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Original Research Article

A Prospective Assessment of the Role of Diffusion-Weighted MRI in the Evaluation of Perianal Fistulae

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Abstract

Aim: The present study was conducted to evaluate the role of diffusion-weighted MRI in the evaluation of perianal fistulae.

Methods: This prospective study was conducted in the Department of Radiology, IGIMS, Patna, Bihar, India and included 40 patients with a total of 50 cryptogenic perianal fistulas and abscesses. These patients presented to the surgery clinic during the time period of one year. These patients were then referred for MRI evaluation if a perianal fistula was suspected.

Results: The study included 40 patients, 33 were males and 7 were females. Mean age was 36 ± 8.8 years old with a range of 24–60 years of age. The total number of cryptogenic perianal fistulas and abscess was 50. These included 40 fistulas and 10 abscesses. Eight patients had more than 1 fistula or fistula and abscess. The sites of these fistulas/abscesses were inter-sphincteric (n = 30, 60 %), trans-sphincteric (n = 10, 20 %), and extra-sphincteric (n = 10, 20 %).

Conclusion: DWI alone is not superior to the T2W regarding the visibility of perianal fistula in our study. However, the best performance was observed for combined DWI-T2W image evaluation, although it was not statistically significant than DWI or T2W alone.

Keywords: Anal fistula, Perianal glands, Diffusion-weighted MRI, Diffusion MRI

Introduction

Fistula-in-ano is an inflammatory disorder of anorectal region characterized by a tract between the anal canal and the perianal skin. [1,2] Fistula-in-ano is usually a sequela of a poorly managed perianal abscess. This condition can also be associated with tuberculosis, cancer, and radiotherapy, etc. [2,3] Fistula-in-ano is the second most common anorectal disease after haemorrhoids. [2] Surgery is considered the treatment of choice aiming to avoid recurrence and preserve anal sphincter function. The risk of recurrence increases to 25% if surgeons fail to recognise and remove radically a fistula and its associated elements during corrective surgery, especially internal

openings and secondary tracts. [1,4-6] Accordingly, a precise and comprehensive preoperative assessment of fistula tract is a pivotal diagnostic strategy and contributes significantly to the success rate of surgery. Most of these fistulas occur due to idiopathic inflammation of the cryptogenic glands in the anal mucosa. Less common causes include Crohn's disease, child birth-related trauma, or radiotherapy. The advent of MRI has offered a major help to these patients as it allowed the direct visualization of the fistulous tract, its site in relation to the anal sphincters, and the extent of the fistula—and its abscess—in relation to the anal sphincters and levatorani muscle.

Diffusion-weighted imaging (DWI) has been studied by several researchers to evaluate whether it adds any value to other MRI sequences in the evaluation of perianal inflammation. Some authors have suggested that DWI is more sensitive than T2W sequence regarding the visibility of the fistula. [7] Others suggested that restricted diffusion indicated activity of the fistula, and some even suggested that it represents a good alternative for post-contrast imaging in case gadolinium cannot be used. [8,9]

Diffusion-weighted imaging (DWI) provides good contrast between the acute inflammatory process and adjacent normal-appearing tissues. [10] Various recent literatures showed good sensitivity and specificity of DWI for detection of perianal fistula, assessment of fistulas activity, and its complicating abscesses. [7.10,11]

DWI with higher b-value provides better contrast, more tissue diffusibility, and less T2 shine-through effect. Increasing b-value in DWI is associated with decreased apparent diffusion coefficient (ADC) value, reduction of T2 shine-through effect in perianal fistula and/or associated abscess. Higher b-value DWI images provide more conspicuity of the perianal fistula or associated abscess from the surrounding structures. [12]

The present study was conducted to evaluate the role of diffusion-weighted MRI in the evaluation of perianal fistulae.

Methods

This prospective study was conducted in the Department of Radiology, IGIMS, Patna, Bihar, India and included 40 patients with a total of 50 cryptogenic perianal fistulas and abscesses. These patients presented to the surgery clinic during the time period of one year. These patients were then referred for MRI evaluation if a perianal fistula was suspected.

Inclusion criteria: Any patient with suspected perianal fistula or abscess, eGFR ≥ 60 ml/min/ 1.73m2, and no contra-indication to IV gadolinium contrast or to MRI.

Exclusion criteria: Patients with other types or perianal fistulas, any contra-indication to gadolinium contrast or MRI

The decision of surgery was based solely on clinical and laboratory evaluation, which included the following criteria: severe pain or restriction of daily activity, restriction of sexual activity, reddish edematous skin, pus discharge, and increased serum C-reactive protein (CRP) levels (> 5 mg/L). Fistulas which were confirmed to show pus at surgery were considered to be active, whereas fistulas which did not reveal pus, did not require surgery, or were associated with normal CRP levels were considered non-active. Patients were classified according to the activity of fistulas into Positive Inflammatory Activity (PIA) and Negative Inflammatory Activity (NIA) groups. [10,13]

MR imaging

All patients were imaged on a 1.5-T Philips Achieva machine (Philips Healthcare, Best, the Netherlands). The body coil (dStream Torso coil) was used.

