

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: **Acute Onset of Scrotal Pain—Without Trauma, Without Antecedent Mass**

Variant 1: **Adult or Child.**

Radiologic Procedure	Rating	Comments	RRL*
US duplex Doppler scrotum	9	This is an excellent procedure that is generally available and has high sensitivity and specificity.	O
MRI pelvis (scrotum) without and with IV contrast	4	Consider this procedure after US with duplex Doppler and if torsion is unlikely based on US and/or no surgical exploration is planned.	O
Tc-99m scrotal scintigraphy	3		☼☼☼
MRI pelvis (scrotum) without IV contrast	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

ACUTE ONSET OF SCROTAL PAIN— WITHOUT TRAUMA, WITHOUT ANTECEDENT MASS

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Summary of Literature Review

Introduction/Background

The ability to confidently establish a surgical versus a nonsurgical diagnosis for acute scrotal pain is important. The benefits of early surgery for testicular salvage in ischemic disease, primarily torsion of the spermatic cord, are well known [1] but must be balanced against the costs of operating unnecessarily on a large number of patients with nonsurgical disease, primarily acute epididymitis [1-3]. Although the acute scrotum is defined as acute scrotal swelling with or without pain, most patients present with pain as their primary complaint. The most common differential diagnoses of the acute scrotum include 1) torsion of the spermatic cord, 2) torsion of the testicular appendages, and 3) acute epididymitis or epididymoorchitis. Less common diagnoses include strangulated hernia, segmental testicular infarction, trauma, testicular tumor, and idiopathic scrotal edema. This appropriateness discussion, however, will be limited to patients with acute pain who have no history of trauma and no history of a mass before the onset of pain.

Acute epididymitis is commonly the cause of acute scrotal pain in adults and should be differentiated from testicular torsion. Testicular torsion is rare in patients older than age 35 [4]. Acute epididymitis is commonly the cause of acute scrotal pain in patients younger than age 18, very common in patients age 19 to 25, and overwhelmingly the etiology in patients older than age 25. Acute scrotal pain in prepubertal boys occurs most commonly from torsion of the testicular appendages, a process that may clinically mimic testicular torsion or epididymoorchitis [5]. A pathognomonic physical examination finding (“blue dot sign”) is infrequently encountered.

Patients with testicular torsion typically present with abrupt scrotal pain, whereas those with epididymitis have a more gradual onset of pain. Patients with torsion will have a normal urinalysis, whereas those adults (but not children) [6] with epididymitis will have an abnormal urinalysis. There is, however, overlap in the clinical presentation of the different causes of acute scrotal pain. Imaging in clinically equivocal cases may lead to an early diagnosis of testicular torsion and thus decrease the number of unnecessary surgeries. A study comparing primary scrotal exploration (294 patients) and initial ultrasound (US) examination (332 patients) with exploration for positive US results or a high clinical suspicion of torsion [2] showed that US obviated the need for exploration in many patients and thus shortened hospital stays.

Radionuclide Imaging

Radionuclide scrotal imaging (RNSI) was first introduced in 1973 and was soon used as the primary imaging modality for evaluation of the acute scrotum. In the differentiation of testicular torsion and epididymoorchitis, there is a reported sensitivity range of 89%–98% and specificity of 90%–100% [4,7-11]. Since the acceptance of Doppler US as the primary imaging for evaluation of acute scrotum, RNSI is uncommonly used, and there are no recent large case series to evaluate its accuracy or compare it to the current US technique [7,12]. One old series on children showed potential value of RNSI when scrotal US findings are equivocal [13]. However, with the

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improved US technology it is not clear that this finding holds true. A potential pitfall in RNSI is that photon-deficient areas secondary to hydrocele, spermatocele, and rarely an inguinal hernia can be mistaken for an avascular testis [8]. One study found that 20 of 27 photopenic scrotal lesions were false-positives (not torsion), and the US examination prevented unnecessary surgery in 16 (59%) of these cases [8]. Problems in examination performance may arise in infants and very small children whose genitalia are small and therefore difficult to image. The unavailability of RNSI equipment in many radiology practices as well as its use of ionizing radiation, its poor anatomical detailing, and the time required for RNSI examinations may be also limiting factors [4].

