Radiology

REVIEWS AND COMMENTARY • REVIEW

2018 FIGO Staging System for Uterine Cervical Cancer: Enter Cross-Sectional Imaging

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Imaging plays a central role in the 2018 International Federation of Gynecology and Obstetrics staging system for uterine cervical cancer. The revision calls for a more precise measurement of primary tumor size, best assessed with imaging. Evaluation for abdominopelvic retroperitoneal lymphadenopathy, either with imaging alone or with pathologic analysis, is now also part of staging. Choice of modality depends on the technology available within the practice setting. In high-resource settings, pelvic MRI (to assess tumor size and central pelvic spread) and torso fluorodeoxyglucose PET/CT (to assess lymphadenopathy and distant metastases) are used to assign stage and to plan therapy. In lower-resource settings, analogous modalities are pelvic US and chest radiography. Although imaging is already a part of pretreatment planning in some high-resource settings, its incorporation into assigning stage is a new development.

Online supplemental material is available for this article.

Gynecologic cancers are staged according to the International Federation of Gynecology and Obstetrics (FIGO) system (1). Although a parallel TNM system for gynecologic cancers has been described by the American Joint Committee on Cancer, the FIGO system continues to predominate worldwide in clinical practice and for cancer database reporting (2). The first staging system put forth by FIGO around the turn of the 20th century applied to carcinoma of the uterine cervix, at the time the most common cancer among women in the developed world (3). The most recent revision of the FIGO staging system was announced in 2018 (Table 1).

Whereas FIGO staging of most gynecologic cancers relies on surgery and pathologic analysis, uterine cervical cancer is unusual among the gynecologic cancers in that it is staged clinically with pelvic examination, often under anesthesia with bladder cystoscopy and colposcopy, in combination with imaging. Preceding versions of the staging system included imaging with chest and skeletal radiography, intravenous pyelography, and barium enema (4–6). These low-technology choices reflected the demographic reality that nearly 85% of invasive cervical cancer is diagnosed in low-resource settings where advanced imaging modalities are unavailable.

Staging according to the old systems (ie, FIGO cervical staging systems from 1999, 2009, and 2014) was inaccurate, with 20%–40% of stage IB–IIIB cancers understaged and up to 64% of stage IIIB cancers overstaged (7–9). Older systems did not include assessment of lymph node metastases, an important determinant for prognosis and treatment planning. Moreover, radical trachelectomy, an emerging fertility-preserving technique in which the uterine corpus is anastomosed to the vagina to treat the many women diagnosed during their reproductive years, was not a consideration with these older systems.

To compensate for these shortfalls, treatment planning for invasive cervical cancer in much of the developed world has included modern cross-sectional and functional imaging such as CT, MRI, and fluorine 18 fluorodeoxyglucose, or FDG, PET (10,11). Such pretreatment imaging spared many women the particularly toxic combination of surgery, followed by concurrent chemotherapy and radiation therapy. Instead, they are triaged to one or the other curative, and far less morbid, options (12). The revisions introduced in the 2018 FIGO staging system are intended to address the gap between the staging formalism and ongoing clinical practice and to explicitly acknowledge the role that advanced imaging has come to play in the care of women with invasive uterine cervical cancer (13).

In this article, we review the 2018 FIGO staging system for cervical cancer and the new additions relevant to radiologists. Imaging modalities for staging in a range of high- to low-resource practice settings are presented. The standards for image acquisition and interpretation are summarized with cases illustrating potential pitfalls. Finally, we describe how the recommended imaging choices can be directly applied to the new staging system.

What's New?

One of the major changes in the updated staging system is that stage IB disease (ie, invasive carcinoma limited to the cervix) now includes three, rather than two, subgroups based on tumor size measured in its maximal dimension. The maximal cross-sectional tumor diameter visualized in any plane is measured both at imaging and at pathologic analysis. (1). The size and extent of local spread of the primary tumor in the central pelvis can now be assessed by using clinical examination, imaging, or pathologic measurement. This revision is based on observational data that define two clinically distinct patient populations (14). Patients with tumors less than 2 cm (ie, stage IB1) demonstrate a nearly twofold lower risk of cervical cancer death compared with patients with tumors measuring

Abbreviation

FIGO = International Federation of Gynecology and Obstetrics

Summary

With the 2018 International Federation of Gynecology and Obstetrics staging system for uterine cervical cancer, imaging is formally incorporated as a source of staging information and as a supplement to clinical examination (ie, pelvic examination, cystoscopy and colposcopy) to obtain an accurate description of tumor spread.

Essentials

- The 2018 International Federation of Gynecology and Obstetrics (FIGO) uterine cervical cancer staging system introduces a new primary tumor size cutoff value of 2 cm (ie, stage IB1 vs IB2), used to evaluate patients for fertility-sparing radical trachelectomy and to estimate prognosis.
- Retroperitoneal lymphadenopathy in the abdomen and pelvis, also new to the 2018 FIGO revision, can be diagnosed at imaging alone or with pathologic analysis.
- Both US and MRI accurately measure the primary tumor and assess parametrial spread better than does CT or physical examination.
- PET CT is more sensitive than is CT or MRI in depicting metastases to the retroperitoneal lymph nodes.
- Torso (chest, abdomen, and pelvis) PET CT reveals unsuspected distant metastases (eg, chest, peritoneum, bone, etc) that changes the stage, prognosis, and treatment plan in 14% of women with local-regionally advanced (ie, clinically suspected FIGO stage IB3, IIA2, ≥IIB) cervical cancer.

