

**American College of Radiology
ACR Appropriateness Criteria®
Staging and Surveillance of Testicular Cancer**

Variant 1: Initial staging of pure seminoma testicular cancer. Diagnosed by orchiectomy.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☼
CT abdomen and pelvis with IV contrast	Usually Appropriate	☼☼☼
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	☼☼☼
CT chest with IV contrast	May Be Appropriate	☼☼☼
CT chest without IV contrast	May Be Appropriate	☼☼☼
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
MRI head without and with IV contrast	May Be Appropriate	○
US abdomen and retroperitoneum	Usually Not Appropriate	○
US scrotum	Usually Not Appropriate	○
CT chest without and with IV contrast	Usually Not Appropriate	☼☼☼
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☼☼☼☼
MRI head without IV contrast	Usually Not Appropriate	○
Bone scan whole body	Usually Not Appropriate	☼☼☼
FDG-PET/CT whole body	Usually Not Appropriate	☼☼☼☼

Variant 2:**Initial staging of nonseminoma testicular cancer. Diagnosed by orchiectomy.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☼
CT abdomen and pelvis with IV contrast	Usually Appropriate	☼☼☼
CT chest with IV contrast	Usually Appropriate	☼☼☼
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	☼☼☼
CT chest without IV contrast	May Be Appropriate	☼☼☼
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
MRI head without and with IV contrast	May Be Appropriate	○
US abdomen and retroperitoneum	Usually Not Appropriate	○
US scrotum	Usually Not Appropriate	○
CT chest without and with IV contrast	Usually Not Appropriate	☼☼☼
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☼☼☼☼
MRI head without IV contrast	Usually Not Appropriate	○
Bone scan whole body	Usually Not Appropriate	☼☼☼
FDG-PET/CT whole body	Usually Not Appropriate	☼☼☼☼

Variant 3:**Surveillance of stage IA and IB pure seminoma testicular cancer. Diagnosed by orchiectomy.
No clinical suspicion of recurrence.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☼
CT abdomen and pelvis with IV contrast	Usually Appropriate	☼☼☼
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	○
US scrotum	May Be Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	☼☼☼
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
US abdomen and retroperitoneum	Usually Not Appropriate	○
CT chest with IV contrast	Usually Not Appropriate	☼☼☼
CT chest without and with IV contrast	Usually Not Appropriate	☼☼☼
CT chest without IV contrast	Usually Not Appropriate	☼☼☼
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☼☼☼☼
MRI head without and with IV contrast	Usually Not Appropriate	○
MRI head without IV contrast	Usually Not Appropriate	○
Bone scan whole body	Usually Not Appropriate	☼☼☼
FDG-PET/CT whole body	Usually Not Appropriate	☼☼☼☼

Variant 4:**Surveillance of stage IA and IB nonseminoma testicular cancer. Diagnosed by orchiectomy.
No clinical suspicion of recurrence.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	⊕
CT abdomen and pelvis with IV contrast	Usually Appropriate	⊕⊕⊕
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	○
US scrotum	May Be Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	⊕⊕⊕
CT chest with IV contrast	May Be Appropriate	⊕⊕⊕
CT chest without IV contrast	May Be Appropriate	⊕⊕⊕
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
US abdomen and retroperitoneum	Usually Not Appropriate	○
CT chest without and with IV contrast	Usually Not Appropriate	⊕⊕⊕
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	⊕⊕⊕⊕
MRI head without and with IV contrast	Usually Not Appropriate	○
MRI head without IV contrast	Usually Not Appropriate	○
Bone scan whole body	Usually Not Appropriate	⊕⊕⊕
FDG-PET/CT whole body	Usually Not Appropriate	⊕⊕⊕⊕

Variant 5:**Surveillance of stage IA and IB pure seminoma and nonseminoma testicular cancer. Diagnosed by orchiectomy. Suspected recurrence.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☼
CT abdomen and pelvis with IV contrast	Usually Appropriate	☼☼☼
CT chest with IV contrast	Usually Appropriate	☼☼☼
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	○
US scrotum	May Be Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	☼☼☼
CT chest without IV contrast	May Be Appropriate	☼☼☼
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
MRI head without and with IV contrast	May Be Appropriate	○
FDG-PET/CT whole body	May Be Appropriate	☼☼☼☼
US abdomen and retroperitoneum	Usually Not Appropriate	○
CT chest without and with IV contrast	Usually Not Appropriate	☼☼☼
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☼☼☼☼
MRI head without IV contrast	Usually Not Appropriate	○
Bone scan whole body	Usually Not Appropriate	☼☼☼

STAGING AND SURVEILLANCE OF TESTICULAR CANCER

Expert Panel on Urological Imaging: Nicola Schieda, MD^a; Aytekin Oto, MD^b; Brian C. Allen, MD^c; Oguz Akin, MD^d; Samantha J. Barker, MD^e; Pat F. Fulgham, MD^f; Lori Mankowski Gettle, MD, MBA^g; Jodi K. Maranchie, MD^h; Bhavik N. Patel, MD, MBAⁱ; David M. Schuster, MD^j; Dan Smith, MD^k; Ismail B. Turkbey, MD^l; Mark E. Lockhart, MD, MPH.^m

Summary of Literature Review

Introduction/Background

Although testicular cancer is relatively uncommon, it is the most common solid tumor in men between the ages of 20 and 34 years [1]. The National Cancer Institute estimates that there will be 9,470 new cases of testicular cancer in the United States and approximately 440 deaths from the disease in 2021 [1]. Over 95% of testicular tumors are of germ cell origin and are malignant; of these, 40% are pure seminoma testicular cancers. The nonseminoma testicular cancers are clinically more aggressive [2]. Testicular cancer has an excellent prognosis, with 5 year survival rates of approximately 95% [3]. Non-germ-cell tumors are less common and are typically benign and have their origin from the Leydig and Sertoli cells or from connective tissue stroma.

Malignant testicular germ-cell tumors metastasize by either the hematogenous or lymphatic route. Nodal metastases typically follow the testicular lymphatic drainage pathway alongside the testicular veins to regional lymph node groups. Tumors from the left testis will metastasize to the left para-aortic nodal group just below the left renal vein and interaortocaval group, whereas right testicular tumors will metastasize to the paracaval, precaval, and interaortocaval groups. Crossover of lymphatic involvement may occur in either right-sided or left-sided tumors; however, it is unusual to have contralateral metastasis without involvement of the ipsilateral nodes [4]. Further spread to nonregional lymph node groups, including common iliac, internal iliac, and external iliac nodes, or via the thoracic duct to the left supraclavicular nodes and subsequently to the lungs, constitutes distant metastasis [5]. Prior scrotal or inguinal surgery can alter the lymphatic drainage; therefore, external iliac and inguinal lymph nodes are considered regional in that context [6].

