Malignant Diseases of the Female Genital Tract

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Introduction

Advances in cross-sectional imaging have led to an increasingly important role for radiology in the management of malignant gynecological conditions. A number of imaging modalities can be used to evaluate malignant diseases of the female pelvis, including ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography/computed tomography (PET/CT). These modalities have different roles in screening, diagnosis, staging, treatment selection and follow-up. The aim of this chapter is to review the role of different techniques in the imaging of malignant gynecological conditions. The emphasis is on the use of MRI in the staging of endometrial and cervical cancer following the revised FIGO (International Federation of Gynecology and Obstetrics) criteria, implemented beginning June 1, 2009 [1].

Ultrasound

The primary imaging modality in the initial assessment of suspected gynecological pathology is US. It is used to evaluate a suspected pelvic mass, characterize adnexal lesions, and identify endometrial abnormalities in the postmenopausal patient. Transabdominal and transvaginal US can assist in image-guided fine needle aspiration cytology or biopsy and can also be used to guide placement of brachytherapy seeds in the treatment of cervical and endometrial cancer.

Magnetic Resonance Imaging

This is the imaging modality of choice in the staging of uterine and cervical cancer and in the characterization of adnexal lesions when the US findings are indeterminate. The advantages of MRI include superb spatial and tissue contrast resolution, the absence of ionizing radiation, its multiplanar capability, and its fast techniques. However, the optimization of MRI sequences and clinical protocols, as outlined below, is crucial to ensure best results.
DWI can help in the evaluation of tumor response to radiotherapy in patients with cervical cancer [8] and is useful in the detection of peritoneal implants and metastatic lymph nodes in patients with gynecological malignancies [9]. DWI is also useful in detecting peritoneal implants in patients with gynecological malignancies [10]. Ultrasmall particles of iron oxide (USPIO) have been shown to improve the detection of lymph node metastases independent of node size in patients with endometrial and cervical cancer [10].

**Computed Tomography**

The role of CT in the imaging of malignant uterine conditions is limited due to its poor soft-tissue contrast. The main role of CT is in staging, treatment planning, and follow-up of patients with ovarian cancer. However, CT is important in the evaluation of other gynecological malignancies by identifying enlarged lymph nodes and distant metastases and detecting recurrent pelvic tumors.

**Positron Emission Tomography/Computed Tomography**

Patients with malignant gynecological conditions are increasingly being evaluated with PET/CT. This modality is very valuable in the detection of metastatic lymph nodes as it has better sensitivity and specificity than MRI; it can also differentiate tumor recurrence from radiation fibrosis. PET/CT is also very useful in evaluating recurrent tumor prior to salvage therapy. Maximum standard uptake values (SUV) at staging can predict survival in patients with cervical carcinoma. However, it must be remembered that in pre-menopausal patients physiological uptake can be seen in the uterus, ovarian follicles, and corpus luteum cysts. The uptake of 2-deoxy-2-[fluorine-18]fluoro-d-glucose (FDG) can also be seen in certain benign ovarian and uterine tumors as well as in inflammatory and infectious processes.

**Endometrial Carcinoma**

On US, endometrial carcinoma is seen as a thickened endometrium (>5 mm in post-menopausal patients). On sonohysterography, endometrial carcinoma may present as an intrauterine polypoid mass or as an asymmetrical thickening of the endometrium. It is, however, impossible to distinguish between benign endometrial polyps, endometrial hyperplasia, and endometrial carcinoma confined to the endometrium using US alone. Therefore, endometrial carcinomas are typically diagnosed at endometrial biopsy or dilatation and curettage, with MRI being reserved to evaluate the extent of disease [11].

Imaging criteria for staging of endometrial cancer are based on the TNM/FIGO (International Federation of Obstetrics and Gynecology) classification. The overall staging accuracy of MRI has been reported to be between 85 and 93% [4, 5, 12]. Routine use of dynamic intravenous contrast enhancement is necessary for state-of-the-art MRI evaluation of endometrial cancer [4, 5].

- **Stage IA** tumors involve <50% of the myometrial thickness (Fig. 1). The presence of low-signal-intensity tumor (equilibrium and later phases of enhancement) within the outer myometrium or beyond indicates deep myometrial invasion and thus stage IB disease. Erroneous MRI assessment of the depth of myometrial invasion may occur due to an indistinct zonal anatomy, the presence of co-existent benign pathology (leiomyomas, adenomyosis), tumor extension into the uterine cornu, or a polypoid tumor distending the uterus so that rather than deep myometrial infiltration there is a thin rim of myometrium stretched over the tumor [2].

  In **stage II** disease, the fibrocervical stroma is disrupted by high-signal-intensity tumor on T2-weighted images, together with the disruption of normal enhancement of the cervical mucosa by low-signal-intensity tumor on late dynamic contrast-enhanced MRI.

  In **stage III** disease, tumor extends outside the uterus but not outside the true pelvis. **Stage IIIA** is marked by

![Fig. 1 a, b. Stage 1A endometrial carcinoma. Sagittal T2-weighted fast spin echo (FSE) (a) and sagittal gadolinium-enhanced 3D T1-weighted gradient-recalled echo (GRE) (b) images show an endometrial carcinoma invading the inner half of the myometrium. The depth of myometrial invasion is better appreciated on the gadolinium-enhanced 3D T1-weighted GRE MR image (arrow).](image)