2–4 cm (ie, stage IB2). Moreover, stage IB1 tumors are more likely to be adenocarcinoma with low-grade histologic features, whereas stage IB2 tumors are more likely to be squamous cell carcinoma with high-grade histologic features (14).

This new primary tumor size cutoff value of 2 cm also corresponds to the eligibility criteria for radical trachelectomy, a fertility-sparing treatment for cervical cancer in which the uterine cervix, parametria, and the vaginal cuff are resected (15,16). During the operation, a cerclage is sutured across the isthmus to ensure uterine competence for future pregnancy. To be considered a candidate for this procedure, the woman must be considered to have stage I (ie, tumor confined to the cervix) and not stage II (ie, tumor growth into the upper third of the vagina or the parametria) disease. Additional inclusion criteria specify that the tumor cannot extend into the uterine corpus or must be a specific distance from the internal cervical os at MRI, and that the pelvic lymph nodes must be evaluated surgically and deemed negative for metastases (17–19).

Assessment of abdominopelvic retroperitoneal lymph nodes in cervical cancer staging was introduced with the 2018 update and was not in any previous versions of the FIGO system. Patients with pelvic and/or para-aortic lymph node metastases are designated as having stage IIIC disease, irrespective of primary tumor size or local pelvic spread. Stage IIIC1 corresponds to nodal metastases confined to the pelvis and stage IIIC2 to para-aortic nodal metastases. Lymph node status is to be assigned based on imaging and/or pathologic analysis and the methodology is to be recorded.

Lymphadenopathy assessed at cross-sectional imaging is a major prognostic factor for survival and an important determinant in treatment planning (20,21). Two conventional curative treatment options for invasive cervical cancer are radical hysterectomy with lymphadenectomy in early stage disease (IA, IB1, and IIA1) or radiation therapy with concurrent platinum-based chemotherapy for patients with local-regionally advanced disease (tumor >4 cm, stage IIB or greater). However, in patients with lymphadenopathy, surgery alone does not cure and 10%–30% of patients with early stage disease harbor lymph node metastases (22). The 2018 FIGO cervical cancer staging system now enables identification and upstaging of these patients based on pretreatment lymph node imaging, thereby sparing them unnecessary surgery and long-term morbidity (12,23).

Image Acquisition and Interpretation by Modality

With the FIGO 2018 staging system for uterine cervical cancer, imaging is formally incorporated as a source of staging information and as a supplement to clinical examination (ie, pelvic examination, cystoscopy, and colposcopy) to obtain an accurate description of tumor spread (Table 1) (1). Stage predicts patient prognosis and guides treatment planning. For patients suspected of having stage IB (invasive cancer ≥5 mm) disease or greater, imaging is indicated to assign stage (see Fig E1 [online]). Choice of modality depends on the technology available within the practice setting (Table 2).

Radiographic Imaging

Chest radiography in posterior-anterior and lateral views is performed in patients with local-regionally advanced disease to evaluate for pulmonary metastases. Most common are lung nodules, although pleural effusions or masses can also be seen. Consensus guidelines state that radiography, not CT, is the initial choice for chest imaging if PET/CT is not performed (10,11).

US Imaging

Endovaginal or endorectal US with a high-frequency (eg, 7–9 MHz) transducer is used to measure the primary tumor and to assess for local spread into the uterine cervical stroma (stage IB) or parametria (stage IIB) in patients suspected of having early stage disease. At US, tumor is typically homogeneously solid and hypoechoic relative to the uterine cervical stroma (24–27). In patients suspected of having advanced disease, transabdominal US can be used to evaluate for hydronephrosis (stage IIIB) if cross-sectional imaging with CT, MRI, or PET/CT—usually performed for retroperitoneal nodal evaluation—is not performed.

CT Imaging

Abdominopelvic CT is performed to evaluate for retroperitoneal lymphadenopathy (stage IIIC). It is usually performed as part of a PET/CT examination or as an alternative to abdominopelvic MRI if the latter examination is contraindicated or unavailable. If performed as an alternative to pelvic MRI, then intravenous contrast material should be administered for soft-tissue contrast to aid in distinguishing tumor from the normal uterine and other pelvic tissues. However, because tumor is usually homogeneously enhancing similar to normal cervical tissue, CT is usually suboptimal for assessing tumor

Table 1: 2018 FIGO Staging System for Uterine Cervical Cancer

Stage	Description
I	Carcinoma is strictly confined to the cervix (extension to the uterine corpus should be disregarded)
IA	Invasive carcinoma that can be diagnosed only with microscopy, with maximum depth of invasion <5 mm
IA1	Stromal invasion <3 mm in depth
IA2	Stromal invasion ≥3 mm and <5 mm in depth
IB	Invasive carcinoma confined to the uterine cervix, with measured deepest invasion ≥5 mm
IB1*	Tumor measures <2 cm in greatest dimension
IB2*	Tumor measures ≥2 cm and <4 cm in greatest dimension
IB3*	Tumor measures ≥4 cm in greatest dimension
II	Carcinoma invades beyond the uterus, but has not extended onto the lower third of the vagina or to the pelvic wall
IIA	Limited to the upper two-thirds of the vagina without parametrial involvement
IIA1	Tumor measures <4 cm in greatest dimension
IIA2	Tumor measures ≥4 cm in greatest dimension
IIB	With parametrial involvement but not up to the pelvic wall
III	Carcinoma involves the lower third of the vagina and/or extends to the pelvic wall and/or causes hydronephrosis or nonfunctioning kidney and/or involves pelvic and/or para-aortic lymph nodes
IIIA	Involves the lower third of the vagina, with no extension to the pelvic wall
IIIB	Extension to the pelvic wall and/or hydronephrosis or nonfunctioning kidney from tumor
IIIC*	Involvement of pelvic and/or para-aortic lymph nodes, irrespective of tumor size and extent[†]
IIIC1*	Pelvic lymph node metastasis only
IIIC2*	Para-aortic lymph node metastasis
IV	Carcinoma has extended beyond the true pelvis or has involved (biopsy-proven) the mucosa of the bladder or rectum
IVA	Spread to adjacent pelvic organs
IVB	Spread to distant organs

Note.— Imaging and pathologic analysis, where available, can be used to supplement clinical findings for all stages. FIGO = International Federation of Gynecology and Obstetrics. (Adapted, under a CC BY license, from reference 1.)

