American College of Radiology
ACR Appropriateness Criteria®
Pretreatment Evaluation and Follow-up of Invasive Cancer of the Cervix

Variant: 1   Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
US pelvis transvaginal	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT pelvis with IV contrast	May Be Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	May Be Appropriate	☢☢☢☢
US pelvis transabdominal	Usually Not Appropriate	O
CT pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 2   Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
MRI abdomen without and with IV contrast	May Be Appropriate	O
MRI abdomen without IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT chest without IV contrast	May Be Appropriate	☢☢☢
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
Radiography chest	Usually Not Appropriate	☢
CT abdomen and pelvis without IV contrast	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	☢☢☢☢

Variant: 3   Initial treatment response assessment of cervical cancer after chemoradiation.

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
MRI pelvis without IV contrast	Usually Appropriate	O
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢

MRI abdomen without and with IV contrast	May Be Appropriate	O
MRI abdomen without IV contrast	May Be Appropriate	O
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
CT chest with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
Radiography chest	Usually Not Appropriate	☢
CT abdomen and pelvis without 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	☢☢☢☢

Variant: 4 Surveillance of treated cervical cancer in asymptomatic patients.

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
MRI abdomen without and with IV contrast	May Be Appropriate (Disagreement)	O
MRI abdomen without IV contrast	May Be Appropriate (Disagreement)	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT abdomen and pelvis without IV contrast	May Be Appropriate (Disagreement)	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
Radiography chest	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	☢☢☢☢

Variant: 5 Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI abdomen without and with IV contrast	Usually Appropriate	O
MRI pelvis without and with IV contrast	Usually Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
MRI abdomen without IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT abdomen and pelvis without IV contrast	May Be Appropriate (Disagreement)	☢☢☢

CT chest without IV contrast	May Be Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	May Be Appropriate (Disagreement)	☢☢☢☢
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
Radiography chest	Usually Not Appropriate	☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢

Panel Members

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Summary of Literature Review

Introduction/Background

The American Cancer Society estimates there will be 14,100 new cases of invasive cervical cancer and 4,280 cervical cancer–related deaths in the United States in 2022 [1]. Mortality rates have dropped in recent decades as a result of Papanicolaou (PAP) smear and human papillomavirus (HPV) screening, which can detect cervical dysplasia and cancer in situ and allow for early, minimally invasive, and curative treatment [1]. Known risk factors for cervical cancer include HPV infection (particularly by HPV strains 16 and 18), cigarette smoking, and immunosuppression [2]. The recent development of an HPV vaccine, which specifically protects against HPV strains 16, 18, 31, 33, 45, 52, and 58, is expected to continue to drive down cervical cancer incidence in the future [3].

Cervical cancer is staged based on the International Federation of Gynecology and Obstetrics (FIGO) classification system. FIGO staging for cervical cancer was revised in 2018 to incorporate radiologic and pathologic data [2]; imaging plays an important role in pretreatment assessment including staging, treatment response assessment, and surveillance of cervical cancer. Accurate determination of tumor size and local extension as well as identification of nodal and distant metastases are important, not only for their prognostic value—with outcomes strongly linked to nodal status—but also because they determine the treatment strategy used (surgery versus chemoradiation) [4]. Cervical cancer recurrence typically occurs within the first 0.5 to 3 years after treatment and is accompanied by the development of symptoms such as vaginal bleeding, discharge, and abdominal/pelvic pain in the majority of cases. In 46% to 95% of patients, disease recurrence can be diagnosed by physical examination and history alone; once disease recurrence is clinically suspected, imaging plays a critical role in determining its extent and to inform the treatment strategy of either pelvic exenteration surgery, chemoradiation, or immunotherapy [5,6].

Discussion of Procedures by Variant

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.

Imaging is recommended for staging evaluation in any person with a clinically visible tumor or a microscopic tumor that is found to have >5 mm of invasion on biopsy, corresponding to stage 1B or greater disease [2]. Accurate determination of the size and local extent of the tumor is critical because this determines the treatment strategy used.

Definitive surgery with radical hysterectomy with lymph node sampling is the treatment of choice for smaller (≤4 cm), locally confined invasive cervical cancers (within the cervix or invading only the upper two-thirds of the vagina): stages IA2, IB1, IB2, and IIA1 [2]. Alternatively, trachelectomy can be considered for patients with stage IA2 or IB1 tumors who wish to maintain fertility. In this procedure, the cervix, parametrium, and vaginal cuff are removed with pelvic sentinel node biopsy or lymphadenectomy, and a cerclage suture is placed around the uterine isthmus to preserve uterine competency. Tumor size and location are critical factors in the assessment of trachelectomy candidacy, with cervix-confined tumors <2 cm in size and located >1 cm from the internal cervical os considered ideal features. Some centers will consider trachelectomy for patients with tumors <4 cm or as close to 0.5 cm from the internal os [7,8].

In contrast, primary chemoradiotherapy is the treatment of choice for larger invasive cervical cancers (>4 cm) given their high likelihood of occult nodal metastases, locally advanced tumors invading the parametrium, lower one-third of the vagina, or adjacent pelvic organs, or those with known nodal or distant metastases (stages IB3, IIA2, IIB, III, and IVA, respectively) [2]. In this population, pretreatment imaging plays a critical role in radiation therapy treatment planning, specifically for contouring of the radiation field.

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
A. CT Pelvis With IV Contrast

Compared to MRI, CT provides very poor soft tissue characterization in the pelvis and therefore demonstrates a lower accuracy for the determination of local extent of invasive cervical cancer [9]. One multicenter study found that invasive cervical cancers, which appeared hypodense to the normal cervical stroma, were only well delineated in 35% to 73% of contrast-enhanced CT examinations [10]. Considering individual features, meta-analyses have shown CT with intravenous (IV) contrast to have 43% to 55% sensitivity and 71% specificity for parametrial invasion, and 41% sensitivity and 92% specificity for bladder invasion [11,12]. In comparison, MRI demonstrated 71% specificity (95% confidence interval [CI], 62%-79%) and 91% sensitivity (95% CI, 88%-93%) for parametrial invasion, and 84% sensitivity (95% CI, 57%-95%) and 95% specificity (95% CI, 87%-98%) for bladder invasion [12].