Staging of testicular cancer is based upon determination of extent of disease and follows the tumor, nodes, and metastases (TNM) staging system used by the American Joint Committee on Cancer [5]. TNM staging of testicular cancer is a major factor that determines treatment and prognosis in men with testicular cancer. Imaging is used to assess for expected locations of lymph node involvement and metastatic disease. Most patients with stage IA and IB pure seminoma testicular cancers are cured by orchiectomy [7]. Surveillance is strongly preferred in this group of patients; however, because 15% to 20% of men experience relapse, adjuvant therapy with one or two cycles of single-agent carboplatin or radiotherapy to decrease risk of relapse can be considered in certain high-risk patients [8-11]. Irrespective of management strategy, disease-specific survival approaches 100% [8-11]. In men who relapse while on surveillance in stage I pure seminoma testicular cancer, most relapses occur in the abdominal and pelvic lymph nodes [8-11]. The 2021 National Comprehensive Cancer Network (NCCN) guidelines recommend, apart from physical examination and serum tumor markers, imaging surveillance to detect relapse for 5 years after orchiectomy [8]. In this document, clinical suspicion of tumor relapse indicates abnormal physical examination or serum markers and no clinical suspicion of tumor relapse indicates a normal physical examination and tumor markers. The management strategies and prognosis of men with stage II and higher pure seminoma testicular cancer and nonseminoma testicular cancer, as well as restaging and follow-up approaches, are beyond the scope of this document but have been described in detail by the 2021 NCCN guidelines [8].

^aOttawa Hospital Research Institute and the Department of Radiology, The University of Ottawa, Ottawa, Ontario, Canada. ^bPanel Chair, University of Chicago, Chicago, Illinois. ^cPanel Vice-Chair, Duke University Medical Center, Durham, North Carolina. ^dMemorial Sloan Kettering Cancer Center, New York, New York. ^eUniversity of Minnesota, Minneapolis, Minnesota. ^fUrology Clinics of North Texas, Dallas, Texas; American Urological Association. ^gUniversity of Wisconsin, Madison, Wisconsin. ^hUPMC, Pittsburgh, Pennsylvania; American Urological Association. ⁱStanford University Medical Center, Stanford, California. ^jEmory University Hospital, Atlanta, Georgia. ^kThe Ottawa Hospital, University of Ottawa, Ottawa, Ontario, Canada, Primary care physician. ^lNational Institutes of Health, Bethesda, Maryland. ^mSpecialty Chair, University of Alabama at Birmingham, Birmingham, Alabama.

The American College of Radiology seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through representation of such organizations on expert panels. Participation on the expert panel does not necessarily imply endorsement of the final document by individual contributors or their respective organization.

Reprint requests to: publications@acr.org

Discussion of Procedures by Variant

Variant 1: Initial staging of pure seminoma testicular cancer. Diagnosed by orchiectomy.

Bone Scan Whole Body

Bone metastases from testicular cancer are uncommon. In one study, bone scan was able to detect metastases to the iliac bones ipsilateral to the testicular tumor before they were detectable by CT [12].

CT Abdomen and Pelvis

CT is the reference standard imaging test used for assessing the retroperitoneum for the presence of metastatic lymphadenopathy. CT is rapid, reproducible, and provides excellent imaging assessment of the para-aortic and paracaval regions [13-15]. Challenges related to CT are that many young men have little retroperitoneal fat, which may be an impediment for readers interpreting the study, and that CT cannot detect metastatic disease in lymph nodes of normal size. Additionally, inflammatory lymph nodes cannot be differentiated from those that are enlarged from metastases [16].

Lymph nodes >1 cm in short axis are highly suspicious for metastatic disease, particularly if they are located in the hilar regions of the kidney or in the para-aortic or caval areas (eg, testicular cancer landing zones). Various studies have established the accuracy of CT in detecting metastatic retroperitoneal lymph nodes from testicular cancer, which ranges from 73% to 97%, sensitivity ranges from 65% to 96%, and specificity from 81% to 100% [7,17-22]. Data also indicate that the accuracy of CT declines in patients with limited disease (eg, stage N1 and stage N2) and also if the upper limit of normal lymph node size is lowered [15,17,21]. Of note, most of these studies are relatively old and were performed using single-slice CT; however, limited newer data suggest similar accuracy using multi-slice CT compared with single-slice CT [23].

It is important to recognize that a significant percentage of metastatic lymph nodes will be <1 cm, up to 60% in one series [24]. For this reason, some authors suggest using a cut-off value of 0.7 cm to 0.8 cm in testicular cancer at the expense of reduced specificity [24,25]. These cut-off values are for the short-axis measurement when assessing the likelihood of nodal disease (N0 versus N1 disease); however, when assessing the nodal burden, the lymph nodes should be measured in long axis (eg, N1 versus N2 and N3 disease) [6,25]. Two studies have also evaluated the value of nodal craniocaudal length or volume as risk factors for recurrence in testicular cancer [26,27]. Another study comparing lymph node measurements performed by expert radiologists, other observers, and a semiautomated process showed excellent correlation between measurements, indicating that the task of actually measuring lymph nodes, which can be time consuming and tedious, could potentially be delegated or automated in the future [28].

The use of iodinated intravenous (IV) contrast media, as well as oral contrast media, may aid in detection of retroperitoneal lymph nodes, clarifying the adjacent normal anatomic structures including blood vessels and the duodenum [29].

CT Chest

Although CT is more sensitive than radiography for detecting recurrent disease in the chest [30,31], this added sensitivity is offset by lower specificity and a higher false positive detection rate for abnormalities that are not related to testicular cancer metastases [32]. Chest CT is recommended during initial staging if chest radiograph is abnormal or when abdominal CT is abnormal [8]. Detection of mediastinal and hilar lymph nodes may be aided by the use of iodinated IV contrast media [33].

FDG-PET/CT Whole Body

Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET has been used for staging and restaging patients with testicular cancer, but its incremental value in staging patients compared with CT or MRI has yet to be defined. For initial staging, PET may be slightly more sensitive than CT [34-39], but it is not recommended by the NCCN [40].

