

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Staging of Invasive Cancer of the Cervix

Variant 1: FIGO stage 1b1, tumor size <4 cm.

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis without and with contrast	8	Appropriateness can depend on clinical circumstances, availability, and expertise. See comments regarding contrast in text under "Anticipated Exceptions."	None
FDG-PET whole body with concurrent diagnostic CT abdomen and pelvis	8	Appropriateness can depend on clinical circumstances, availability, and expertise.	High
CT abdomen and pelvis with contrast	5	Performed without concurrent whole-body PET.	High
X-ray chest	4		Min
US abdomen	2		None
US pelvis transabdominal	2		None
US pelvis transvaginal	2		None
X-ray contrast enema	1		Med
X-ray intravenous urography	1		Med
NUC Tc-99m bone scan whole body	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: FIGO stage 1b2, tumor size >4 cm.

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis without and with contrast	9	Appropriateness can depend on clinical circumstances, availability, and expertise. See comments regarding contrast in text under "Anticipated Exceptions."	None
FDG-PET whole body with concurrent diagnostic CT abdomen and pelvis	9	Appropriateness can depend on clinical circumstances, availability, and expertise.	High
X-ray chest	5		Min
CT abdomen and pelvis with contrast	5	Performed without concurrent whole-body PET.	High
US pelvis transvaginal	2		None
US pelvis transabdominal	2		None
US abdomen	2		None
X-ray contrast enema	1		Med
X-ray intravenous urography	1		Med
NUC Tc-99m bone scan whole body	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Clinical Condition:**Staging of Invasive Cancer of the Cervix****Variant 3:****FIGO stage greater than Ib.**

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
MRI pelvis without and with contrast	9	Appropriateness can depend on clinical circumstances, availability, and expertise. See comments regarding contrast in text under "Anticipated Exceptions."	None
FDG-PET whole body with concurrent diagnostic CT abdomen and pelvis	9	Appropriateness can depend on clinical circumstances, availability, and expertise.	High
CT abdomen and pelvis with contrast	7	Performed without concurrent whole-body PET.	High
CT chest with contrast	7		Med
X-ray chest	2		Min
US pelvis transabdominal	2		None
US abdomen	2		None
NUC Tc-99m bone scan whole body	2	Greater than stage II. Symptoms of bone metastases.	Med
US pelvis transvaginal	2		None
X-ray intravenous urography	1		Med
X-ray contrast enema	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

STAGING OF INVASIVE CANCER OF THE CERVIX

Expert Panel on Women's Imaging: Leslie M. Scutt, MD¹; Rochelle F. Andreotti, MD²; Susanna I. Lee MD, PhD³; Sandra O. DeJesus Allison, MD⁴; Mindy M. Horrow, MD⁵; Marcia C. Javitt, MD⁶; Anna S. Lev-Toaff, MD⁷; Ann E. Podrasky, MD⁸; Carolyn Zelop, MD.⁹

Summary of Literature Review

Cervical cancer is the third most common gynecological malignancy in the United States. It is estimated that during 2007 there were approximately 11,150 new cases of cervical cancer and 3,670 deaths from this disease in the United States [1]. Between 1959-61 and 1989-91, there has been a 63% decrease in the mortality of cervical cancer [2,3]. Furthermore, the American Cancer Society reports that the death rate from cervical cancer decreased 29% from 1991 to 2003 [4]. This improvement in mortality has been attributed to a significant increase in detection of early-stage, small cancers due to the development of the Papanicolaou smear. However, only minor improvement has been achieved in the survival rate for invasive cervical cancer [5]. Established risk factors for cervical cancer include early sexual activity, especially with multiple partners, cigarette smoking, immunosuppression, and infection with human papilloma viruses 16 and 18 [6].

