Assessment of myometrial invasion and nodes status on T2-weighted images and dynamic-contrast-enhanced magnetic resonance imaging in patients with endometrial cancer

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Purpose

Endometrial cancer (EC) is the fourth most common tumor affecting women in developed countries, with an incidence which is steadily rising because of increasing longevity and escalating levels of obesity. Its prognosis depends on many factors, such as stage, depth of myometrial invasion, cervical stroma and lympho-vascular invasion, nodes status and histological grade (1). Therefore, preoperative information about depth of myometrial invasion and histological grade is essential in the planning of surgical approach of these patients. Magnetic Resonance Imaging (MRI) is a very useful technique in the pre-operative staging of EC; infact it can accurately detect myometrial infiltration, which strongly correlates with tumor grade, nodes involvement and overall patient survival. Together with the histological grade, MRI allows a selections of patients for pelvic and para-aortic nodes dissection, thus obviating the need for radical surgery treatment in patient with low-risk disease (2). In particular, the application of Dynamic Contrast material-Enhanced (DCE) MRI has been shown to improve T2-weighted (T2w) sequences capability in the assessment of the depth of myometrial invasion; however, in literature there is disagreement as far as its role in staging endometrial cancer (3-5). After gadolinium administration, endometrial carcinoma enhances earlier than does normal endometrium, while normal myometrium enhances intensely compared with hypointense endometrial tumors. Therefore, maximum contrast between hyperintense myometrium and hypointense endometrial cancer occurs 50-120 sec after contrast medium administration.(6) The purpose of our study was to compare the diagnostic performance of DCE-MRI sequences with T2 weighted ones in assessing the depth of myometrial invasion by Endometrial Cancer (EC) and lymph-nodes status.
Methods and Materials

Between August 2012 and November 2012 12 patients affected by histologically proved EC were enrolled in our prospective study.

MR examination was performed on a 1.5T scanner (Symphony, Siemens) equipped with high-performing gradients (amplitude 30 mT/m), with patient in supine position; before exam beginning, 20 mg of N-butile-scopolamine were injected i.v. to reduce bowel movements artifacts. Then we started with TSE T2-weighted sequences on multiple planes (FOV: 220x220, slice thickness: 4mm, effective matrix: 384x75, FA: 180°, TR: 4400, TE: 104 both for sagittal and coronal planes; slice thickness: 3mm, effective matrix: 320x75, FA: 180°, FOV: 280x280, TR: 5452, TE: 103 for axial oblique plane), TSE T1-weighted on axial oblique plane, with and without fat saturation; DCE-MR imaging was performed after administration of 0.1 mmol/kg of a gadolinium chelate at a rate of 2mL/sec by using a three-dimensional spoiled gradient-recalled echo (GRE) T1-weighted (T1w) sequence on the axial oblique plane (thickness: 3mm, FOV: 350x87.5mm, TR: 291, TE: 414). Images were acquired prior to contrast medium injection and then during multiple phases (9) of enhancement in axial oblique and sagittal plane (precontrast and post-contrast sequences until 120 seconds after i.v. contrast medium injection in the axial oblique plane, post-contrast sequences at 180 seconds in both the sagittal and the axial oblique planes and a late sequence at 240 seconds in the axial plane).

Tumors were defined as lesions of heterogeneous intermediate signal intensity relative to the hyperintense normal endometrium and mildly hyperintense relative to the normal myometrium on T2-weighted images (figures 1-2); the images obtained at 120 seconds after gadolinium administration were the most accurate in the assessment of the depth of myometrial invasion (figures 3-4); delayed-phase images obtained 3-4 minutes after gadolinium administration were useful in detecting cervical stroma invasion.

The depth of myometrial invasion was calculated both on TSE T2-weighted sequences and on DCE-MRI ones on the axial oblique and the sagittal plane. It was defined as the distance between inner myometrial interface and deepest myometrial invasion point. The myometrial invasion ratio was invasion depth divided by myometrial thickness, defined as <50% vs >50%, according with FIGO new staging. The standard of reference were the histologic results.