MRI Abdomen and Pelvis

MRI has also been studied for staging and surveillance of testicular cancer, to identify metastatic retroperitoneal lymphadenopathy [41-46]. Limited evidence from single-institution studies indicates comparable efficacy to CT for detection of retroperitoneal lymphadenopathy, notably without the need for gadolinium-based contrast agents (GBCAs) [41,43].

A limitation of the literature regarding MRI for detection of metastatic retroperitoneal lymphadenopathy is that the studies are older and do not incorporate diffusion-weighted imaging (DWI). DWI can substantially improve identification of lymph nodes; however, it is still limited by significant overlap between benign and malignant

lymph nodes [6]. A study published in 2020 showed comparable accuracy between MRI, which included DWI and omitted GBCAs, and CT for detection of metastatic retroperitoneal lymph nodes in testicular germ-cell tumors [47].

MRI Head

MRI of the head, without and with GBCAs, is recommended during the initial staging of testicular cancer if the patient is symptomatic or has high-risk features (eg, human chorionic gonadotropin [hCG] >5000 IU/L or extensive lung metastases) [8-11].

Radiography Chest

Studies have shown that chest radiography is beneficial in pure seminoma testicular cancer during the initial staging of testicular cancer to assess for the presence of pulmonary metastases [48,49]. Chest CT is recommended during initial staging if chest radiograph or abdominal CT is abnormal [8].

US Abdomen and Retroperitoneum

Ultrasound (US) of the abdomen and retroperitoneum to detect retroperitoneal lymph node metastases is less accurate and reproducible than CT, MRI, or PET/CT [50].

US Scrotum

Scrotal US is frequently used and should always be the initial imaging modality in assessing patients with scrotal masses. Scrotal US should always be performed during the initial workup of a scrotal mass before orchiectomy to localize the tumor, plan surgery, and clear the contralateral testicle of disease [40]. After initial triage and orchiectomy, scrotal US does not have a role in the initial staging or restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8].

Variant 2: Initial staging of nonseminoma testicular cancer. Diagnosed by orchiectomy.

Bone Scan Whole Body

Bone metastases from testicular cancer are uncommon. In one study, bone scan was able to detect metastases to the iliac bones ipsilateral to the testicular tumor before they were detectable by CT [12].

CT Abdomen and Pelvis

CT is the reference standard imaging test used for assessing the retroperitoneum for the presence of metastatic lymphadenopathy. CT is rapid, reproducible, and provides excellent imaging assessment of the para-aortic and paracaval regions [13-15]. Challenges related to CT are that many young men have little retroperitoneal fat, which may be an impediment for readers interpreting the study, and that CT cannot detect metastatic disease in lymph nodes of normal size. Additionally, inflammatory lymph nodes cannot be differentiated from those that are enlarged from metastases [16].

Lymph nodes >1 cm in short axis are highly suspicious for metastatic disease, particularly if they are located in the hilar regions of the kidney or in the para-aortic or caval areas (eg, testicular cancer landing zones). Various studies have established the accuracy of CT in detecting metastatic retroperitoneal lymph nodes from testicular cancer, which ranges from 73% to 97%, sensitivity ranges from 65% to 96%, and specificity from 81% to 100% [7,17-22]. Data also indicate that the accuracy of CT declines in patients with limited disease (eg, stage N1 and stage N2) and also if the upper limit of normal lymph node size is lowered [15,17,21]. Of note, most of these studies are relatively old and were performed using single-slice CT; however, limited newer data suggest similar accuracy using multi-slice CT compared with single-slice CT [23].

It is important to recognize that a significant percentage of metastatic lymph nodes will be <1 cm, up to 60% in one series [24]. For this reason, some authors suggest using a cut-off value of 0.7 cm to 0.8 cm in testicular cancer at the expense of reduced specificity [24,25]. These cut-off values are for the short-axis measurement when assessing the likelihood of nodal disease (N0 versus N1 disease); however, when assessing the nodal burden, the lymph nodes should be measured in long axis (eg, N1 versus N2 and N3 disease) [6,25]. Two studies have also evaluated the value of nodal craniocaudal length or volume as risk factors for recurrence in testicular cancer [26,27]. Another study comparing lymph node measurements performed by expert radiologists, other observers, and a semiautomated process showed excellent correlation between measurements, indicating that the task of actually measuring lymph nodes, which can be time consuming and tedious, could potentially be delegated or automated in the future [28].

The use of iodinated IV contrast media, as well as oral contrast media, may aid in detection of retroperitoneal lymph nodes, clarifying the adjacent normal anatomic structures including blood vessels and the duodenum [29].

CT Chest

Although CT is more sensitive than radiography for detecting recurrent disease in the chest [30,31], this added sensitivity is offset by lower specificity and a higher false positive detection rate for abnormalities that are not metastatic [32].

For nonseminoma testicular cancer, a slight advantage for chest CT has been noted compared with chest radiography [48,51], and chest CT is recommended during the initial staging of nonseminoma testicular cancer by the NCCN and European Association of Urology guidelines [8,9]. Detection of mediastinal and hilar lymph nodes may be aided by the use of iodinated IV contrast media [33].

FDG-PET/CT Whole Body

FDG-PET has been used for staging and restaging patients with testicular cancer, but its incremental value in staging patients compared with CT or MRI has yet to be defined. For initial staging, PET may be slightly more sensitive than CT [34-39], but it is not recommended by the NCCN [40].

A 2007 trial by the National Cancer Research Institute's Testis Cancer Clinical Studies Group using FDG-PET in an effort to predict relapse in patients with high-risk stage I nonseminoma testicular cancer was terminated early because of unacceptable relapse rates among PET-negative patients [52].

MRI Abdomen and Pelvis

MRI has also been studied for staging and surveillance of testicular cancer to identify metastatic retroperitoneal lymphadenopathy [41-46]. Limited evidence from single-institution studies indicates comparable efficacy to CT for detection of retroperitoneal lymphadenopathy, notably without the need for GBCAs [41,43].

A limitation of the literature regarding MRI for detection of metastatic retroperitoneal lymphadenopathy is that the studies are older and do not incorporate DWI. DWI can substantially improve identification of lymph nodes; however, it is still limited by significant overlap between benign and malignant lymph nodes [6]. A study published in 2020 showed comparable accuracy between MRI, which included DWI and omitted GBCAs, and CT for detection of metastatic retroperitoneal lymph nodes in testicular germ-cell tumors [47].