Imaging sequences included T1W, T2W, fat suppressed T1W and T2W, STIR as well as post-contrast T1W sequences in 3 orthogonal planes. The axial plane was used for evaluation.

DWI was added to the study with the following criteria: axial, TR/TE = 6400/100 ms; slice thickness = 5 mm; interslice gap = 0.5 mm; number of slices = 24; matrix size = 188 × 192, with reconstruction to 256 × 256; FOV = 385mm × 385 mm; NEX = 4; and b values of 100, 300, and 600 s/mm2. For the T2W sequence, the acquisition parameters were as follows: axial, TR/TE =

3840/90 ms; slice thickness = 5 mm; interslice gap = 0.6 mm; matrix size = 320 × 220; and FOV = 380 × 240 mm. For post-contrast fat suppressed T1W-SPIR, the acquisition parameters were as follows: Axial, TR/TE = 570/8 ms; slice thickness = 5 mm; interslice gap = 0.6 mm; matrix size = 320 × 220; FOV = 380 × 385 mm.

Image analysis

The perianal fistula was evaluated on T2W, DWI and post-contrast fat-suppressed T1W sequences as per its visualization and extent. Both authors (LM, 16 years of experience: NO, 26 years of experience) evaluated all patients in consensus. T2W and DWI images were evaluated separately 2 weeks apart; then, both sequences were simultaneously evaluated after 2 more weeks, to avoid recall bias. Only the DWI images with b value of 600 s/ mm2 were used for visibility comparison. The visibility of fistulas was graded on a 3-point scale from 0 to 2, as follows: 0 = no evident fistula, 1 = probably fistula, and 2 = distinct fistula. Scores of 1 and 2 were indicative of fistula presence (Fig. 1) [4]. ADC values were recorded from the corresponding ADC maps. A small ROI was placed within the area of abnormality—on the slice where it is best visualized—and the minimum ADC value was recorded. To evaluate the performance of DWI in grading the perianal inflammation, the extent of the perianal fistula/ abscess was determined on DWI, combined T2W and DWI and combined T2W and post-contrast images, separately. [14] The fistula was then graded according to St. James's University Hospital classification using each of the DWI, combined T2W and DWI, and combined T2W and post-contrast images, separately. [15,16] The combined T2W and post-contrast images were used as the reference for grading the perianal fistula/abscess. [17] In cases of perianal abscess with non-visualization of the related fistula, the same steps were followed; minimum ADC value was recorded from the abscess core, and the grade was determined using DWI, combined T2W and DWI, and combined T2W and post-contrast images.

Statistical analysis

Statistical analyses were performed using SPSS software (version 21.0; SPSS Inc., Chicago, IL, USA). Numerical data, e.g., age and ADC value, is represented as mean ± standard deviation, while non-parametric data is represented as percentage. The visibility scores on each of the DWI and the T2W images were compared to those on the combined T2W and DWI image evaluation using chi-square test. The same visibility scores (DWI images alone, T2W images alone, and combined T2W and DWI image evaluation) were compared between PIA and NIA groups, also using chi-square test. All perianal abscesses belonged to the PIA group and were well visualized on both sequences, so they were excluded from the 2 later analyses. Independent sample T test was used to compare between ADC values of perianal fistulas between PIA and NIA groups. Perianal abscesses were also excluded from this analysis because they all belonged to the PIA group. ADC values were correlated to the CRP level and leucocytic count using Pearson's bivariate correlation test. Finally, the grading of the perianal fistula/abscess (St. James's

University Hospital grading system) on DWI and combined DWI and T2W was compared to the combined T2W and post-contrast evaluation and between PIA and NIA groups using Wilcoxon signed rank test. Significance level is considered if $p < 0.05$.

Results

Table 1: Demographic features of PIA and NIA groups

	PIA	NIA	Significance level
Age	36.4 ± 10 years	36 ± 6.4 years	0.5
Gender	16 males, 4 female	17 males, 3 females	0.40
St. James's University Hospital grade	Grade 1: 6 Grade 2: 4 Grade 3: 1 Grade 4: 5 Grade 5: 4 Extra-sphincteric: 2	Grade 1: 15 Grade 2: 0 Grade 3: 3 Grade 4: 0 Grade 5: 2 Extra-sphincteric: 3	0.017

The study included 40 patients, 33 were males and 7 were females. Mean age was 36 ± 8.8 years old with a range of 24–60 years of age. The total number of cryptogenic perianal fistulas and abscess was 50. These included 40 fistulas and 10 abscesses. Eight patients had more than 1 fistula or fistula and abscess. The sites of these fistulas/abscesses were inter-sphincteric (n = 30, 60 %), trans-sphincteric (n = 10, 20 %), and extra-sphincteric (n = 10, 20 %).