* Indicates stages that are new from the 2009 FIGO system.

[†] Stage IIIC should be annotated with *r* (radiology) or *p* (pathologic analysis) to indicate the method used to allocate this stage. Imaging modality or pathologic technique should also be documented.

extent of central pelvic spread and accurate measurement of the tumor (Fig 1) (28). For diagnosing lymphadenopathy based on morphology, there is variability in the literature on the acceptable size of cutoff value, which ranges between 0.8 cm and 1.0 cm in short-axis measurements (29,30). This variability is reader specific and attributable to the preference for minimizing false-negative or false-positive findings. To be consistent with consensus guidelines for solid tumor measurement, we report tumor involvement as "likely" if the lymph node measures greater than or equal to 1.0 cm and as "almost certainly" if it measures greater than or equal to 1.5 cm in short axis (30). Other features such as density, shape, and the presence or absence of the fatty hila have been suggested as important but consensus guidelines are silent on how they should be applied.

Chest CT without or with contrast enhancement is performed to evaluate for distant metastases (stage IVB). It is usually performed as part of a PET/CT examination or to follow-up abnormalities seen at chest x-ray. Chest CT findings of metastases are pulmonary nodules or involvement of the supraclavicular nodes, a station in the drainage pathway of the primary tumor (31). Mediastinal lymphadenopathy, unlike retroperitoneal or supraclavicular lymphadenopathy, does not result from direct drainage of the primary tumor; instead, it would suggest underlying pulmonary metastases.

MRI Examination

Pelvic MRI visualizes the primary tumor and evaluates tumor spread into the soft tissues of the central pelvis. Diagnostic-quality imaging requires a system greater than or equal to 1.5 T and intravenous contrast material administration. Table E1 (online) is a representative protocol for image acquisition. Multiplanar fast spin-echo T2 images help evaluate for tumor invasion into the parametria (stage IIB) and pelvic sidewall (stage IIIB), and images after gadolinium-based contrast agent administration help assess for peritoneal, nodal, and bone metastases (10,32). These small field-of-view images are optimized for high-spatial-resolution and soft-tissue contrast imaging of the central pelvis. Tumor, both primary and metastatic, is of intermediate signal intensity (ie, lower than fat but higher than myometrium or cervical stroma) on fast spin-echo T2-weighted images and enhances homogeneously or heterogeneously but less avidly than the normal myometrium in the venous phase of the contrast material bolus (Fig 1) (33,34). Some tumors, especially after cone biopsy, may be of too small a volume to be seen at MRI.

Often, large field-of-view anatomic images (eg, gradient-echo T1-weighted or echo planar T2-weighted images) from the level of the renal hilum through the pelvic floor are also obtained in the axial plane to evaluate for hydronephrosis (stage IIIB) and lymphadenopathy (stage IIIC). These should be routinely

Table 2: Choice of Imaging Based on Resource Availability for Staging of Patients with Uterine Cervical Cancer

Resource Setting and Primary Target for Diagnosis*	FIGO Stage
Basic	
Chest radiography	
Lung metastases	IVB
Limited	
Pelvic US	
Tumor size	IB
Parametrial tumor spread	IIB
Abdominal US	
Hydronephrosis	IIIB
Chest radiography	
Lung metastases	IVB
Enhanced	
Abdominopelvic MRI†	
Tumor size	IB
Parametrial tumor spread	IIB
Tumor spread to pelvic sidewall	IIIB
Hydronephrosis	IIIB
Retroperitoneal adenopathy	IIIC
Chest radiography‡	
Lung metastases	IVB
Maximal	
Pelvic MRI	
Tumor size	IB
Parametrial tumor spread	IIB
Tumor spread to pelvic sidewall	IIIB
Torso fusion FDG PET/CT§	
Hydronephrosis	IIIB
Retroperitoneal adenopathy	IIIC
Distant metastases including lungs, peritoneum, extraretroperitoneal lymph nodes, and bones‖	IVB

Note.—Imaging is appropriate in women with tumor invasive to a depth greater than or equal to 5 mm. FDG = fluorodeoxyglucose, FIGO = International Federation of Gynecology and Obstetrics.

* Complete description is available in reference 53.

† Examination should include small field-of-view images tailored for soft-tissue evaluation of the central pelvis and large field-of-view images of the abdomen and pelvis to evaluate retroperitoneal lymph nodes and the renal collecting system.

‡ Abnormalities should be further evaluated with chest CT.

§ PET and CT images should be acquired with hybrid scanner and analysis should include fusion imaging. CT should be of diagnostic quality but use of iodinated contrast material is optional.

‖ Abnormalities should be confirmed with pathologic analysis.