The prognosis of cervical carcinoma is primarily determined by whether lymph nodes are involved by tumor [7]. This in turn is predicted clinically and pathologically by the stage of disease, the volume of the primary tumor, and the histologic grade [8-15]. The current staging system for cervical cancer is based on the International Federation of Gynecology and Obstetrics (FIGO) classification [16]. It defines the clinical staging system for cervical carcinoma based on clinical assessment, including physical examination under anesthesia, colposcopy, endocervical curettage, hysteroscopy, cystoscopy, proctoscopy, intravenous urography, barium enema (BE), and x-rays of lungs and skeleton [17]. Errors in clinical FIGO staging have been consistently reported. When compared with surgical findings, FIGO staging errors are 28% in stage Ib disease and 50%-64% in stage IIA-IIb disease [18-23]. Clinical evaluation underestimates the surgical stage in 15%-36% of patients [18-23]. In clinically staged Ib disease, underestimation of tumor extent occurs in 21% and overestimation in 6% of patients [18-23].

Inaccuracy in clinical staging is predominantly due to difficulties in evaluating parametrial and pelvic sidewall invasion, bladder or rectal wall invasion, metastatic spread, in evaluating primary endocervical (endophytic) tumors, and in estimating primary tumor size [18-23]. Aside from the inaccuracies of clinical staging, evaluation of lymph node metastasis, which is an important prognostic factor and a determinant in treatment planning, is not included in the clinical staging system [17]. In surgically treated stages Ib and IIA cervical cancer, survival rates decline from 85%-90% to 50%-55%, respectively, in the presence of metastatic lymph nodes [12,24]. In spite of these limitations of clinical FIGO staging, modern cross-sectional imaging modalities such as ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI) have not been incorporated into clinical staging. Among the most common arguments against the use of CT or MRI as staging tools are their high cost, interobserver variability, and lack of availability, especially in the underdeveloped regions of the world where invasive cervical cancer is the most prevalent [17].

Current Role of Imaging

The most important issue in staging cervical cancer is to distinguish early disease (stages IA and IB) that can be treated with surgery or combined chemo-radiation therapy from advanced disease that must be treated with radiation alone or radiation combined with chemotherapy [25]. Imaging modalities must be directed to solve this clinically important question. Conventional radiological studies such as excretory urography, BE, and lymphangiography are less commonly used today. However, there has been an increase in the use of cross-sectional imaging, particularly CT and MRI [26].

Radiographs

Chest radiographs are obtained as a staging procedure to identify pleural effusion or pulmonary metastasis, which occur in the late stages of cervical cancer. However, chest CT is superior to plain film in both cases.

Excretory Urography

Excretory urography is a sensitive test for detecting urinary obstruction. However, a low incidence (2.4%) of urinary obstruction in stage Ib disease argues against the routine use of this test [27,28]. Discontinuation of the routine use of BE, cystoscopy, and sigmoidoscopy has been suggested previously [27-29].

Ultrasound

Transabdominal US is a sensitive noninvasive means of detecting hydronephrosis but has a limited role in evaluating the local extent of cervical cancer. Transrectal and transvaginal US have been used in assessing local

¹Principal Author, Yale University School of Medicine, New Haven, Conn; ²Panel Chair, Vanderbilt University Medical Center, Nashville, Tenn; ³Panel Vice-chair, Massachusetts General Hospital, Boston, Mass; ⁴Georgetown Hospital, Washington, DC; ⁵Albert Einstein Medical Center, Philadelphia, Pa; ⁶Walter Reed Army Medical Center, Washington, DC; ⁷Thomas Jefferson University Hospital, Philadelphia, Pa; ⁸Baptist Hospital of Miami, Miami, Fla; ⁹St. Francis Hospital and Medical Center, Hartford, Conn, American College of Obstetrics and Gynecology.

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

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

disease but are limited in the detection of parametrial disease and pelvic side wall involvement due to poor soft-tissue contrast, small field of view, and operator dependence [30,31].

