The Value of DWIBS Evaluating the Rectal Carcinoma Involved the Perirectal Space

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Abstract: Objectives: This article is aimed to study the value of the magnetic resonance diffusion weighted imaging with background suppression (MR-DWIBS) evaluating the involvement of the rectal perirectal space by the rectal carcinoma. Materials and Methods: The magnetic resonance images and clinical data of sixty patients with rectal carcinoma were proved by pathologic results retrospectively. The pathologic diagnosis of all the patients was rectal ulcer type and intermediate differentiated adenocarcinoma. All patients underwent pelvic magnetic resonance scanning before the surgical operation. The emphasis of the images analysis was placed on the DWIBS features of the tumors and the features of involvement of the rectal perirectal space. Results: The relative ADC value and relative eADC value were significant different between the groups of perirectal space involvement or perirectal space no involvement in the patients with rectal carcinoma ($p<0.05$). Conclusions: The relative ADC and eADC value of the rectal tumor can be used to assess the biological behavior of rectal carcinoma.

1. Introduction

Colorectal cancer is a common malignant cancer[1], and the Incidence of rectal cancer in chinese population is increasing obviously[2]. As the new technique of the magnetic resonance-diffusion weighted imaging, the diffusion weighted whole body imaging with background body signal suppression (DWIBS) has been thought to have great value in the diagnosis of tumor, and which is helpful for the diagnosis and treatment of preoperative staging of rectal cancer[3-5]. To our knowledge, few studies explore the DWIBS features of the rectal perirectal space involvement by the rectal carcinoma[6-8].The goal of this retrospective study was to evaluate the value of the magnetic resonance diffusion weighted imaging with background suppression (MR-DWIBS). In order to finish this goal, MR-DWIBS evaluate the involvement of the rectal perirectal space by the rectal carcinoma. The method is measure the relative exponential apparent diffusion coefficient (eADC) value and relative apparent diffusion coefficient (ADC) value of the tumor.

2. Materials and methods

2.1. Subjects

Between September 2012 and August 2014, sixty patients with rectal moderately differentiated ulcer-type adenocarcinoma underwent MR examination prior to surgical operation. All the patients were confirmed by operation and pathology. And all the patients had not received prior treatment for rectal cancer. Protocols and informed consent provisions were reviewed and approved by the Institutional Review Board of the Affiliated Hospital of Weifang Medical University. The patient (There are 38 males and 22 females.) ages ranged from 34 to 89 years old (60.6±12.0 years). The interval between MR examination and surgical operation ranges from 7 to 14 days.

Among the sixty patients, the perirectal space (PRS) invaded by the tumor was detected in 21

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patients, and the tumor invade the r ectal wall without PRS invasion was detected in 39 patients based on the pathologic results. The pathologic results showed lymph nodes metastasis in 34 cases. Distant metastasis has not been detected in all patients.

2.2. MRI

1.5T MRI scanner (Philips, Achieva Nova Dual, Holland) and pelvic phased-array multicoil were used to perform the MR examinations. All patients were scanned in supine position with both feet first. Specified inspection protocol includes axial T1WI (TR=400 ms, TE=14 ms, matrix size 288×448, slice thickness / slice gap = 4mm / 1mm, field of view = 35cm×35cm, 3 excitations), axial T2-SPAIR (TR=3500 ms, TE=65 ms, matrix size 224×256, slice thickness / slice gap = 4mm / 1mm, field of view = 35cm×35cm, 3 excitations), and DWIBS (TR=1400 ms, TE=65 ms, TI=180ms, matrix size 128×176, slice thickness / slice gap = 5mm / 0mm, field of view = 40cm×40cm, 6 excitations, b-values 0 and 800s/mm^2), which was showed in the axial plane at the same place. The ADC and eADC maps were automatically generated using the operating system. The ADC values were measured from two DWIBS images acquired at b-values of 0 and 800 s/mm^2.