MRI Head

MRI of the head, without and with GBCAs, is recommended during the initial staging of testicular cancer if the patient is symptomatic or has high-risk features (eg, hCG >5000 IU/L, extensive lung metastases, choriocarcinoma, nonpulmonary visceral metastases, or alpha-fetoprotein [AFP] >10,000 ng/mL) [8-11].

Radiography Chest

Studies have shown that chest radiography is beneficial during the initial staging of testicular cancer, assessing for pulmonary metastases [48,49]. For nonseminoma testicular cancer, a slight advantage for chest CT has been noted compared with chest radiography [48,51], and chest CT is useful during the initial staging of nonseminoma testicular cancer by the NCCN and European Association of Urology guidelines [8,9].

US Abdomen and Retroperitoneum

US of the abdomen and retroperitoneum to detect retroperitoneal lymph node metastases is less accurate and reproducible than CT, MRI, or PET/CT [50].

US Scrotum

Scrotal US is frequently used and should always be the initial imaging modality in assessing patients with scrotal masses. Scrotal US should always be performed during the initial workup of a scrotal mass before orchiectomy to localize the tumor, plan surgery, and clear the contralateral testicle of disease [40]. After initial triage and orchiectomy, scrotal US does not have a role in the initial staging or restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8].

Variant 3: Surveillance of stage IA and IB pure seminoma testicular cancer. Diagnosed by orchiectomy. No clinical suspicion of recurrence.

Bone Scan Whole Body

Bone metastases from testicular cancer are uncommon. In one study, bone scan was able to detect metastases to the iliac bones ipsilateral to the testicular tumor before they were detectable by CT [12].

CT Abdomen and Pelvis

CT is the reference standard imaging test used for assessing the retroperitoneum for the presence of metastatic lymphadenopathy. CT is rapid, reproducible, and provides excellent imaging assessment of the para-aortic and paracaval regions [13-15]. Challenges related to CT are that many young men have little retroperitoneal fat, which may be an impediment for readers interpreting the study, and that CT cannot detect metastatic disease in lymph nodes of normal size. Additionally, inflammatory lymph nodes cannot be differentiated from those that are enlarged from metastases [16].

Lymph nodes >1 cm in short axis are highly suspicious for metastatic disease, particularly if they are located in the hilar regions of the kidney or in the para-aortic or caval areas (eg, testicular cancer landing zones). Various studies have established the accuracy of CT in detecting metastatic retroperitoneal lymph nodes from testicular cancer, which ranges from 73% to 97%, sensitivity ranges from 65% to 96%, and specificity from 81% to 100% [7,17-22]. Data also indicate that the accuracy of CT declines in patients with limited disease (eg, stage N1 and stage N2) and also if the upper limit of normal lymph node size is lowered [15,17,21]. Of note, most of these studies are relatively old and were performed using single-slice CT; however, limited newer data suggest similar accuracy using multi-slice CT compared with single-slice CT [23].

It is important to recognize that a significant percentage of metastatic lymph nodes will be <1 cm, up to 60% in one series [24]. For this reason, some authors suggest using a cut-off value of 0.7 cm to 0.8 cm in testicular cancer at the expense of reduced specificity [24,25]. These cut-off values are for the short-axis measurement when assessing the likelihood of nodal disease (N0 versus N1 disease); however, when assessing the nodal burden the lymph nodes should be measured in long axis (eg, N1 versus N2 and N3 disease) [6,25]. Two studies have also evaluated the value of nodal craniocaudal length or volume as risk factors for recurrence in testicular cancer [26,27]. Another study comparing lymph node measurements performed by expert radiologists, other observers, and a semiautomated process showed excellent correlation between measurements, indicating that the task of actually measuring lymph nodes, which can be time consuming and tedious, could potentially be delegated or automated in the future [28].

The use of iodinated IV contrast media, as well as oral contrast media, may aid in detection of retroperitoneal lymph nodes, clarifying the adjacent normal anatomic structures including blood vessels and the duodenum [29].

Surveillance is strongly preferred for patients with stage I pure seminoma testicular cancer [8-11]. Surveillance protocols no longer include chest CT [30] and may eliminate pelvic CT, except in cases in which the pelvis is deemed high risk [53-55]. The number and frequency schedule of follow-up CT examinations of the abdomen and pelvis is variable [56]. Most recently, the 2021 NCCN guidelines recommends different intensity of follow-up for stage I pure seminoma testicular cancer and nonseminoma testicular cancer, which also depends on the presence or absence of risk factors for metastatic disease [8].

CT Chest

Although CT is more sensitive than radiography for detecting recurrent disease in the chest [30,31], this added sensitivity is offset by lower specificity and a higher false positive detection rate for abnormalities that are not metastatic [32]. Detection of mediastinal and hilar lymph nodes may be aided by the use of iodinated IV contrast media [33].

Several studies indicate that chest radiography is sufficient when compared with CT for follow-up of stage I seminomas [30,32,49,54], and the NCCN advise CT chest only be performed if the patient is symptomatic [40].

FDG-PET/CT Whole Body

FDG-PET has been used for staging and restaging patients with testicular cancer, but its incremental value in staging patients compared with CT or MRI has yet to be defined. For initial staging, PET may be slightly more sensitive than CT [34-39]. The use of PET for surveillance of stage 1A and 1B pure seminoma is not well studied.

MRI Abdomen and Pelvis

MRI has also been studied for staging and surveillance of testicular cancer to identify metastatic retroperitoneal lymphadenopathy [41-46]. Limited evidence from single-institution studies indicates comparable efficacy to CT for detection of retroperitoneal lymphadenopathy, notably without the need for GBCAs [41,43].

A limitation of the literature regarding MRI for detection of metastatic retroperitoneal lymphadenopathy is that the studies are older and do not incorporate DWI. DWI can substantially improve identification of lymph nodes; however, it is still limited by significant overlap between benign and malignant lymph nodes [6]. A study published

in 2020 showed comparable accuracy between MRI, which included DWI and omitted GBCAs, and CT for detection of metastatic retroperitoneal lymph nodes in testicular germ-cell tumors [47].

MRI Head

MRI of the head is not recommended during the surveillance of pure seminoma testicular cancer unless the patient is symptomatic.

Radiography Chest

In pure seminoma testicular cancer under surveillance, studies have shown that lung relapses are rarely detected by chest radiography alone, with most relapses detected by abnormal serum markers or abdominal and pelvic CT scan [57-59], calling into question the value of chest radiography in surveillance of stage I pure seminoma testicular cancer. The 2021 NCCN guidelines, however, do provide an option for chest radiography for stage I pure seminoma testicular cancer patients undergoing surveillance if clinically indicated [8].

