

## American College of Radiology ACR Appropriateness Criteria®

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

**Variant 1:** Without trauma, without antecedent mass.

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
US scrotum with Doppler	9	Excellent study that is generally available and has high sensitivity and specificity. Operator and equipment dependent. Requires small parts transducer with slow-flow-enhancing techniques. Must be performed in a timely manner. In equivocal situations, power Doppler evaluation of the spermatic cord may be helpful.	None
NUC Tc-99m scan scrotum	7	Well-established study. Interpretative experience and careful technique required. Must be performed in a timely manner.	Med
MRI pelvis (scrotum) without and with contrast	3	May be helpful if other tests inconclusive, but must be performed in short time frame.	None
US scrotum	1	Relatively insensitive to earliest changes secondary to decreased or absent perfusion.	None
NUC Ga-67 or In-111 WBC labeling scrotum	1	Infection diagnosis not obtainable in appropriate time frame. Isolated case reports as incidental finding.	High
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

An 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 exams 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.

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

Expert Panel on Urologic Imaging: Erick M. Remer, MD<sup>1</sup>; Isaac R. Francis, MD<sup>2</sup>; Deborah A. Baumgarten, MD<sup>3</sup>; Edward I. Bluth, MD<sup>4</sup>; William H. Bush, Jr., MD<sup>5</sup>; David D. Casalino, MD<sup>6</sup>; Nancy S. Curry, MD<sup>7</sup>; Gary M. Israel, MD<sup>8</sup>; S. Zafar H. Jafri, MD<sup>9</sup>; Akira Kawashima, MD<sup>10</sup>; Nicholas Papanicolaou, MD<sup>11</sup>; Carl M. Sandler, MD<sup>12</sup>; David B. Spring, MD<sup>13</sup>; Pat Fulgham, MD.<sup>14</sup>

### **Summary of Literature Review**

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 [1,2] but must be balanced against the costs of operating on the much larger number of patients with nonsurgical disease, primarily acute epididymitis [2-5]. Although the acute scrotum is defined as acute unilateral scrotal swelling, with or without pain, most patients present with pain as their primary or at least major concurrent complaint. The differential diagnosis of the acute scrotum includes: 1) torsion of the testis, 2) torsion of the testicular appendages, 3) acute epididymitis or epididymo-orchitis, 4) mumps orchitis, 5) strangulated hernia, 6) inflammatory type of testicular tumor, 7) acute hydrocele, and 8) traumatic hemorrhage. This diagnostic 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. A minor traumatic episode may call attention to a scrotal process; and in the adolescent, just becoming aware of his sexuality may be an enabling event for him to voice his symptoms.

Torsion is decidedly rare in patients older than 35 years [1,3,6]. Acute epididymitis is commonly the cause of acute 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. There are enough exceptions to these demographics, particularly in patients younger than age 30 years, such that these statistics must be used with caution. In this group there is also significant overlap in the presence of clinical factors that may favor torsion (abrupt onset, normal urinalysis) or epididymitis (more

gradual onset, abnormal urinalysis). Acute scrotal pain in prepubertal boys occurs most commonly from torsion of the testicular appendages, but may clinically mimic testicular torsion or epididymo-orchitis [7]. A pathognomonic physical examination finding (“blue dot sign”) is infrequently encountered.

Radionuclide scrotal imaging (RNSI) is an accurate examination in the differential diagnosis of ischemia versus infection [8]. The specificity in the diagnosis of ischemia versus other photon-deficient lesions is slightly lower [8]. Photon-deficient areas secondary to hydrocele, spermatocele, uncommonly edematous appendix testis, 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 ultrasound (US) examination prevented unnecessary surgery in 16 (59%) of these cases [9]. There have been many large series reported [1,3,10-14]. The examination and the technique are well established [1,3,8] and reproducible, and most imaging specialists and nuclear medicine technologists have been trained in the performance and interpretation of these examinations. With scintigraphy, some problems arise in infants and very small children whose genitalia are small and therefore difficult to image. Because this examination is performed relatively infrequently in many departments, the experience of individual practitioners may be limited. With increasing use of sonography, experience with RNSI, especially for more recently trained physicians, is decreasing. Availability and time of examination can also be limiting factors [15].

The imaging of infected scrotal contents, testis, or epididymitis with the radionuclide infection imaging agents Ga-67 or In-111 WBC has been noted in isolated case reports [16,17]. There is, however, no routine indication for their use.

