American College of Radiology
ACR Appropriateness Criteria®
Newly Diagnosed Palpable Scrotal Abnormality

Variant: 1 Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
US duplex Doppler scrotum	Usually Appropriate	O
US scrotum	Usually Appropriate	O
MRI pelvis (scrotum) without and with IV contrast	May Be Appropriate	O
MRI pelvis (scrotum) without IV contrast	May Be Appropriate	O
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT pelvis without IV contrast	Usually Not Appropriate	☢☢☢
Nuclear medicine scan scrotum	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 2 Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
US duplex Doppler scrotum	Usually Appropriate	O
US scrotum	Usually Appropriate	O
MRI pelvis (scrotum) without and with IV contrast	May Be Appropriate	O
MRI pelvis (scrotum) without IV contrast	May Be Appropriate	O
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT pelvis without IV contrast	Usually Not Appropriate	☢☢☢
Nuclear medicine scan scrotum	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

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Summary of Literature Review

Introduction/Background

Palpable scrotal abnormalities are caused by a variety of disorders, ranging from indolent benign conditions to aggressive tumors as well as infectious and vascular processes, often requiring emergent surgical intervention [1-3]. In these patients, the diagnostic workup typically begins with a complete clinical history and physical examination, including analysis of risk factors, often followed by imaging [4,5].

Germ cell testicular tumors (GCTT) are the most frequently diagnosed cancer in young men and constitute approximately 95% of all testicular tumors [6]. It is estimated that 1 in 250 men will develop GCTT during their lifetime, most often between 20 to 34 years of age, representing 0.5% of all new malignancies [6]. GCTT histologically include seminoma and nonseminoma (52% and 48%, respectively) or mixed tumors [7].

Several risk factors have been studied to determine the risk of development of testicular cancer. These include cryptorchidism (relative risk [RR] ≥3.18), hypospadias (RR 2.41), inguinal hernia (RR 1.37), and other birth-related factors of a lower risk [8,9]. Cryptorchidism is associated with a higher risk for ipsilateral testicular cancer (RR 6.33) than contralateral testicular cancer (RR 1.74) [8]. The role of testicular microlithiasis in the carcinogenesis remains controversial with more recent literature, suggesting it only increases the chance of testicular malignancy in patients with other known risk factors of GCTT [10]. Testicular microlithiasis in the absence of a solid mass or other risk factors for GCTT does not confer an increased risk of malignant neoplasm and does not require further evaluation or follow-up [11,12].

Most patients with GCTT are diagnosed quite early and present with stage I disease, when the tumor is confined to the testicle; in these patients, inguinal orchiectomy is the first recommended maneuver that has both diagnostic and therapeutic aims [13]. Close clinical and imaging surveillance with or without short-course adjuvant chemotherapy are accepted alternatives for patients with stage I disease [6]. In patients with more advanced disease presenting with extratesticular tumor, several courses of chemotherapy followed by the judicious surgical removal of residual tumor is commonly used. High-risk patients and those with relapsing or refractory disease are referred to specialized tertiary centers for advanced high-dose chemotherapy plus autologous hematopoietic support [8].

Palpable scrotal abnormality is a common reason for patients who are referred for scrotal imaging. This document summarizes the initial imaging approach for these patients. Follow-up of normal or abnormal initial imaging findings is beyond the scope of this document. See the ACR Appropriateness Criteria[®] topics on "Acute Onset of Scrotal Pain-Without Trauma, Without Antecedent Mass" [14] and "Staging of Testicular Malignancy" [15] for further guidance.

Special Imaging Considerations

Contrast-enhanced ultrasound (CEUS) and US shear-wave elastography (SWE) are gaining clinical acceptance as useful additions to first-line US examinations of the scrotum in patients with newly

diagnosed palpable scrotal abnormality.