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
B. CT Pelvis Without and With IV Contrast

CT pelvis without IV contrast provides very poor soft tissue characterization in the pelvis [13] and therefore is not useful for the evaluation of the local extent of invasive cervical cancer. The addition of noncontrast CT images would not appreciably add information to the contrast-enhanced CT evaluation.

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
C. CT Pelvis Without IV Contrast

CT without IV contrast provides very poor soft tissue characterization in the pelvis [13] and therefore is not useful for the evaluation of local extent of invasive cervical cancer.

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
D. FDG-PET/CT Skull Base to Mid-Thigh

Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET/CT is most commonly used in addition to pelvic MRI for nodal and metastatic disease assessment (as described in Variant 2), although it can also contribute to the evaluation of local disease extent. Physiologic excreted radiotracer in the bladder may obscure FDG uptake in the region of the cervix in some patients [9]. However, a meta-analysis showed similar overall diagnostic performance for PET/CT and MRI for local extent of disease assessment, with an overall sensitivity of 73% (95% CI, 56%-85%) and specificity of 91% (95% CI, 83%-96%) for PET/CT compared to a sensitivity of 71% (95% CI, 62%-79%) and specificity of 91% (88%-93%) for MRI [12].

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
E. FDG-PET/MRI Skull Base to Mid-Thigh

Although still not in widespread clinical use, research has shown PET/MRI to be a promising new modality for comprehensive examination of cervical cancer disease extent. The MRI examination offers ideal imaging of the primary tumor for local extent evaluation, whereas the PET component offers superior sensitivity for the detection of nodal and hematogenous metastases. This is supported by a prospective study of 53 patients with cervical cancer that showed whole body PET/MRI performed comparably to MRI alone for local disease assessment with 85% accuracy versus 87% but better for the detection of lymph node metastases demonstrating 83% sensitivity, 90% specificity, and 87% accuracy compared to 71%, 83%, and 77%, respectively for MRI alone [14]. Considering local invasion, a study of 33 patients who underwent pretreatment PET/MRI showed a higher area under the curve than MRI alone for the detection of parametrial invasion (0.89 versus 0.73), vaginal invasion (85% versus 74%), and deep cervical stromal invasion (96% versus 74%) [15]. In addition to the staging evaluation, PET/MRI offers prognostic information with a higher maximum standardized uptake value (SUV_{max}) associated with poorer prognosis [16,17] and was found to be an independent predictor of progression-free survival (hazard radio [HR] = 4.57).

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
F. MRI Pelvis Without and With IV Contrast

MRI is used to determine invasive cervical cancer tumor size and the extent of local invasion. Its superior soft tissue characterization allows for a more accurate staging assessment than can be obtained by CT or ultrasound (US) [11,18-20]. T2-weighted noncontrast sequences in the sagittal plane, axial oblique plane through the axis of the cervix, and coronal oblique planes though the axis of the cervix are the foundations of the anatomic assessment [21,22].

One prospective study of 100 patients with prehysterectomy MRIs showed 86% agreement between MRI and surgical pathologic findings for tumor size and local extent evaluation (95% CI, 76.3%-90.9%) [23]. Another meta-analysis of 115 studies published between 2000-2019, 78 of which focused on MRI, showed MRI had a pooled sensitivity of 71% to 88% and specificity of 86% to 95% for the extent of cervical cancer invasion. Specifically, MRI had 71% sensitivity (95% CI,

62%-79%) and 91% specificity (95% CI, 98%-93%) for parametrial invasion, 71% sensitivity (95% CI, 54%-84%) and 86% specificity (95% CI, 81%-89%) for vaginal invasion, and 84% sensitivity (95% CI, 57%-95%) and 95% specificity (95% CI, 87%-98%) for bladder invasion [12]. For trachelectomy assessment, a study of 79 women with early stage cervical cancer who underwent radical hysterectomy and presurgical MRI showed MRI had sensitivity of 73%, specificity of 98.3%, positive predictive value (PPV) of 95%, and negative predictive value (NPV) of 88.1% for tumors within ≤5 mm of the internal os [24].

The addition of diffusion-weighted imaging (DWI) to the local extent assessment—in which the tumor shows restricted diffusion relative to the normal cervical stroma—improves interobserver agreement [25] and increases the sensitivity and specificity for parametrial involvement (82% sensitivity [95% CI, 70%-94%] and 97% specificity [95% CI, 95%-99%]) with DWI/apparent diffusion coefficient (ADC), compared to 72% sensitivity (95% CI, 62%- 82%) and 91% specificity (95% CI, 89%-93%) without DWI/ADC [26]. This same meta-analysis showed MRI evaluation on a 3T scanner compared with a 1.5T scanner had a higher sensitivity of 84% (95% CI, 76%-93%) versus 66% (95% CI, 55%-77%), but a similar specificity of 94% (95% CI, 91%-98%) versus 94% (95% CI, 91%-97%) for local extent evaluation. Postcontrast images are also helpful because they may increase the conspicuity of small lesions [27,28] and may help to distinguish between cervical and endometrial primaries when the tumor involves both anatomic regions [29].

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
G. MRI Pelvis Without IV Contrast

Although IV contrast administration is preferred, MRI pelvis without IV contrast may improve the conspicuity of small lesions compared with other imaging modalities [27,28] and may help to distinguish between cervical and endometrial primaries when the tumor involves both anatomic regions [29]. The T2-weighted noncontrast sequences in the sagittal plane, axial oblique plane through the axis of the cervix, and coronal oblique planes though the axis of the cervix are the foundations of the anatomic assessment [21,22], and the DWI/ADC images may help to detect small lesions. Because of its inherent superior soft tissue contrast, a noncontrast MRI is strongly preferred to a noncontrast CT.

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
H. US Pelvis Transabdominal

Transabdominal US of the pelvis plays a limited role in local staging of cervical cancers because of poorer evaluation of the gynecologic organs. For pelvic imaging, transvaginal US (TVUS) is preferred.