Color Doppler ultrasound (CDU) is also a valuable exam for evaluating testicular perfusion [4,12,18-27]. Studies in the early 1990s showed a reasonable sensitivity and specificity for diagnosis of torsion [21,27] comparable to RNSI [24,28]. The CDU equipment has improved, and experience has increased, with resultant sensitivity and specificity now ranging from approximately 89%-100% [29-33]. Experience with CDU in evaluating the acute scrotum has increased, both for practicing physicians and for those in training. It is readily available at most, if not all, institutions and can be done quickly without any specific preparations. Power Doppler (US) can be used in place of, or as an adjunct to, CDU [34]. Power Doppler has been shown to demonstrate flow where CDU does not and, in general, to demonstrate slower flow than CDU

<sup>1</sup>Principal Author, Cleveland Clinic Foundation, Cleveland, Ohio; <sup>2</sup>Panel Chair, University of Michigan, Ann Arbor, Mich; <sup>3</sup>Emory University Hospital, Atlanta, Ga; <sup>4</sup>Ochsner Foundation Hospital, New Orleans, La; <sup>5</sup>University of Washington Medical Center, Seattle, Wash; <sup>6</sup>Northwestern University, Chicago, Ill; <sup>7</sup>Medical University of South Carolina, Charleston, SC; <sup>8</sup>New York University Medical Center, New York, NY; <sup>9</sup>William Beaumont Hospital, Royal Oak, Mich; <sup>10</sup>Mayo Clinic, Rochester, Minn; <sup>11</sup>Hospital of University of Pennsylvania, Philadelphia, Pa; <sup>12</sup>UT MD Anderson Cancer Center, Houston, Texas; <sup>13</sup>Kaiser Permanente Medical Center, Oakland, Calif; <sup>14</sup>Urology Clinics of North America, Dallas, Texas, American Urological Association.

Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

An 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 exams 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.

[15,35,36]. Power Doppler US is especially useful to demonstrate intratesticular flow in prepubertal testes [37,38].

Doppler US is not without drawbacks, and one area of concern has been its application in the young child and particularly the prepubertal child [39]. Studies in children have shown a sensitivity of 89% and specificity of 100%, but there were technically unsuccessful studies which emphasize the need for experience and proper equipment settings when examining the young child [40]. Settings optimized to detect slow flow include a small color-sampling box, lowest pulse repetition frequency, and lowest possible threshold setting [27]. Blood flow can occasionally be preserved in patients with torsion [41,42]. Attention to spectral Doppler waveforms patterns (high-resistance arterial waveform, monophasic waveform) [42] and spermatic cord morphology (thick spermatic cord) [41,43-45] may help diminish false negative examinations. A multicenter study of 919 patients aged 1-18 years studied for an acute scrotum found false negative CDU studies in 50 of 208 patients with torsion (sensitivity 76%) [44]. An abnormal spermatic cord "twist" was identified, however, in 199 of 208 patients (sensitivity 96%). Further, a normal linear cord (705/711, 99% specificity) was found in patients without torsion.

In a comparison of 294 patients with primary scrotal exploration and 332 with US first and exploration if US was positive or there was a high clinical suspicion of torsion [5], one study found that US could obviate the need for exploration in many patients, and thus minimized and shortened hospital stays.

Gray-scale US alone is capable of evaluating the cystic or solid nature of scrotal masses and often the signs of an inflamed epididymitis and a necrotic testicle, but it is much less sensitive to the earliest changes resulting from decreased or absent testicular perfusion. In the setting of torsion, a normal homogenous echo pattern is, however, likely to indicate a viable testis, whereas a hypoechoic or inhomogeneous testis is likely to be nonviable [46].

The most common cause of acute scrotal pain in adolescent boys and adults is epididymo-orchitis. Gray-scale US combined with color Doppler imaging is the prime imaging means to make this diagnosis. The epididymis is enlarged and may be increased or decreased in echogenicity. Scrotal wall thickening and hydrocele are common. The testis is involved in 20%-40% of cases (epididymo-orchitis). Increased color Doppler flow in the epididymis and, if involved, the testis, is characteristic. The most common cause of acute scrotal pain in the child is torsion of a testicular appendage (appendix epididymis or appendix testis). Reactive changes (hydrocele, epididymal head enlargement, increased color Doppler flow) from torsion of a testicular appendage may mimic epididymitis [7]. The torsed testicular appendage can be

difficult to identify with US. It was seen in only 9 of 29 patients (31%) in one study [7], but it is usually larger, rounder, and has more surrounding flow than normal appendages [47]. Size alone may discriminate torsed from normal testicular appendages with low sensitivity (67%) but high specificity (100%), obviating surgery in some cases [48].