Ultrasound

Standard US of the scrotum should include both grayscale and Doppler studies. Linear high-resolution transducers should be used. The studies should include both the scrotum and inguinal areas. Grayscale US alone can distinguish the cystic or solid nature of scrotal masses and often can identify an inflamed epididymitis or a necrotic testis, but it is much less sensitive to the earliest changes resulting from decreased or absent testicular perfusion. In patients with torsion, however, a normal homogenous echo pattern is likely to indicate a viable testis, whereas a hypoechoic or inhomogeneous testis is likely to be nonviable [14]. One study has shown a high sensitivity of grayscale US to detect torsion of the spermatic cord. An abnormal spermatic cord “twist” was identified in 199 of 208 patients (sensitivity 96%). Further, a normal linear cord was found in patients without torsion (705 of 711 patients, 99% specificity) [15]. The finding of a twisted cord has also been referred to as the “whirlpool sign” and can be found at the external inguinal ring, above the testis, and posterior to the testis and may be best seen in longitudinal, transverse, or oblique scans depending on the particular patient [16].

Color Doppler US (CDU) is a valuable examination for evaluating testicular perfusion [14,17]. Color duplex Doppler, a method frequently employed, involves the simultaneous acquisition and display of color Doppler and spectral Doppler waveforms in conjunction with grayscale sonographic imaging. Settings optimized to detect slow flow include use of a small color-sampling box, lowest pulse repetition frequency, and lowest possible threshold. CDU equipment has improved, and experience with CDU in evaluating the acute scrotum has increased, both by practicing physicians and by those in training. It is readily available and can be done quickly without any specific preparation. Power Doppler US can be used in place of, or as an adjunct to, CDU. Power Doppler US has been shown to demonstrate flow where CDU does not and has been shown, in general, to demonstrate slower flow better than CDU [14]. Power Doppler US is especially useful to demonstrate intratesticular flow in prepubertal testes [4].

A large number of primarily retrospective studies have investigated the utility of CDU in assessing testicular torsion. In those studies that deal with more than 20 cases of testicular torsion for which CDU is available in all cases, there is a reported sensitivity of CDU in detecting torsion ranging from 96% to 100%, with a specificity of 84%–95% [18]. A negative US examination is highly predictive of the absence of torsion at the time of imaging [19].

Doppler US is not without drawbacks. One area of concern has been its application in the young child, particularly the prepubertal child [20]. Studies in children have shown a sensitivity of 89% and specificity of 100%, but technically unsuccessful studies can occur, emphasizing the need for experience and proper equipment settings when examining the young child [4].

Blood flow can occasionally be preserved in patients with torsion [21,22]. Attention to spectral Doppler waveforms patterns (high-resistance arterial waveform, monophasic waveform) [22] and spermatic cord morphology (twisted or thickened spermatic cord) [15,16,21] may help diminish false-negative examinations.

The most common cause of acute scrotal pain in adolescent boys and adults is epididymo-orchitis. Grayscale US combined with color Doppler imaging is the prime imaging means to make this diagnosis. The epididymis is enlarged, has increased flow, and may be increased or decreased in echogenicity. Scrotal wall thickening and hydrocele are common. A recent retrospective study of patients with epididymitis reported a 47% rate of concomitant orchitis, which substantiates other earlier studies [23]. The most common cause of acute scrotal pain in the child is torsion of an appendix testis [24]. Reactive changes (hydrocele, epididymal head enlargement, increased color Doppler flow) from torsion of a testicular appendage may mimic epididymitis [5]. A torsed testicular appendage can be difficult to identify with US. It was seen in only 9 of 29 patients (31%) in 1 study [5], but it is usually larger, rounder, and has more surrounding flow than normal appendages [25]. A size criterion of >5.6 mm alone may discriminate torsed from normal testicular appendages with low sensitivity (67%) but high specificity (100%), obviating surgery in some cases [26].

Scrotal fat necrosis is an uncommon cause of mild to moderate scrotal pain typically in overweight prepubescent boys with recent cold exposure, usually from swimming. Typically diagnosed clinically, bilateral intrascrotal masses caudal to the testes are palpated. On US, the testes are normal, and the scrotal fat caudal to the testes is characteristically hyperechoic with posterior shadowing [27].

