

**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	○
US scrotum	Usually Appropriate	○
MRI pelvis (scrotum) without and with IV contrast	May Be Appropriate	○
MRI pelvis (scrotum) without IV contrast	May Be Appropriate	○
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	⊕⊕⊕
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	⊕⊕⊕⊕
CT pelvis without and with IV contrast	Usually Not Appropriate	⊕⊕⊕⊕
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	○
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	○
Nuclear medicine scan scrotum	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	○
US scrotum	Usually Appropriate	○
MRI pelvis (scrotum) without and with IV contrast	May Be Appropriate	○
MRI pelvis (scrotum) without IV contrast	May Be Appropriate	○
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	⊕⊕⊕
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	⊕⊕⊕⊕
CT pelvis without and with IV contrast	Usually Not Appropriate	⊕⊕⊕⊕
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	○
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	○
Nuclear medicine scan scrotum	Usually Not Appropriate	⊕⊕⊕

## NEWLY DIAGNOSED PALPABLE SCROTAL ABNORMALITY

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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]  $\geq 3.18$ ), 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<sup>®</sup> 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.

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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 where 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.**

##### **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.

##### **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.

##### **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.

##### **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.

##### **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.

## **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].

## **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.**

## **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.

## **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.

## **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.

## **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 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].

## **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.

## **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].

## 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 nonhomogeneously 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 Recommendations

- **Variation 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).
- **Variation 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 go to [www.acr.org/ac](http://www.acr.org/ac).

### 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 [52].

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.”

## References

1. Crawford P, Crop JA. Evaluation of scrotal masses. *Am Fam Physician* 2014;89:723-7.
2. Schmoll HJ, Jordan K, Huddart R, et al. Testicular seminoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2010;21 Suppl 5:v140-6.
3. Schmoll HJ, Jordan K, Huddart R, et al. Testicular non-seminoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2010;21 Suppl 5:v147-54.
4. Mittal PK, Abdalla AS, Chatterjee A, et al. Spectrum of Extratesticular and Testicular Pathologic Conditions at Scrotal MR Imaging. *Radiographics* 2018;38:806-30.
5. Albers P, Albrecht W, Algaba F, et al. EAU guidelines on testicular cancer: 2011 update. *Eur Urol* 2011;60:304-19.
6. Goldberg H, Klaassen Z, Chandrasekar T, Fleshner N, Hamilton RJ, Jewett MAS. Germ Cell Testicular Tumors-Contemporary Diagnosis, Staging and Management of Localized and Advanced disease. *Urology* 2019;125:8-19.
7. Moch H, Cubilla AL, Humphrey PA, Reuter VE, Ulbright TM. The 2016 WHO Classification of Tumours of the Urinary System and Male Genital Organs-Part A: Renal, Penile, and Testicular Tumours. *Eur Urol* 2016;70:93-105.
8. Honecker F, Aparicio J, Berney D, et al. ESMO Consensus Conference on testicular germ cell cancer: diagnosis, treatment and follow-up. *Ann Oncol* 2018;29:1658-86.
9. Wang SQ, Ren FY, Wang JH, et al. Diagnostic value of multislice spiral computed tomography (CT) combined with CT angiography for intra-abdominal undescended testis secondary seminomas. *Cancer Imaging* 2019;19:24.
10. Aoun F, Slaoui A, Naoum E, et al. Testicular microlithiasis: Systematic review and Clinical guidelines. *Prog Urol* 2019;29:465-73.
11. Stephenson A, Eggener SE, Bass EB, et al. Diagnosis and Treatment of Early Stage Testicular Cancer: AUA Guideline. *J Urol* 2019;202:272-81.
12. Richenberg J, Belfield J, Ramchandani P, et al. Testicular microlithiasis imaging and follow-up: guidelines of the ESUR scrotal imaging subcommittee. *Eur Radiol* 2015;25:323-30.