Magnetic resonance imaging (MRI) techniques has been rarely used in diagnosing the acute scrotum, although reports of its use in scrotal disease are increasing [49-51]. In one report, 11 patients with subacute signs and symptoms were evaluated, and a differential diagnosis between ischemia in six patients and infection in five patients could be made [6]. In a second study of 39 patients with an acute scrotum and an inconclusive US and physical exam, MRI had a sensitivity of 93% and a specificity of 100% for torsion [51]. Experimental studies also suggest potential use of MRI in acute torsion [52]. Another study [53] suggests that MRI may be useful to identify patients with segmental testicular infarction when US is not conclusive.

### Summary

Both CDU and RNSI are valuable techniques for determining the etiology of acute scrotal pain. Although some authors still suggest immediate surgical exploration in patients with a strong clinical impression of testicular ischemia [2,46,54,55], if either CDU or RNSI is readily available and can be performed within 30-60 minutes of the request to simultaneously prepare an operating room, there is ample evidence that fewer patients with infection will be operated on, and also that patients with an ischemic testis will not be treated with antibiotics for infection. The choice of CDU or RNSI should be based on availability and operator experience. In most institutions, availability and experience will favor CDU. If one performs CDU and there remains a question about a diagnosis, US evaluation of the spermatic cord, MRI, or RNSI may be of value.

### 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. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

An 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 exams 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.

Relative Radiation Level Designations	
Relative Radiation Level	Effective Dose Estimate Range
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

