Preoperative staging of cervical carcinoma with MR imaging: a reappraisal of diagnostic accuracy and pitfalls

Abstract The purpose of this study was to assess the diagnostic accuracy and pitfalls of MR imaging in preoperative staging of cervical cancer. Magnetic resonance imaging was performed to determine the tumor staging for 41 patients with cervical carcinoma emphasizing tumor size, parametrial invasion, vaginal invasion, and lymph node metastases. According to the correlation of MR findings with surgical-pathological features, there was less than 5 mm discrepancy in the size in 29 of 34 tumors (85.3%) that were larger than 1 cm. In assessing parametrial invasion, vaginal invasion and lymph node metastases, MR imaging had an accuracy of 95, 83, and 86%, respectively. In determining stage of disease and differentiating operable (≤stage IIA) from advanced disease (≥stage IIB), MR imaging had an accuracy of 82.9 and 93%. Pitfalls leading to staging errors included difficulties in differentiating cancer foci from surrounding tissue edema and detecting microscopic tumor extension. Magnetic resonance imaging is accurate in the evaluation of parametrial invasion and differentiation of operable from advanced disease. The ability of MR imaging to detect microscopic extracervical tumor extension and differentiate cancer foci from surrounding tissue edema is not as reliable.

Keywords Uterine neoplasms · Cervical carcinoma · Tumor staging · MR imaging

Introduction

Cervical cancer is the leading cause of cancer death among women in Taiwan [1]. Accurate tumor staging is crucial for appropriate therapy. Although there are numerous prognostic factors that may affect treatment planning, clinical International Federation of Obstetrics and Gynecology (FIGO) staging for tumor extension is usually the main determinant in guiding therapy choices. Nevertheless, clinical FIGO staging also has limitations. When correlated with surgical staging, clinical staging for cervical cancer has an error rate of 26–66% [2, 3, 4, 5]. Magnetic resonance imaging, with superb soft tissue contrast and multiplanar capabilities, has been shown to be reliable in the evaluation of gynecological malignancies including cervical cancer [6, 7, 8]; however, the potential pitfalls of MR imaging in cervical cancer staging have not been completely explored.

The purpose of this study was to evaluate the role of MR imaging in pre-operative staging of cervical cancer as well as to explore the potential pitfalls. The diagnostic accuracy was assessed by correlating the MR imaging features of cervical cancer with its histopathology in 41 patients.
Materials and methods

This prospective study was conducted between April 1996 and June 1999, in which 79 consecutive women who presented with primary untreated carcinoma of cervix were included. All patients were examined and staged clinically by gynecologists based on the International Federation of Obstetrics and Gynecology staging system (FIGO 1995) [9]. Forty-one patients, ranging in age from 32 to 78 years (mean age 56.6 years), subsequently underwent surgical exploration and treatment. The pre-operative imaging features were correlated with the operative findings and histopathological findings. The remaining 38 women did not undergo surgical treatment because of high surgical risks, clinically advanced disease status, or refusal of surgical intervention (they preferred radiotherapy) or did not undergo MR imaging due to pacemaker implantation, intracranial vascular clips, and claustrophobia, and, therefore, were excluded from this study.

The MR imaging was performed with a 1.5-T scanner (Signa, GE Medical Systems, Milwaukee, Wis.; or Magnetom Vision, Siemens, Erlangen, Germany), by using a pelvic or a torso phased-array coil. Fast spin-echo T2-weighted images were obtained with the following parameters: TR 4000–4500 ms; TE 85–90 ms; 5-mm slice thickness, 0–1-mm intersection gap, echo train length 8 [10], two signals acquired (NEX), 512 x 256 matrix, and field of view (FOV) 20 cm. Spin-echo T1-weighted images were obtained with the following parameters: TR/TE 600–700/10–20 ms; 5-mm slice thickness; 1-mm intersection gap; 2 NEX; 256 x 128 matrix; and FOV 20 cm. The T1- and T2-weighted images were obtained by scanning 5 cm above the aortic bifurcation down to the level below the symphysis pubis including the distal vagina in the axial plane, which is perpendicular to the craniocaudal axis of the cervix. In addition, T2-weighted sagittal images, parallel to craniocaudal axis of the cervix, were obtained in each patient. Post-contrast-enhanced T1-weighted axial images scanning from the symphysis pubis to the renal hilum were obtained after a bolus intravenous injection of 0.1 mmol/kg of gadopentetate dimeglumine (Magnevist, Schering, Berlin, Germany).

The MR images were interpreted independently by two radiologists (M. H.S. and J. H.W.) who had no knowledge of detailed clinical information other than the diagnosis of cervical cancer. The MR features of each case of cervical cancer were analyzed with respect to the following: (a) tumor size; (b) status of the parametrium, upper vagina, pelvic sidewall, urinary bladder, and rectum; and (c) lymph node metastasis. The tumor size was recorded by measuring the largest diameter of the tumor mass in either transverse or sagittal direction. The criterion for parametrial invasion was based on the disruption of the full thickness of the hypointense cervical stroma with the presence of hypointense tumor component within the parametrium (Fig. 1) [11]. Lymph nodes with the diameter greater than 1 cm were considered positive. According to the FIGO system advocated by Togashi et al. [12], the tumors were staged based on the MR features. The degree of interobserver agreement between the two radiologists was assessed with the x² statistic.

Radical hysterectomy and pelvic lymph node dissection were performed within 2 weeks after MR imaging in 33 patients (pre-operative chemotherapy or radiotherapy were administered in 6 of them before MR imaging), and extended radical hysterectomy with pelvic lymph node dissection in 8 patients [13, 14]. The pathologic assessment of the surgical specimens was focused on the tumor size, tumor involvement of the parametrium, vagina, rectum or urinary bladder, and lymph node status. We then correlated MR imaging findings with the corresponding pathological features.

Results

Based on the surgical–pathological findings, 3 patients were categorized according to FIGO system as stage IA: 20 patients, stage IB: 4 patients, stage IIA: 12 patients, stage IIB: 1 patient, stage IIIA: and 1 patient, stage IV. Histopathological examinations showed that 34 tumors (83%) were squamous cell carcinoma and 7 tumors (17%) were adenocarcinoma. With respect to tumor size, 10 tumors were larger than 4 cm in diameter. Seven tumors were less than 0.5 cm of which 3 tumors were only identified microscopically. The size of the other 24 tumors ranged from 1 to 4 cm.

Based on the MR findings, the tumor staging by the two radiologists was concurrent in 37 of 41 patients (x² = 0.81). For the other patients, agreement on the tumor staging was reached by consensus in conference. As a result, 2 patients were classified as stage IA cervical cancer, 20 patients with stage IB, 3 patients with stage IIA, 14 patients with stage IIB, 1 patient with stage IIIA, and 1 patient with stage IV. The correlation of pathological and MR staging is shown in Table 1. The overall accuracy of tumor staging by MR imaging was 82.9% (34 of 41). In differentiation of operable (≤stage IIA) status from the advanced (≥stage IIB) stage of the cervical cancers, MR imaging had an accuracy of 93% (86–100%; 95% confidence interval).

On T2-weighted images, tumors presented as well-demarcated hyperintense masses in 32 patients (Fig. 2) or as an area of hyperintense signal intensity with fluffy border in 7 patients. However, there were two tumors which showed no signal changes on T2-weighted images. Out of 34 tumors > 1 cm in diameter, the tumor sizes of 29 were determined by MR images to be within