13. Aparicio J, Terrasa J, Duran I, et al. SEOM clinical guidelines for the management of germ cell testicular cancer (2016). *Clin Transl Oncol* 2016;18:1187-96.
14. Wang CL, Aryal B, Oto A, et al. ACR Appropriateness Criteria® Acute Onset of Scrotal Pain-Without Trauma, Without Antecedent Mass. *J Am Coll Radiol* 2019;16:S38-S43.
15. American College of Radiology. ACR Appropriateness Criteria®: Staging of Testicular Malignancy. Available at: <https://acsearch.acr.org/docs/69375/Narrative/>. Accessed September 30, 2021.
16. Lock G, Schmidt C, Helmich F, Stolle E, Dieckmann KP. Early experience with contrast-enhanced ultrasound in the diagnosis of testicular masses: a feasibility study. *Urology* 2011;77:1049-53.
17. Valentino M, Bertolotto M, Derchi L, et al. Role of contrast enhanced ultrasound in acute scrotal diseases. *Eur Radiol* 2011;21:1831-40.
18. Moschouris H, Stamatou K. Re: Lock et al.: Early experience with contrast-enhanced ultrasound in the diagnosis of testicular masses: a feasibility study (*Urology* 2011;77:1049-1053). *Urology* 2011;78:480-1; author reply 81.
19. Bertolotto M, Derchi LE, Sidhu PS, et al. Acute segmental testicular infarction at contrast-enhanced ultrasound: early features and changes during follow-up. *AJR Am J Roentgenol* 2011;196:834-41.
20. Lung PF, Jaffer OS, Sellars ME, Sriprasad S, Kooiman GG, Sidhu PS. Contrast-enhanced ultrasound in the evaluation of focal testicular complications secondary to epididymitis. *AJR Am J Roentgenol* 2012;199:W345-54.
21. Huang DY, Sidhu PS. Focal testicular lesions: colour Doppler ultrasound, contrast-enhanced ultrasound and tissue elastography as adjuvants to the diagnosis. *Br J Radiol* 2012;85 Spec No 1:S41-53.
22. Lerchbaumer MH, Auer TA, Marticorena GS, et al. Diagnostic performance of contrast-enhanced ultrasound (CEUS) in testicular pathologies: Single-center results. *Clin Hemorheol Microcirc* 2019;73:347-57.
23. Drudi FM, Maghella F, Martino G, et al. Detection of small testicular masses in monorchid patients using US, CPDUS, CEUS and US-guided biopsy. *J Ultrasound* 2016;19:25-8.
24. Zeng B, Chen F, Qiu S, et al. Application of Quasistatic Ultrasound Elastography for Examination of Scrotal Lesions. *J Ultrasound Med* 2016;35:253-61.
25. Pedersen MR, Sloth Othter PJ, Nissen HD, Vedsted P, Moller H, Rafaelsen SR. Elastography and diffusion-weighted MRI in patients with testicular microlithiasis, normal testicular tissue, and testicular cancer: an observational study. *Acta Radiol* 2019;60:535-41.
26. Konstantatou E, Fang C, Romanos O, et al. Evaluation of Intratesticular Lesions With Strain Elastography Using Strain Ratio and Color Map Visual Grading: Differentiation of Neoplastic and Nonneoplastic Lesions. *J Ultrasound Med* 2019;38:223-32.
27. Marcon J, Trottmann M, Rubenthaler J, Stief CG, Reiser MF, Clevert DA. Shear wave elastography of the testes in a healthy study collective - Differences in standard values between ARFI and VTIQ techniques. *Clin Hemorheol Microcirc* 2016;64:721-28.
28. Marcon J, Trottmann M, Rubenthaler J, et al. Three-dimensional vs. two-dimensional shear-wave elastography of the testes - preliminary study on a healthy collective. *Clin Hemorheol Microcirc* 2016;64:447-56.
29. Aigner F, De Zordo T, Pallwein-Prettner L, et al. Real-time sonoelastography for the evaluation of testicular lesions. *Radiology* 2012;263:584-9.
30. Rocher L, Criton A, Gennisson JL, et al. Characterization of Testicular Masses in Adults: Performance of Combined Quantitative Shear Wave Elastography and Conventional Ultrasound. *Ultrasound Med Biol* 2019;45:720-31.
31. Pastore AL, Palleschi G, Maceroni P, et al. Correlation between semiquantitative sonoelastography and immunohistochemistry in the evaluation of testicular focal lesions. *Cancer Imaging* 2014;14:29.
32. Rizvi SA, Ahmad I, Siddiqui MA, Zaheer S, Ahmad K. Role of color Doppler ultrasonography in evaluation of scrotal swellings: pattern of disease in 120 patients with review of literature. *Urol J* 2011;8:60-5.
33. Dudea SM, Ciurea A, Chiorean A, Botar-Jid C. Doppler applications in testicular and scrotal disease. *Med Ultrason* 2010;12:43-51.
34. Schroder C, Lock G, Schmidt C, Loning T, Dieckmann KP. Real-Time Elastography and Contrast-Enhanced Ultrasonography in the Evaluation of Testicular Masses: A Comparative Prospective Study. *Ultrasound Med Biol* 2016;42:1807-15.
35. Montgomery JS, Bloom DA. The diagnosis and management of scrotal masses. *Med Clin North Am* 2011;95:235-44.
36. Weatherspoon K, Polansky S, Catanzano T. Ultrasound Emergencies of the Male Pelvis. *Semin Ultrasound CT MR* 2017;38:327-44.