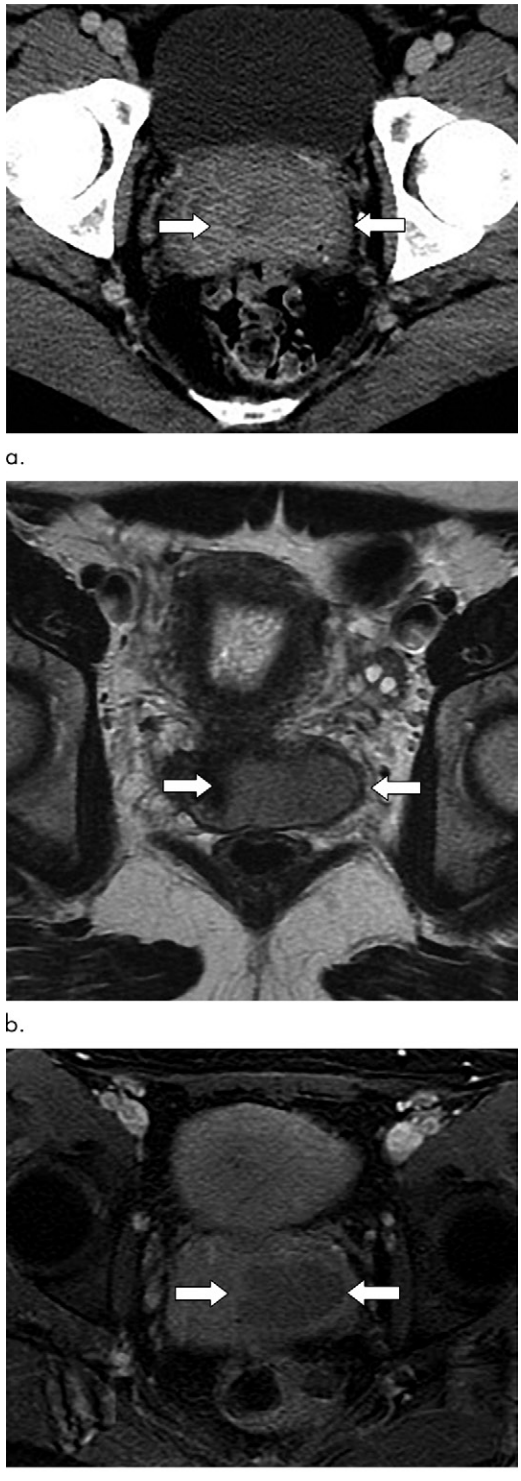


Figure 1: Images show uterine cervical cancer at CT versus MRI. **(a)** Contrast-enhanced CT, **(b)** axial fast spin-echo T2-weighted MRI, and **(c)** axial T1 images after gadolinium-based contrast agent administration through pelvis of a woman with stage IB2 cervical cancer (arrows). Tumor size (stage IB and IIA), cervical stromal invasion (stage IA), and lack of parametrial spread (stage IIB) are assessed well with MRI but poorly with CT.

acquired if a PET/CT or an abdominopelvic CT is not planned. As with CT, lymph nodes are evaluated not only based on size, but also for abnormal signal and/or shape.

Diffusion-weighted imaging, when added to conventional MRI sequences, improves lesion detection (35–42). Consequently, we routinely include diffusion-weighted imaging with *b* values of 0 and 1000 sec/mm^2 to facilitate lesion detection

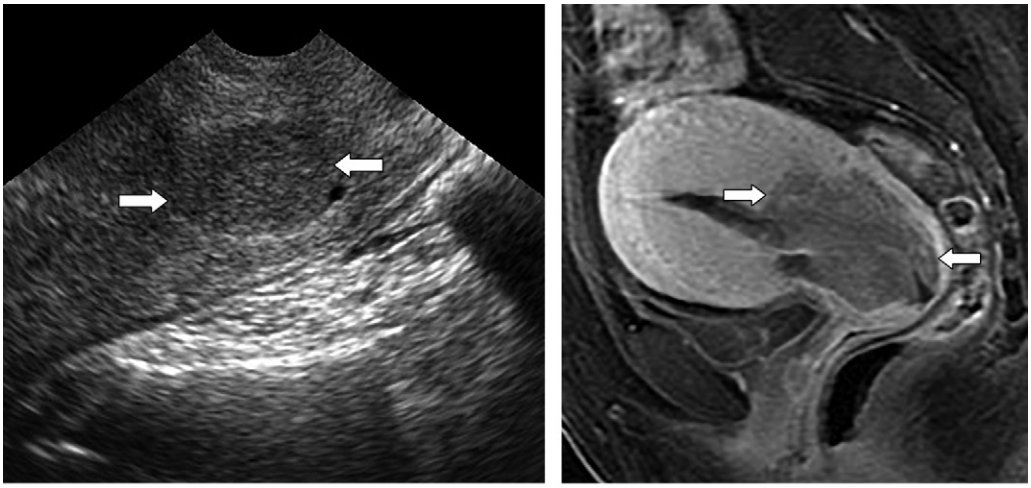
Table 3: US versus MRI for Tumor Size and Parametrial Spread

Parameter	US*	MRI*
Tumor size <2 cm (FIGO stage <IB1)		
Sensitivity (%)	89 (71/80)	84 (67/80)
Specificity (%)	89 (91/102)	87 (89/102)
Tumor size >4 cm (FIGO stage >1B3)		
Sensitivity (%)	78 (25/32)	81 (26/32)
Specificity (%)	99 (148/150)	95 (143/150)
Parametrial extension (FIGO stage ≥IIB)		
Sensitivity (%)	77 (10/13)	69 (9/13)
Specificity (%)	98 (166/169)	92 (155/169)

Source.—Reference 54.