Computed Tomography

CT has staging accuracy ranging from 32%-80% in cervical cancer [30,32-44]. The sensitivity for parametrial invasion ranges from 17%-100%, with an average of 64% [34-37,39-41,44]. Specificity ranges from 50%-100%, with an average of 81% [34-37,39-41,44]. There is a consensus in the literature that the value of CT increases with higher stages of disease, and that it has limited value (a positive predictive value of 58%) in evaluating early parametrial invasion [34-37,39-41,44]. CT has been reported to have an accuracy of 92% in depicting advanced disease [44]. However, a recent ACRIN® trial reported that CT had sensitivity of only 42% for detecting advanced disease, with sensitivity and specificity for detecting parametrial invasion ranging from 14%-38% and from 84%-100%, respectively [26,45]. The major limitation of CT in local staging is its inadequate differentiation between tumor and normal cervical stroma or parametrial structures [46]. Therefore, CT is mainly used in advanced disease and in the assessment of lymph nodes. The positive predictive value of CT for nodal involvement ranges from 50.8%-65%, with negative predictive value ranging from 86%-96% [32,33,35-44,47,48], with sensitivities reported recently to range from 31%-65% [26,47]. The reliance on size criterion alone (>1 cm) for diagnosing malignant lymphadenopathy on CT is believed to account for the low sensitivity, as microscopic metastases will be missed. CT is also performed to detect distant metastases, for radiotherapy planning, and for guiding interventional procedures [49].

Magnetic Resonance Imaging

MRI is very accurate in determining tumor size and location (exophytic or endocervical), the depth of stromal invasion, and the local extension of the tumor. MRI is superior to clinical evaluation in assessing tumor size, and MRI measurements are within 0.5 cm of the surgical size in 70%-94% of cases [13,40,46,50-53]. However, a recent ACRIN® trial reported that neither MRI nor CT was accurate for evaluating the cervical stroma [46]. The use of an endovaginal coil has been reported to be helpful in assessing small-volume disease [54]. The staging accuracy of MRI ranges from 75%-96% [34-37,40,51,53,55-60]. The sensitivity of MRI in evaluating parametrial invasion ranging from 40%-57% and the specificity from 77%-80% [34-37,40,45,51,53,55-60]. In studies that compare MRI and CT for evaluating parametrial invasion, MRI was superior to CT [34-37,40,51,53,55-57,59,60]. In evaluating nodal disease, the sensitivity and specificity ranges of MRI, 30%-73% and 93%-95%, respectively, are similar to those of CT [34-37,40,47,51,53,55-66]. Similar to CT, MRI relies on size

criteria for assessing lymph nodes and thus will miss microscopic disease [67]. In assessing local tumor invasion, T2-weighted images are superior to contrast-enhanced T1-weighted images [68].

MRI can be a cost-effective staging technique. In a study of patients with cervical cancer, those who underwent MRI as the initial imaging procedure for staging required fewer tests and procedures compared with those who underwent standard clinical imaging [69]. Tumor size >4 cm, parametrial invasion, and extension are related to the likelihood of a positive lymph node, which significantly affects patient management and prognosis for survival [13,47,54]. Since these predictive criteria of the primary tumor are best evaluated radiologically, routine use of MRI has been recommended.

Lymphangiography

Although lymphangiography has been routinely used in the past for the pretreatment evaluation of lymph node metastases, it has been mostly replaced in this role by CT and MRI. Single studies that have compared lymphangiography and CT [70-72] have shown similar accuracy (72%-91% and 71%-88%, respectively) for both modalities. CT may have a slightly higher specificity than lymphangiography (88%-95% vs 59%-93%), but lymphangiography is more sensitive than CT (63%-88% vs 53%-72%), especially in early stages (I-II) of disease [70-72]. In a meta-analysis comparing the utility of lymphangiography, CT, and MRI in patients with cervical cancer, summary-receiver-operator characteristics revealed no significant differences in their overall performance, although MRI tended to perform better [73].

Positron Emission Tomography

Although the current use of positron emission tomography (PET) in the initial evaluation of cervical cancer is still under investigation, PET can be used to assess nodal disease and tumor recurrence. In the detection of metastatic lymph nodes in patients with cervical cancer, PET has been reported to have a sensitivity ranging from 79%-91% and a specificity ranging from 95%-100%, which are higher than those for MRI and CT [74,75] although microscopic metastases may still be missed [76]. Accuracy rates are reportedly higher for PET than MRI (78% vs 67%) [64]. Another study demonstrated that prognosis was best when patients had both PET-negative and CT-negative lymph node status and that the presence of PET-positive para-aortic lymph nodes was the most significant negative prognostic factor for progression-free survival [7]. Hybrid PET/CT represents a potentially significant advance in imaging of metastatic lymph nodes, combining the functional, metabolic imaging capabilities of PET with the spatial resolution of CT. Recent studies report sensitivity ranges of 58%-72%, specificity ranges of 93%-99%, and accuracy ranges of 85%-99% for PET/CT in detecting