Variant 1: Initial local staging of pretreatment cervical cancer; assessment of local tumor extension (T staging) for any clinically visible lesion.
I. US Pelvis Transvaginal

TVUS of the pelvis has been evaluated as an alternative to MRI for the assessment of local disease extent. One meta-analysis, which compared the performance of US and MRI for local extent of disease assessment, showed similar performance between the 2 modalities, with US demonstrating a pooled sensitivity of 78% (95% CI, 48%-93%) and specificity of 96% (95% CI, 84%-99%) for parametrial involvement, compared to 68% sensitivity (95% CI, 54%-80%) and 91% specificity (95% CI, 94%-95%) for MRI [30]. Contrast-enhanced US also shows similar diagnostic performance to

MRI, with a study of 108 women with invasive cervical cancer who underwent both contrast-enhanced US and MRI demonstrating strong correlation between the 2 modalities for tumor size (r = 0.84-0.88) and moderate concordance for vaginal and parametrial invasion [31]. Weaknesses of TVUS compared to MRI include the assessment of bulky tumors >4 cm [32].

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).

As of 2018, the FIGO staging system incorporates radiologic and pathologic data in the assessment [2]. A new stage was created as a result of this, corresponding to radiologically suspected or pathologically confirmed nodal disease in the pelvis (IIIC1) and para-aortic (IIIC2) stations. When unsuspected nodal disease is found at surgical pathology, adjuvant radiation is necessary, with high morbidity. Therefore, the identification of nodal disease on preoperative imaging is paramount for the selection of the appropriate treatment strategy.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
A. CT Abdomen and Pelvis With IV Contrast

CT abdomen and pelvis with IV contrast may be used for the assessment of nodal and distant metastatic disease. Reported rates of unsuspected metastatic disease at a diagnosis range from 6.2% in a study of 1,158 consecutively evaluated cervical cancer patients to 13.7% in a study of patients with stage IB2 or greater disease on local assessment. The other most common sites of metastatic disease are in the lung, peritoneum, supraclavicular lymph nodes, liver, and bone [33-35].

With regards to nodal disease assessment, a meta-analysis of 115 studies published from 2000 to 2019 showed contrast-enhanced CT demonstrated good, although slightly inferior performance, compared to MRI and PET, with a pooled sensitivity and specificity of 51% (95% CI, 36%-67%) and 87% (95% CI, 81%-92%), compared to 57% (95% CI, 49%-64%) and 93% (95% CI, 89%-95%) for MRI, and 57% (95% CI, 48%-65%) and 95% (95% CI, 93%-97%) for PET [12]. Another meta-analysis of 72 studies found similar results with CT demonstrating a pooled sensitivity of 58% and a specificity of 92%, compared to 56% and 93% for MRI and 75% and 98% for PET [36]. These differences in performance are likely accounted for by difficulty in detecting disease in nodes <1 cm in size, for which MRI or PET are more sensitive.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
B. CT Abdomen and Pelvis Without and With IV Contrast

The addition of noncontrast CT abdomen and pelvis images would not appreciably add to the contrast-enhanced CT evaluation.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
C. CT Abdomen and Pelvis Without IV Contrast

CT abdomen and pelvis without IV contrast provides very poor soft tissue characterization in the pelvis [13] and therefore is not useful for the evaluation of invasive cervical cancer. Nodal metastases may be detected on a noncontrast-enhanced examination based on an abnormal size of >0.8 cm in axial short axis in the pelvis or >1 cm in axial short axis in the abdomen, an abnormally rounded shape, or loss of the normal fatty hilum. However, sensitivity may be

decreased because of the difficulties distinguishing lymph nodes from adjacent vessels and/or small bowel loops.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
D. CT Chest With IV Contrast

Evaluation of the chest for metastatic disease is critical for patients with stage IB2 or greater disease because the rate of occult metastases is as high as 38% in this population [33]. Given its superior diagnostic performance for the detection of small pulmonary nodules, chest CT is preferred to chest radiography for this purpose. Although IV contrast is not necessary for the evaluation of the lung parenchyma and pleural spaces, it is strongly preferred for the detection of abdominopelvic metastases. Therefore, CT chest with IV contrast is commonly performed along with the abdomen and pelvis examination.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
E. CT Chest Without and With IV Contrast

The addition of noncontrast CT chest images would not appreciably add to the contrast-enhanced CT evaluation.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
F. CT Chest Without IV Contrast

Evaluation of the chest for metastatic disease is critical for patients with stage IB2 or greater disease because the rate of occult metastases is as high as 38% in this population [33]. Given its superior diagnostic performance for the detection of small pulmonary nodules, chest CT is preferred to chest radiography for this purpose.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
G. FDG-PET/CT Skull Base to Mid-Thigh

PET/CT is the current modality of choice for assessment for nodal and distant metastatic disease. The National Comprehensive Cancer Network (NCCN) guidelines recommend a PET/CT be performed at the time of initial staging for all patients with stage IB2 disease or greater, given a rate of unsuspected distant metastatic disease of 13.7% in this population [33,37]. A multicenter study of 153 cervical cancer patients showed PET/CT had an overall sensitivity, specificity, PPV, and NPV of 54.8%, 97.7%, 79.3%, and 93.1%, respectively, for the detection of distant cervical cancer metastases. The most common sites of distant metastatic disease are the lung, peritoneum, supraclavicular lymph nodes, liver, and bone [33-35].

With regards to lymph node assessment, a meta-analysis of 72 studies showed PET to have superior performance to MRI and CT, with a pooled sensitivity of 75% and a specificity of 98%, compared to 56% and 93% for MRI and 58% and 92% for CT [36]. Another meta-analysis of 115 studies published from 2000 to 2019 also showed PET had superior performance, with a pooled sensitivity and specificity of 57% (95% CI, 48%-65%) and 95% (95% CI, 93%-97%) compared to 57% (95% CI, 49%-64%) and 93% (95% CI,89%-95%) for MRI and 51% (95% CI, 36%-67%) and 87% (95% CI, 81%-92%) for CT [12]. The high specificity of PET/CT for nodal assessment allows for a high NPV of 93.1% [38]. This prospective study in 153 patients also showed that the addition of

PET to diagnostic CT was associated with a mild but statistically significant increase in sensitivity to detect abdominal nodal metastases in advanced cervical cancer [38].