Note.— Data in parentheses are primary ratios. Patient is clinically suspected to have low-stage disease (ie, less than International Federation of Gynecology and Obstetrics [FIGO] stage IIA).

* Reference standard is pathologic analysis.



a. b.

Figure 2: Images show uterine cervical cancer size at US versus MRI. **(a)** Sagittal endovaginal US image in a woman presenting with abnormal uterine bleeding shows 2.3-cm solid mass (arrows), pathologically diagnosed as invasive adenocarcinoma and initially staged as IB2. **(b)** Sagittal MRI after gadolinium-based contrast agent administartion shows that tumor (arrows) extends into uterine corpus and measures 4.8 cm, corresponding to stage IB3.

(42). Although the choice of *b* values for nodal detection for gynecologic cancer has not been standardized, most studies use maximum *b* values of 800–1000 sec/mm^2 (35–41). When compared with the conventional T1- or T2-weighted sequences, the diffusion-restricted tumor is more conspicuous against the normal tissue and is especially useful when gadolinium-based contrast agent cannot be administered. Similarly, intrauterine tumor growth, lymph node metastases, and peritoneal carcinomatosis are more reliably depicted with diffusion-weighted imaging than with conventional noncontrast sequences (37, 43, 44). The derived apparent diffusion coefficients offer an opportunity for quantitative imaging but have yet to be incorporated into clinical examination protocols (45).

FDG PET/CT Imaging

FDG PET/CT examination should be performed in a single sitting in a hybrid scanner in accordance with parameters defined by society guidelines (46). Imaging routinely encompasses the skull base through the proximal thighs. Negative rather than positive oral contrast material is used to minimize attenuation-correction artifact. The patient is asked to void before scanning to decrease bladder volume. Following the attenuation-correction CT, we acquire the PET images in the caudocranial direction to minimize the interval for bladder filling and bowel peristalsis that could cause misregistration between the CT and PET images (47).

Accurate tracer localization to avoid both false-positive and false-negative errors requires that the PET and CT data be acquired in the same sitting and that the CT be performed with sufficient beam energy to be anatomically interpretable (48). Fusion of the PET signal with the anatomic CT images helps to address the limited special resolution and soft-tissue contrast of PET. Administration of intravenous iodinated contrast material is optional but can aid in the evaluation of solid organs (eg, uterine corpus, liver, kidneys).

PET/CT is best used to evaluate for hydronephrosis (stage IIIB), retroperitoneal lymphadenopathy (stage IIIC), and distant metastases (stage IVB). A lymph node is considered positive for metastasis when it is within the anatomic nodal drainage pathway for the primary tumor and demonstrates tracer uptake greater than that of a clearly a normal node elsewhere on the scan (48). The primary drainage of uterine cervical cancer is to the pelvic sidewall (ie, external iliac, obturator, and internal iliac) and the supraclavicular lymph nodes (23,47). Distant metastases noted at PET/CT should be confirmed with pathologic analysis, because this finding significantly impacts patient prognosis and treatment (49,50).

Choice of Imaging and Staging Pitfalls

The choice of imaging for staging is modified based on the availability of the technology and expertise (Table 2). Most

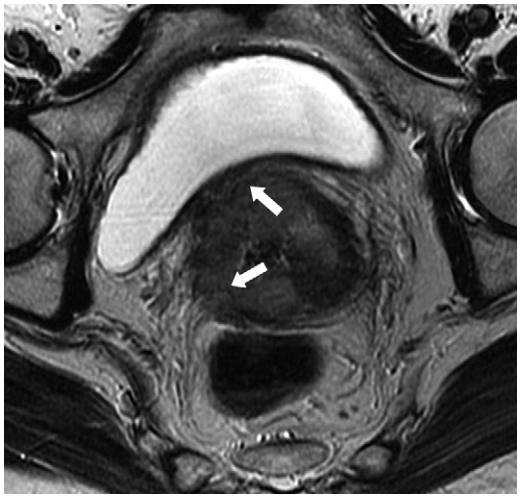


Figure 3: Image shows uterine cervical cancer with parametrial involvement. Axial oblique fast spin-echo T2-weighted image in a woman clinically staged as IB shows tumor that extends beyond dark stromal ring of cervix into adjacent parametria (arrows) corresponding to stage IIB.

cervical cancers are diagnosed in low-resource settings where options such as modern cross-sectional and functional imaging (eg, CT, MRI, PET/CT), brachytherapy, and on-site pathologic analysis are either constrained or not accessible at all. Given this, oncologists have stratified management of cervical cancer according to the resource intensity of the practice setting (51). Choice of imaging for staging is also modified to reflect this variability.

Tumor Size and Central Pelvic Spread

MRI is preferred over CT or pelvic examination for measuring primary tumor size. A prospective multicenter trial of 208 women demonstrated that MRI correlated more closely with pathologic measurements than did CT or physical examination (28). If MRI is unavailable, then US with an endovaginal or endorectal probe is an alternative in women when the clinical examination suggests early stage disease. A prospective trial of 189 women with FIGO stage IA2–IIA cervical cancer (ie, invasive tumors <4 cm) showed that maximal tumor dimension measured with US agreed with those obtained with MRI or pathologic analysis (Table 3) (52). However, the limited field of view and soft-tissue contrast of US can impede accurate assessment of bulky tumors (Fig 2) and precludes evaluation of retroperitoneal lymph nodes.