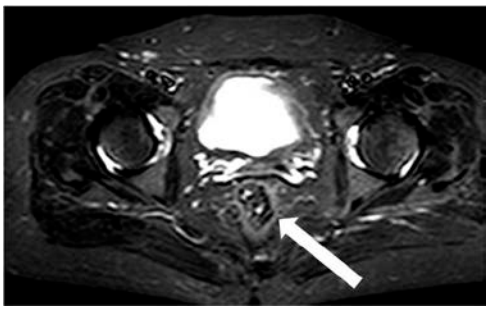
The regions of interest (ROIs) were drawn by a radiologist regarding the pathologic results. The ROIs were placed manually within the tumor and endeavour to cover the solid part of the tumor based on the anatomical T2-SPAIR images. Three ROIs with oval shape were placed manually within the normal obturator internus muscle of each patient.

Relative ADC value and eADC value were calculated (ADC value of the tumor / ADC value of the obturator internus muscle, relative ADC value of the tumor / relative ADC value of the obturator internus muscle).

2.3. Statistical Analysis

We used SPSS v. 11.5 (Chicago, IL) obtained the statistical analyses. An independent-sample t-test was used to evaluate the difference of the relative ADC value and eADC value were calculated in different groups. A p value less than 0.05 was considered statistically significant.

2.4. Figures



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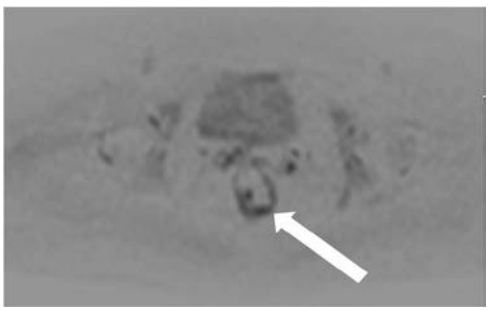
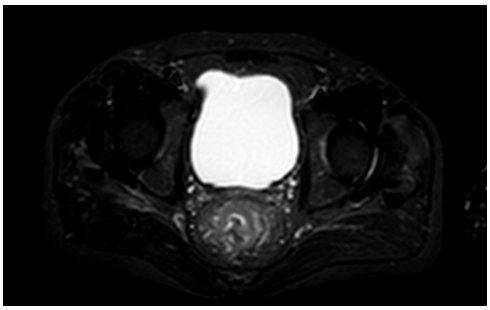


B

Figure 1. A 63-year-old female with rectal ulcer type intermediate differentiated adenocarcinoma without perirectal space involvement. A: axial T2-SPAIR image. The mass is slight hyperintensity without perirectal space involvement (arrow). B: DWIBS image (inverted black-and-white gray scale). The mass shows abnormal signal intensity (arrow).



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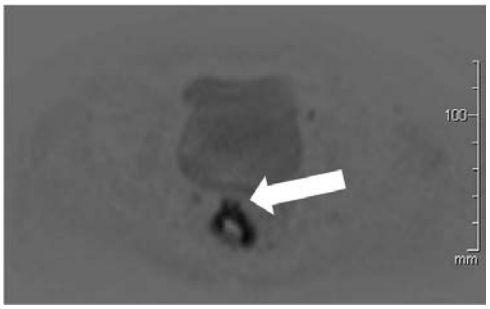

B

Figure 2. A 59-year-old man with rectal ulcer type intermediate differentiated adenocarcinoma invading the perirectal space. A: axial T2-SPAIR image. The mass is slight hyperintensity invading into the perirectal fat tissues. B: DWIBS image (inverted black-and-white gray scale). The mass shows abnormal signal intensity (arrow).

3. Results

MR examination were finished include all patients. The RCa displayed iso-intensity or slight hypointensity on T1WI and iso-intensity or slight hyperintensity on T2-SPAIR images (Figure 1, 2). On the DWIBS images (b=800s/mm^2), the RCa showed high signal. The lesion showed abnormal signal intensity on DWIBS images (inverted black-and-white gray scale) (Figure 1, 2).

The relative ADC value and relative eADC value were 0.96±0.30 and 1.14±0.38 in the male group. The relative ADC value and relative eADC value were 0.92±0.32 and 1.16±0.28 in the female group.