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
H. FDG-PET/MRI Skull Base to Mid-Thigh

Although still not in widespread clinical use, research has shown PET/MRI to be a promising new modality for comprehensive examination of cervical cancer disease extent. The MRI examination offers ideal imaging of the primary tumor for local extent evaluation, whereas the PET component offers superior sensitivity for the detection of nodal and hematogenous metastases. This is supported by a prospective study of 53 patients with cervical cancer that showed whole body PET/MRI performed comparably to MRI alone of the local disease extent with 85% accuracy versus 87% but was better for the detection of lymph node metastases demonstrating 83% sensitivity, 90% specificity, and 87% accuracy compared to 71%, 83%, and 77%, respectively, for MRI alone [14]. Higher SUV_{max} is associated with poorer prognosis [16,17]. In addition to the staging evaluation, PET/MRI offers prognostic information with a higher SUV_{max} associated with poorer prognosis [16,17], and in 1 study was found to be an independent predictor of progression-free survival (HR = 4.57).

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
I. MRI Abdomen Without and With IV Contrast

MRI abdomen without and with IV contrast may be used for the assessment of nodal and distant metastatic disease, preferably with IV contrast. It may be obtained along with the pelvic MRI performed for local disease extent assessment. If these examinations are obtained simultaneously, dynamic contrast-enhanced (DCE) imaging should be obtained of the pelvis to prioritize the local extent of disease assessment, with only delayed contrast-enhanced imaging obtained of the abdomen.

With regards to nodal disease assessment, nodes are considered abnormal on MRI if their axial short axis is >1 cm in the abdomen or if they display abnormal morphologic characteristics such as rounded shape, loss of the normal fatty hilum, heterogenous signal, or more pronounced diffusion restriction than uninvolved lymph nodes. Using these criteria, a meta-analysis of 115 studies published from 2000 to 2019 showed MRI performed comparably to PET for nodal metastatic disease assessment, with a pooled sensitivity and specificity of 57% (95% CI, 49%-64%) and 93% (95% CI, 89%-95%), compared to 57% (95% CI, 48%-65%) and 95% (95% CI, 93%-97%) for PET. In this study, MRI performed better than CT, which had a pooled sensitivity and specificity of 51% (95% CI, 36%-67%) and 87% (95% CI, 81%-92%), respectively [12]. Another meta-analysis of 72 studies showed MRI had comparable performance to CT and inferior performance to PET, with a sensitivity of 58% and a specificity of 93% compared to 75% and 98% for PET and 58% and 92% for CT [36].

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
J. MRI Abdomen Without IV Contrast

MRI abdomen without IV contrast may be employed for the assessment of nodal and distant metastatic disease and may be obtained along with the pelvic MRI performed for local disease extent assessment. Although IV contrast administration is preferred because it may increase the

conspicuity of small lesions, it still demonstrates inherent superior soft tissue contrast compared to CT, and the DWI/ADC images may help to detect small metastatic foci.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
K. MRI Pelvis Without and With IV Contrast

Evaluation for pelvic and lower para-aortic lymph node metastases can be performed at the time of local disease assessment, preferably with IV contrast. Nodes are considered abnormal on MRI if their axial short axis is >0.8 cm in the pelvis or if they display abnormal morphologic characteristics such as rounded shape, loss of the normal fatty hilum, heterogenous signal, or more pronounced diffusion restriction than uninvolved lymph nodes. Using these criteria, a meta-analysis of 115 studies published from 2000 to 2019 showed MRI performed comparably with PET with a pooled sensitivity and specificity of 57% (95% CI, 49%-64%) and 93% (95% CI, 89%-95%), compared to 57% (95% CI, 48%-65%) and 95% (95% CI, 93%-97%) for PET. In this study, MRI performed better than CT, which had a pooled sensitivity and specificity of 51% 57% (95% CI, 49%-64%) and 93% (95% CI, 89%-95%), compared to 57% (95% CI, 48%-65%) and 95% (95% CI, 93%-97%), respectively [12]. Another meta-analysis of 72 studies showed MRI had a comparable performance to CT and an inferior performance to PET, with a sensitivity of 58% and a specificity of 93% compared to 75% and 98% for PET and 58% and 92% for CT [36].

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
L. MRI Pelvis Without IV Contrast

Evaluation for pelvic and lower para-aortic lymph node metastases can be performed at the time of local disease assessment. Nodes are considered abnormal on MRI if their axial short axis is >1 cm or if they display abnormal morphologic characteristics such as rounded shape, loss of the normal fatty hilum, heterogenous signal, or more pronounced diffusion restriction than uninvolved lymph nodes. Although IV contrast administration is preferred because it may increase the conspicuity of small lesions, it still demonstrates inherent superior soft tissue contrast compared to nonenhanced CT, and MRI may help detect even subcentimeter-sized disease foci [39]. In a study of 53 patients, MRI was able to detect tumors as small as 0.6 cm but missed a 0.3 cm sized lesion [40].

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
M. Radiography Chest

Chest radiographs are recommended by the Society of Gynecologic Oncology for the detection of pulmonary metastases (in the form of pulmonary nodules or pleural effusions). However, chest radiographs have a low rate of detection of thoracic metastases (ranging from 0%-20%) compared to 80% to 95% reported by chest CT [41,42]. Therefore, chest CT is preferred.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
N. US Abdomen

Abdominal US can be used to detect hydronephrosis, which may indicate parametrial invasion and ureteral obstruction corresponding to stage IIIb disease. Although abdominal US may also show metastatic disease in other organs such as the liver or upper abdominal lymph nodes, its narrow field of view makes it a poor modality for a complete nodal and metastatic disease assessment.

Cross-sectional imaging with CT or MRI is preferred for this evaluation.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
O. US Pelvis Transabdominal

Transabdominal US of the pelvis plays a limited role in the staging of cervical cancers because of its incomplete evaluation of the gynecologic organs. For pelvic imaging, TVUS is preferred.

Variant 2: Initial systemic staging of pretreatment cervical cancer; assessment of lymph node and distant metastases (N/M staging).
P. US Pelvis Transvaginal

Although TVUS of the pelvis plays an important role in local disease assessment, its limited depth of penetration makes it a poor choice of modality for a complete nodal and metastatic disease assessment. Cross-sectional imaging is preferred.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.

