EDITORIAL

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Are we expecting too much from the diffusion-weighted MRI?

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Diffusion-weighted magnetic resonance imaging (DW- MRI) is a method where the signal required to produce a MRI image is determined by the "mobility of water". Diffusivity measurements have multiple components related to tissue cellularity and organization, integrity of the cell membranes, extracellular space tortuosity and perfusion (1).

Until recent years, main limitation for the use of DWI in the body area wa the artefacts originating from the physiologic movements which decrease the diagnostic yield of the method. With advanced technology, elimination of disturbing artifacts can be possible to a degree…

Diffusion-weighted imaging signal intensity and the values of apparent diffusion coefficient (ADC) are of particular interest, because these parameters can sometimes show changes in bowel wall, when no abnormalities are typically seen on conventional MR images. Therefore, this method is rapidly becoming an adjunct to a conventional body MRI study, especially in the early detection of cancer. The ADC map provides quantitative information on diffusion. It is a measure of the freedom of water diffusion and is useful in tissue characterization. Malign lesions are characterized by a high signal on DWI and a low signal on ADC. Measured values from ADC map are believed to be low because of a shift (diffusion) of water within malign tissue, from the extracellular to the intracellular compartment, is relatively restricted. Thus, one of the important advantages of the DWI is that it can manifest the nature of the lesion without the need for intravenous contrast material injection. This is particularly beneficial in patients with reduced renal function (1).

In the current issue of Turkish Journal of Gastroenterology, Solak and colleagues (2) have investigated the value of DW-MRI in the differentiation of benign and malignant diffuse bowel wall thickening. They discussed the diagnostic importance and potential use of ADC measurements. For quantitative analysis in DW-MRI, a radiologist has measured the thickened colonic wall ADC values in the three regions of interest (ROI) by using dedicated software at the workstation. A circular ROI with a diameter of at least 4 mm2 has been placed to three different portions of the thickened wall to obtain average ADC values of the lesion. The authors concluded that benign bowel pathologies leading to wall thickening had significantly higher ADC values than those of malignant ones. In ROC curve analysis, the cut-off value of ADC to differentiate benign from malignant wall thickening was found as 1.21mm^2/s with a sensitivity of 100%, a specificity of 87,3%, and an accuracy of 89,3%. With visual assessment of the DWIs and the measurements of ADC values, malignant lesions were differentiated from benign ones with sensitivity of 100%, specificity of 89,2%, and an accuracy of 90,4%.

Before considering whether this bald conclusion does justice to the possible contribution of DWI to the noninvasive differentiation of benign and malign bowel lesions, it is worth considering that, even in the absence of DWI, experienced eyes can easily pick out the nature of the lesions on conventional T2-weighted MR images. Indeed, the authors of this study could also accurately perceive the differences of malignancy or benignity of the suspicious lesion with visual assessment. Howe-

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ver, it is not clear from the study that how they have evaluated the images and if they have blinded to T2- weighted sequences for this assessment. In this study, small ROIs have been used for ADC measurements. ROI size might affect the accuracy of measurements, since the tissue changes can be heterogeneous in terms of its internal structure and signal intensity. In a study conducted by Lambregts et al, mean tumour ADCs in rectal cancer were measured according to three distinct ROI protocols: [a] 'Whole-volume', [b] 'Single-slice' and [c] 'Solid tumour samples'. It is reported that ADC measurements of the whole tumour volume provide the most reproducible results (3).

Previously it was demonstrated that qualitative assessment of DW- MRI is useful for detecting colorectal cancers (4). Evaluation of inflammatory bowel disease (IBD) using DW- MRI have also found place in the literature (5-8). Oussalah et al. (8) recently reported clinical–radiological results obtained with DW-MRI in 96 patients with IBD, 35 with ulcerative colitis (UC), and 61 with CD. They stated that in patients with UC it is possible to replace completely the use of the intravenous contrast material with MR-DWI in the identification of active inflammatory bowel segments. Kılıçkesmez et al. (5) also evaluated the value of quantitative DW- MRI in the assessment of the inflammatory activity in UC. They found that DW-MRI is useful in identifying disease activity in UC patients, especially when the disease involved rectum. In another study from the same authors (6) was concerning the rectosigmoid colon. In that study, the authors showed that quantitative DWI might be able to differentiate inflammatory and neoplastic involvements. When we look at this perspective, the study conducted by Solak et al. (2) obviously, is not the first study aiming to differentiate benign and malignant diffuse bowel wall thickening with DW- MRI. A difference from previous study comes from the inclusion of longer intestinal segments to be assessed. However, the results of the study are similar to those of the earlier study (6) in that they call for further research and requirement of increasing patient population size. Actually, this conclusion is justified because of the overlapping ADC values. It has been known previously that a number of benign lesions can exhibit hyperintensity on DW- MRI with high b-values, (9) and that ADC values in benign and malignant lesions may overlap, which makes it difficult to distinguish lesions using DW- MRI alone. In both studies (2,6), it was emphasized that, radiologists should be aware of possible overlaps of ADC values that may lead to misdiagnoses when only DWI is interpreted.