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

metastatic lymph nodes from cervical cancer [62,77]. Another study showed that when abdominal CT is negative, PET has a sensitivity of 85.7%, a specificity of 94.4%, and an accuracy of 92% for detecting para-aortic lymph node metastasis in patients with advanced cervical cancer [78], prompting some to advocate routine PET imaging in such cases [79]. For detecting recurrence, PET has been reported to have sensitivity and specificity ranges of 85.7%-90.3% and 76.1%-86.7%, respectively [80-82]. PET has added value in patients with recurrent cervical cancer who undergo salvage therapy, as it can provide precise restaging information [83,84]. A recent study suggests that abnormal PET findings were the most significant prognostic factor for developing metastasis and death from cervical cancer [85].

Nuclear Medicine Bone Scan

Bone scans do not seem warranted for initial screening in asymptomatic patients with stage 0, I, or II cervical carcinoma [86,87], but may be useful in patients with advanced disease (stage III and IV) who are symptomatic for bone metastases, such as with pain or hypercalcemia. Future research will determine if PET/CT will replace bone scans.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF), also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF[88-90], a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (eg, >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The FDA has recently issued a “black box” warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated GFR <30 mL/min/1.73m²), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment

suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s) [89].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

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

References

1. Jemal A, Siegel R, Ward E, Murray T, Xu J, Thun MJ. Cancer statistics, 2007. *CA Cancer J Clin* 2007; 57(1):43-66.
2. Wingo PA, Tong T, Bolden S. Cancer statistics, 1995. *CA Cancer J Clin* 1995; 45(1):8-30.
3. American Cancer Society. Cancer facts and figures 1995. Atlanta, Ga. *American Cancer Society* 1995.
4. American Cancer Society. Cancer facts and figures 2004. Atlanta, Ga. *American Cancer Society* 2004.
5. Pettersson F, ed. Annual report on the results of treatment in gynecologic cancer. *Int Fed Gynecol Obstet* 1991; 36(suppl):27-130.
6. Rylander E. Cervical intraepithelial neoplasia. In: Kavanaugh JJ, ed. *Cancer in women*. Malden, Mass.: Blackwell Science; 1998:251-258.
7. Grigsby PW, Siegel BA, Dehdashti F. Lymph node staging by positron emission tomography in patients with carcinoma of the cervix. *J Clin Oncol* 2001; 19(17):3745-3749.
8. Burghardt E, Pickel H. Local spread and lymph node involvement in cervical cancer. *Obstet Gynecol* 1978; 52(2):138-145.
9. Gauthier P, Gore I, Shingleton HM, Soong SJ, Orr JW, Jr., Hatch KD. Identification of histopathologic risk groups in stage IB squamous cell carcinoma of the cervix. *Obstet Gynecol* 1985; 66(4):569-574.
10. Hoskins WJ, Perez C, Young RC. Gynecologic tumors. In: Devita VT, Hellman S, Rosenberg SA, eds. *Cancer-principles & practice of oncology, Vol. 1. 3rd ed.* Philadelphia, Pa.: J. B. Lippincott; 1989:1114-1119.
11. Hricak H, Quivey JM, Campos Z, et al. Carcinoma of the cervix: predictive value of clinical and magnetic resonance (MR) imaging assessment of prognostic factors. *Int J Radiat Oncol Biol Phys* 1993; 27(4):791-801.
12. Piver MS, Chung WS. Prognostic significance of cervical lesion size and pelvic node metastases in cervical carcinoma. *Obstet Gynecol* 1975; 46(5):507-510.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