This variant primarily applies to response assessment of the locally advanced primary tumor after chemoradiation. Literature on assessment of initial treatment response of cervical cancer after chemoradiation is evolving, with emphasis on the use of MRI or PET/CT, which can help in both response assessment and detection of complete response versus residual disease. This information is critical for the management because patients with refractory disease (presence of residual tumor after 6 months of completion of treatment) in the pelvis without distant metastases may be considered for pelvic exenteration. There is also a growing body of literature exploring the use of the functional parameters such as DWI or ADC images on MRI or metabolic parameters on PET/CT as prognostic biomarkers.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
A. CT Abdomen and Pelvis With IV Contrast

There is no relevant literature supporting the use of CT abdomen and pelvis with IV contrast for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation. CT may be used for response assessment of nodal and distant metastatic disease [37]. Use of IV contrast material is generally preferred. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
B. CT Abdomen and Pelvis Without and With IV Contrast

There is no relevant literature supporting the use of CT abdomen and pelvis without and with IV contrast for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation. CT may be used for response assessment of nodal and distant metastatic disease [37]; however, a dual-phase study without and with IV contrast is unnecessary.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
C. CT Abdomen and Pelvis Without IV Contrast

There is no relevant literature supporting the use of CT abdomen and pelvis without IV contrast for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation. CT may be used for response assessment of nodal and distant metastatic disease [37]. Although the use of IV contrast material is preferred, the assessment may be performed without IV contrast. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

**Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
D. CT Chest With IV Contrast**

CT chest with IV contrast is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for response assessment of distant metastatic disease [37]. Use of IV contrast material is generally preferred. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

**Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
E. CT Chest Without and With IV Contrast**

CT chest without and with IV contrast is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for response assessment of distant metastatic disease [37]. Dual-phase study without and with IV contrast is unnecessary.

**Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
F. CT Chest Without IV Contrast**

CT chest without IV contrast is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for response assessment of distant metastatic disease [37]. Although the use of IV contrast material is preferred, the assessment may be performed without IV contrast. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

**Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
G. FDG-PET/CT Skull Base to Mid-Thigh**

Multiple studies have shown that FDG-PET/CT is useful in assessing metabolic response of cervical cancer to chemoradiation [43-47]. In a prospective study with 88 patients, changes in FDG-PET/CT metabolic parameters such as SUV_{max} and total lesion glycolysis (TLG) helped predict histopathological response to chemoradiation [48]. In a retrospective study involving 82 patients, metabolic tumor volume (MTV), TLG, and nodal involvement on PET/CT were the significant predictors of response [45]. Higher tumor SUV_{max} and TLG are also shown to be significantly associated with poor response to chemoradiation [49], whereas MTV has been shown to adversely affect prognosis [50]. A meta-analysis including 12 studies with 1,104 patients demonstrated that response on FDG-PET/CT was a significant prognostic factor and suggested that PET/CT has a role in follow-up assessment of patients with cervical cancer [51]. PET/CT reportedly has better performance than MRI for the detection of active disease after chemoradiation. In a study that included 55 patients, sensitivity, specificity, and accuracy of PET/CT for detection of residual disease was 60%, 100%, and 89%, whereas that of MRI was 27%, 100%, and 80%, respectively [52].

**Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
H. FDG-PET/MRI Skull Base to Mid-Thigh**

The literature on the use of FDG-PET/MRI for response assessment of cervical cancer is limited. FDG-PET/MRI likely has a role in assessment of response after chemoradiation. In a prospective case control study with 45 patients, SUV_{max} was an independent predictor of progression-free survival [53]. In addition, MTV and minimum ADC helped predict progression-free survival in stage I and II disease. Although both FDG-PET and MRI are shown to have utility in response assessment of patients with cervical cancer, additional research is needed to assess the utility of FDG-PET/MRI in these patients.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.

I. MRI Abdomen Without and With IV Contrast

MRI abdomen without and with IV contrast is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for response assessment of distant metastatic disease [37]. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
J. MRI Abdomen Without IV Contrast

MRI abdomen without IV contrast is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for response assessment of distant metastatic disease [37]. If there is distant metastatic disease, imaging of the chest, abdomen, and pelvis is concurrently performed.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation.
K. MRI Pelvis Without and With IV Contrast

MRI pelvis without and with IV contrast has a role in assessment of response of cervical cancer after chemoradiation. Given its excellent soft tissue contrast, MRI allows excellent visualization of tumor and allows serial volume measurements as well as early assessment of therapy failure by demonstrating increase in size [54]. Response to treatment results in fibrotic change, and reconstitution of normal low T2 signal of the cervical stroma is the most reliable indicator of complete response to radiation therapy [54,55]. Residual or refractory disease has intermediate T2 signal and restricted diffusion. MRI also has a likely role in patients with early-stage cervical cancer following conization. A retrospective study of 55 patients found that MRI had overall 73% accuracy in detection of pathologically proved residual tumor [56].

In a small retrospective study of 32 patients, T2-weighted images were useful in assessing change in the tumor volume [57]. In a study of 185 patients, MRI was able to demonstrate the change in size of primary tumor after radiation. Initial tumor size and the rate of decrease of tumor size were significantly associated with local recurrence-free survival and overall survival rates [58]. A meta-analysis including 4 studies and 147 patients demonstrated that MRI had 83.5% sensitivity, 88.5% specificity, and 84.3% accuracy for detection of residual tumor after brachytherapy [59]. In other studies, the sensitivity, specificity, and accuracy of MRI was 27% to 69%, 71% to 100%, and 71% to 80%, with 1 of these studies concluding that MRI had an overall lower performance than PET/CT [52,60]. In another study, there was a relatively low agreement between posttreatment MRI and pathology for assessment of tumor size [23]. A small retrospective study of 51 patients also demonstrated that MRI had high sensitivity and low specificity in identifying persistent parametrial invasion after neoadjuvant chemotherapy [14].

DWI and DCE MRI likely have a role in assessment of these patients. In a retrospective study of 52 patients using DWI and DCE MRI, an initial increase in tumor signal intensity on DCE MRI, higher than myometrium, as well as low signal on ADC images were significantly associated with incomplete response [61]. In this study, there was excellent agreement between the 3 readers. In a meta-analysis, pretreatment ADC values alone were not reliable in assessing treatment response [62]; however, other studies have indicated that multiparametric MRI with DWI and DCE images together may help predict response to chemoradiation [63,64]. Patients with disease recurrence also had a lower ADC both pre- and posttreatment, as well as had a smaller interval change in ADC values [65]. In a retrospective study with 102 patients, tumors with infiltrative growth pattern on MRI were associated with a lower overall and locoregional recurrence-free survival rates after

chemoradiation [66]. Finally, MRI is also helpful for assessment of posttreatment complications [54].