Radial spread of tumor out of the uterine cervix into the parametria correlates with stage IIB disease and triages the patient away from primary surgery to concurrent chemotherapy and radiation therapy (Fig 3). At MRI, this is best seen on fast spin-echo T2 long-axis oblique views of the cervix where the isointense tumor extends beyond the dark stromal ring of the cervix. Imaging with US or MRI is indicated to help detect parametrial involvement, as both modalities are more sensitive than is physical examination. A prospective multicenter trial demonstrated that, in patients with early stage tumor intended for curative surgery, sensitivity of MRI versus clinical examination to help detect parametrial extension was 53% versus 29% (53). Another prospective multicenter trial showed that the false-negative rate with US and MRI for parametrial extension was comparable and very low (ie, <3%). The false-positive rate was also low, but was higher for MRI (8%) than for US (2%; $P < .001$) (Table 3) (52).

Aside from staging, if radiation therapy is anticipated, then pelvic MRI is the preferred examination for treatment planning because it best defines the geometry of tumor growth in the central pelvis (54). MRI affords a larger field of view than does US and greater tissue contrast than does CT. Thus, MRI best delineates tumor spread into the uterine corpus, pelvic sidewalls, and adjacent viscera such as bladder and bowel.

Retroperitoneal Lymph Node Metastases

The 2018 FIGO staging system explicitly states that the status of the pelvic and para-aortic lymph nodes (stage IIIC) can be determined with imaging. PET/CT, MRI, and CT are the imaging options. Other option for nodal evaluation is surgical and includes lymphadenectomy or sentinel node biopsy, the latter limited to sites where the necessary surgical and pathologic expertise are available (55,56). Although surgery is more sensitive, imaging is less morbid in avoiding the short- and long-term complications of lymphadenectomy (57).

PET/CT is the most sensitive imaging examination for detection of lymphadenopathy. A meta-analysis of 72 studies involving 5042 women found that PET demonstrates a higher sensitivity (75%) and comparable specificity (98%) to MRI (sensitivity of 56% and specificity of 93%) and CT (sensitivity of 58% and specificity of 92%) (58). In a paired comparison, a multicenter prospective trial of 153 women showed that PET/CT is more sensitive than is CT alone, especially in depicting lymph nodes in the para-aortic stations (Fig 4, Table 4) (59). Detection of lymphadenopathy that extends beyond the pelvis into the para-aortic region is clinically significant, not only because it upstages the patient, but it also expands the fields for radiation therapy. If PET/CT is unavailable, then CT or MRI is a second-line alternative with both modalities demonstrating similar diagnostic performance (28,60).

Distant Metastases

Cervical cancer can manifest with tumor beyond the pelvic soft tissues and the retroperitoneal lymph nodes. Presence of distant metastases (stage IVB) confers a substantially poorer prognosis and indicates that local-regionally–directed therapies, such as surgery and radiation therapy, will not be sufficient for cure (49,50). Treatment will involve systemic chemotherapy with local-regional therapy modified to play a less aggressive role. Thus, early detection of stage IVB disease significantly impacts patient treatment and represents an opportunity to decrease treatment-related morbidity.

PET/CT is indicated and is the preferred examination for whole-body staging in patients with local-regionally advanced cancer at pelvic examination (ie, clinical stage IB3, IIA2, >IIB) and in patients in whom radiography, CT, or MRI indicates