US Abdomen and Retroperitoneum

US of the abdomen and retroperitoneum to detect retroperitoneal lymph node metastases is less accurate and reproducible than CT, MRI, or PET/CT [50].

US Scrotum

Scrotal US does not have a role in the restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8]. Scrotal US should always be performed during the initial workup of a scrotal mass before orchiectomy to localize the tumor, plan surgery, and clear the contralateral testicle of disease [40]. After initial triage and orchiectomy, scrotal US does not have a role in the initial staging or restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8].

Variant 4: Surveillance of stage IA and IB nonseminoma testicular cancer. Diagnosed by orchiectomy. No clinical suspicion of recurrence.

Bone Scan Whole Body

Bone metastases from testicular cancer are uncommon. In one study, bone scan was able to detect metastases to the iliac bones ipsilateral to the testicular tumor before they were detectable by CT [12].

CT Abdomen and Pelvis

CT is the reference standard imaging test used for assessing the retroperitoneum for the presence of metastatic lymphadenopathy. CT is rapid, reproducible, and provides excellent imaging assessment of the para-aortic and paracaval regions [13-15]. Challenges related to CT are that many young men have little retroperitoneal fat, which may be an impediment for readers interpreting the study, and that CT cannot detect metastatic disease in lymph nodes of normal size. Additionally, inflammatory lymph nodes cannot be differentiated from those that are enlarged from metastases [16].

Lymph nodes >1 cm in short axis are highly suspicious for metastatic disease, particularly if they are located in the hilar regions of the kidney or in the para-aortic or caval areas (eg, testicular cancer landing zones). Various studies have established the accuracy of CT in detecting metastatic retroperitoneal lymph nodes from testicular cancer, which ranges from 73% to 97%, sensitivity ranges from 65% to 96%, and specificity from 81% to 100% [7,17-22]. Data also indicate that the accuracy of CT declines in patients with limited disease (eg, stage N1 and stage N2) and also if the upper limit of normal lymph node size is lowered [15,17,21]. Of note, most of these studies are relatively old and were performed using single-slice CT; however, limited newer data suggest similar accuracy using multi-slice CT compared with single-slice CT [23].

It is important to recognize that a significant percentage of metastatic lymph nodes will be <1 cm, up to 60% in one series [24]. For this reason, some authors suggest using a cut-off value of 0.7 cm to 0.8 cm in testicular cancer at the expense of reduced specificity [24,25]. These cut-off values are for the short-axis measurement when assessing the likelihood of nodal disease (N0 versus N1 disease); however, when assessing the nodal burden, the lymph nodes should be measured in long axis (eg, N1 versus N2 and N3 disease) [6,25]. Two studies have also evaluated the value of nodal craniocaudal length or volume as risk factors for recurrence in testicular cancer [26,27]. Another study comparing lymph node measurements performed by expert radiologists, other observers, and a semiautomated process showed excellent correlation between measurements, indicating that the task of actually measuring lymph nodes, which can be time consuming and tedious, could potentially be delegated or automated in the future [28].

The use of iodinated IV contrast media, as well as oral contrast media, may aid in detection of retroperitoneal lymph nodes, clarifying the adjacent normal anatomic structures including blood vessels and the duodenum [29].

Surveillance protocols no longer include chest CT [30] and may eliminate pelvic CT, except in cases in which the pelvis is deemed high risk [53-55]. The number and frequency schedule of follow-up CT examinations of the abdomen and pelvis is variable [56]. Most recently, the 2021 NCCN guidelines recommends different intensity of follow-up for stage I pure seminoma testicular cancer and nonseminoma testicular cancer, which also depends on the presence or absence of risk factors for metastatic disease [8].

CT Chest

Although CT is more sensitive than radiography for detecting recurrent disease in the chest [30,31], this added sensitivity is offset by lower specificity and a higher false positive detection rate for abnormalities that are not metastatic [32]. Detection of mediastinal and hilar lymph nodes may be aided by the use of iodinated IV contrast media [33]. In patients with thoracic symptoms, the NCCN advises the use of CT chest for follow-up of patients with nonseminoma undergoing surveillance [8].

FDG-PET/CT Whole Body

FDG-PET has been used for staging and restaging patients with testicular cancer, but its incremental value in staging patients compared with CT or MRI has yet to be defined. For initial staging, PET may be slightly more sensitive than CT [34-39].

A 2007 trial by the National Cancer Research Institute's Testis Cancer Clinical Studies Group using FDG-PET in an effort to predict relapse in patients with high-risk stage I nonseminoma testicular cancer was terminated early because of unacceptable relapse rates among PET-negative patients [52].

MRI Abdomen and Pelvis

MRI has also been studied for staging and surveillance of testicular cancer to identify metastatic retroperitoneal lymphadenopathy [41-46]. Limited evidence from single-institution studies indicates comparable efficacy to CT for detection of retroperitoneal lymphadenopathy, notably without the need for GBCAs [41,43].

A limitation of the literature regarding MRI for detection of metastatic retroperitoneal lymphadenopathy is that the studies are older and do not incorporate DWI. DWI can substantially improve identification of lymph nodes; however, it is still limited by significant overlap between benign and malignant lymph nodes [6]. A study published in 2020 showed comparable accuracy between MRI, which included DWI and omitted GBCAs, and CT for detection of metastatic retroperitoneal lymph nodes in testicular germ-cell tumors [47].

MRI Head

MRI of the head is not recommended during the surveillance of pure seminoma testicular cancer unless the patient is symptomatic.

Radiography Chest

The 2021 NCCN guidelines recommend chest radiography for surveillance of Stage I nonseminoma testicular cancer [8].

US Abdomen and Retroperitoneum

US of the abdomen and retroperitoneum to detect retroperitoneal lymph node metastases is less accurate and reproducible than CT, MRI, or PET/CT [50].

US Scrotum

Scrotal US does not have a role in the restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8]. Scrotal US should always be performed during the initial workup of a scrotal mass before orchiectomy to localize the tumor, plan surgery, and clear the contralateral testicle of disease [40]. After initial triage and orchiectomy, scrotal US does not have a role in the initial staging or restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8].

Variant 5: Surveillance of stage IA and IB pure seminoma and nonseminoma testicular cancer. Diagnosed by orchiectomy. Suspected recurrence.