Cases with imaging myometrial involvement more or equal than 50% were considered as true positive (TP) and false positive(FP); true negative (TN) and false negative (FN) cases were those with imaging myometrial invasion less than 50%.

Diagnostic performance of both T2W and DCE sequences in the assessment of myometrial invasion were evaluated, considering sensibility, specificity, positive and negative predictive value and diagnostic accuracy for each one, with a significative statistical correlation of p value <0.05.
Fig. 1: Axial oblique T2-WI shows an ill-defined, huge and mild hyperintense lesion (white arrow) inside the endometrial cavity which seems to involve the myometrium greater than 50% of its depth.

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Fig. 2: Dynamic-enhanced, fat suppressed axial-oblique T1-WI of the same patient as in fig.1 shows the minimaly enhancing lesion and depicts better myometrial involvement, which in less than 50%.

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Fig. 3: Sagittal T2-WI shows an other case of endometrial cancer (white arrow) distending the endometrial cavity. The hypointense line of the junctional zone (red arrow) seems to be preserved.

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Fig. 4: Gadolinium-enhanced, fat-suppressed axial oblique T1-WI of another patient shows the heterogeneous and minimaly enhancing mass which is confined within endometrial cavity.

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Results

Among the 12 patients enrolled in our study, two of them were excluded because the histological result was atypical hyperplasia, which is not detectable on MR images. Therefore, 10 women in post-menopausal age were included in our study, with a mean age of 63 yrs (range 50-76). All the patients underwent surgery: in cases hysteroanexsectomy was performed, in 9 cases hysteroanexsectomy with pelvic and lomboaortic nodes dissection was performed; the histological subtypes were endometrioid adenocarcinoma in 8 patients (80%) and clear cell adenocarcinoma in 2 cases (20%). Histological grade was G1 in 7 patients (70%) and G2 in 3 patients (30%). Considering pathological classification, 9 cases were classified as pT1a (90%) and 1 (10%) as pT1b.

Both T2weighted-sequences (T2w) an DCE-MR sequences allowed the identification of lesion in all the cases.

On T2w images, 7 lesions were classified as tumors involving less than 50% of the myometrial thickness and 3 lesions involving more than 50% of the myometrial thickness, with 1 case of FN and 3 cases of FP.

DCE-MRI identified 8 lesions involving less than 50% of myometrium and 2 lesions involving more than 50% of myometrial thickness, with 1 FP case.

Only in one case, both T2w and DCE sequences identified, according with histological results, nodes metastases.

The diagnostic performance of T2w sequence in assessing myometrial involvement was calculated, showing values of sensitivity of 0%, specificity of 67%, PPV of 0% and NPV of 86%.

The corresponding values of DCE were respectively 100%, 89%, 50% and 100%.

The diagnostic accuracy values were respectively 60% and 90%.

In one case of endometrioid adenocarcinoma poorly differentiated, both T2w and DCE sequences overestimated myometrial involvement, and in one case of well differentiated endometrioid adenocarcinoma T2w images were more diagnostic than DWI ones.

Our study has some limits: firstly, the limited sample and then also the presence of multiple leiomyomas within myometrial thickness of at least 4 patients, which are the main responsible of the very low sensitivity of T2w sequences.
Conclusion

MR imaging is very accurate in the assessment of endometrial cancer, delineating its local extent and its involvement of myometrial thickness; our results show that DCE-MR is able to detect myometrial infiltration with a higher accuracy than does T2w sequences.

However, in literature there is some controversy regarding the added value of DCE-MR in staging of EC; the majority of studies have shown a improvement in staging and diagnostic accuracy with DCE-MR (4,7), owing to its better overall resolution, related to motion artifacts which are less pronounced on T1w sequences than on T2w ones, because of the shorter imaging time.

Moreover, there are a lot of conflicting results about the role of MRI in detecting metastatic nodes; in fact reactive nodes have high signal intensity on DCE, which it has been reported both for benign than malignant ones (8).


