauma, it is important to document the continuity of echogenic tunica albuginea and smooth maintained testicular contour to rule out testicular rupture.

Position statement 6

Changes in testis echotexture may be the clue of underlying testicular parenchymal injury.

Position statement 7

Testicular vascularity should be demonstrated using CDUS as an aid in deciding between surgery and nonoperative management in mild injury and between orchiectomy and testicular repair in severe injury.

Intratesticular haematomas

Intratesticular haematomas are often found in patients with scrotal trauma, either isolated or in association with other scrotal injuries. When small, haematomas can be managed conservatively if tunica albuginea is intact [1]. Early after trauma, haematomas may be isoechoic to testis and difficult to identify at US [2]. In our experience, in patients with significant scrotal trauma and unremarkable scrotal US, depending on the clinical judgement, it may be appropriate to repeat US in 24 h to detect intratesticular haematoma which may not be apparent at the time of presentation [2, 17, 18]. US follow-up is also indicated to detect complications such as infection and ischaemia [19, 20]. Ten percent of intratesticular tumours are detected incidentally in patients presenting with a history of scrotal trauma. Therefore, it is mandatory to follow all intratesticular parenchymal abnormalities to complete resolution by US such that incidental intratesticular tumours are not missed [19, 21, 22]. CEUS can be helpful to differentiate between intratesticular haematoma and intratesticular tumour. Rupture of testis secondary to an unrecognised underlying testicular tumour has also been described [23]. The sonologists should be aware of this possibility, particularly when there is a testicular rupture and the history is of only mild trauma (Fig. 3).