Bone Scan Whole Body

Bone metastases from testicular cancer are uncommon. In one study, bone scan was able to detect metastases to the iliac bones ipsilateral to the testicular tumor before they were detectable by CT [12].

CT Abdomen and Pelvis

CT is the reference standard imaging test used for assessing the retroperitoneum for the presence of metastatic lymphadenopathy. CT is rapid, reproducible, and provides excellent imaging assessment of the para-aortic and paracaval regions [13-15]. Challenges related to CT are that many young men have little retroperitoneal fat, which may be an impediment for readers interpreting the study, and that CT cannot detect metastatic disease in lymph nodes of normal size. Additionally, inflammatory lymph nodes cannot be differentiated from those that are enlarged from metastases [16].

Lymph nodes >1 cm in short axis are highly suspicious for metastatic disease, particularly if they are located in the hilar regions of the kidney or in the para-aortic or caval areas (eg, testicular cancer landing zones). Various studies have established the accuracy of CT in detecting metastatic retroperitoneal lymph nodes from testicular cancer, which ranges from 73% to 97%, sensitivity ranges from 65% to 96%, and specificity from 81% to 100% [7,17-22]. Data also indicates that the accuracy of CT declines in patients with limited disease (eg, stage N1 and stage N2) and also if the upper limit of normal lymph node size is lowered [15,17,21]. Of note, most of these studies are relatively old and were performed using single-slice CT; however, limited newer data suggest similar accuracy using multi-slice CT compared with single-slice CT [23].

It is important to recognize that a significant percentage of metastatic lymph nodes will be <1 cm, up to 60% in one series [24]. For this reason, some authors suggest using a cut-off value of 0.7 cm to 0.8 cm in testicular cancer at the expense of reduced specificity [24,25]. These cut-off values are for the short-axis measurement when assessing the likelihood of nodal disease (N0 versus N1 disease); however, when assessing the nodal burden, the lymph nodes should be measured in long axis (eg, N1 versus N2 and N3 disease) [6,25]. Two studies have also evaluated the value of nodal craniocaudal length or volume as risk factors for recurrence in testicular cancer [26,27]. Another study comparing lymph node measurements performed by expert radiologists, other observers, and a semiautomated process showed excellent correlation between measurements, indicating that the task of actually measuring lymph nodes, which can be time consuming and tedious, could potentially be delegated or automated in the future [28].

The use of iodinated IV contrast media, as well as oral contrast media, may aid in detection of retroperitoneal lymph nodes, clarifying the adjacent normal anatomic structures including blood vessels and the duodenum [29].

The number and frequency schedule of follow-up CT examinations of the abdomen and pelvis is variable [56]. Most recently, the 2021 NCCN guidelines recommends different intensity of follow-up for stage I pure seminoma testicular cancer and nonseminoma testicular cancer, which also depends on the presence or absence of risk factors for metastatic disease [8].

CT Chest

Although CT is more sensitive than radiography for detecting recurrent disease in the chest [30,31], this added sensitivity is offset by lower specificity and a higher false positive detection rate for abnormalities that are not metastatic [32]. Detection of mediastinal and hilar lymph nodes may be aided by the use of iodinated IV contrast media [33].

Several studies indicate that chest radiography is sufficient when compared with CT for follow-up of stage I pure seminoma testicular cancers [30,32,49,54]. However, the 2021 NCCN guidelines advise the use of chest CT in both patients with Stage I pure seminoma or nonseminoma testicular cancer with thoracic symptoms [8].

FDG-PET/CT Whole Body

FDG-PET has been used for staging and restaging patients with testicular cancer, but its incremental value in staging patients compared with CT or MRI has yet to be defined. For initial staging, PET may be slightly more sensitive than CT [34-39].

MRI Abdomen and Pelvis

MRI has also been studied for staging and surveillance of testicular cancer to identify metastatic retroperitoneal lymphadenopathy [41-46]. Limited evidence from single-institution studies indicates comparable efficacy to CT for detection of retroperitoneal lymphadenopathy, notably without the need for GBCAs [41,43].

A limitation of the literature regarding MRI for detection of metastatic retroperitoneal lymphadenopathy is that the studies are older and do not incorporate DWI. DWI can substantially improve identification of lymph nodes; however, it is still limited by significant overlap between benign and malignant lymph nodes [6]. A study published in 2020 showed comparable accuracy between MRI, which included DWI and omitted GBCAs, and CT for detection of metastatic retroperitoneal lymph nodes in testicular germ cell tumors [47].

MRI Head

MRI of the head is not recommended during the surveillance of pure seminoma testicular cancer unless the patient is symptomatic.

Radiography Chest

In pure seminoma testicular cancer under surveillance, studies have shown that lung relapses are rarely detected by chest radiography alone, with most relapses detected by abnormal serum markers or abdominal and pelvic CT scan [57-59], calling into question the value of chest radiography in surveillance of stage I pure seminoma testicular cancer. The 2021 NCCN guidelines recommend chest radiography for stage I pure seminoma testicular cancer patients undergoing surveillance as clinically indicated [8]. Chest radiography is recommended by the 2021 NCCN guidelines for stage I nonseminoma; in patients with thoracic symptoms, CT Chest is advised [8].

US Abdomen and Retroperitoneum

US of the abdomen and retroperitoneum to detect retroperitoneal lymph node metastases is less accurate and reproducible than CT, MRI, or PET/CT [50].

US Scrotum

Scrotal US does not have a role in the restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8]. Scrotal US should always be performed during the initial workup of a scrotal mass before orchiectomy to localize the tumor, plan surgery, and clear the contralateral testicle of disease [40]. After initial triage and orchiectomy, scrotal US does not have a role in the initial staging or restaging of men with testicular cancer diagnosis established by orchiectomy unless there is concern for contralateral tumor or equivocal clinical examination [8].

Summary of Recommendations

- **Variante 1:** CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast is usually appropriate for the initial imaging of pure seminoma testicular cancer diagnosed by orchiectomy. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). Radiography chest is also usually appropriate and complements either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast.
- **Variante 2:** CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast is usually appropriate for the initial staging of nonseminoma testicular cancer diagnosed by orchiectomy. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). Radiography chest or CT chest with IV contrast is usually appropriate and are equivalent alternatives. Radiography chest is complementary to either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast. CT chest with IV contrast is complementary to either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast.
- **Variante 3:** CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast is usually appropriate for surveillance of pure seminoma testicular cancer when there is no suspicion for recurrence. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). Radiography chest is also usually appropriate and complements either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast.