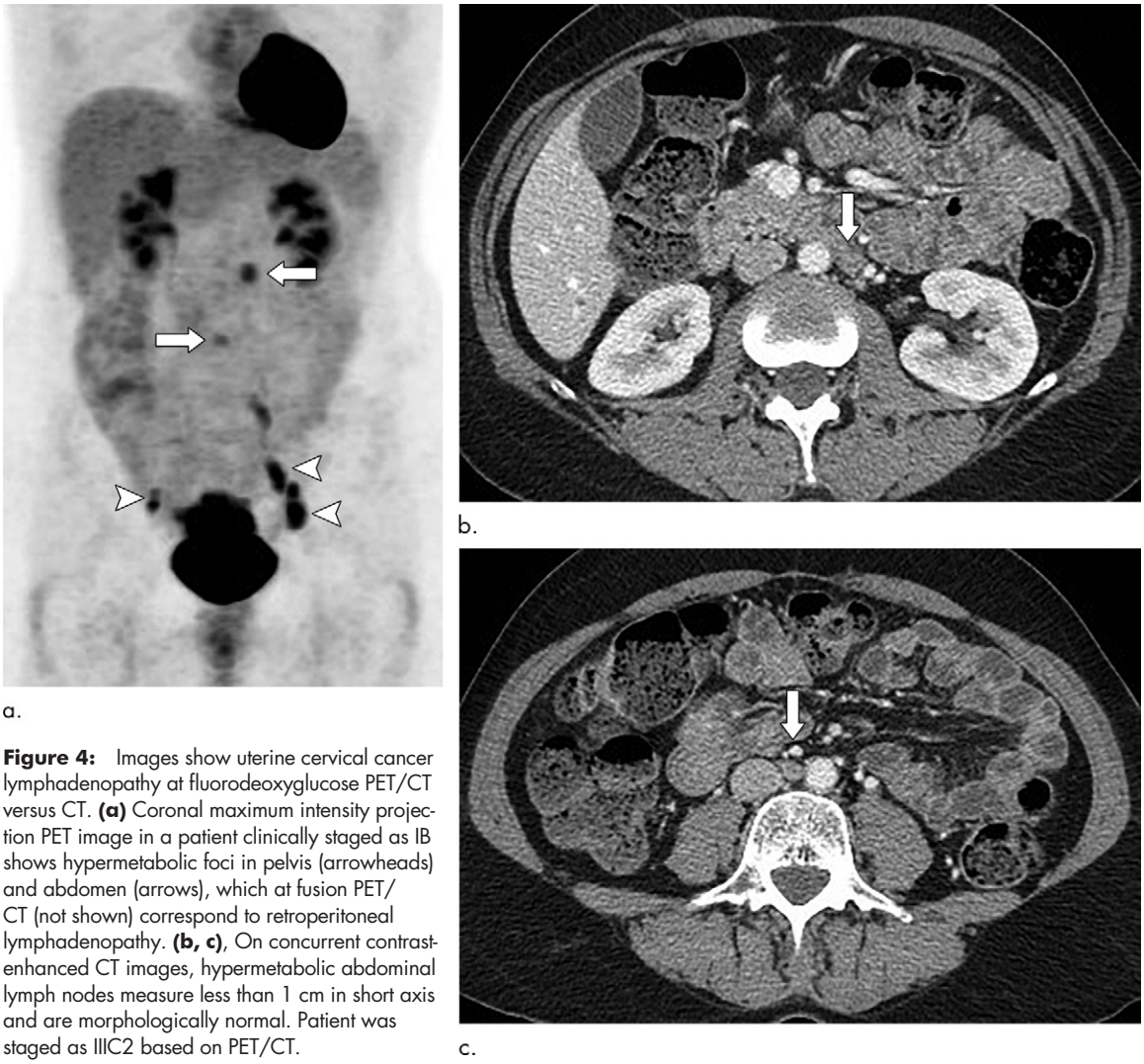


Figure 4: Images show uterine cervical cancer lymphadenopathy at fluorodeoxyglucose PET/CT versus CT. **(a)** Coronal maximum intensity projection PET image in a patient clinically staged as IB shows hypermetabolic foci in pelvis (arrowheads) and abdomen (arrows), which at fusion PET/CT (not shown) correspond to retroperitoneal lymphadenopathy. **(b, c)**, On concurrent contrast-enhanced CT images, hypermetabolic abdominal lymph nodes measure less than 1 cm in short axis and are morphologically normal. Patient was staged as IIIC2 based on PET/CT.

Table 4: CT versus PET/CT in Detecting Abdominal Retroperitoneal Metastases in Uterine Cervical Cancer

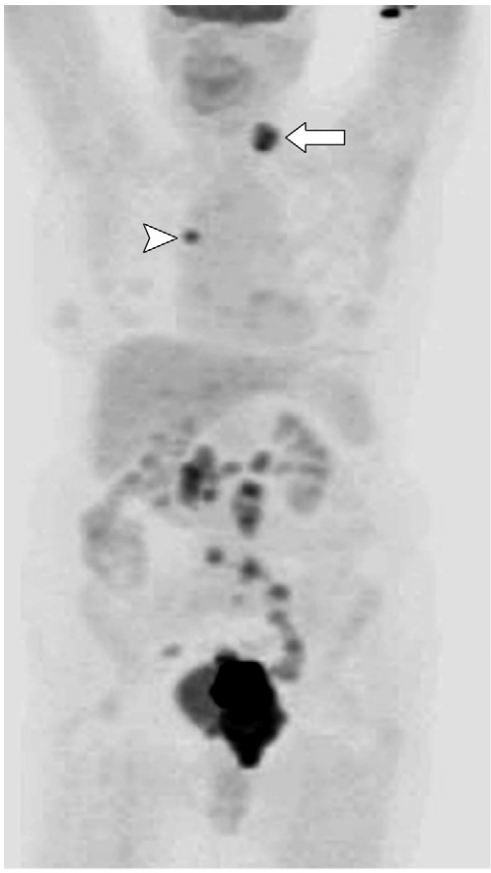
Parameter	FDG PET/CT*	CT	*P* Value†
Sensitivity (%)	50 (44, 56)	42 (36, 48)	.05
Specificity (%)	85 (80, 89)	89 (84, 92)	.21

Note.—Adapted, with permission, from reference 59. Data in parentheses are 95% confidence intervals.
* PET and CT images acquired in a hybrid scanner and interpreted with inclusion of fusion imaging.
† McNemar test statistic.

extrauterine spread of the primary tumor. In a multicenter prospective trial, 14% (21 of 153) of women with locally regionally advanced cervical cancer (2014 FIGO stage IB2, IIA with tumors >4 cm, and IIB–IVA with clinical examination) demonstrated unsuspected distant metastases (Fig 5) (61). Lungs, peritoneum, supraclavicular and thoracic lymph nodes, and bones represented the involved sites in the order of prevalence. Most of these metastases (ie, thoracic lymphadenopathy, pulmonary nodules <1 cm, and bone metastases) are not depicted with pelvic MRI and chest radiography, the recommended alternative modalities if PET/CT is unavailable (62). The specificity and positive predictive value of PET/CT was 98% and 79%, respectively. Thus, distant metastases depicted with PET/CT should be confirmed with biopsy, because a designation of stage IVB is associated with a significant change in treatment strategy.

Prognosis

Because of its sensitivity in depicting lymph node metastases, PET and PET/CT are a strong predictor of disease-specific survival (15,63). In a prospective cohort study of 560 patients at a single center, the risk of recurrent disease was shown to increase incrementally on the basis of the most distant level of lymph node involvement at PET, with a hazard ratio of 2.40 (95% confidence interval: 1.63, 3.52) for pelvic, 5.88 (95% confidence interval: 3.80, 9.09) for paraaortic, and 30.27 (95% confidence interval: 16.56, 55.34) for supraclavicular involvement (63).