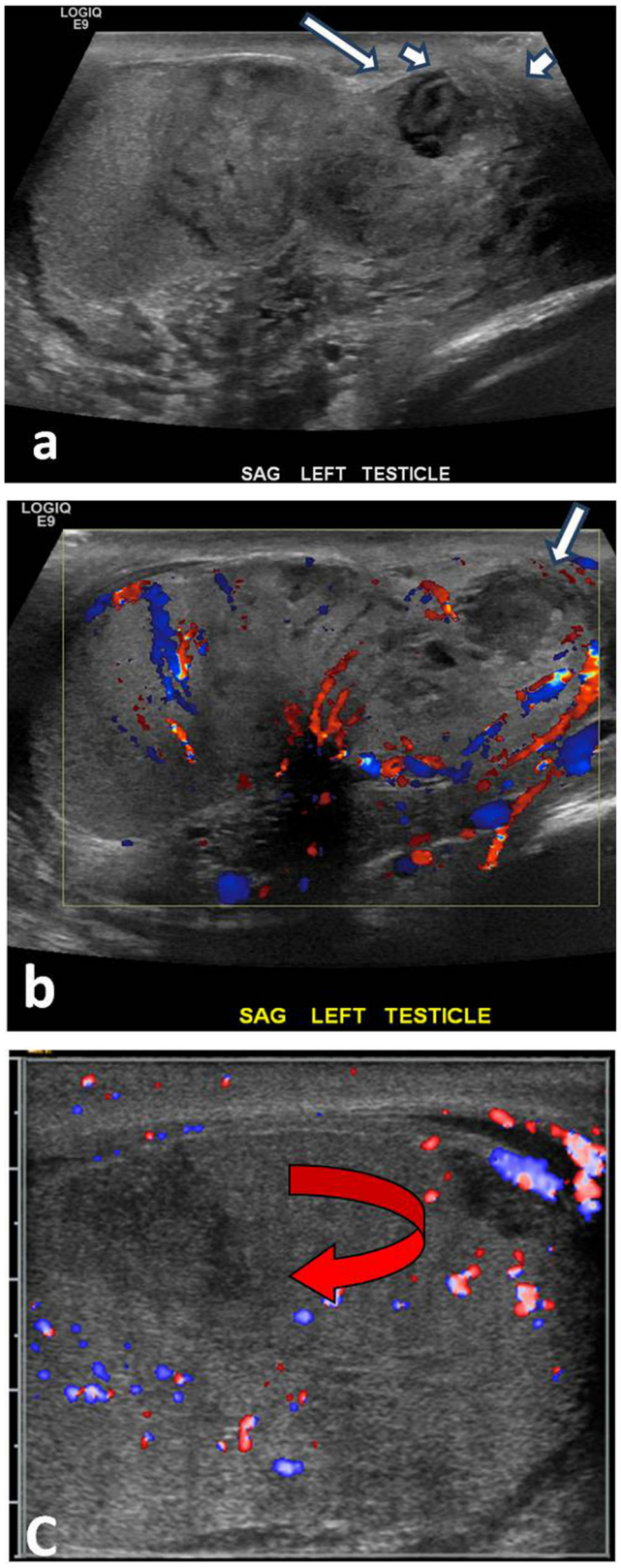

Fig. 2 Testicular rupture and fracture. **a** Contour abnormality of the lower pole of the testis with protrusion of the testicular parenchyma (short arrows) through the ruptured tunica albuginea (long arrow). **b** Corresponding Colour Doppler image demonstrates avascularity in the extruded testicular tissue (arrow). Features indicate testicular rupture. **c** A linear, hypoechoic area through the testicular parenchyma with absent vascularity in another patient status post testicular trauma representing testicular fracture (curved arrow)

Position statement 8

Although any intratesticular focal lesion in the setting of scrotal trauma is more likely to represent intratesticular haematoma, follow-up is recommended to exclude an underlying tumour.

Post-traumatic hydrocele, haematocele and extratesticular haematomas

Nearly all patients with scrotal trauma develop a hydrocele, usually small and resolves spontaneously. Haematoceles are common and are usually managed conservatively. Larger ones, however, may require surgery, if they compress the vessels of the spermatic cord or directly compress testicular parenchyma and cause testicular ischemia [24]. It has been suggested that haematocele smaller than 3 times the size of the contralateral testicle may be managed conservatively while in larger haematoceles prompt drainage is recommended, irrespective of the presence of associated testicular rupture as it has a higher probability to be missed on ultrasound in these cases [1]. Low-frequency curved transducers may be required to evaluate large haematocele due to better penetration. Other techniques like power Doppler, SMI or CEUS can be used to detect testicular vascularity as CDUS can be less sensitive due to large collection. At US, an acute haematocele can appear isoechoic to testis making identification of parenchyma extrusion difficult [16]. In the subacute and chronic stages, a haematocele becomes more hypoechoic, often with mixed appearances developing with debris [16] (Fig. 4). Extratesticular haematomas may involve the spermatic cord, epididymis and scrotal wall. Similar to haematocele, their appearance varies with time (Fig. 5).

Position statement 9

In patients with large extratesticular blood collection, testicular vascularity should be evaluated using CDUS.

Traumatic epididymitis

Following a trauma, the epididymis may be painful, heterogeneously enlarged and hypervascularised, mimicking epididymitis [25]. In these patients, US may also reveal areas consistent with small haematomas and contusions [17] (Fig. 6).