- **Variante 4:** CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast is usually appropriate for surveillance of nonseminoma testicular cancer when there is no suspicion for recurrence. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient’s care). Radiography chest is also usually appropriate and complements either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast.
- **Variante 5:** Radiography chest, CT chest with IV contrast, CT abdomen and pelvis with IV contrast, or MRI abdomen and pelvis without and with IV contrast is usually appropriate for surveillance of pure seminoma and nonseminoma testicular cancer when recurrence is suspected. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient’s care). Radiography chest or CT chest with IV contrast is usually appropriate and are equivalent alternatives. Radiography chest is complementary to either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast. CT chest with IV contrast is complementary to either CT abdomen and pelvis with IV contrast or MRI abdomen and pelvis without and with IV contrast.

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.

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 [60].

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. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer Statistics, 2021. *CA Cancer J Clin* 2021;71:7-33.
2. Bahrami A, Ro JY, Ayala AG. An overview of testicular germ cell tumors. *Arch Pathol Lab Med* 2007;131:1267-80.
3. Brenner H, Gondos A, Arndt V. Recent major progress in long-term cancer patient survival disclosed by modeled period analysis. *J Clin Oncol* 2007;25:3274-80.
4. Pano B, Sebastia C, Bunesch L, et al. Pathways of lymphatic spread in male urogenital pelvic malignancies. *Radiographics* 2011;31:135-60.
5. Amin MB, Edge S, Greene F, et al. *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer; 2017.
6. Hedgire SS, Pargaonkar VK, Elmi A, Harisinghani AM, Harisinghani MG. Pelvic nodal imaging. *Radiol Clin North Am* 2012;50:1111-25.
7. Epstein BE, Order SE, Zinreich ES. Staging, treatment, and results in testicular seminoma. A 12-year report. *Cancer* 1990;65:405-11.
8. NCCN Clinical Practice Guidelines in Oncology. Testicular Cancer. Version 2.2021. Available at: https://www.nccn.org/professionals/physician_gls/pdf/testicular.pdf. Accessed September 30, 2021.
9. 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.
10. Roth BJ. Management of Clinical Stage I Germ Cell Tumors. *Urol Clin North Am* 2019;46:353-62.
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. Braga FJ, Arbex MA, Haddad J, Maes A. Bone scintigraphy in testicular tumors. *Clin Nucl Med* 2001;26:117-8.
13. Dixon AK, Ellis M, Sikora K. Computed tomography of testicular tumours: distribution of abdominal lymphadenopathy. *Clin Radiol* 1986;37:519-23.
14. MacVicar D. Staging of testicular germ cell tumours. *Clin Radiol* 1993;47:149-58.
15. Rowland RG, Weisman D, Williams SD, Einhorn LH, Klatte EC, Donohue JP. Accuracy of preoperative staging in stages A and B nonseminomatous germ cell testis tumors. *J Urol* 1982;127:718-20.
16. McMahon CJ, Rofsky NM, Pedrosa I. Lymphatic metastases from pelvic tumors: anatomic classification, characterization, and staging. *Radiology* 2010;254:31-46.
17. Hilton S, Herr HW, Teitcher JB, Begg CB, Castellino RA. CT detection of retroperitoneal lymph node metastases in patients with clinical stage I testicular nonseminomatous germ cell cancer: assessment of size and distribution criteria. *AJR Am J Roentgenol* 1997;169:521-5.
18. Husband JE, Barrett A, Peckham MJ. Evaluation of computed tomography in the management of testicular teratoma. *Br J Urol* 1981;53:179-83.
19. Jing B, Wallace S, Zornoza J. Metastases to retroperitoneal and pelvic lymph nodes: computed tomography and lymphangiography. *Radiol Clin North Am* 1982;20:511-30.

20. Richie JP, Garnick MB, Finberg H. Computerized tomography: how accurate for abdominal staging of testis tumors? *J Urol* 1982;127:715-7.
21. Strohmeyer T, Geiser M, Ackermann R, Mumperow E, Hartmann M. Value of computed tomography in the staging of testicular tumors. *Urol Int* 1988;43:198-200.
22. Thomas JL, Bernardino ME, Bracken RB. Staging of testicular carcinoma: comparison of CT and lymphangiography. *AJR Am J Roentgenol* 1981;137:991-6.
23. Hansen J, Jurik AG. Diagnostic value of multislice computed tomography and magnetic resonance imaging in the diagnosis of retroperitoneal spread of testicular cancer: a literature review. *Acta Radiol* 2009;50:1064-70.
24. Hudolin T, Kastelan Z, Knezevic N, Goluza E, Tomas D, Coric M. Correlation between retroperitoneal lymph node size and presence of metastases in nonseminomatous germ cell tumors. *Int J Surg Pathol* 2012;20:15-8.
25. Coursey Moreno C, Small WC, Camacho JC, et al. Testicular tumors: what radiologists need to know--differential diagnosis, staging, and management. *Radiographics* 2015;35:400-15.
26. Howard SA, Gray KP, O'Donnell EK, Fennessy FM, Beard CJ, Sweeney CJ. Craniocaudal retroperitoneal node length as a risk factor for relapse from clinical stage I testicular germ cell tumor. *AJR Am J Roentgenol* 2014;203:W415-20.
27. Maakaron JE, Gasparis PT, Althouse S, et al. Three-dimensional lymph node volume and craniocaudal lymph node length as an independent risk factor for recurrence or presence of micrometastasis in clinical stage I non-seminomatous germ cell tumors: A retrospective study. *J Clin Oncol* 2015;33:e15547-e47.
28. Ozturk C, Velleman T, Bongaerts AH, et al. Assessment of Volumetric versus Manual Measurement in Disseminated Testicular Cancer; No Difference in Assessment between Non-Radiologists and Genitourinary Radiologist. *PLoS One* 2017;12:e0168977.
29. Einstein DM, Singer AA, Chilcote WA, Desai RK. Abdominal lymphadenopathy: spectrum of CT findings. *Radiographics* 1991;11:457-72.
30. Harvey ML, Geldart TR, Duell R, Mead GM, Tung K. Routine computerised tomographic scans of the thorax in surveillance of stage I testicular non-seminomatous germ-cell cancer--a necessary risk? *Ann Oncol* 2002;13:237-42.
31. Meyer CA, Conces DJ. Imaging of intrathoracic metastases of nonseminomatous germ cell tumors. *Chest Surg Clin N Am* 2002;12:717-38.
32. Horan G, Rafique A, Robson J, Dixon AK, Williams MV. CT of the chest can hinder the management of seminoma of the testis; it detects irrelevant abnormalities. *Br J Cancer* 2007;96:882-5.
33. Cascade PN, Gross BH, Kazerooni EA, et al. Variability in the detection of enlarged mediastinal lymph nodes in staging lung cancer: a comparison of contrast-enhanced and unenhanced CT. *AJR Am J Roentgenol* 1998;170:927-31.
34. Cremerius U, Effert PJ, Adam G, et al. FDG PET for detection and therapy control of metastatic germ cell tumor. *J Nucl Med* 1998;39:815-22.
35. Cremerius U, Wildberger JE, Borchers H, et al. Does positron emission tomography using 18-fluoro-2-deoxyglucose improve clinical staging of testicular cancer?--Results of a study in 50 patients. *Urology* 1999;54:900-4.
36. de Wit M, Brenner W, Hartmann M, et al. [18F]-FDG-PET in clinical stage I/II non-seminomatous germ cell tumours: results of the German multicentre trial. *Ann Oncol* 2008;19:1619-23.
37. Hain SF, O'Doherty MJ, Timothy AR, Leslie MD, Partridge SE, Huddart RA. Fluorodeoxyglucose PET in the initial staging of germ cell tumours. *Eur J Nucl Med* 2000;27:590-4.
38. Lassen U, Daugaard G, Eigtved A, Hojgaard L, Damgaard K, Rorth M. Whole-body FDG-PET in patients with stage I non-seminomatous germ cell tumours. *Eur J Nucl Med Mol Imaging* 2003;30:396-402.
39. Spermon JR, De Geus-Oei LF, Kiemeny LA, Witjes JA, Oyen WJ. The role of (18)fluoro-2-deoxyglucose positron emission tomography in initial staging and re-staging after chemotherapy for testicular germ cell tumours. *BJU Int* 2002;89:549-56.
40. NCCN Clinical Practice Guidelines in Oncology. Testicular Cancer. NCCN Evidence Blocks. Version 2.2021. Available at: https://www.nccn.org/professionals/physician_gls/pdf/testicular_blocks.pdf. Accessed September 30, 2021.
41. Ellis JH, Bies JR, Kopecky KK, Klatte EC, Rowland RG, Donohue JP. Comparison of NMR and CT imaging in the evaluation of metastatic retroperitoneal lymphadenopathy from testicular carcinoma. *J Comput Assist Tomogr* 1984;8:709-19.
42. Glazer HS, Lee JK, Levitt RG, et al. Radiation fibrosis: differentiation from recurrent tumor by MR imaging. *Radiology* 1985;156:721-6.

