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Magnetic Resonance Imaging / Formation image de résonance magnétique

Radiologic and Pathological Correlation of Staging of Rectal Cancer with 3 Tesla Magnetic Resonance Imaging

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Abstract

Purpose: To assess the sensitivity and specificity of 3 Tesla magnetic resonance imaging (MRI) in the prediction of extramural spread and metastatic adenopathy in rectal carcinoma.

Materials and Methods: This was a prospective cohort study that included forty consecutive patients with rectal carcinoma from the Department of Colorectal Surgery. Three Tesla (3T) MRI was performed on these patients after a 4-hour fast and cleansing water enema. T1-weighted and T2-weighted images were obtained with high-resolution images T2-weighted sequences through the pelvis. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 3T MRI for prediction of metastatic adenopathy and extramural spread were calculated. The TNM staging based on MRI was compared with histopathology of the resected specimen (taken as the criterion standard).

Results: In our study, sensitivity, specificity, PPV, and NPV of 3T MRI for prediction of metastatic adenopathy were 100%, 78.3%, 77.3%, and 100%, respectively. Sensitivity, specificity, PPV, and NPV of 3T MRI for prediction of extramural tumour spread were 100% and 20%, 89.7% and 100%, respectively (ie, prediction of stages T3 and above).

Conclusion: MRI allows accurate measurement of the depth of extramural tumour spread. In the assessment of metastatic adenopathy, however, MRI has a low specificity. This study shows that MRI is unlikely to miss any significant parameter in staging of rectal carcinoma. However, it has a tendency to overstage extramural spread of tumour.

Résumé

Objet: L'étude avait pour but d'évaluer la sensibilité et la spécificité de l'imagerie par résonance magnétique (IRM) 3T comme moyen de prédiction de la propagation extramurale et de la présence d'adénopathie métastatique du cancer du rectum.

Matériel et méthodes: Il s'agit d'une étude de cohorte prospective incluant 40 patients consécutifs du service de chirurgie colorectale, qui souffraient de cancer du rectum. Une exploration par IRM 3T a été effectuée sur des patients à jeun depuis quatre heures et qui avaient subi un lavement évacuateur à l'eau. Des images pondérées en T1 et T2 ont été obtenues ainsi que des séquences haute résolution en pondération T2 au niveau du bassin. La sensibilité, la spécificité, la valeur prédictive positive (VPP) et la valeur prédictive négative (VPN) de l'IRM 3T comme méthode prédictive de l'envahissement ganglionnaire et de la propagation extramurale ont été calculées. La stadification TNM évaluée par IRM a été comparée à celle obtenue par histopathologie des spécimens réséqués (considérée comme la référence).

Résultats: La sensibilité, la spécificité, la VPP et la VPN de l'IRM 3T comme méthode de prédiction de l'adénopathie métastatique étaient de 100 %, 78,3 %, 77,3 % et 100 % respectivement. La sensibilité, la spécificité, la VPP et la VPN de l'IRM 3T comme méthode de prédiction de la propagation extramurale des tumeurs étaient de 100 %, 20 %, 89,7 % et 100 % respectivement (prédiction des stadifications T3 et supérieures).

Conclusion: L'IRM permet de mesurer avec exactitude la profondeur de la propagation extramurale. La spécificité de l'IRM s'est toutefois révélée basse pour l'évaluation de l'adénopathie métastatique. Selon l'étude, les risques que l'IRM ne détecte aucun paramètre significatif de la stadification du cancer du rectum sont très faibles. Par contre, on a observé une tendance à la surestimation pour la propagation extramurale des tumeurs.

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Key words: Rectal cancer; 3 Tesla; Magnetic resonance imaging; MRI; Staging

Rectal cancer is a common malignancy that has a variable outcome, with local recurrence after resection that often leads to incurable disease. Prognosis depends largely on the stage of the tumour at the time of clinical presentation. The diagnosis is usually made on the basis of a digital rectal examination, endoscopy, and confirmatory histologic findings. However, these findings do not show the depth of tumour spread or the extent of lymph node involvement, both of which are important prognostic factors. The modern management of rectal cancer is multimodal, with decisions made by a multidisciplinary team before surgery. Management decisions are largely based on preoperative staging by magnetic resonance imaging (MRI), which enables assessment of mural, extramural, and nodal disease, and assessment of the circumferential resection margin.

T1 lesions may be amenable to local excision, whereas T2 and early T3 lesions without nodal disease are amenable to a properly performed excision by the total mesorectal excision (TME) technique [1,2]. Neoadjuvant therapy is unnecessary as long as there is a 2-mm circumferential resection margin on the MRI. Circumferential margin involvement is still an important predictor of local recurrence in rectal carcinoma: not 1 mm but 2 mm is the limit.

T2N1, bulky T3N0, and T3N1 disease require preoperative neoadjuvant therapy. This may be in the form of short-course radiotherapy (RT) to decrease local recurrence or long-course chemoradiotherapy to reduce local recurrence and downstage the tumour.

Therefore, MRI has an undeniable role in the management of rectal cancer. At present, phased-array MRI best fulfills the requirements for preoperative local staging of rectal cancer [3]. However, preoperative detection of the other prognostic factor, nodal status continues to be a problem.

To the best of our knowledge, there are very few studies that used a 3 Tesla (3T) magnet. The purpose of our study was to assess the accuracy of prediction of extramural tumour spread and adenopathy of 3T high-field MRI by using external coils in preoperative staging of rectal cancer and compare it with histopathologic TNM staging.

Material and Methods

Study Design

This was a prospective cohort study.

Study Population

The study population consisted of 40 consecutive consenting patients with biopsy-proven rectal carcinoma referred from the Department of Colorectal Surgery between

July 2006 and July 2007. The study was approved by the institutional review board.

Inclusion criterion:

- Patients with rectal carcinoma located below the sacral promontory.

Exclusion criteria:

- Rectal carcinoma located above the sacral promontory.
- Patients who did not have an operation.
- Patients whose surgical specimens did not have complete pathological data.
- Suboptimal imaging.

Rectal Distension and Use of Contrast

Gadolinium was not used in this study. Water was administered through the rectum for distension and also as a negative contrast agent. The patients were instructed to fast for 4 hours before the examination and then were prepared with a bowel enema to clean the distal part of the colon and rectum. Water was administered by means of a rectal tube, and the rectum was filled until the patient indicated discomfort. No intravenous antiperistaltic agent was administered.

MRI Examination

Coils. Cardiac phased-array external coils.

Sequence protocols. A preliminary pilot study was performed on 5 patients.

Various imaging sequences were performed, before and after administration of gadolinium, which included T1-weighted, T2-weighted, and fat-suppressed images, and the optimum sequences were selected for application in the final study. High-resolution T2-weighted imaging was primarily used in this study. This sequence uses a high-resolution matrix, thin-section (3–5 mm) imaging, and a small field of view. Images were acquired in the axial, coronal, and sagittal planes to depict the length and extent of the tumour in all 3 dimensions. MRI was performed at our institution at 3 Tesla (T) (Achieva; Quasar Dual, Philips Medical Systems, Best, The Netherlands) with 18.0 mT/m, a rise time of 0.16 msec, and a slew rate of 200 mT/m/s. The subjects were positioned supine and in the head-first position.

Sequences used were precontrast T1-weighted 2-dimensional turbo spin echo (656/10 msec; echo train length, 5; section thickness, 8 mm; intersection gap, 0.8 mm; number of signals acquired, 4; matrix, 166 × 256; field of view, 25 cm; and T2-weighted 2-dimensional turbo spin echo high-resolution images (3,427/150; echo train length, 25; section

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