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

<u>**Variant 1:**</u>   **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	O
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	O
MRI head without and with IV contrast	May Be Appropriate	O
US abdomen and retroperitoneum	Usually Not Appropriate	O
US scrotum	Usually Not Appropriate	O
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	O
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	O
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	O
MRI head without and with IV contrast	May Be Appropriate	O
US abdomen and retroperitoneum	Usually Not Appropriate	O
US scrotum	Usually Not Appropriate	O
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	O
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	O
US scrotum	May Be Appropriate	O
CT abdomen and pelvis without IV contrast	May Be Appropriate	☢☢☢
MRI abdomen and pelvis without IV contrast	May Be Appropriate	O
US abdomen and retroperitoneum	Usually Not Appropriate	O
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	O
MRI head without IV contrast	Usually Not Appropriate	O
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	O
US scrotum	May Be Appropriate	O
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	O
US abdomen and retroperitoneum	Usually Not Appropriate	O
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	O
MRI head without IV contrast	Usually Not Appropriate	O
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	O
US scrotum	May Be Appropriate	O
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	O
MRI head without and with IV contrast	May Be Appropriate	O
FDG-PET/CT whole body	May Be Appropriate	☢☢☢☢
US abdomen and retroperitoneum	Usually Not Appropriate	O
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	O
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, MBA[j]; 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].

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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.

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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].

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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

- **Variant 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.

- **Variant 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.

- **Variant 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.

- **Variant 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.

- **Variant 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."

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