The relative ADC value and relative eADC value were not significant different between the male groups and female groups (t=-0.496, 0.170, p>0.05).

The relative ADC value and relative eADC value were 0.83±0.21 and 1.27±0.35 in the groups of perirectal space involvement. The relative ADC value and relative eADC value were 1.01±0.33 and 1.09±0.33 in the groups of without perirectal space involvement.

The relative ADC value and relative eADC value were significant different between the groups of perirectal space involvement or without perirectal space involvement in the patients with rectal carcinoma (t=-2.641, 2.015, p<0.05).

4. Discussion

DWI is helpful for the characterization of the tumor by measuring the water diffusion characteristics. The water diffusion characteristics are rest with many factors, for example, extracellular space or density of cell, extracellular fluid viscosity, vascularity and cell membrane integrity[9]. Based on the measurement of the apparent diffusion coefficient (ADC) value, which is influenced by the extracellular space or density of cell, extracellular fluid viscosity, vascularity and cell membrane integrity[10-11]. As the new technique of the DWI, DWIBS play an important role in the presurgical assessment of rectal cancer and show intuitive images[6].

The apparent diffusion coefficient (ADC) value of the tumor tissue was related to the

extracellular space or cell density, viscosity of extracellular fluid, vascularity and integrity of cell membrane. Because of the high density of tumor cells, the relative space of cells increases and the extracellular space decreases, the tumor tissue has lower ADC value, which reduces the ADC value[12-13].

It has been reported that the ADC value was influenced by many factors, such as scanning equipment, the size of b value, the individual difference of the examinee and so on[14-15]. The difference of ADC values of the tumor tissues may be caused by the type and differentiation of tumors[16]. Cerfolio, et al reported that[17], for the Positron Emission Computed Tomography examination of the lung cancer, a ratio of one maximum standardized uptake value divided by another can negate the inherent differences of different maximum standardized uptake value and standardize the values. In order to reduce the influence of tumor type and scanning environment to measure the ADC values, make sure the pathologic result of all patients was rectal moderately differentiated ulcer-type adenocarcinoma, and all the patients underwent the examination by using the same magnetic scanner. In order to standardize the ADC values and reduce the measurement variation, we calculated the rADC values of RCa (the ADC and eADC value of the tumor was divided by ADC value of normal obturator internus muscle of the same patient).

The rectal fascia exist in the adipose tissue outside the rectum. The rectal extraperitoneal space is divided into the perirectal space and pararectal space based on the rectal fascia. The perirectal space is the space between the wall of the rectum below the rectal peritoneal reflection and rectal fascia[18].It has been reported that the total mesorectal excision is the main surgical procedure for the patients with rectal carcinoma[19]. Preoperative identification of the invasion of the perirectal space (mesorectum) and rectal fascia by the tumor tissue has important clinical significance.

Rectal cancer showed more invasiveness of tumors in the perirectal space involvement than that without the perirectal space involvement[8], and metastatic lymph nodes showed increased signal intensity on the DWI images[20]. In this study, because water molecules diffusion of rectal cancer tissues is limited, the tumor showed high signal on the DWIBS images.The relative ADC value of the rectal carcinoma with perirectal space involvement was lower than that without perirectal space involvement, and relative eADC value of the rectal carcinoma with perirectal space involvement was higher than that without perirectal space involvement. These results showed that the relative ADC and eADC value combined with conventional MRI features can be used to assess perirectal space involvement or not by the rectal tumor.

In this study, in the group of perirectal space involvement, the relative ADC value and relative eADC value were significant different between the groups of perirectal space involvement or perirectal space no involvement in the patients with rectal carcinoma. The reasons may be: the tumor tissues had higher cell density and enlargement of cell atypia in the rectal carcinoma with perirectal space involvement, which limited diffusion of water molecules in rectal cancer tissues, reduced the relative ADC value and enlarged the relative eADC value.

In a word, DWIBS combined with conventional MRI features has important clinical significance to identify the staging of rectal cancer, also the measurement of the relative ADC value and relative eADC value have great meaningful to indicate the invasiveness of rectal cancer.

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