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation. L. MRI Pelvis Without IV Contrast

MRI pelvis without IV contrast may have a role in assessment of response of cervical cancer after chemoradiation; however, use of IV contrast may add value. In a study of 185 patients, MRI was able to demonstrate the change in the size of the primary tumor after radiation, and initial tumor size and the rate of decrease of tumor size were significantly associated with local recurrence-free and overall survival rates [58]. A meta-analysis including 4 studies and 147 patients, MRI had 83.5% sensitivity, 88.5% specificity, and 84.3% accuracy for detection of residual tumor after brachytherapy; however, it remains unclear if these results also translate to MRI without IV contrast [59]. MRI parameters on DWI and DCE images also likely have a role in assessment of these patients. In a meta-analysis, pretreatment ADC values on MRI alone were not reliable in assessing treatment response [62]; however, other studies have indicated that multiparametric MRI with DWI and DCE images together may help predict response to chemoradiation [63,64]. In another small retrospective study in 32 patients, T2-weighted images were shown to be useful in assessing changes in the tumor volume [57]. In a retrospective study with 102 patients, tumors with infiltrative growth pattern on MRI were associated with a lower overall and locoregional recurrence-free survival rates after chemoradiation [66].

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation. M. Radiography Chest

Chest radiography is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation; however, it may be used for detection of distant metastatic disease [37].

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation. N. US Abdomen

Abdominal US is not useful for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation. O. US Pelvis Transabdominal

There is no relevant literature to support the use of transabdominal pelvic US for the evaluation of initial treatment response assessment of primary cervical cancer after chemoradiation.

Variant 3: Initial treatment response assessment of cervical cancer after chemoradiation. P. US Pelvis Transvaginal

In a prospective study of 128 women, TVUS showed an overall 92% accuracy in predicting response to chemotherapy, with decreased tumor volume being the most important association of response [67]. In another retrospective study of 51 patients, TVUS had a high sensitivity and specificity in identifying persistent parametrial invasion after neoadjuvant chemotherapy [68]. Another prospective study with 88 patients showed that after 2 weeks of neoadjuvant treatment, TVUS was able to demonstrate higher tumor volume in patients with partial response compared to those with complete response [69]. In the same study, additional color Doppler and contrast features was also significantly different in the partial- and complete-response groups, both before and after 2 weeks of treatment; however, the sensitivity (48%-77%) and specificity (58%-84%) of various US parameters were not high enough for accurate prospective prediction of treatment

response [69].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.

Recurrent cervical cancer is defined as local regrowth of tumor, presence of distant metastases, or a combination of both 6 months after the completion of treatment. The recurrence rates are in the range of 10% to 20%, and the majority of recurrences occur within 2 to 3 years after the initial treatment [5]. Cervix, parametrium, vaginal vault, pelvic sidewall, or retroperitoneal lymph nodes are the most common sites of recurrence. Patients with recurrent disease are often symptomatic. As a result, the Society of Gynecologic Oncology recommends against routine imaging surveillance of posttreatment cervical cancer patients [5].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
A. CT Abdomen and Pelvis With IV Contrast

For stage I patients who undergo nonfertility sparing treatment, use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the abdomen and pelvis may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate a preference for PET/CT for this purpose [37]. Use of IV contrast is generally preferred. Imaging of the chest, abdomen, and pelvis is often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
B. CT Abdomen and Pelvis Without and With IV Contrast

For stage I patients who undergo nonfertility sparing treatment, use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the abdomen and pelvis may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate a preference for PET/CT for this purpose [37]. Dual-phase study without and with IV contrast is unnecessary.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
C. CT Abdomen and Pelvis Without IV Contrast

For stage I patients who undergo nonfertility sparing treatment, use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the abdomen and pelvis may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate a preference for PET/CT for this purpose [37]. Although the use of IV contrast material is preferred, the assessment may be performed without IV contrast. Imaging of the chest, abdomen, and pelvis is often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
D. CT Chest With IV Contrast

For stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the chest may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate a preference for PET/CT for this purpose [37]. Use of IV contrast is generally preferred. Imaging of the chest, abdomen, and pelvis is

often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
E. CT Chest Without and With IV Contrast

For stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the chest may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate a preference for PET/CT for this purpose [37]. Dual-phase study without and with IV contrast is unnecessary.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
F. CT Chest Without IV Contrast

For stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage II to IV patients, CT of the chest may be used within 3 to 6 months after completion of therapy; however, NCCN guidelines indicate preference for PET/CT for this purpose [37]. Although the use of IV contrast material is preferred, the assessment may be performed without IV contrast. Imaging of the chest, abdomen, and pelvis is often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
G. FDG-PET/CT Skull Base to Mid-Thigh

FDG PET/CT is useful in the evaluation of local and distant recurrence even in asymptomatic patients, as well as in excluding metastatic disease in patients with pelvic recurrence amenable to radical surgery [5,37,54]. A meta-analysis including 18 studies and 762 patients showed that PET/CT had a pooled sensitivity and specificity of 92% (95% CI, 91%-94%) and 84% (95% CI, 74%-91%) and an area under the curve of 0.95 [70]. In another meta-analysis, the pooled sensitivity and specificity of PET/CT to detect local recurrence was 82% (95% CI, 72%-90%) and 98% (95% CI, 96%-99%), whereas that for distant metastasis was 87% (95% CI, 80%-92%) and 97% (95% CI, 96%-98%) [71]. In a retrospective study with 84 patients, higher MTV was associated with a higher rate of recurrence in patients with stage IIB to IVA cervical cancer [72]. Additional studies have indicated that metabolic parameters including SUV_{max}, MTV, and TLG may help predict outcomes including overall survival and therefore can influence the follow-up imaging strategy [43,46,73,74].