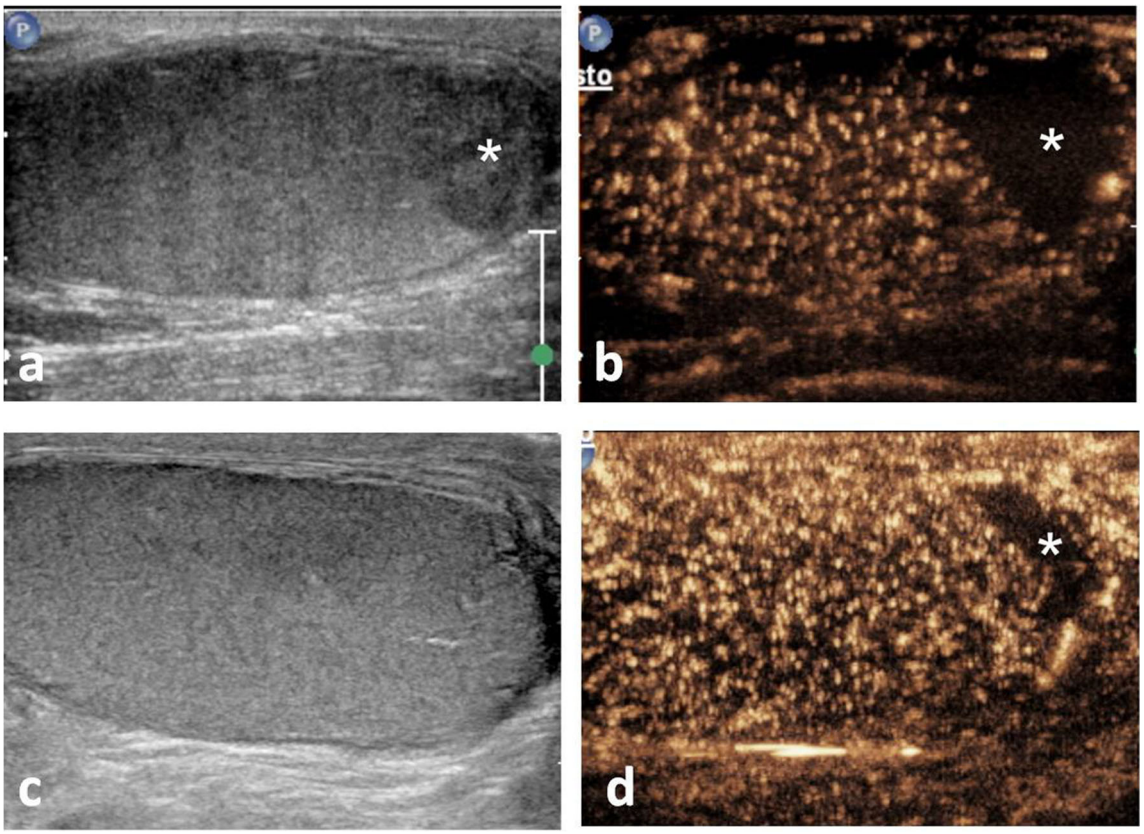

Fig. 3 Intratesticular haematoma. **a**, **b** Patient investigated 3 h after the trauma. **a** Greyscale US shows a barely visible, hypoechoic area in the lower pole of the testis (asterisk). **b** Contrast-enhanced ultrasound (CEEUS) shows a well-defined area lacking contrast enhancement in the lower pole of the testis (asterisk) consistent with haematoma. **c**, **d** Follow-up US examination performed 4 days after the trauma. **c** Greyscale US shows complete disappearance of the lesion. **d** CEUS shows a residual non-enhancing crescent area (asterisk), markedly reduced in size compared to the first CEUS suggesting interval improvement

Position statement 10

Post-traumatic injury to the epididymis may mimic epididymitis. History of trauma is relevant for the correct diagnosis.

Testicular dislocation

Testicular dislocation is extra-scrotal migration of one or both testes as a consequence of direct scrotal trauma. It is bilateral in 30–50% of cases, and right testis is most commonly involved [26, 27]. Motorcycle collisions are the most frequent causative mechanism. The testis can be displaced in the inguinal canal, in the abdomen, in the femoral region or, superficially, in the subcutaneous tissue. Physical examination usually allows the diagnosis revealing a tender mass and an empty hemiscrotum. In polytrauma patients with severe life-threatening injuries, the scrotum may be difficult to examine, and testicular dislocation can be found unexpectedly during CT imaging performed to assess abdominal and pelvic injuries. Extending the CT examination to the perineal and scrotal region is important. Also, dislocation may be overlooked or misinterpreted and recognised by the patient himself after discharge or incidentally, weeks to years after the injury [28].