13. Soutter WP, Hanoch J, D'Arcy T, Dina R, McIndoe GA, DeSouza NM. Pretreatment tumour volume measurement on high-resolution magnetic resonance imaging as a predictor of survival in cervical cancer. *Bjog* 2004; 111(7):741-747.
14. Van Nagel JR, Jr., Donaldson ES, Parker JC, Van Dyke AH, Wood EG. The prognostic significance of cell type and lesion size in patients with cervical cancer treated by radical surgery. *Gynecol Oncol* 1977; 5(2):142-151.
15. White CD, Morley GW, Kumar NB. The prognostic significance of tumor emboli in lymphatic or vascular spaces of the cervical stroma in Stage IB squamous cell carcinoma of the cervix. *Am J Obstet Gynecol* 1984; 149(3):342-349.
16. Creasman WT. New gynecologic cancer staging. *Gynecol Oncol* 1995; 58(2):157-158.
17. Pecorelli S, Odicino F. Cervical cancer staging. *Cancer J* 2003; 9(5):390-394.
18. Chung CK, Nahhas WA, Zaino R, Stryker JA, Mortel R. Histologic grade and lymph node metastasis in squamous cell carcinoma of the cervix. *Gynecol Oncol* 1981; 12(3):348-354.
19. Dargent D, Frobert JL, Beau G. V factor (tumor volume) and T factor (FIGO classification) in the assessment of cervix cancer prognosis: the risk of lymph node spread. *Gynecol Oncol* 1985; 22(1):15-22.
20. Delgado G, Bundy B, Zaino R, Sevin BU, Creasman WT, Major F. Prospective surgical-pathological study of disease-free interval in patients with stage IB squamous cell carcinoma of the cervix: a Gynecologic Oncology Group study. *Gynecol Oncol* 1990; 38(3):352-357.
21. Lagasse LD, Creasman WT, Shingleton HM, Ford JH, Blessing JA. Results and complications of operative staging in cervical cancer: experience of the Gynecologic Oncology Group. *Gynecol Oncol* 1980; 9(1):90-98.
22. Van Nagell JR, Jr., Roddick JW, Jr., Lowin DM. The staging of cervical cancer: inevitable discrepancies between clinical staging and pathologic findings. *Am J Obstet Gynecol* 1971; 110(7):973-978.
23. Zander J, Baltzer J, Lohe KJ, Ober KG, Kaufmann C. Carcinoma of the cervix: an attempt to individualize treatment. Results of a 20-year cooperative study. *Am J Obstet Gynecol* 1981; 139(7):752-759.
24. Fuller AF, Jr., Elliott N, Kosloff C, Hoskins WJ, Lewis JL, Jr. Determinants of increased risk for recurrence in patients undergoing radical hysterectomy for stage IB and IIA carcinoma of the cervix. *Gynecol Oncol* 1989; 33(1):34-39.
25. Kaur H, Silverman PM, Iyer RB, Verschraegen CF, Eifel PJ, Charnsangavej C. Diagnosis, staging, and surveillance of cervical carcinoma. *AJR* 2003; 180(6):1621-1631.
26. Hricak H, Gatsonis C, Chi DS, et al. Role of imaging in pretreatment evaluation of early invasive cervical cancer: results of the intergroup study American College of Radiology Imaging Network 6651-Gynecologic Oncology Group 183. *J Clin Oncol* 2005; 23(36):9329-9337.
27. Shingleton HM, Fowler WC, Jr., Koch GG. Pretreatment evaluation in cervical cancer. *Am J Obstet Gynecol* 1971; 110(3):385-389.
28. van Nagell JR, Jr., Sprague AD, Roddick JW, Jr. The effect of intravenous pyelography and cystoscopy on the staging of cervical cancer. *Gynecol Oncol* 1975; 3(1):87-91.
29. Lindell LK, Anderson B. Routine pretreatment evaluation of patients with gynecologic cancer. *Obstet Gynecol* 1987; 69(2):242-246.
30. Cobby M, Browning J, Jones A, Whipp E, Goddard P. Magnetic resonance imaging, computed tomography and endosonography in the local staging of carcinoma of the cervix. *Br J Radiol* 1990; 63(753):673-679.
31. Innocenti P, Pulli F, Savino L, et al. Staging of cervical cancer: reliability of transrectal US. *Radiology* 1992; 185(1):201-205.
32. Brenner DE, Whitley NO, Prempre T, Villasanta U. An evaluation of the computed tomographic scanner for the staging of carcinoma of the cervix. *Cancer* 1982; 50(11):2323-2328.