In abstract section, the authors have noted that the patients in malignancy group have had scirrhous type of colorectal cancer. This inclusion criterion seems very strict. Because, scirrhous carcinoma is extraordinarily uncommon in the colon. In a series of 12,000 cases of colonic carcinoma studied by Fahl, et al. (10), 11 instances of this type were found. If this was the case, the study under consideration has utmost importance. Also, to my knowledge, scirrhous type carcinoma does not take part in current histologic typing and grading WHO classification of colorectal cancer. In previous studies without predominancy of scirrhous type, the low ADC values were found in cancer (4, 6). Actually, the two subtypes of colorectal adenocarcinoma (signet ring cell adenocarcinoma and mucinous adenocarcinoma) produce different signal intensities on conventional MRI than ordinary form and can influence the ADC values of the tumor. It is established that mucinous adenocarcinoma of the rectum showed higher ADC values compared to well-differentiated adenocarcinoma as a result of low cellularity, due to extracellular mucin (11). From this aspect of view, ADC values of mucinous adenocarcinoma may mimick those of benign lesions.

Again, if we ask the same question as in the title, the answer will be: no, if ever DWI is used as a supplemental sequence of conventional MRI. With the use of a qualitative assessment of high b-value images and ADC maps, the technique is very helpful to facilitate this differentiation when bowel wall thickening is found on conventional MRI incidentally. Because the factors that influence the diffusivity are complex, meticulous technique and knowledge of potential interpretive pitfalls will help to avoid mistakes.

REFERENCES

1. Qayyum A. Diffusion-weighted imaging in the abdomen and pelvis: concepts and applications. Radiographics 2009; 29: 797-1810.
2. Solak A, Genç B, Solak I, et al. The value of diffusion-weighted magnetic resonance imaging in the differential diagnosis in diffuse bowel wall thickening. Turk J Gastroenterol 2013; 24: 154-60.

3. Lambregts DM, Beets GL, Maas M, et al. Tumour ADC measurements in rectal cancer: effect of ROI methods on ADC values and interobserver variability. Eur Radiol 2011; 21: 2567-2574.
4. Ichikawa T, Erturk SM, Motosugi U, et al. High-b-value diffusion-weighted MRI in colorectal cancer. AJR Am J Roentgenol 2006;187:181-4.
5. Kılıçkesmez O, Soylu A, Yaşar N, et al. Is quantitative diffusion-weighted MRI a reliable method in the assessment of the inflammatory activity in ulcerative colitis? Diagn Interv Radiol 2010;16:293-8.
6. Kilickesmez O, Atilla S, Soylu A, et al. Diffusion-weighted imaging of the rectosigmoid colon: preliminary findings. J Comput Assist Tomogr 2009;33:863-6.
7. Maccioni F, Patak MA, Signore A, Laghi A. New frontiers of MRI in Crohn's disease: motility imaging, diffusion-weighted imaging, perfusion MRI, MR spectroscopy, molecular imaging, and hybrid imaging (PET/MRI). Abdom Imaging 2012; 37:974-82.
8. Oussalah A, Laurent V, Bruot O, et al. Diffusion-weighted magnetic resonance without bowel preparation for detecting colonic inflammation in inflammatory bowel disease.Gut 2010;59:1056-65.
9. Feuerlein S, Pauls S, Juchems MS, et al. Pitfalls in abdominal diffusion-weighted imaging: how predictive is restricted water diffusion for malignancy. AJR Am Roentgenol 2009;193:1070-6.
10. Fahl JC, Dockerty MB, Judd ES. Scirrhous carcinoma of the colon and rectum. Surg Gynecol Obstet 1960;111: 759-66.
11. Nasu K, Kuroki Y, Minami M. Diffusion-weighted imaging findings of mucinous carcinoma arising in the ano-rectal region: comparison of apparent diffusion coefficient with that of tubular adenocarcinoma. Jpn J Radiol 2012;30:120-7.