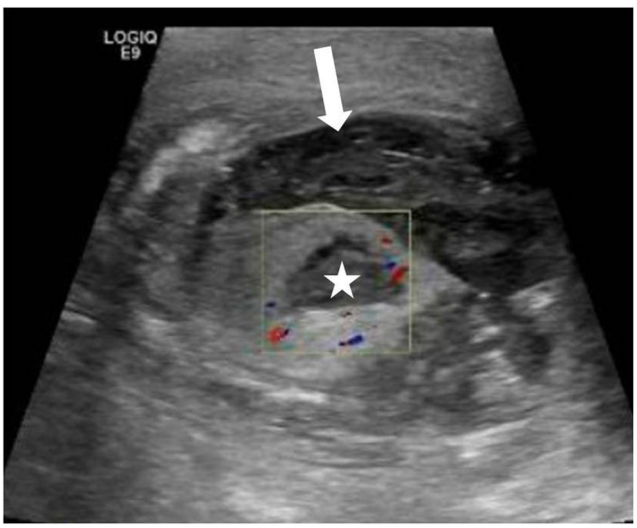

Fig. 4 Post-traumatic haematocele. Scrotal swelling and pain 5 h after trauma. Colour Doppler US shows thick fluid collection suggesting haematocele (arrow) and avascular intratesticular lesion suggesting haematoma (star) and adjacent preserved testicular vascularity

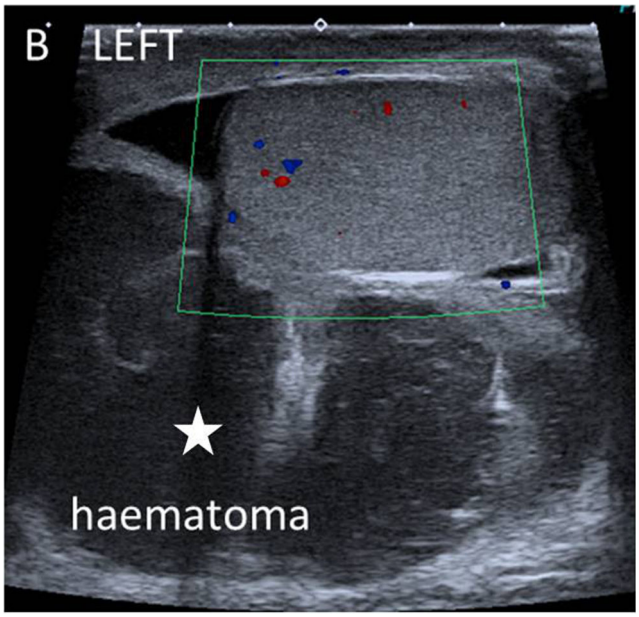

Fig. 5 Post-traumatic extratesticular haematomas. Patient with Crush injury presenting with swelling after 3 days. Colour Doppler US showed large extratesticular haematoma (star) with intact testicular outline and vascularity

US can be used to locate the testis, to assess parenchymal viability, and to identify associated injuries to the testis, such as a haematoma, rupture or spermatic cord torsion [29]. In case of non-diagnostic US or CT imaging, MR imaging may be helpful (Supplementary Fig. 1).

Position statement 11

In a patient with polytrauma, testicular dislocation may be identified unexpectedly during a CT examination performed to assess abdominal and pelvic injuries. Extending CT scanning to the perineal and scrotal regions is advisable.

Position statement 12

If testicular dislocation is identified clinically, US can be used to locate the testis, identify intratesticular injuries and assess parenchymal viability. CT or MRI may be considered in cases of inconclusive US findings.

Post-traumatic torsion

Torsion of the spermatic cord follows trauma in 4–8% of cases [30]. Delayed diagnosis is frequent, since scrotal pain is often incorrectly attributed solely to the traumatic injury. As with non-traumatic spermatic cord torsion, the probability of successful testicular salvage depends on the duration of the torsion and degree of twisting [30, 31]. CDUS findings are similar to those of non-traumatic torsion. Arterial flow, in particular, can be present in low-degree torsion. Spectral Doppler analysis of the intratesticular arteries, to identify high-resistance flow compared to the contralateral testis, and evaluation of the spermatic cord to look for the whirlpool sign (twisting of spermatic cord) and pseudomass of redundant spermatic cord and epididymal head are necessary to avoid false negative examinations [22, 32].

Position statement 13

Post-traumatic testicular torsion should be considered in a polytrauma patient presenting with severe scrotal pain.

