

Pitfalls in abdominal diffusion-weighted imaging – How specific is restricted water diffusion for malignancy?

S. Feuerlein¹, S. Pauls¹, M. S. Juchems¹, H.-J. Brambs¹, and A. S. Ernst¹

¹Radiology, University of Ulm, Ulm, Germany, Germany

Purpose

As DWI is increasingly implemented into routine protocols of abdominal MRI, positive findings both in expected as in unexpected locations become more common and might constitute diagnostic problems especially in patients with suspected benign disease. The aim of our retrospective study was to investigate the potential pitfalls of false positive findings in abdominal DWI by identifying benign lesions that have restricted diffusion and therefore might mimic malignant tumors.

Materials & Methods

The local institutional review board approved this study.

Patients: A total of 230 consecutive patients (Table 1) underwent abdominal MRI including DWI between January and October 2008.

MR imaging: All imaging was performed using a 1.5 T whole body MR imaging system (Magnetom Avanto; Siemens Medical Solutions, Erlangen, Germany). Transverse diffusion-weighted images were obtained using a single-shot spin-echo echo-planar imaging sequence (b-values of 0, 150, 500 and 1000 s/mm²). Pixel-wise ADC maps were generated.

Image analysis: Lesions were detected by two blinded investigators using only the b=1000 sequence. Restricted diffusion was confirmed by measuring the ADC. Proof of diagnosis was obtained by biopsy or surgical exploration (38 patients), unequivocal imaging features in the conventional T1-weighted and T2-weighted sequences or computed tomography (8 patients) or typical behavior in cross-sectional follow-up imaging studies (7 patients).

Indication	n	Age	Male	Female	Lesions	Malign.	%
Liver	74	55.7	26	48	13	11	74%
Pancreas	23	51.3	15	8	3	1	33%
Colon/Rectum	16	57.6	4	12	7	7	100%
Uterus/Ovaries	21	65.8	n/a	21	13	12	92%
Miscellaneous	96	47.0	54	42	19	12	63%
Total	230	50.8	99	131	55	43	78%

Results

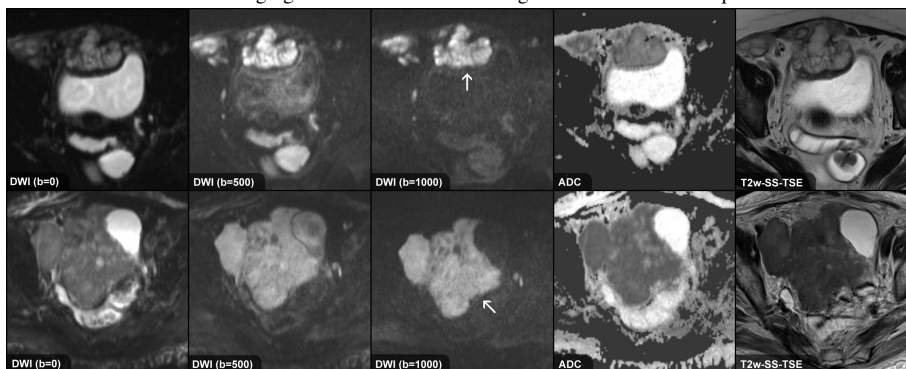
A total of 55 lesions with restricted diffusion were found in 52 of the 230 patients. The mean ADC of all lesions was 809 mm²/s. Forty-three lesions were malignant (78.2%), the mean ADC in this group was lower than in the benign group (793 vs. 866) although this difference was not statistically significant (p=0.72). **Liver:** 11 of 13 lesions were malignant (avg. ADC 809). The two benign lesions included one hemangioma and one adenoma (ADC 1049). **Pancreas:** 1 of 3 lesions was malignant (pancreatic adenocarcinoma). One benign lesion was a mature cystic pancreatic teratoma. The very low ADC of 789 was measured within a solid part corresponding to lymphoid tissue in postoperative histology. The second benign lesion was a case of histologically confirmed autoimmune pancreatitis (ADC 799). **Colon/Rectum:** All 7 lesions were malignant (colorectal carcinoma, ADC 923). **Uterus/Ovaries:** 12 of 13 lesions were malignant (ADC 799). The only benign lesion was a peritumoral abscess. **Miscellaneous:** 12 of 19 lesions were malignant including lymphoma, bladder cancer, skeletal metastasis, soft tissue tumors, breast cancer and mesenteric metastasis. The remaining 7 benign lesions consisted of 3 cases of inflammatory bowel wall thickening in patients with confirmed Crohn's disease (ADC 969), one Bartholin cyst (ADC 758), one hemorrhagic ovarian cyst (ADC 847), one posttraumatic renal abscess (ADC 350) and one very rare case of bilateral renal Rosai-Dorfman disease (ADC 929).

Discussion/Conclusion

As DWI is increasingly included into routine abdominal MR protocols, a rising number of lesions are detected, frequently as incidental findings. Some lesions like the thickened bowel wall in patients with Crohn's disease, the autoimmune pancreatitis, the hemorrhagic ovarian cyst or the Bartholin cyst were obviously benign and would most likely not constitute major diagnostic problems. In the cases of abscesses and liver adenoma, which can mimic invasive tumors, malignancy most likely cannot be ruled out based on imaging features alone and histological confirmation is required.

Abscesses (Figure 1): The abscesses in our study have similarities with solid tumors displaying severely restricted diffusion and a medium T2 relaxation time. Despite the different clinical presentation of the two entities biopsy will be necessary in most cases even if an abscess seems highly likely.

Figure 1: A periuterine abscess (white arrow, upper row) in a 56-year-old patient in direct visual comparison with a bladder cancer in a 73 year-old patient (white arrow, lower row). Note the very similar appearance in the DW images.



Hemangioma: We found a hemangioma in a 40-year-old female patient with moderately restricted diffusion (ADC 1049 mm²/s). One possible explanation is sclerosis of the hemangioma. There are no reports about diffusion characteristics in sclerosed hemangioma. Further work is necessary to investigate the potential restriction of water diffusion in sclerosed hemangioma.

Autoimmune pancreatitis is a rare form of chronic pancreatitis based on an autoimmune inflammatory process. Our histologically confirmed case of AIP involved the whole organ and therefore had to be distinguished from pancreatic lymphoma and mild acute pancreatitis more than from pancreatic adenocarcinoma. Since both the former two entities usually present with focal or diffuse restriction of diffusion, the value of DWI for inclusion or exclusion of these lesions is limited. Regarding DWI in acute pancreatitis there is only one recent case report in the literature. Especially considering the similar clinical presentation of AIP and mild acute pancreatitis further efforts are needed to evaluate the possible differentiation of these two entities with DWI.

In conclusion, diffusion-weighted imaging is an important complementary tool in evaluating abdominal pathologies and is increasingly used in routine imaging. Restricted diffusion is generally considered to be associated with malignant tumors as a result of high cellularity. However, when interpreting DW images, it should be kept in mind that a number of benign lesions, as high as 22% in our cohort, could demonstrate restricted diffusion, thus mimicking malignancy.