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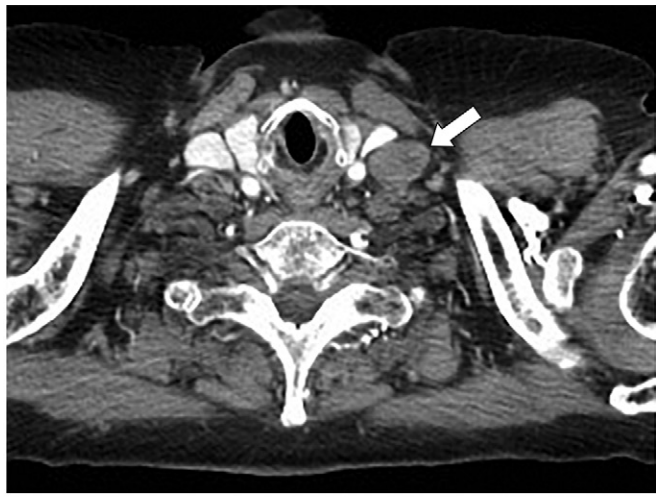

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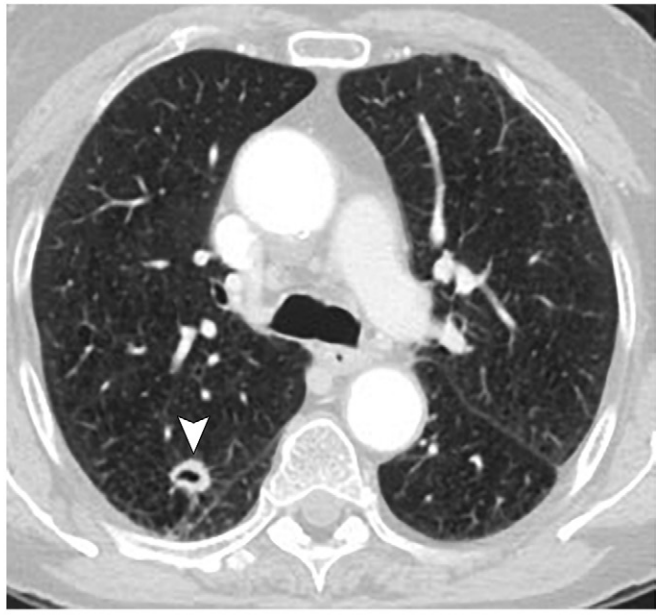

c.

Figure 5: Images show uterine cervical cancer with thoracic metastases. **(a)** Coronal maximal intensity projection PET image in a patient staged as IB following clinical examination and normal chest x-ray (not shown) shows hypermetabolic foci in left upper (arrow) and right middle (arrowhead) thorax corresponding to **(b)** left supraclavicular lymphadenopathy (arrow) and **(c)** cavitary right lung nodule (arrowhead), respectively. If PET/CT is unavailable, then chest radiography is recommended as first-line imaging modality for thoracic imaging. Source.—References 8 and 9. Patient was staged as IVB based on PET/CT and lymph node biopsy that showed metastases at pathologic analysis.

What's Next?

Fluorine 18 FDG PET/MRI, in which MRI and PET data are acquired simultaneously in a single scanner, demonstrates promise to be an important tool in FIGO cervical cancer staging (42). The examination offers "one-stop staging" by assessing the pelvic tumor with MRI and evaluating the entire body for retroperitoneal nodal and distant metastases. Although sensitivity of PET/MRI for pulmonary nodule depiction is suboptimal (ie, depicts 70% nodules seen at CT), it demonstrates high sensitivity (ie, 96%) for depicting FDG-avid nodules (64). The technology would enable multiparametric functional imaging with diffusion-weighted imaging and FDG, both of which are under development as quantitative biomarkers. However, clinical implementation of PET/MRI would require that the challenges posed by attenuation correction be better solved, especially in the abdomen and pelvis. In addition, patient table times with the current scanners are long (ie, ≥1.0 h), which would represent a relative contraindication in many patients.

Invasive uterine cervical cancer is a disease that primarily afflicts women who lack access to preventive health care, such as Papanicolaou test screening and the human papilloma virus vaccine. For these women, the modern cross-sectional and functional imaging introduced into the 2018 FIGO staging system is unlikely to prove beneficial. Although this revision acknowledges the progress that the developed countries have made in incorporating imaging for cervical staging to treat patients more effectively and with less morbidity, it also highlights the stark disparities in the care of patients with cervical cancer worldwide. Dissemination of the advantages of imaging for cervical cancer staging lies within the domain of global health development efforts. Radiologists, among other physicians, should continue to participate in ongoing efforts to improve access to advances in medical technology and expertise in low-resource settings (65,66).

Conclusion

Imaging plays a central role in the 2018 International Federation of Gynecology and Obstetrics staging system for uterine cervical cancer. The new system introduces retroperitoneal lymphadenopathy as a factor and specifies that cross-sectional imaging, ideally PET/CT, be used to assess nodal status. In this context, PET/CT is preferred as the imaging modality because it also enables depiction of occult distant metastases, another factor in staging. Additionally, the revision calls for a more precise description of primary tumor size, which should be measured with MRI, especially for trachelectomy planning. For oncologists, the use of modern imaging will enable them to stage more accurately, to counsel on prognosis with greater certainty, and to tailor treatment to be curative but less morbid. As radiologists now a play an active role in assigning stage, we should turn our attention to arriving at consensus standards and criteria for image acquisition, interpretation, and reporting to achieve optimum quality in the care of uterine cervical cancer.

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