Penetrating injuries

The incidence of penetrating trauma to the scrotum is increasing [2]. Superficial wounds can be managed conservatively but any penetrating injury usually requires surgical exploration [1, 33, 34], although nonoperative treatment could be a

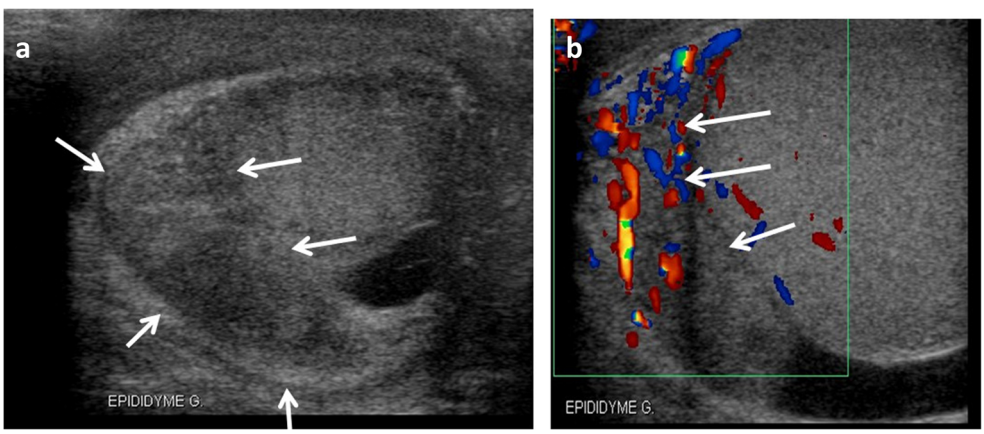

Fig. 6 Post-traumatic epididymitis. Patient with a recent history of direct scrotal trauma. Greyscale (left) and Colour Doppler US (right) shows swollen body of epididymis with increased vascularity (arrows) consistent with acute epididymitis

safe alternative in hemodynamically stable patients with unremarkable US findings [35].

US is able to assess the extent and severity of injuries, locate foreign bodies and depict missile trajectory. Use of sterile gel and transducer covers is mandatory [16]. CDUS allows evaluation of testis viability. CT imaging is able to locate foreign bodies not identified at US, helping with surgical extraction.

Position statement 14

In patients with penetrating traumas, US can be used to evaluate injury severity, assess testis viability and locate foreign bodies.

Role of contrast-enhanced ultrasound

Guidelines from the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) recommend contrast-enhanced ultrasound (CEUS) as a problem-solving modality in imaging the testis [36–38]. In scrotal trauma, CEUS may change the clinical management of the patient, ultimately obviating the need for exploratory surgery, or changing the surgical planning towards a more conservative approach [16, 39–43]. CEUS is highly effective in demonstrating parenchymal vascularisation, vascular lesions and ischaemic or necrotic areas. It is therefore indicated to unequivocally identify presence or absence of flow when CDUS is not diagnostic. CEUS clearly depicts fracture lines, intratesticular and extratesticular haematomas and presence of active bleeding [16, 40–44]. No flow is seen after ultrasound contrast agent administration in a high-degree, post-traumatic spermatic cord torsion and in post-traumatic infarction. CEUS also demonstrates the integrity of the tunica vasculosa, an indirect sign of intact tunica albuginea [40, 45]. The normal tunica vasculosa presents as an uninterrupted enhancing network stuck to the inner part of the tunica albuginea. CEUS is able to differentiate between intratesticular haematomas, which are avascular, and hypovascular tumours incidentally detected in a trauma setting [16] (Fig. 3).

Position statement 15

CEUS can be used to identify presence or absence of flow when CDUS is not diagnostic.

Position statement 16

CEUS can be used to identify testicular rupture, fracture lines, haematomas and ischaemic changes in equivocal cases at conventional US.

Position statement 17

CEUS can be used to distinguish between avascular and poorly vascularised lesions, thus helping to differentiate between haematomas and tumours.

Role of elastography

Ultrasound strain elastography, a newer sonographic technique, has been developed as an adjunctive tool to provide additional information on tissue stiffness in clinical practice to further improve diagnostic confidence. In the onset of trauma, palpation of the scrotal content may be difficult, or even impossible, but US elastography as a part of a multiparametric US investigation is usually feasible. The visual elasticity score (VES), which grades the elastographic appearance into 5- or 6-point scales, adapted from breast elastography, has been used to categorise stiffness of a testicular abnormality. A VES cut-off of 3 may be used to classify testicular lesion stiffness into 'hard' (VES > 3) or 'soft' (VES ≤ 3 [46]).