## References

- Chen DC, Holder LE, Melloul M. Radionuclide scrotal imaging: further experience with 210 new patients. Part 2: Results and discussion. *J Nucl Med* 1983; 24(9):841-853.
- Joyce JM, Grossman SJ. Scrotal scintigraphy in testicular torsion. *Emerg Med Clin North Am* 1992; 10(1):93-102.
- Holder LE, Martire JR, Holmes ER, Wagner HN, Jr. Testicular radionuclide angiography and static imaging: anatomy, scintigraphic interpretation, and clinical indications. *Radiology* 1977; 125(3):739-752.
- Lerner RM, Mevorach RA, Hulbert WC, Rabinowitz R. Color Doppler US in the evaluation of acute scrotal disease. *Radiology* 1990; 176(2):355-358.
- Lam WW, Yap TL, Jacobsen AS, Teo HJ. Colour Doppler ultrasonography replacing surgical exploration for acute scrotum: myth or reality? *Pediatr Radiol* 2005; 35(6):597-600.
- Trambert MA, Mattrey RF, Levine D, Berthoty DP. Subacute scrotal pain: evaluation of torsion versus epididymitis with MR imaging. *Radiology* 1990; 175(1):53-56.
- Karmazyn B, Steinberg R, Livne P, et al. Duplex sonographic findings in children with torsion of the testicular appendages: overlap with epididymitis and epididymo-orchitis. *J Pediatr Surg* 2006; 41(3):500-504.
- Lutzker LG, Zuckier LS. Testicular scanning and other applications of radionuclide imaging of the genital tract. *Semin Nucl Med* 1990; 20(2):159-188.
- Hod N, Maizlin Z, Strauss S, Horne T. The relative merits of Doppler sonography in the evaluation of patients with clinically and scintigraphically suspected testicular torsion. *Isr Med Assoc J* 2004; 6(1):13-15.
- Eshghi M, Silver L, Smith AD. Technetium 99m scan in acute scrotal lesions. *Urology* 1987; 30(6):586-593.
- Golimbu M, Florio FE, Al-Askari S, Morales PA, Passalacqua A. Value of scrotal scanning. Report of 62 cases. *Urology* 1985; 25(1):89-92.
- Lewis AG, Bukowski TP, Jarvis PD, Wacksman J, Sheldon CA. Evaluation of acute scrotum in the emergency department. *J Pediatr Surg* 1995; 30(2):277-281; discussion 281-272.
- Melloul M, Paz A, Lask D, Manes A, Mukamel E. The value of radionuclide scrotal imaging in the diagnosis of acute testicular torsion. *Br J Urol* 1995; 76(5):628-631.
- Nakielny RA, Thomas WE, Jackson P, Jones M, Davies ER. Radionuclide evaluation of acute scrotal disease. *Clin Radiol* 1984; 35(2):125-129.
- Sidhu PS. Clinical and imaging features of testicular torsion: role of ultrasound. *Clin Radiol* 1999; 54(6):343-352.
- Debatin JF, Beytas EM. Indium 111 white blood cell imaging of epididymitis. *Eur J Nucl Med* 1990; 17(5):286-289.
- Farrer PA. Gallium-67 imaging in acute epididymo-orchitis. *Clin Nucl Med* 1980; 5(9):417-418.
- Atkinson GO, Jr., Patrick LE, Ball TI, Jr., Stephenson CA, Broecker BH, Woodard JR. The normal and abnormal scrotum in children: evaluation with color Doppler sonography. *AJR* 1992; 158(3):613-617.
- Burks DD, Markey BJ, Burkhard TK, Balsara ZN, Haluszka MM, Canning DA. Suspected testicular torsion and ischemia: evaluation with color Doppler sonography. *Radiology* 1990; 175(3):815-821.
- Dewire DM, Begun FP, Lawson RK, Fitzgerald S, Foley WD. Color Doppler ultrasonography in the evaluation of the acute scrotum. *J Urol* 1992; 147(1):89-91.
- Fitzgerald SW, Erickson S, DeWire DM, et al. Color Doppler sonography in the evaluation of the adult acute scrotum. *J Ultrasound Med* 1992; 11(10):543-548.
- Horstman WG, Middleton WD, Melson GL. Scrotal inflammatory disease: color Doppler US findings. *Radiology* 1991; 179(1):55-59.
- Middleton WD, Melson GL. Testicular ischemia: color Doppler sonographic findings in five patients. *AJR* 1989; 152(6):1237-1239.
- Middleton WD, Siegel BA, Melson GL, Yates CK, Andriole GL. Acute scrotal disorders: prospective comparison of color Doppler US and testicular scintigraphy. *Radiology* 1990; 177(1):177-181.
- Ralls PW, Jensen MC, Lee KP, Mayekawa DS, Johnson MB, Halls JM. Color Doppler sonography in acute epididymitis and orchitis. *J Clin Ultrasound* 1990; 18(5):383-386.
- Suzer O, Ozcan H, Kupeli S, Gheiler EL. Color Doppler imaging in the diagnosis of the acute scrotum. *Eur Urol* 1997; 32(4):457-461.
- Wilbert DM, Schaerfe CW, Stern WD, Strohmaier WL, Bichler KH. Evaluation of the acute scrotum by color-coded Doppler ultrasonography. *J Urol* 1993; 149(6):1475-1477.
- Paltiel HJ, Connolly LP, Atala A, Paltiel AD, Zurakowski D, Treves ST. Acute scrotal symptoms in boys with an indeterminate clinical presentation: comparison of color Doppler sonography and scintigraphy. *Radiology* 1998; 207(1):223-231.
- al Mufti RA, Ogedegbe AK, Lafferty K. The use of Doppler ultrasound in the clinical management of acute testicular pain. *Br J Urol* 1995; 76(5):625-627.
- Baker LA, Sigman D, Mathews RI, Benson J, Docimo SG. An analysis of clinical outcomes using color doppler testicular ultrasound for testicular torsion. *Pediatrics* 2000; 105(3 Pt 1):604-607.
- Galejs LE, Kass EJ. Color Doppler ultrasound evaluation of the acute scrotum. *Tech Urol* 1998; 4(4):182-184.
- Hendriks AJ, Dang CL, Vroegindewij D, Korte JH. B-mode and colour-flow duplex ultrasonography: a useful adjunct in diagnosing scrotal diseases? *Br J Urol* 1997; 79(1):58-65.
- Kadish HA, Bolte RG. A retrospective review of pediatric patients with epididymitis, testicular torsion, and torsion of testicular appendages. *Pediatrics* 1998; 102(1 Pt 1):73-76.
- Hamper UM, DeJong MR, Caskey CI, Sheth S. Power Doppler imaging: clinical experience and correlation with color Doppler US and other imaging modalities. *Radiographics* 1997; 17(2):499-513.
- Coley BD, Frush DP, Babcock DS, et al. Acute testicular torsion: comparison of unenhanced and contrast-enhanced power Doppler US, color Doppler US, and radionuclide imaging. *Radiology* 1996; 199(2):441-446.
- Zinn HL, Cohen HL, Horowitz M. Testicular torsion in neonates: importance of power Doppler imaging. *J Ultrasound Med* 1998; 17(6):385-388.
- Bader TR, Kammerhuber F, Herneth AM. Testicular blood flow in boys as assessed at color Doppler and power Doppler sonography. *Radiology* 1997; 202(2):559-564.
- Luker GD, Siegel MJ. Scrotal US in pediatric patients: comparison of power and standard color Doppler US. *Radiology* 1996; 198(2):381-385.
- Stehr M, Boehm R. Critical validation of colour Doppler ultrasound in diagnostics of acute scrotum in children. *Eur J Pediatr Surg* 2003; 13(6):386-392.
- Yazbeck S, Patriquin HB. Accuracy of Doppler sonography in the evaluation of acute conditions of the scrotum in children. *J Pediatr Surg* 1994; 29(9):1270-1272.
- Bentley DF, Ricchiuti DJ, Nasrallah PF, McMahon DR. Spermatic cord torsion with preserved testis perfusion: initial anatomical observations. *J Urol* 2004; 172(6 Pt 1):2373-2376.
- Dogra VS, Rubens DJ, Gottlieb RH, Bhatt S. Torsion and beyond: new twists in spectral Doppler evaluation of the scrotum. *J Ultrasound Med* 2004; 23(8):1077-1085.