33. Camilien L, Gordon D, Fruchter RG, Maiman M, Boyce JG. Predictive value of computerized tomography in the presurgical evaluation of primary carcinoma of the cervix. *Gynecol Oncol* 1988; 30(2):209-215.
34. Ho CM, Chien TY, Jeng CM, Tsang YM, Shih BY, Chang SC. Staging of cervical cancer: comparison between magnetic resonance imaging, computed tomography and pelvic examination under anesthesia. *J Formos Med Assoc* 1992; 91(10):982-990.
35. Janus CL, Mendelson DS, Moore S, Gendal ES, Dottino P, Brodman M. Staging of cervical carcinoma: accuracy of magnetic resonance imaging and computed tomography. *Clin Imaging* 1989; 13(2):114-116.
36. Kim SH, Choi BI, Han JK, et al. Preoperative staging of uterine cervical carcinoma: comparison of CT and MRI in 99 patients. *J Comput Assist Tomogr* 1993; 17(4):633-640.
37. Kim SH, Choi BI, Lee HP, et al. Uterine cervical carcinoma: comparison of CT and MR findings. *Radiology* 1990; 175(1):45-51.
38. Matsukuma K, Tsukamoto N, Matsuyama T, Ono M, Nakano H. Preoperative CT study of lymph nodes in cervical cancer--its correlation with histological findings. *Gynecol Oncol* 1989; 33(2):168-171.
39. Newton WA, Roberts WS, Marsden DE, Cavanagh D. Value of computerized axial tomography in cervical cancer. *Oncology* 1987; 44(2):124-127.
40. Subak LL, Hricak H, Powell CB, Azizi L, Stern JL. Cervical carcinoma: computed tomography and magnetic resonance imaging for preoperative staging. *Obstet Gynecol* 1995; 86(1):43-50.
41. Vas W, Wolverson M, Freel J, Salimi Z, Sundaram M. Computed tomography in the pretreatment assessment of carcinoma of the cervix. *J Comput Tomogr* 1985; 9(4):359-368.
42. Villasanta U, Whitley NO, Haney PJ, Brenner D. Computed tomography in invasive carcinoma of the cervix: an appraisal. *Obstet Gynecol* 1983; 62(2):218-224.
43. Walsh JW, Amendola MA, Konerding KF, Tisnado J, Hazra TA. Computed tomographic detection of pelvic and inguinal lymph-node metastases from primary and recurrent pelvic malignant disease. *Radiology* 1980; 137(1 Pt 1):157-166.
44. Walsh JW, Goplerud DR. Prospective comparison between clinical and CT staging in primary cervical carcinoma. *AJR Am J Roentgenol* 1981; 137(5):997-1003.
45. Hricak H, Gatsonis C, Coakley FV, et al. Early invasive cervical cancer: CT and MR imaging in preoperative evaluation - ACRIN/GOG comparative study of diagnostic performance and interobserver variability. *Radiology* 2007; 245(2):491-498.
46. Mitchell DG, Snyder B, Coakley F, et al. Early invasive cervical cancer: tumor delineation by magnetic resonance imaging, computed tomography, and clinical examination, verified by pathologic results, in the ACRIN 6651/GOG 183 Intergroup Study. *J Clin Oncol* 2006; 24(36):5687-5694.
47. Bellomi M, Bonomo G, Landoni F, et al. Accuracy of computed tomography and magnetic resonance imaging in the detection of lymph node involvement in cervix carcinoma. *Eur Radiol* 2005; 15(12):2469-2474.
48. Whitley NO, Brenner DE, Francis A, et al. Computed tomographic evaluation of carcinoma of the cervix. *Radiology* 1982; 142(2):439-446.
49. Pannu HK, Fishman EK. Evaluation of cervical cancer by computed tomography: current status. *Cancer* 2003; 98(9 Suppl):2039-2043.
50. Choi SH, Kim SH, Choi HJ, Park BK, Lee HJ. Preoperative magnetic resonance imaging staging of uterine cervical carcinoma: results of prospective study. *J Comput Assist Tomogr* 2004; 28(5):620-627.
51. Hricak H, Lacey CG, Sandles LG, Chang YC, Winkler ML, Stern JL. Invasive cervical carcinoma: comparison of MR imaging and surgical findings. *Radiology* 1988; 166(3):623-631.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

