Diffusion-weighted MR Imaging for the Diagnosis of Intra-abdominal or Anal Fistula

M. Hori[1], A. Oto[1], S. Orrin[1], K. Suzuki[1], and R. L. Baron[1]
[1]Department of Radiology, The University of Chicago, Chicago, IL, United States

INTRODUCTION:

An intra-abdominal or anal fistula is a condition which extends from a diseased intestinal segment to another organ or to the skin. The major cause of these fistulae is Crohn's disease, and other causes including colonic diverticulitis, radiotherapy and surgery for pelvic malignancies. Magnetic resonance (MR) imaging is increasingly thought to be an accurate and non-invasive imaging technique for the diagnosis of intra-abdominal or anal fistula [1,2]. Investigators have used MR techniques such as T1-weighted sequences with and/or without intravenous gadolinium (Gd) administration, T2-weighted sequences, and short tau inversion recovery (STIR) sequences.

Diffusion-weighted MR imaging is possible by analyzing the spin dephasing and signal loss caused by random motion along magnetic field gradients. Because inflammatory tissues can usually be seen as marked high signal areas on diffusion-weighted MR images, it could be a good sequence for the diagnosis of anal fistulae. To the best of our knowledge, no reports have shown the value of diffusion-weighted MR imaging in the diagnosis of anal fistula. The purpose of this study was to determine whether the additional use of diffusion-weighted MR imaging improves detection of anal or abdominal fistulae and to compare it with Gd-enhanced MR imaging.

METHODS:

Fifteen patients (8 men, 7 women; mean age 39.1; range, 20-79 years), who underwent MR imaging including T2-weighted, diffusion-weighted, and Gd-enhanced T1-weighted imaging, constituted our study population. Twelve of the 15 patients had Crohn's disease, one patient had diabetes, one patient had colonic diverticulitis, and one patient had no known other disease. MR imaging was performed using a 1.5-T superconducting MR system and 8-channel phased-array body multi-coil. No bowel preparation was performed. The MR imaging protocol consisted of T2-weighted fast spin-echo (FSE) with fat suppression sequence; diffusion-weighted single-shot echo-planar sequence (TR / TE; 3000-10000/70-80, b factors 0 and 800 s/mm2, 128 x 128 matrix, 4 signals acquired, section thickness 5 mm, and section interval 7 mm); and T1-weighted 3D gradient echo with fat suppression sequence before and after i.v. Gd administration. All images were obtained in a transaxial plane. For T2-weighted imaging, coronal and sagittal images were also obtained.

Two experienced radiologists reviewed MR images, blinded to each patient's clinical history. The radiologists initially evaluated only fat-suppressed T2-weighted images. This was followed by an evaluation of the T2-weighted images combined with either diffusion weighted images (group 1, 7patients) or Gd enhanced T1 images (group 2, 8 patients). Two weeks later radiologists reviewed group 1 T2-weighted images combined with Gd-enhanced T1 images and group 2 T2 images with diffusion weighted images. In each evaluation session, the radiologists reviewed images of each patient, recording the location of possible fistulae by consensus on an evaluation sheet on which cross-sectional drawings of body were printed. Each possible fistula was scored by consensus in terms of the presence of fistulae using a four-point scale: 1, probably not a fistula; 2, a possible fistula; 3, a probable fistula; and 4, a definite fistula. If a fistula was not detected, a score of 0 was allocated.

After completing the two reviewing sessions, the two evaluating radiologists and another radiologist reviewed all the images and clinical records together for each patient. Locations of fistulae were determined by consensus among the three radiologists based on MR images, clinical records, and surgical records. These locations of fistulae were used as reference standards. Twenty-four intra-abdominal or anal fistulae were identified in the 15 patients. Eighteen anal fistulae in 12 patients, three ceco-sigmoid fistulae in one patient, two small bowel-skin fistulae in one patient, one vagina-sigmoid fistula in one patient were characterized. The sensitivity in detecting fistulae was calculated by the confidence scores of fistulae using the above reference standard, and considering the confidence rating of 3 or 4 as positive diagnosis.

RESULTS:

All fistulae appeared hyperintense on diffusion-weighted images (Fig. 1). Of the 24 fistulae, 20 (83%) were detected on T2-weighted images, and 23 (96%) and 23 (96%) were detected on diffusion-weighted images and T2-weighted images combined and on Gd-enhanced T1-weighted images and T2-weighted images combined, respectively. There were no statistically significant differences in sensitivity among the three techniques ($p > .25$, McNemar's test). The confidence scores of the radiologists in predicting presence of abdominal or anal fistulae are given in Table 1. Confidence scores with diffusion-weighted images and T2-weighted images combined or those with Gd-enhanced T1-weighted images and T2-weighted images combined were significantly greater than those with T2-weighted images alone (p=.0013 and .0084, respectively). There was no significant difference in confidence scores between diffusion-weighted images and T2-weighted images combined and Gd-enhanced T1-weighted images and T2-weighted images combined (p=.53).

TABLE 1: Results of confidence scores for 24 fistulae in 15 patients

Score	T2w	DW+T2w *	CE+T2w †
4	10 (41.7)	18 (75.0)	16 (66.7)
3	10 (41.7)	4 (16.7)	7 (29.2)
2	2 (8.3)	1 (4.2)	1 (4.2)
1	0 (0.0)	0 (0.0)	0 (0.0)
0	2 (8.3)	1 (4.2)	0 (0.0)

Note. − Data in parentheses are percentages.
* Score was significantly greater than that with T2w images (p=.0013).
† Score was significantly greater than that with T2w images (p=.0084).

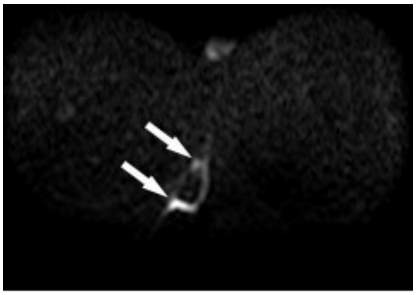

Figure 1. Axial difussion-weighted MR image clearly shows an analnal fistula as marked hyper intensity area (arrows).

DISCUSSION:

Diffusion-weighted MR imaging shows high signal contrast between tumorous or inflammatory tissues and surrounding structures. The fistulae appear hyperintense whereas the background signal is significantly suppressed on diffusion-weighted images. This is an advantage of the technique in diagnosing fistula. Diffusion-weighted imaging was successful in depicting fistulae and provides added value to fat-suppressed T2-weighted imaging by increasing the confidence level of radiologists. With recent concerns over the safety of MR contrast agents in certain populations, these data suggest that diffusion weighted imaging may be equally effective for diagnosing abdominal/anal fistulae.

REFERENCES:

1. Schmidt S, et al. Diagnostic performance of MRI for detection of intestinal fistulas in patients with complicated inflammatory bowel conditions. *Eur Radiol.* 2007;17:2957-2963.
2. Halligan S, Stoker J. Imaging of fistula in ano. *Radiology* 2006;239:18-33.