T2-Weighted MRI of Rectosigmoid Carcinoma: Comparison of Respiratory-Triggered Fast Spin-Echo, Breath-Hold Fast-Recovery Fast Spin-Echo, and Breath-Hold Single-Shot Fast Spin-Echo Sequences

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Introduction

T2-weighted MRI plays an important role in the diagnosis of rectosigmoid carcinoma. Motion artifacts caused by respiration and peristalsis are problematic for imaging of rectosigmoid diseases. To reduce the respiratory motion artifacts, respiratory-triggered fast spin-echo sequence can be used. On the other hand, breath-hold T2-weighted images with fast-recovery fast spin-echo and single-shot fast spin-echo sequences also can be utilized. The purpose of our prospective study were to evaluate the abilities of T2-weighted images using respiratory-triggered fast spin-echo (RTFSE), breath-hold fast-recovery fast spin-echo (BHFRFSE), and breath-hold single-shot fast spin-echo (BHSSFSE) sequences in the detection of rectosigmoid carcinomas and to compare three types of T2-weighted images.

Materials and methods

39 patients (29 men and 10 women, aged 44-89 years, mean age 62.1) were included in this study, who underwent pelvic MRI for the evaluation of susopicious rectosigmoid carcinoma before surgery. All lesions were histologically confirmed. In 24 patients, lesions penetrated through the rectal wall (T3-T4). All MR examinations were performed on a 1.5T superconducting magnet (Horizon LX Echospeed; GE Medical Systems, Milwaukee, WI) with a pelvic phased-array coil. An antiperistaltic drug (7.5 mg of timepidium bromide; SESDEN; Tanabe Seiyaku Co., Ltd., Osaka, Japan) was administered to 24 patients who were younger than 70 years old and who had no contraindications. All patients were studied in the prone position with per anal injection of 400-600 ml of air. Three T2-weighted images with 5 mm thickness were obtained in the identical plane. Utilized imaging parameters were as follows: 1) RTFSE: TR = 4000-7000 msec, effective TE (eTE) = 85 msec, echo train length (ETL) = 16, receiver band width (RBW) = 62.5 kHz, matrix = 256×256, field of view (FOV) = 20×20-24×24 cm, number of excitations (NEX) = 2, respiratory trigger point = 20-30%; 2) BHFRFSE: TR = 2000 msec, eTE = 85 msec, ETL = 17, RBW = 31.2 kHz, matrix = 256×160, FOV = 20×20-24×24 cm, NEX = 1; 3) BHSSFSE: TR = ∞, eTE = 96 msec, RBW = 62.5 kHz, matrix = 256×192, FOV = 20×18-24×24 cm, NEX = 0.5.

Qualitative evaluations were performed without awareness of patient's history, clinical or other radiological findings. Motion artifact, blurring, depiction of muscularis propria, tumor recognition, and overall quality were graded using a five-point scale (one; unacceptable, two; severe or poor, three; moderate or fair, four; mild or good, five; absent or excellent). Existence or absence of penetration through the rectal wall by the tumor was also evaluated, and then sensitivities, specificities, and accuracies were calculated.

Quantitatively, the mean signal intensities (SIs) of tumor, skeletal muscle, and fat were measured. Tumor-to-muscle contrast (| SI of the tumor - SI of the skeletal muscle | / SI of the skeletal muscle) and tumor-to-fat contrast (| SI of the tumor - SI of the fat | / SI of the fat) were calculated.

Results

Motion artifact was most prominent with RTFSE and the least with BHSSFSE among three sequences (Table 1). In 8 patients, poor image quality caused by motion artifact (graded as moderate or severe on five-point scale) with RTFSE sequence was noted. Blurring effects were more severe with BHSSFSE sequence than with the other two sequences (Table 1). Scores for depiction of muscularis propria, tumor recognition and overall quality were the highest with BHFRFSE among three sequences.

The accuracy for detecting the penetration through the rectal wall by the tumor was the highest with BHFRFSE sequence (Table 2).

The results of quantitative evaluations are summarized in Table 3. With BHFRFSE sequence, tumor-to-muscle contrast was the lowest while tumor-to-fat contrast was the highest. RTFSE and BHSSFSE sequences were equivalent regarding tumor-to-muscle contrast and tumor-to-fat contrast.

Summary

BHFRFSE sequence might be useful in the depiction of rectosigmoid carcinomas and the evaluation of local invasion because of its less motion artifacts and better depiction of muscularis propria than with the other two sequences. RTFSE sequence is potentially a useful method for patients who can breathe regullary. For the patients who cannot hold their breath stably, BHSSFSE sequence can be utilized.

Table 1. Scores of Artifacts and Image Quality with Three MR Pulse Sequences (mean±standard deviation)

	RTFSE	BHFRFSE	BHSSFSE
Motion artifact	4.10±0.97	4.64±0.63	4.97±0.16
Blurring	3.87±0.86	4.21±0.80	3.13±0.62
Depiction of muscularis propria	2.33±0.98	2.77±0.78	2.03±0.71
Tumor recognition	3.95±1.05	4.46±0.79	3.95±0.86
Overall quality	4.08±0.90	4.49±0.68	4.26±0.64

Table 2. Evaluation of Penetration through the Rectal Wall with Three MR Pulse Sequences

	RTFSE	BHFRFSE	BHSSFSE
Sensitivity	0.75	0.83	0.83
Specificity	0.53	0.67	0.53
Accuracy	0.67	0.77	0.72

Table 3. Quantitative Evaluations with Three MR Pulse Sequences (mean±standard deviation)

	RTFSE	BHFRFSE	BHSSFSE
Tumor-to-muscle contrast	0.45±0.63	0.35±0.53	0.46±0.50
Tumor-to-fat contrast	0.48±0.13	0.58±0.08	0.51±0.13