An 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 exams 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.

43. Baud C, Veyrac C, Couture A, Ferran JL. Spiral twist of the spermatic cord: a reliable sign of testicular torsion. *Pediatr Radiol* 1998; 28(12):950-954.
44. Kalfa N, Veyrac C, Lopez M, et al. Multicenter assessment of ultrasound of the spermatic cord in children with acute scrotum. *J Urol* 2007; 177(1):297-301; discussion 301.
45. Arce JD, Cortes M, Vargas JC. Sonographic diagnosis of acute spermatic cord torsion. Rotation of the cord: a key to the diagnosis. *Pediatr Radiol* 2002; 32(7):485-491.
46. Middleton WD, Middleton MA, Dierks M, Keetch D, Dierks S. Sonographic prediction of viability in testicular torsion: preliminary observations. *J Ultrasound Med* 1997; 16(1):23-27; quiz 29-30.
47. Yang DM, Lim JW, Kim JE, Kim JH, Cho H. Torsed appendix testis: gray scale and color Doppler sonographic findings compared with normal appendix testis. *J Ultrasound Med* 2005; 24(1):87-91.
48. Baldisserotto M, de Souza JC, Pertence AP, Dora MD. Color Doppler sonography of normal and torsed testicular appendages in children. *AJR* 2005; 184(4):1287-1292.
49. Nagler-Reus M, Guhl L, Volz C, Wuerstlin S, Arlart IP. [Magnetic resonance tomography of the scrotum. Experiences with 129 patients]. *Radiologe* 1995; 35(8):494-503.
50. Terai A, Yoshimura K, Ichioka K, et al. Dynamic contrast-enhanced subtraction magnetic resonance imaging in diagnostics of testicular torsion. *Urology* 2006; 67(6):1278-1282.
51. Watanabe Y, Dohke M, Ohkubo K, et al. Scrotal disorders: evaluation of testicular enhancement patterns at dynamic contrast-enhanced subtraction MR imaging. *Radiology* 2000; 217(1):219-227.
52. Cheng HC, Khan MA, Bogdanov A, Jr., Kwong K, Weissleder R. Relative blood volume measurements by magnetic resonance imaging facilitate detection of testicular torsion. *Invest Radiol* 1997; 32(12):763-769.
53. Fernandez-Perez GC, Tardaguila FM, Velasco M, et al. Radiologic findings of segmental testicular infarction. *AJR* 2005; 184(5):1587-1593.
54. Kass EJ, Lundak B. The acute scrotum. *Pediatr Clin North Am* 1997; 44(5):1251-1266.
55. Siegel MJ. The acute scrotum. *Radiol Clin North Am* 1997; 35(4):959-976.

An 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 exams 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.