Per NCCN guidelines, for stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern, such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. Stage IB3 patients of those with risk factors such as positive nodes, parametrial extension. or positive margins may undergo PET/CT at 3 to 6 months after completion of treatment [37]. Generally, NCCN guidelines recommend the use of PET/CT over CT for the evaluation of metastatic disease [37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
H. FDG-PET/MRI Skull Base to Mid-Thigh

In a prospective study of 45 patients with newly diagnosed cervical cancer, an SUV_{max} was an independent predictor of progression-free survival (HR = 4.57, P < .05). Minimum ADC was an independent predictor of overall survival [53]. Additional studies have indicated that metabolic

parameters including SUV_{max}, MTV, and TLG may help predict outcomes including overall survival [49,73,74]. A retrospective study on 31 patients found PET/MRI to be useful in assessment of recurrent and metastatic disease and also found that that was a significant inverse correlation between SUV_{max} and ADC values [75]. Another small prospective study showed that PET/MRI was able to detect both local and distant recurrence of cervical cancer and found a similar significant inverse correlation between SUV_{max} and ADC values [76].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
I. MRI Abdomen Without and With IV Contrast

At present there is no relevant literature to support the use of MRI abdomen without and with IV contrast for surveillance of patients with asymptomatic cervical cancer [37]. For stage II to IV patients, NCCN guidelines recommend PET/CT (preferred) or CT of the chest, abdomen, and pelvis [37]. Imaging of the chest, abdomen, and pelvis is often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
J. MRI Abdomen Without IV Contrast

At present there is no relevant literature to support the use of MRI abdomen without IV contrast for surveillance of patients with asymptomatic cervical cancer [37]. For stage II through IV patients, NCCN guidelines recommend PET/CT (preferred) or CT of chest, abdomen and pelvis [37]. If MRI is performed, IV contrast should be used unless contraindicated. Imaging of the chest, abdomen, and pelvis is often concurrently performed.

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
K. MRI Pelvis Without and With IV Contrast

MRI pelvis has a role in the surveillance imaging after initial treatment; however, at present there is no consensus on the time interval of follow-up imaging after the initial treatment or the optimal frequency of follow-up imaging [54]. Treatment-related changes in T2 signal can limit early detection of recurrent tumor, which is seen as heterogeneous intermediate to high T2 signal, diffusion-restricting tissue on the background of established low-signal radiation-induced fibrosis [54]. In a meta-analysis including 4 studies and 147 patients, MRI had 83.5% sensitivity, 88.5% specificity, and 84.3% accuracy for detection of residual tumor after brachytherapy [59]. In another retrospective study, MRI had an 81.8% PPV and an 87.5% NPV in detecting histologically confirmed recurrent disease in patients who did not have complete response on posttreatment PET/CT [44]. MRI parameters are also shown to predict recurrence-free interval and therefore may influence the imaging surveillance strategy. In a retrospective study of 103 patients with stage IB to IVA cervical cancer, the smaller increase in ADC values and the smaller decrease in tumor volume during chemoradiation or radiation treatment were predictors of tumor recurrence over a median follow-up period of 2.7 years [77]. In a retrospective study with 102 patients, tumors with infiltrative growth pattern on MRI were associated with a lower overall and locoregional recurrence-free survival rates after chemoradiation [66]. Additional studies and a meta-analysis have also indicated that MRI features, including ADC value and tumor volume, of primary cervical cancer as well as nodal disease can help predict metastasis-free and overall survival rates [77-81]. These findings may influence the surveillance strategy of patients with cervical cancer.

Per NCCN guidelines, for stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and degree of clinical concern, such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage I patients who undergo fertility sparing

treatment, MRI with IV contrast may be performed at 3 to 6 months and then yearly for 2 to 3 years [37]. For stage II through IV patients, pelvic MRI with IV contrast should be considered 3 to 6 months after completion of therapy [37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
L. MRI Pelvis Without IV Contrast

MRI pelvis with IV contrast is the preferred study, but without IV contrast may also be useful. In a retrospective study of 103 patients with stage IB-IVA cervical cancer, the smaller increase in ADC values and the smaller decrease in tumor volume during chemoradiation or radiation treatment were predictors of tumor recurrence over a median follow-up period of 2.7 years [77]. Additional studies have also indicated that MRI features, including ADC value and tumor volume, of primary cervical cancer as well as nodal disease can help predict metastasis-free and overall survival rates [77-80]. These findings may influence the surveillance strategy of patients with cervical cancer.

Per NCCN guidelines, for stage I patients who undergo nonfertility sparing treatment, the use of imaging for surveillance of cervical cancer in asymptomatic patients should be based on symptomatology and the degree of clinical concern, such as clinical examination findings or pelvic, abdominal, or pulmonary symptoms [37]. For stage I patients who undergo fertility sparing treatment, MRI may be performed at 3 to 6 months and then yearly for 2 to 3 years [37]. For stage II through IV patients, pelvic MRI should be considered at 3 to 6 months after completion of therapy [37]. IV contrast should be used unless contraindicated [37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
M. Radiography Chest

There is no relevant literature to support the use of chest radiography in the surveillance of patients with cervical cancer [5,37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
N. US Abdomen

There is no relevant literature to support the use of US abdomen in the surveillance of patients with cervical cancer [5,37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
O. US Pelvis Transabdominal

There is no relevant literature to support the use of pelvic transabdominal US in the surveillance of patients with cervical cancer [5,37].

Variant 4: Surveillance of treated cervical cancer in asymptomatic patients.
P. US Pelvis Transvaginal

There is no relevant literature to support the use of pelvic TVUS in the surveillance of patients with cervical cancer [5,37].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.

The majority of patients with recurrent cervical cancer are symptomatic, with the symptoms ranging from abdominal and pelvic pain, leg symptoms such as pain or lymphedema, vaginal bleeding or discharge, urinary symptoms, cough, and weight loss [5]. CT, MRI, and PET/CT all have a role in detection of local or distant recurrence in symptomatic patients, as well as in the response assessment after chemotherapy.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
A. CT Abdomen and Pelvis With IV Contrast

CT may be used for the assessment of known distant recurrence, preferably with use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was 76% (95% CI, 44%-93%) [82]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
B. CT Abdomen and Pelvis Without and With IV Contrast

CT may be used for assessment of known distant recurrence, preferably with use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was 76% (95% CI, 44%-93%) [82]. Dual-phase study without and with IV contrast is unnecessary.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
C. CT Abdomen and Pelvis Without IV Contrast

CT may be used for the assessment of known distant recurrence, preferably with the use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated the use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was 76% (95% CI, 44%-93%) [82]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
D. CT Chest With IV Contrast