52. Narayan K, McKenzie A, Fisher R, Susil B, Jobling T, Bernshaw D. Estimation of tumor volume in cervical cancer by magnetic resonance imaging. *Am J Clin Oncol* 2003; 26(5):e163-168.
53. Togashi K, Nishimura K, Sagoh T, et al. Carcinoma of the cervix: staging with MR imaging. *Radiology* 1989; 171(1):245-251.
54. deSouza NM, Dina R, McIndoe GA, Soutter WP. Cervical cancer: value of an endovaginal coil magnetic resonance imaging technique in detecting small volume disease and assessing parametrial extension. *Gynecol Oncol* 2006; 102(1):80-85.
55. Bipat S, Glas AS, van der Velden J, Zwinderman AH, Bossuyt PM, Stoker J. Computed tomography and magnetic resonance imaging in staging of uterine cervical carcinoma: a systematic review. *Gynecol Oncol* 2003; 91(1):59-66.
56. Greco A, Mason P, Leung AW, Dische S, McIndoe GA, Anderson MC. Staging of carcinoma of the uterine cervix: MRI-surgical correlation. *Clin Radiol* 1989; 40(4):401-405.
57. Lien HH, Blomlie V, Iversen T, Trope C, Sundfor K, Abeler VM. Clinical stage I carcinoma of the cervix. Value of MR imaging in determining invasion into the parametrium. *Acta Radiol* 1993; 34(2):130-132.
58. Sheu M, Chang C, Wang J, Yen M. MR staging of clinical stage I and IIa cervical carcinoma: a reappraisal of efficacy and pitfalls. *Eur J Radiol* 2001; 38(3):225-231.
59. Togashi K, Nishimura K, Itoh K, et al. Uterine cervical cancer: assessment with high-field MR imaging. *Radiology* 1986; 160(2):431-435.
60. Waggenspack GA, Amparo EG, Hannigan EV. MR imaging of uterine cervical carcinoma. *J Comput Assist Tomogr* 1988; 12(3):409-414.
61. Choi HJ, Kim SH, Seo SS, et al. MRI for pretreatment lymph node staging in uterine cervical cancer. *AJR* 2006; 187(5):W538-543.
62. Choi HJ, Roh JW, Seo SS, et al. Comparison of the accuracy of magnetic resonance imaging and positron emission tomography/computed tomography in the presurgical detection of lymph node metastases in patients with uterine cervical carcinoma: a prospective study. *Cancer* 2006; 106(4):914-922.
63. Kim SH, Kim SC, Choi BI, Han MC. Uterine cervical carcinoma: evaluation of pelvic lymph node metastasis with MR imaging. *Radiology* 1994; 190(3):807-811.
64. Park W, Park YJ, Huh SJ, et al. The usefulness of MRI and PET imaging for the detection of parametrial involvement and lymph node metastasis in patients with cervical cancer. *Jpn J Clin Oncol* 2005; 35(5):260-264.
65. Popovich MJ, Hricak H, Sugimura K, Stern JL. The role of MR imaging in determining surgical eligibility for pelvic exenteration. *AJR* 1993; 160(3):525-531.
66. Yang WT, Lam WW, Yu MY, Cheung TH, Metreweli C. Comparison of dynamic helical CT and dynamic MR imaging in the evaluation of pelvic lymph nodes in cervical carcinoma. *AJR* 2000; 175(3):759-766.
67. Narayan K. Arguments for a magnetic resonance imaging-assisted FIGO staging system for cervical cancer. *Int J Gynecol Cancer* 2005; 15(4):573-582.
68. Sironi S, De Cobelli F, Scarfone G, et al. Carcinoma of the cervix: value of plain and gadolinium-enhanced MR imaging in assessing degree of invasiveness. *Radiology* 1993; 188(3):797-801.
69. Hricak H, Powell CB, Yu KK, et al. Invasive cervical carcinoma: role of MR imaging in pretreatment work-up--cost minimization and diagnostic efficacy analysis. *Radiology* 1996; 198(2):403-409.
70. Feigen M, Crocker EF, Read J, Crandon AJ. The value of lymphoscintigraphy, lymphangiography and computer tomography scanning in the preoperative assessment of lymph nodes involved by pelvic malignant conditions. *Surg Gynecol Obstet* 1987; 165(2):107-110.