37. Patel HD, Ramos M, Gupta M, et al. Magnetic Resonance Imaging to Differentiate the Histology of Testicular Masses: A Systematic Review of Studies With Pathologic Confirmation. *Urology* 2020;135:4-10.
38. Tsili AC, Argyropoulou MI, Giannakis D, Sofikitis N, Tsampoulas K. MRI in the characterization and local staging of testicular neoplasms. *AJR Am J Roentgenol* 2010;194:682-9.
39. Tsili AC, Bertolotto M, Turgut AT, et al. MRI of the scrotum: Recommendations of the ESUR Scrotal and Penile Imaging Working Group. *Eur Radiol* 2018;28:31-43.
40. Tsili AC, Argyropoulou MI, Astrakas LG, et al. Dynamic contrast-enhanced subtraction MRI for characterizing intratesticular mass lesions. *AJR Am J Roentgenol* 2013;200:578-85.
41. Thomas LJ, Brooks MA, Stephenson AJ. The Role of Imaging in the Diagnosis, Staging, Response to Treatment, and Surveillance of Patients with Germ Cell Tumors of the Testis. *Urol Clin North Am* 2019;46:315-31.
42. McDonald MW, Reed AB, Tran PT, Evans LA. Testicular tumor ultrasound characteristics and association with histopathology. *Urol Int* 2012;89:196-202.
43. Oldenburg J, Fossa SD, Nuver J, et al. Testicular seminoma and non-seminoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2013;24 Suppl 6:vi125-32.
44. Sommers D, Winter T. Ultrasonography evaluation of scrotal masses. *Radiol Clin North Am* 2014;52:1265-81.
45. Shtricker A, Silver D, Sorin E, et al. The value of testicular ultrasound in the prediction of the type and size of testicular tumors. *Int Braz J Urol* 2015;41:655-60.
46. Carkaci S, Ozkan E, Lane D, Yang WT. Scrotal sonography revisited. *J Clin Ultrasound* 2010;38:21-37.
47. Bertolotto M, Muca M, Curro F, Bucci S, Rocher L, Cova MA. Multiparametric US for scrotal diseases. *Abdom Radiol (NY)* 2018;43:899-917.
48. Dieckmann KP, Frey U, Lock G. Contemporary diagnostic work-up of testicular germ cell tumours. *Nat Rev Urol* 2013;10:703-12.
49. Wasnik AP, Maturen KE, Shah S, Pandya A, Rubin JM, Platt JF. Scrotal pearls and pitfalls: ultrasound findings of benign scrotal lesions. *Ultrasound Q* 2012;28:281-91.
50. Mirochnik B, Bhargava P, Dighe MK, Kanth N. Ultrasound evaluation of scrotal pathology. *Radiol Clin North Am* 2012;50:317-32, vi.
51. Philips S, Nagar A, Dighe M, Vikram R, Sunnapwar A, Prasad S. Benign non-cystic scrotal tumors and pseudotumors. *Acta Radiol* 2012;53:102-11.
52. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: <https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf>. Accessed September 30, 2021.

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.