An uncommon cause of acute scrotal pain in adult men (median age 37–38) is segmental testicular infarction [28,29]. Although most cases are considered idiopathic, a number of associated conditions have been described, including epididymo-orchitis, trauma, or hematological disorders (sickle cell disease, polycythemia, and hypersensitivity angitis) and previous surgery. Although a wedge-shaped avascular focal area on US is considered the classic appearance [29], round lesions were seen in 13 of 24 patients (54.2%), and color Doppler flow was seen in 4 of 24 patients (16.7%) in one series [28]. Magnetic resonance imaging (MRI) may be useful to identify patients with segmental testicular infarction when US is not conclusive. Segmental infarction is most often imperceptible on unenhanced T1-weighted MR images but may show a central high-signal-intensity focus from hemorrhage. It is well-marginated but has variable signal intensity on T2-weighted images. After administration of gadolinium chelate contrast medium, it is avascular but is most often circumscribed by an enhancing rim [29]. Because distinguishing between segmental testicular infarction and testicular tumor can be difficult, most authors in the past recommended surgery, but more recently a conservative approach with US follow-up has been recommended [30]. Contrast-enhanced US (CEUS) is a technique applying a US contrast media, such as microbubbles administered intravenously into the systemic circulation, to highlight echogenicity differences between structures. Preliminary data suggest that CEUS is more accurate in the final diagnosis compared to traditional US, especially for cases of segmental infarction, potentially reducing the need for further imaging [31,32]. However, CEUS is still under investigation and is not FDA approved.

Acute idiopathic scrotal edema (AISE) is a rare, self-limiting condition that is characterized by sudden onset of edema and erythema of the scrotal wall. It is more commonly observed in children than in adults and is often diagnosed by exclusion. AISE is usually painless. The hallmarks of US findings are marked thickening of the scrotal wall with a heterogeneous striated and edematous appearance with increased vascularity [33,34]. Other findings include increased peritesticular blood flow, reactive hydrocele, and enlargement and increased vascularity of the inguinal lymph nodes [34]. The testes and epididymides are normal and do not show increased vascularity.

Magnetic Resonance Imaging

MRI techniques are not typically used for the acute scrotum due to the limited availability of equipment and the long examination time involved. However, the use of MRI in scrotal diseases is increasing [35-37]. A retrospective study reports that MRI has a 93% sensitivity and 100% specificity for diagnosing testicular torsion [35].

The most sensitive finding in torsion is decreased or lack of perfusion on dynamic contrast-enhanced MRI [38]. Other characteristics include low or very low signal intensities with spotty or streaky patterns on fat-suppressed T2-weighted, heavily T2-weighted, or T2*-weighted images [38]. The use of a combination of dynamic contrast-enhanced T1-weighted MR imaging with T2- and T2*-weighted sequences may help distinguish patients with torsion alone from those with torsion and hemorrhagic necrosis [38].

Summary of Recommendations

- Patients in whom there is a strong clinical suspicion for testicular torsion can be promptly referred for scrotal exploration.
- CDU with grayscale imaging and special attention to the spermatic cord is the study of choice to evaluate patients with acute scrotal pain due to its widespread availability and its ability to diagnose testicular torsion with a high degree of sensitivity and specificity and to distinguish other causes of scrotal pain and swelling.
- RNSI is infrequently used due to longer examination times, less availability, use of radiation, and diminished diagnostic capability in young boys.
- If one performs CDU and results are equivocal for testicular torsion, scrotal exploration may ensue.
- Future studies are needed to evaluate the role of MRI in patients with acute scrotal pain who have equivocal CDU findings.

Summary of Evidence

Of the 38 references cited in the ACR Appropriateness Criteria® *Acute Onset of Scrotal Pain — without Trauma, without Antecedent Mass* document, all of them are categorized as diagnostic references including 1 good quality study and 20 quality studies that may have design limitations. There are 17 references that may not be useful as primary evidence.

The 38 references cited in the ACR Appropriateness Criteria® *Acute Onset of Scrotal Pain — without Trauma, without Antecedent Mass* document were published between 1983-2013.

While there are references that report on studies with design limitations, 1 good quality study provides good evidence.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	0 mSv	0 mSv
☼	<0.1 mSv	<0.03 mSv
☼☼	0.1-1 mSv	0.03-0.3 mSv
☼☼☼	1-10 mSv	0.3-3 mSv
☼☼☼☼	10-30 mSv	3-10 mSv
☼☼☼☼☼	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.