43. Hogeboom WR, Hoekstra HJ, Mooyaart EL, et al. The role of magnetic resonance imaging and computed tomography in the treatment evaluation of retroperitoneal lymph-node metastases of non-seminomatous testicular tumors. *Eur J Radiol* 1991;13:31-6.
44. Harisinghani MG, Saksena M, Ross RW, et al. A pilot study of lymphotropic nanoparticle-enhanced magnetic resonance imaging technique in early stage testicular cancer: a new method for noninvasive lymph node evaluation. *Urology* 2005;66:1066-71.
45. Sohaib SA, Koh DM, Barbachano Y, et al. Prospective assessment of MRI for imaging retroperitoneal metastases from testicular germ cell tumours. *Clin Radiol* 2009;64:362-7.
46. Rud E, Langberg CW, Baco E, Lauritzen P, Sandbaek G. MRI in the Follow-up of Testicular Cancer: Less is More. *Anticancer Res* 2019;39:2963-68.
47. Laukka M, Mannisto S, Beule A, Kouri M, Blomqvist C. Comparison between CT and MRI in detection of metastasis of the retroperitoneum in testicular germ cell tumors: a prospective trial. *Acta Oncol* 2020;59:660-65.
48. Fernandez EB, Colon E, McLeod DG, Moul JW. Efficacy of radiographic chest imaging in patients with testicular cancer. *Urology* 1994;44:243-8; discussion 48-9.
49. Steinfeld AD, Macher MS. Radiologic staging of chest in testicular seminoma. *Urology* 1990;36:428-30.
50. Mao Y, Hedgire S, Harisinghani M. Radiologic Assessment of Lymph Nodes in Oncologic Patients. *Current Radiology Reports* 2013;2.
51. See WA, Hoxie L. Chest staging in testis cancer patients: imaging modality selection based upon risk assessment as determined by abdominal computerized tomography scan results. *J Urol* 1993;150:874-8.
52. Huddart RA, O'Doherty MJ, Padhani A, et al. 18fluorodeoxyglucose positron emission tomography in the prediction of relapse in patients with high-risk, clinical stage I nonseminomatous germ cell tumors: preliminary report of MRC Trial TE22--the NCRI Testis Tumour Clinical Study Group. *J Clin Oncol* 2007;25:3090-5.
53. Sohaib SA, Koh DM, Husband JE. The role of imaging in the diagnosis, staging, and management of testicular cancer. *AJR Am J Roentgenol* 2008;191:387-95.
54. White PM, Adamson DJ, Howard GC, Wright AR. Imaging of the thorax in the management of germ cell testicular tumours. *Clin Radiol* 1999;54:207-11.
55. Sadow CA, Maurer AN, Prevedello LM, Sweeney CJ, Silverman SG. CT restaging of testicular germ cell tumors: The incidence of isolated pelvic metastases. *Eur J Radiol* 2016;85:1439-44.
56. Rustin GJ, Mead GM, Stenning SP, et al. Randomized trial of two or five computed tomography scans in the surveillance of patients with stage I nonseminomatous germ cell tumors of the testis: Medical Research Council Trial TE08, ISRCTN56475197--the National Cancer Research Institute Testis Cancer Clinical Studies Group. *J Clin Oncol* 2007;25:1310-5.
57. De La Pena H, Sharma A, Glicksman C, et al. No longer any role for routine follow-up chest x-rays in men with stage I germ cell cancer. *Eur J Cancer* 2017;84:354-59.
58. Kollmannsberger C, Tandstad T, Bedard PL, et al. Patterns of relapse in patients with clinical stage I testicular cancer managed with active surveillance. *J Clin Oncol* 2015;33:51-7.
59. Tolan S, Vesprini D, Jewett MA, et al. No role for routine chest radiography in stage I seminoma surveillance. *Eur Urol* 2010;57:474-9.
60. 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.