Original article / Gastrointestinal imaging

Added value of diffusion-weighted magnetic resonance imaging for the diagnosis of perianal fistula


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Keywords
Magnetic resonance imaging; Diffusion-weighted MR imaging; Perianal fistula; Perineum

Abstract
Purpose: To evaluate the added value of diffusion-weighted (DWI) magnetic resonance imaging (MRI) by comparison with T2-weighted images alone in the diagnosis of perianal fistula.

Material and methods: MRI examinations of 123 patients (97 men, 26 women; mean age, 41.9 years) with suspected perianal fistula were retrospectively evaluated by two radiologists. Fat-suppressed T2-weighted fast spin echo images, DWI (b values, 0 and 1000 s/mm²) and fat-suppressed gadolinium chelate-enhanced T1-weighted images were evaluated for each patient by using a four-point scale. Confidence scores and sensitivities were calculated for T2-weighted images alone, the combination of DWI and T2-weighted images and the combination of gadolinium chelate-enhanced T1-weighted images and T2-weighted images. The combination of gadolinium chelate-enhanced and T2-weighted images was used as reference standard.

Results: Perianal fistulas were present in 92/123 patients (74.8%). An almost perfect interobserver agreement was found for T2-weighted images (kappa = 0.868), the combination of gadolinium chelate-enhanced T1-weighted images and T2-weighted images (kappa = 0.96) and the combination of DWI and T2-weighted images (kappa = 0.90). The confidence scores for the diagnosis of perianal fistula for the combination of gadolinium chelate-enhanced T1-weighted images and T2-weighted images were greater than those of T2-weighted images alone for observer 1 (P < 0.001) and observer 2 (P = 0.009). The confidence scores for the combination of DWI and T2-weighted images were greater than those of T2-weighted images alone for observer 1 (P < 0.001) and observer 2 (P = 0.032). Sensitivity and specificity of the combination of DWI and T2-weighted images were greater than those of T2-weighted images alone for both observers.

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http://dx.doi.org/10.1016/j.diii.2016.11.002
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Please cite this article in press as: Cavusoglu M., et al. Added value of diffusion-weighted magnetic resonance imaging for the diagnosis of perianal fistula. Diagnostic and Interventional Imaging (2016), http://dx.doi.org/10.1016/j.diii.2016.11.002
Perianal fistula is a form of anorectal disease encountered in one out of 10,000 persons in the general population, with a high morbidity rate. The most common symptoms are discharge and local pain. Cryptoglandular infections, Crohn disease, radiotherapy and secondary malignancies are the most common underlying causes [1]. Although anorectal fistula can easily be treated surgically, the rate of secondary recurrence is high with foci of infection overlooked during the operation [2]. The fundamental objective of surgery is to eliminate all foci of infection associated with the fistula and the fistula tract, while maintaining functions of the anal sphincter. For successful surgical results, it is essential to visualize extension of the fistula tract and its relationships with the anal sphincter. Currently, magnetic resonance imaging (MRI) remains the standard imaging technique for preoperative evaluation and to investigate postoperative recurrence of perianal fistula [3–7]. MRI allows assessing fistula tract, abscess formations, and secondary tracts, and the relationships of fistula tract with the levator plate and the ischiorectal fossa are adequately visualized. MRI is known to be superior to the other modalities in the visualization of infected tracts and abscesses. The application of preoperative MRI greatly reduces the postoperative recurrence rate, and it is known to be especially important in recurrent and complex diseases [2,8,9].

The diagnosis of perianal fistula with MRI is routinely made with T1-weighted sequences and fat-suppressed T2-weighted turbo spin echo (TSE) or fast spin echo (FSE) [2,10,11]. Gadolinium chelate-enhanced imaging has been included in the MRI fistula protocol because of an improved visualization of abscess and distinction between active disease and fibrous tracts [12]. However, the use of gadolinium chelate has certain disadvantages [13,14]. Therefore, diffusion-weighted imaging (DWI) has gained importance in the diagnosis of perianal fistula.

DWI is a functional imaging technique that provides information about water mobility, tissue cellularity and the integrity of the cellular membranes [15]. DWI provides excellent contrast between lesions such as cancer or inflammatory foci, and the surrounding tissue. DWI is mainly used for detecting and characterizing tumors in body imaging. Recent studies have evaluated DWI in the detection of perianal fistula and their complications [10,16–18]. DWI can easily be included in routine MRI of perianal fistula due to the lack of a need for contrast agent, the shorter sequence period, and also lack of a need for additional equipment. Hori et al. reported the potential utility of DWI for the detection of perianal fistula [17]. Recently, Yoshizako et al. reported that DWI with apparent diffusion coefficient (ADC) measurements may be useful for evaluating perianal fistula activity [18]. Studies with larger study population, which provides a detailed examination of fistulas are necessary to confirm these preliminary results.

The goal of this study was to evaluate the added value of DWI by comparison with T2-weighted images alone in the diagnosis of perianal fistula using the combination of gadolinium chelate-enhanced and T2-weighted images as the standard of reference.

**Material and methods**

**Patients**

This was a retrospective study and a waiver was obtained from the institutional review board, so no informed consent was obtained. We reviewed our archives between May 2015 and January 2016, and identified a total of 126 patients suspected of having perianal fistula. Three of these patients were excluded from the study, since they did not receive intravenous gadolinium chelate. The remaining 123 patients who were included in the study underwent MRI examination including T2-weighted, gadolinium chelate-enhanced T1-weighted and DWI sequences. There were 97 men and 26 women with a mean age of 41.9 years ± 14.33 (SD) (range: 17–79 years).

**MRI acquisition**

All examinations were performed on a 1.5T superconducting MRI system (Excite®, General Electric Healthcare, Milwaukee, Wisconsin, USA). Fat-suppressed T2-weighted FSE sequence (TR: 4900 ms; TE: 89 ms; matrix size: 320 × 320; FOV: 30 cm; section thickness: 5 mm; section interval: 1 mm; number of excitations: 2), three-dimensional (3D) T1-weighted sequence (3D TI-SPACE®) (TR: 600 ms; TE: 6 ms; matrix size: 320 × 224; FOV: 30 cm, section thickness: 5 mm; section interval: 1 mm; NEX: 2) before and 70 seconds after intravenous administration of a gadolinium chelate at a dose of 0.1 mmol/kg of body weight (gadodiamide, Omniscan®, GE Healthcare, Carriagotihol Co. Cork, Ireland) and DWI sequence (TR: 5000 ms; TE: 70 ms, matrix: 128 × 128, FOV: 34 cmms, section thickness: 5 mm, section interval: 1 mm, NEX: 6) were obtained in all patients. DWI was obtained using an echo planar single shot spin echo sequence with b values of 0 and 1000 s/mm². Diffusion gradients were applied in three orthogonal directions to generate three sets of diffusion-weighted imaging (x, y, z axes). ADC values were calculated automatically using a monoexponential fitting algorithm. All images were obtained in the transverse plane. Coronal and sagittal images were also obtained for fat-suppressed T2-weighted FSE and fat-suppressed gadolinium chelate-enhanced T1-weighted images.

**Image analysis**

MR images of each patient were retrospectively evaluated independently by two radiologists experienced in abdominal MRI. The radiologists were informed that the patients were suspected of having perianal fistula. MRI examinations

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Conclusions: DWI has a significant added value compared to T2-weighted imaging alone in the diagnosis of perianal fistula.

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