Testicular haematomas are more often 'soft' [41], but an overlap exists with tumour lesions [41, 47]. One study by Yusuf et al showed that 13 out of the 16 cohort of intratesticular haematoma had a VES of 3 and the reported mean strain ratio was 1.19 (range 0.41–2.36) [38]. Akin to other focal testicular pathologies, an overlap in elastographic appearances exists for testicular haematoma. Preliminary investigations report stiffness changes in haematomas during the healing process [47] (Supplementary Fig. 2).

Position statement 18

In scrotal trauma, 'soft' testicular lesions are usually haematomas. Follow-up is recommended to exclude underlying tumours.

Role of CT and MRI

CT is the imaging modality of choice in polytrauma patients. It is able to locate testis dislocation, blood collections and active bleeding. Including the scrotum in the scanning volume in polytrauma CT examination is therefore recommended and often it is performed with contrast to detect other solid organ injuries and sites of bleeding [48] (Supplementary Fig. 1).

It is often problematic to obtain a scrotal MRI in an emergency, limiting use in scrotal trauma. MRI is indicated to depict the tunica albuginea in cases equivocal for testicular fracture at US. Tunica albuginea is best assessed on T2WI as a hypointense signal intensity line surrounding the testis. In cases of trauma, the minimum requirements for scrotal MRI should include axial T1WI, T2WI in all three planes and

coronal subtracted dynamic contrast-enhanced-MRI [49–52]. MRI can be used to document unequivocally the presence of blood in lesions identified at US. Haematomas have different signal intensity characteristics over time, as a consequence of haemoglobin degradation. Lack of enhancement confirms the benign nature and allows differentiation from hypovascular tumours [50]. If CEUS is not available, MRI can be used to assess unequivocally the presence or absence of flow when CDUS is not diagnostic. Infarctions are well characterised as non-enhancing lesions, sometimes with intralesional haemorrhagic changes [50, 53]. MRI can be useful as a panoramic investigation as in very large lesions and for identification of a dislocated testis (Supplementary Fig. 3). Scrotal scintigraphy is a radio-isotope technique used in the past to differentiate testicular torsion from epididymo-orchitis in acute scrotum. Its use in the clinical practice is currently limited, due to radiation exposure, poor anatomical detail, long examination time and false positive [54].

Position statement 19

MRI can be used in cases of equivocal US findings to identify tears in tunica albuginea, to characterise haematomas, to differentiate tumours from haematomas, to assess presence/absence of flow and to localise a dislocated testis.

Follow-up imaging after treatment

Patients with scrotal trauma are followed up to monitor lesion recovery and to detect late complications. Most guidelines have no specific recommendations for a follow-up regimen. In clinical practice, following initial few days of intensive follow-up, a 3-month follow-up for both clinical evaluation and scrotal US should be scheduled for patients who were managed conservatively. This allows to document resolution of injuries, to identify parenchymal scars and to evaluate size, echotexture and vascularisation of the testes for detecting testicular atrophy [10, 24, 55]. In cases of surgical management, outpatient review should be done at around 2 weeks to assess adequate healing and to detect any signs of infection. Also, the patient should be educated that scrotal swelling can take up to 4 weeks to resolve.

Position statement 20

US follow-up of patients with testicular traumas should be considered to ensure resolution/healing of parenchymal changes and to assess postoperative changes.

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Compliance with ethical standards

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Statistics and biometry No complex statistical methods were necessary for this paper.

Informed consent Written informed consent was not required for this study because this paper provides a summary of available evidence and expert opinion; no new studies on patients were involved.

Ethical approval Institutional Review Board approval was not required because this is an evidence summary and expert recommendation paper. No new studies on human patients were undertaken specifically for this paper.

Study subjects or cohorts overlap All previous studies cited as evidence in this paper are acknowledged in the references.

Methodology Multicentre authored paper on behalf of the Scrotal and Penile Imaging Working Group of the European Society of Urogenital Radiology (ESUR-SPIWG).

Literature review, evidence summary and expert recommendations.

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