CT may be used for the assessment of known distant recurrence, preferably with the use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated the use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was 76% (95% CI, 44%-93%) [82]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
E. CT Chest Without and With IV Contrast

CT may be used for the assessment of known distant recurrence, preferably with the use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was 76% (95% CI, 44%-93%) [82]. Dual-phase study without and with IV contrast is unnecessary.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
F. CT Chest Without IV Contrast

CT may be used for the assessment of known distant recurrence, preferably with the use of IV contrast [37]. In a meta-analysis that included 4 studies that evaluated use of CT for this purpose, the summary estimate of the sensitivity of CT was 90% (95% CI, 82%-94%), and the specificity was

76% (95% CI, 44%-93%) [82]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
G. FDG-PET/CT Skull Base to Mid-Thigh

NCCN guidelines support the use of PET/CT over CT for the evaluation of metastatic disease [37]. In patients with suspected recurrence, FDG-PET/CT is useful in detection of local and distant disease, as well as in excluding metastatic disease in patients with pelvic recurrence who are amenable to radical surgery [37,54]. A meta-analysis of 9 PET/CT studies in mostly symptomatic women found an overall sensitivity of 95% (95% CI, 91%-97%) and a specificity of 87% (95% CI, 82%-91%) for detection of recurrent disease [82]. PET/CT is also helpful in assessment of metabolic response and has been shown to correlate well with radiologic response [47].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
H. FDG-PET/MRI Skull Base to Mid-Thigh

There is limited literature on use of PET/MRI for the evaluation of known or suspected recurrent disease; however, a retrospective study on 31 patients found PET/MRI to be useful in the assessment of recurrent and metastatic disease and also found that there was a significant inverse correlation between SUV_{max} and ADC values [75]. Another small prospective study showed that PET/MRI was able to detect both local and distant recurrence of cervical cancer and found a similar significant inverse correlation between SUV_{max} and ADC values [76]. These studies indicate a potential of PET/MRI for concurrent assessment of both PET- and MRI-based functional biomarkers.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
I. MRI Abdomen Without and With IV Contrast

MRI may be useful for the assessment of distant disease and for the assessment of response, preferably with the use of IV contrast [37]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
J. MRI Abdomen Without IV Contrast

MRI may be used for the assessment of distant disease and for the assessment of response, preferably with the use of IV contrast [37]. Imaging of the chest, abdomen, and pelvis is often concurrently performed for evaluation of distant metastatic disease.

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
K. MRI Pelvis Without and With IV contrast

Per NCCN guidelines, pelvic MRI is useful for patients with suspected recurrence, preferably with IV contrast [37].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
L. MRI Pelvis Without IV contrast

Per NCCN guidelines, pelvic MRI is useful for patients with suspected recurrence, preferably with IV contrast [37].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
M. Radiography Chest

There is no relevant literature to support the use of chest radiography in the surveillance of patients with cervical cancer [5,37]. The rate of detection of thoracic disease on chest radiograph is reportedly 20% to 47% [5].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
N. US Abdomen

There is no relevant literature to support the use of US abdomen in the surveillance of patients with cervical cancer [5,37].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
O. US Pelvis Transabdominal

There is no relevant literature to support the use of pelvic transabdominal US in the surveillance of patients with cervical cancer [5,37].

Variant 5: Evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. Follow-up imaging.
P. US Pelvis Transvaginal

There is no relevant literature to support the use of pelvic TVUS in the surveillance of patients with cervical cancer [5,37].

Summary of Recommendations

- **Variant 1**: MRI pelvis without and with IV contrast is usually appropriate for the initial local staging of pretreatment cervical cancer. FDG-PET/MRI skull base to mid-thigh can help in the assessment of nodal and metastatic disease assessment and can also contribute to the evaluation of local disease extent. These procedures are complementary (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care).
- **Variant 2**: MRI pelvis without and with IV contrast or CT abdomen and pelvis with IV contrast or CT chest with IV contrast are usually appropriate for the initial systemic staging of pretreatment cervical cancer assessing the lymph node and distinct metastases (N/M staging). These procedures are complementary (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care). Alternatively, FDG-PET/CT or FDG-PET/MRI skull base to mid-thigh can also be used and are equivalent alternatives to CT and MRI of the abdomen and pelvis with IV contrast.
- **Variant 3**: MRI pelvis without and with IV contrast or MRI pelvis without IV contrast or FDG-PET/MRI skull base to mid-thigh or FDG-PET/CT skull base to mid-thigh is usually appropriate for the initial treatment response assessment of cervical cancer after chemoradiation. These procedures are equivalent alternatives (ie, only one procedure will be

ordered to provide the clinical information to effectively manage the patient's care). MRI pelvis with IV contrast or MRI pelvis with and without IV contrast is usually appropriate for imaging of the pelvis. If imaging of the chest, abdomen, and pelvis is desired, FDG-PET/CT or FDG-PET/MRI skull base to mid-thigh is usually appropriate. The panel did not agree on recommending CT chest with IV contrast for patients in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. Imaging with this procedure is controversial but may be appropriate.

- **Variant 4**: MRI pelvis without and with IV contrast or CT abdomen and pelvis with IV contrast or CT chest with IV contrast are usually appropriate for the surveillance of treated cervical cancer in asymptomatic patients. These procedures are complementary (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care). FDG-PET/MRI skull base to mid-thigh or FDG-PET/CT skull base to mid-thigh are equivalent alternatives to CT and MRI. The panel did not agree on recommending MRI abdomen without and with IV contrast, MRI abdomen without IV contrast and CT abdomen and pelvis without IV contrast for patients in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. Imaging with these procedures is controversial but may be appropriate.

- **Variant 5**: MRI abdomen without and with IV contrast or MRI pelvis without and with IV contrast or CT abdomen and pelvis with IV contrast or CT chest with IV contrast or FDG-PET/MRI skull base to mid-thigh or FDG-PET/CT skull base to mid-thigh is usually appropriate for the follow-up imaging for evaluation of known or suspected cervical cancer local recurrence or distant metastatic disease. These procedures are complementary (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care). The panel did not agree on recommending CT abdomen and pelvis without IV contrast and CT abdomen and pelvis without and with IV contrast for patients in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. Imaging with this procedure is controversial but may be appropriate.

Supporting Documents

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

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

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.

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

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria[®] Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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Disclaimer

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.

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