Cervical Cancer: Role of MRI in Patient Management

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Recent developments in MR techniques have magnified the added value of MRI in management of patients with cervical cancer. This presentation will briefly review the role of MR in clinical practice and discuss features of recent MR technique.

Cervical cancer is the second most common cancer in women worldwide, and more than 80% of cases are found in developing nations. Cervical cancer is usually a slow-growing cancer, which is almost always caused by human papillomavirus (HPV) infection. The lesion begins on the surface, presenting as a preinvasive lesion for a long period, and gradually invades more deeply into the cervical stroma to evolve into invasive cervical cancer (stage IB or higher). Preinvasive lesions are identifiable by PAP smear and evaluated clinically by means of biopsy etc. MR imaging is basically used only for invasive cervical cancer.

The staging and treatment of the uterine cancers are based on FIGO staging system, which is single most important rationale to provide universal statistics for epidemiology and therapeutic outcome. Although FIGO system has given a firm “no” to apply MR in staging cervical cancer, it finally updated in 2009 to recommend to include tumor size obtained from MR imaging or CT, based on the result of American College of Radiology Imaging Network/Gynecologic Oncology Group (ACRIN6651/GOG 183) clinical study.

MRI can clearly visualize invasive cervical cancers, with detailed display of its extent. Lesions are displayed on T2-weighted images as a lesion with increased signal intensity compared to the adjacent cervical stroma. For demonstration of the tumor, MRI had an accuracy of 95% for invasive diseases. The important roles of MR are the evaluation of the tumor extent and the detection of lymph node (LN) metastases.

In recent multi-institutional study in United States (ACRIN6651/GOG 183) visualization of cervical cancer was significantly better for MRI compared with multi-detector CT, although staging accuracy was similar between two modalities. When the detection of advanced stage (≥ IIB) were evaluated, sensitivity was 29%, 42%, and 53%, respectively for FIGO clinical staging, CT, and MRI; specificity was 99% for FIGO clinical staging, 82% for CT, and 74% for MRI. These results were poorer compared with previous studies, where staging accuracy of cervical cancer was reported to be superior for MRI (77-83%) to CT (63-69%) or US (70%). However, these studies showed the superiority of MRI over FIGO and the fact that FIGO staging was actually submitted after imaging such as CT or MRI examination. MR imaging has also shown sufficient confidence for diagnosing the absence of bladder or rectal invasion to safely obviate the need for invasive cystoscopic
or endoscopic staging in the majority of patients with cervical cancer.

Although morphological assessment by MR imaging plays an important role in the management of patients with cervical cancer, there are many limitations such as early detection of the tumor, precise evaluation of tumor extent, detection of small LN metastases, as well as evaluation of viability of tumor, response to the treatment, and early detection of recurrence. The evaluation of treatment effect is a requisite for cervical cancer because many of the lesions are treated with chemoradiation. Various breakthrough methods and techniques are expected to solve these limitations.

The 3T systems are now rapidly introduced all over the world and show potential for providing excellent images for the uterus, especially for the uterine cervix and vagina. However, at present, improvements shown are not so drastic and the way of evaluations of staging is the same with those on 1.5 T. Diffusion weighted images (DWI) reflect differences in water diffusivity caused by molecular diffusion phenomenon, which is called Brownian motion. DWI recently attracts lots of attention in oncologic fields. DWI can provide excellent tissue contrast based on molecular diffusion and demonstrate abnormal signals in pathologic foci, especially when they are malignant. DWI also enables the quantitative evaluation using apparent diffusion coefficient (ADC), which may have potential roles not only in distinguishing malignant from benign tissues, but also in monitoring the therapeutic outcome. ADC value is also reported to predict the effect of radiation therapy and preoperative chemotherapy for uterine cervical cancer. Pharmacokinetic analysis of DCE MR images provide information about the distribution of contrast agent in vessels and tissues, which may reflect tissue microenvironment such as microvessel density, tissue permeability, and fraction of extracellular extravascular space. These functional techniques may have a potential to detect microscopic changes in tumor by observing alterations in perfusion, oxygenation, and metabolism, and are occasionally called as "imaging biomarkers".

Although some of these functional techniques are still in their experimental stage, they may further broaden the role of MR in the evaluation of cervical cancer, when used in combination with standard imaging methods.