CEUS is one of the most sensitive microvascular-flow imaging modalities currently available in clinical practice and can be used for unequivocal differentiation between hypervascular, hypovascular, and avascular scrotal lesions; presuming that most avascular lesions correspond to a benign disease [16]. CEUS has been demonstrated to be useful in patients with acute scrotal pain, especially in the setting of scrotal trauma or infection [17,18]. CEUS clearly depicts the testicular fracture lines, interruption of the tunica albuginea, and presence of the intratesticular or extratesticular hematoma [17]. In addition, CEUS can improve early diagnosis of testicular torsion, infarction, and postinfectious complications [17,19,20]. It can confirm the absence of vascularity in benign complex cysts, clearly differentiating them from malignant cystic neoplasms [21,22]. It is thought that virtually all testicular tumors display vascularization on CEUS, with the exception of any cystic component and regions of necrosis or "burned out" testicular tumor [16,23].

SWE is a new modality for determining the relative stiffness of tissues that could be used to ascertain the relative stiffness of testes and surrounding scrotal tissues [24,25]. SWE assesses tissue stiffness by inducing a short acoustic "push pulse," which allows deformation of the tissue of interest and generation of transient shear waves, whose propagation speed is measured in meters per second and is proportional to the tissue stiffness [26]. Recent literature demonstrates improved diagnostic performance of combined SWE and conventional US for the characterization of testicular focal masses [27-29]. SWE appears to be a useful modality to differentiate benign lesions from malignant and burned out tumors, as well as Leydig cell tumors from other malignant and burned-out tumors [30,31].

Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously wherein each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
A. CT Abdomen and Pelvis
CT of the abdomen and pelvis is not routinely used as an initial imaging modality for the

evaluation of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection. There is no relevant literature regarding the use of CT of the abdomen and pelvis in these patients.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
B. CT Pelvis

CT of the pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection. There is no relevant literature regarding the use of CT of the pelvis in these patients.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
C. MRI Abdomen and Pelvis

MRI of the abdomen and pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection. There is no relevant literature regarding the use of MRI of the abdomen and pelvis in these patients.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
D. MRI Pelvis (Scrotum)

MRI of the pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection but may be used as a problem-solving tool when findings are not clear on US. There is no relevant literature regarding the use of MRI of the pelvis in these patients.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
E. Nuclear Medicine Scan Scrotum

Nuclear scan of the scrotum is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection. There is no relevant literature regarding the use of nuclear scans of the scrotum in these patients.

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.
F. US Duplex Doppler Scrotum

The combination of grayscale and color-power Doppler US can significantly improve the specificity of B-mode US in scrotal lesion characterization [1,32]. It is very useful in diagnosis of focal inflammatory processes, such as epididymitis and testicular abscess, that can present with palpable scrotal masses in some patients [33]. Nevertheless, duplex US does not allow a definitive differentiation of malignancies from a variety of benign conditions, such as orchitis, dermoid cyst, granuloma, focal fibrosis, adrenal rest, and papillary cystadenoma. In fact, those lesions can mimic cancer, and, as a consequence, the specificity of a duplex US examination of the scrotum is lower than its sensitivity [34]. Other potential diagnoses that may be demonstrated on US include testicular hematoma, rupture (particularly in patients with a history of trauma), infarct, torsion, intratesticular varicocele, and arteriovenous malformations or angiomatosis [35].

Variant 1: Newly diagnosed palpable scrotal abnormality. History of trauma or infection. Initial imaging.

G. US Scrotum

A variety of infectious and traumatic processes can be accurately depicted and characterized on grayscale US [36]. Sonographically, the involved testicle may have heterogenous, hypoechoic echotexture. Additional findings in testicular trauma may include contour abnormality, disruption of the tunica albuginea, or direct visualization of a fracture line. Sonographic appearance of intratesticular hematoma depends on the time from trauma, with the hyperacute or acute hematoma appearing as a heterogeneous or isoechoic area relative to surrounding testicular parenchyma, whereas chronic hematomas are smaller in size and relatively hypoechoic to anechoic. However, scrotal US without Doppler imaging may not be able to differentiate a hematoma from a mass or evaluate for inflammation.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
A. CT Abdomen and Pelvis