71. Furnell EC, Wellner R. [Lymphography--farewell to a routine method in pretherapeutic staging?]. *Rontgenblätter* 1988; 41(2):68-71.
72. La Fianza A, Dore R, Di Giulio G, et al. [Lymph node metastasis of carcinoma of the cervix uteri. Role of lymphography and computerized tomography]. *Radiol Med (Torino)* 1990; 80(4):486-491.
73. Scheidler J, Hricak H, Yu KK, Subak L, Segal MR. Radiological evaluation of lymph node metastases in patients with cervical cancer. A meta-analysis. *JAMA* 1997; 278(13):1096-1101.
74. Havrilesky LJ, Kulasingam SL, Matchar DB, Myers ER. FDG-PET for management of cervical and ovarian cancer. *Gynecol Oncol* 2005; 97(1):183-191.
75. Reinhardt MJ, Ehrhrit-Braun C, Vogelgesang D, et al. Metastatic lymph nodes in patients with cervical cancer: detection with MR imaging and FDG PET. *Radiology* 2001; 218(3):776-782.
76. Hope AJ, Saha P, Grigsby PW. FDG-PET in carcinoma of the uterine cervix with endometrial extension. *Cancer* 2006; 106(1):196-200.
77. Sironi S, Buda A, Picchio M, et al. Lymph node metastasis in patients with clinical early-stage cervical cancer: detection with integrated FDG PET/CT. *Radiology* 2006; 238(1):272-279.
78. Lin WC, Hung YC, Yeh LS, Kao CH, Yen RF, Shen YY. Usefulness of (18F)-fluorodeoxyglucose positron emission tomography to detect para-aortic lymph nodal metastasis in advanced cervical cancer with negative computed tomography findings. *Gynecol Oncol* 2003; 89(1):73-76.
79. Allen D, Narayan K. Managing advanced-stage cervical cancer. *Best Pract Res Clin Obstet Gynaecol* 2005; 19(4):591-609.
80. Chung HH, Jo H, Kang WJ, et al. Clinical impact of integrated PET/CT on the management of suspected cervical cancer recurrence. *Gynecol Oncol* 2007; 104(3):529-534.
81. Havrilesky LJ, Wong TZ, Secord AA, Berchuck A, Clarke-Pearson DL, Jones EL. The role of PET scanning in the detection of recurrent cervical cancer. *Gynecol Oncol* 2003; 90(1):186-190.
82. Ryu SY, Kim MH, Choi SC, Choi CW, Lee KH. Detection of early recurrence with 18F-FDG PET in patients with cervical cancer. *J Nucl Med* 2003; 44(3):347-352.
83. Yen TC, See LC, Chang TC, et al. Defining the priority of using 18F-FDG PET for recurrent cervical cancer. *J Nucl Med* 2004; 45(10):1632-1639.
84. Chang TC, Law KS, Hong JH, et al. Positron emission tomography for unexplained elevation of serum squamous cell carcinoma antigen levels during follow-up for patients with cervical malignancies: a phase II study. *Cancer* 2004; 101(1):164-171.
85. Grigsby PW, Siegel BA, Dehdashti F, Rader J, Zoberi I. Posttherapy [18F] fluorodeoxyglucose positron emission tomography in carcinoma of the cervix: response and outcome. *J Clin Oncol* 2004; 22(11):2167-2171.
86. du Toit JP, Grove DV. Radioisotope bone scanning for the detection of occult bony metastases in invasive cervical carcinoma. *Gynecol Oncol* 1987; 28(2):215-219.
87. Katz RD, Alderson PO, Rosenshein NB, Bowerman JW, Wagner HN, Jr. Utility of bone scanning in detecting occult skeletal metastases from cervical carcinoma. *Radiology* 1979; 133(2):469-472.
88. Broome DR, Girguis MS, Baron PW, Cottrell AC, Kjellin I, Kirk GA. Gadodiamide-associated nephrogenic systemic fibrosis: why radiologists should be concerned. *AJR* 2007; 188(2):586-592.
89. Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document for safe MR practices: 2007. *AJR* 2007; 188(6):1447-1474.
90. Sadowski EA, Bennett LK, Chan MR, et al. Nephrogenic systemic fibrosis: risk factors and incidence estimation. *Radiology* 2007; 243(1):148-157.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.