Table 2: Visibility scores for perianal fistulas between T2W, DWI, and combined T2W and DWI

Visibility score for perianal fistulas	T2W	DWI	Combined T2W and DWI	Significance level
Score 2	25	20	38	0.08–0.26
Score 1	10	15	2	
Score 0	5	5	0	

In perianal fistulas (n = 40), 10 fistulas (60%) were well visualized (score 2) on DWI, in comparison to 20 fistulas (50%) well visualized on T2W. In comparison, 10 fistulas were poorly visualized (score 1) on T2W and only 2 was not visualized (score 0). The visibility scores on T2W were not significantly different from that of DWI ($p = 0.14$) and both of them were less than the visibility scores of the combined DWI and T2W evaluation, although not significant. This is shown in Table 2. All perianal abscesses were well visualized on both sequences, with the same size, location, and extension.

Table 3: Visibility scores for each sequence between PIA and NIA groups

		PIA (n = 10)	NIA (n = 30)	p value
DWI visibility scores	Score 2	4	15	0.74
	Score 1	4	10	
	Score 0	2	5	
T2W visibility scores	Score 2	8	5	0.50
	Score 1	2	10	
	Score 0	0	15	
Combined DWI and T2W visibility scores	Score 2	8	30	0.75

The visibility scores of perianal fistulas on DWI were not significantly different between PIA and NIA groups. Similarly, these scores on T2W did not show any significant variation between PIA and NIA groups. This is shown in Table 3.

Discussion

Before the era of magnetic resonance imaging (MRI), fistulography was used to evaluate fistula-in-ano. However, this technique has a low diagnostic accuracy (~16%), and inability to visualise secondary tracts, abscesses and the sphincter complex due to its suboptimal contrast opacification. [17]As a result, fistulograms are not able to provide information about the relationship between fistula tracts and anal sphincters. Endoanal ultrasonography is the first imaging technique that provides the anatomical details of anal canal. [1] It can be used for the diagnosis and management of not only abscesses and fistula-in-ano, but also anorectal and prostate tumours.

Surgical excision of perianal fistulous tracts and drainage of associated abscess with preservation of anal sphincteric complex is the primary surgical treatment. [18] Fistula recurrence after surgery occurs usually due to untreated or undetected fistula and abscess at the time of surgery. [19] Hence preoperative MRI evaluation of perianal fistula is essential to avoid treatment failure after surgery.

Various MRI sequences, especially combined DWI-T2W images, can identify the fistulous tract in relation to the anal sphincteric complexes, their course, ramifications, or associated abscesses.

One author suggested that rapid and maximum enhancement during dynamic MRI scanning correlated well to the disease activity. However, the applicability of this dynamic imaging is limited by the poor spatial coverage (to improve the temporal resolution) which limits the evaluation of the extent of inflammation.20 DWI is recently being studied by some researchers to compare its performance in visualizing and grading perianal fistulas and abscesses. Extra-cranially, oncologic applications of DWI are the most common. However, the evaluation of abscesses is a very important application for DWI, owing to the maximum contrast between the abscess cavity and the surrounding inflammation on the DWI image. [7,10,11]

In our study, we were unable to reproduce the former results. In our sample of patients, DWI was equally effective as T2W sequence in visualizing perianal fistulas and abscesses, although DWI has detected less number of fistulas than T2W in all visibility grades. But we did agree with Cavusoglu et al., Hori et al., and Bakan et al. that the visibility of perianal fistulas was higher using combined DWI and T2W evaluation, where we detected 96.7 % of perianal fistulas [3, 4, 7]. Only 2 fistulas could not be visualized on both DWI and T2W; this was visualized on post-contrast images, and this patient had a grade 1 perianal fistula with normal CRP; the patient was in the NIA group and did not require surgery. Visibility of perianal fistulas on DWI images was not significantly different for PIA and NIA groups. Perianal abscesses, on the other hand, were equally well visualized on both sequences.[9,13,21]

In our study, all perianal abscesses belonged to the PIA group and the ADC of abscesses were significantly lower than that of perianal fistulas without abscesses, which comes in agreement with Bakan et al. [13]

Using the St. James's University Hospital classification, DWI accurately classified 84.4% of the perianal fistulas and abscesses. Only 2 case were misclassified by DWI alone; this patient had a very small collection with high ADC value, so it was considered grade 1 on DWI images, while on post-contrast images, it was considered grade 2. DWI alone was significantly less than postcontrast images

in the accurate classification of perianal disease, mainly in the NIA group, but not in the PIA group, who are more likely to have surgeries. Using combined DWI and T2W evaluation, 97.8% of the perianal fistulas and abscesses were accurately classified and this was not significantly different between PIA and NIA groups. Our results agree with the results of Cavusoglu et al., where he states that the combined DWI and T2W evaluation had a high diagnostic performance that is not significantly different from the combined T2W and post-contrast images evaluation. [21,22]

Conclusion

DWI alone is not superior to the T2W regarding the visibility of perianal fistula in our study. However, the best performance was observed for combined DWI-T2W image evaluation, although it was not statistically significant than DWI or T2W alone. Mean ADC value calculation with obtained cutoff ADC value helps in differentiating active from the inactive perianal fistulas. We still need a larger study sample to confirm the visibility of perianal fistulas with DWI, T2W, CEMRI, and combined DWI-T2W.

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