CT of the abdomen and pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients without history of trauma or infection. There is no relevant literature regarding the use of CT of the abdomen and pelvis in these patients.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
B. CT Pelvis

CT of the pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients without a history of trauma or infection. There is no relevant literature regarding the use of CT of the pelvis in these patients.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
C. MRI Abdomen and Pelvis

MRI of the abdomen and pelvis is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients without a history of trauma or infection. There is no relevant literature regarding the use of MRI of the abdomen and pelvis in these patients.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
D. MRI Pelvis (Scrotum)

MRI is not routinely used as the initial examination to evaluate scrotal pathology given its uncertain clinical utility when used in addition to standard US [37,38]. In select cases, it could be help distinguish between an intratesticular and extratesticular mass when this cannot be confirmed clinically or with US [8]. MRI may aid in the diagnosis of a primary testicular mass, mostly focusing on differential diagnosis between benign and malignant testicular masses [39]. Quantitative enhancement patterns may be useful to distinguish testicular seminoma from Leydig cell tumors in direct comparison, but it is uncertain how they would perform in a routine clinical practice [40].

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection.

Initial imaging.
E. Nuclear Medicine Scan Scrotum

Nuclear scan of the scrotum is not routinely used as an initial imaging modality for the evaluation of newly diagnosed palpable scrotal abnormality in patients without a history of trauma or infection. There is no relevant literature regarding the use of nuclear scans of the scrotum in these patients.

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
F. US Duplex Doppler Scrotum

The combination of grayscale and color-power Doppler US can significantly improve the specificity of B-mode US in scrotal lesion characterization [1,32]. US duplex may be able to differentiate a solid mass from a mass-like hematoma. which will be avascular (can occur without trauma). Nevertheless, duplex US does not allow a definitive differentiation of malignancies from a variety of benign conditions, such as orchitis, dermoid cyst, granuloma, focal fibrosis, adrenal rest, and papillary cystadenoma. In fact, those lesions can mimic cancer, and, as a consequence, the specificity of duplex US examination of the scrotum is lower than its sensitivity [34].

Variant 2: Newly diagnosed palpable scrotal abnormality. No history of trauma or infection. Initial imaging.
G. US Scrotum

US is traditionally the initial imaging modality to evaluate scrotal pathology in patients without a history of testicular trauma or infection, when scrotal tumors need to be ruled out [41-43]. US is often the sole scrotal imaging technique that a patient will undergo prior to surgery [21]. It is nearly 100% sensitive for the detection of an intrascrotal mass, and 98% to 100% accurate for the delineation between intratesticular and extratesticular processes [44-46]. However, differentiating malignant and benign lesions is not always possible with B-mode US. Because there are no US criteria that allow definitive differentiation of benign from malignant testicular lesions, all lesions with a clearly delineated hypoechoic or inhomogeneous pattern are considered suspicious [47,48]. In addition, differentiation between various subtypes of malignant testicular tumors on US could be challenging. Some studies have suggested that seminoma germ cell tumors are often more homogeneously hypoechoic, whereas the more cystic nonseminomatous germ cell tumors are often nonhomogenously hypoechoic because of areas of calcification and/or necrosis [49]. Even with this noted difference, the tumor tissue type cannot be reliably differentiated solely by its ultrasonographic appearance, and the general consensus is that a sonographic detection of a solid or mixed cystic lesion mass requires additional imaging or surgical exploration [50,51].

Summary of Highlights

- **Variant 1**: US scrotum or US duplex Doppler scrotum is usually appropriate for the initial imaging of newly diagnosed palpable scrotal abnormality in patients with a history of trauma or infection. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).
- **Variant 2**: US scrotum or US duplex Doppler scrotum is usually appropriate for the initial imaging of newly diagnosed palpable scrotal abnormality in patients without a history of trauma or infection. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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, because of both 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 with 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

O	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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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