Clinical Radiology 69 (2014) 687–694

Contents lists available at ScienceDirect

Clinical Radiology

journal homepage: www.clinicalradiologyonline.net

Role of diffusion-weighted MRI in differentiation of hepatic abscesses from non-infected fluid collections

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ARTICLE INFORMATION

Article history:
Received 13 September 2013
Received in revised form
26 January 2014
Accepted 31 January 2014

AIM: To evaluate the role of diffusion-weighted magnetic resonance imaging (DW-MRI) in the differentiation of hepatic abscesses from non-infected fluid collections.

MATERIALS AND METHODS: In this retrospective study, 22 hepatic abscesses and 27 non-infected hepatic fluid collections were examined in 27 patients who underwent abdominal MRI including DW-MRI. Two independent observers reviewed T2-weighted + DW-MRI and T2-weighted + contrast-enhanced T1-weighted (CET1W) images in two sessions. Detection rates and confidence levels were calculated and compared using McNemar's and Wilcoxon's signed rank tests, respectively. Apparent diffusion coefficient (ADC) values of abscesses and non-infected fluid collections were compared using the *t*-test. Receiver operating characteristic (ROC) curves were constructed.

RESULTS: There was no statistically significant difference in the accuracy of detecting abscesses using T2-weighted + DW-MRI (both observers: 21/22, 95.5%) versus T2-weighted + CET1W images (observer 1: 21/22, 95.5%; observer 2: 22/22, 100%; $p < 0.01$). Mean ADC values were significantly lower with abscesses versus non-infected fluid collections (0.83 ± 0.24 versus $2.25 \pm 0.61 \times 10^{-3}$ mm^2/s; $p < 0.001$). With ROC analysis there was good discrimination of abscess from non-infected fluid collections at a threshold ADC value of 1.36×10^{-3} mm^2/s.

CONCLUSION: DW-MRI allows qualitative and quantitative differentiation of abscesses from non-infected fluid collections in the liver.

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Introduction

Diffusion-weighted magnetic resonance imaging (DW-MRI) provides qualitative and quantitative information about tissue cellularity and the integrity of cell membranes. Its diagnostic role has been established for the detection of stroke and diagnosis of intracranial inflammatory processes.[1,2] Technical advances in hardware and coil technology have led to the increasing use of DW-MRI in abdominal imaging. Thus far, hepatic DW-MRI is mainly used for detection of focal liver lesions (FLL), differentiating between malignant and benign liver lesions, diagnosing hepatic fibrosis/cirrhosis, and monitoring response to tumour therapy.[3,4] Research on DW-MRI characteristics of inflammatory processes in the abdomen and pelvis has been relatively limited up to this point.

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http://dx.doi.org/10.1016/j.crad.2014.01.028

For differentiation between liver abscess and non-infected fluid collections, contrast-enhanced computed tomography (CT) is the diagnostic imaging method of choice. CT is the best method in delineation of fluid collections and presence of gas. However, MRI is increasingly used as a first-line technique. Rim enhancement at CT or MRI is suggestive of, but not pathognomonic for, abscess; only diagnostic aspiration can conclusively confirm the diagnosis. Contrast-enhanced CT or MRI may be contraindicated in some cases due to patient allergies or renal failure. Postoperative changes following partial liver resection also render it difficult to differentiate between infected and non-infected collections.

Therefore, the purpose of the present study was to evaluate the role of DW-MRI in the detection of hepatic abscesses and to investigate the utility of apparent diffusion coefficient (ADC) measurements in differentiating abscess from non-infected fluid collections in the liver.

Materials and methods

Patients

In this retrospective, inter-individual, open-label study, 27 patients with hepatic abscesses and/or non-infected fluid collections who underwent gadolinium-enhanced liver MRI including DW-MRI between November 2009 and July 2011 were included and divided into two groups. Group 1 consisted of patients with liver abscesses and group 2 with non-infected fluid collections. All patients with bilioma ($n = 20$) were postoperative with a total number of 27 non-infected fluid collections. Five of 11 patients with hepatic abscesses were postoperative (nine liver abscesses).

Written and verbal informed consent for the MRI examination was obtained from each patient prior to the procedure. The study endorsed the principles of the Declaration of Helsinki and subsequent amendments.[5] Due to the retrospective nature of the evaluation and as examinations were part of the diagnostic routine, approval of the institutional review board of this study was not necessary.

MRI

All patients were positioned supine in a 1.5 T MR system (Magnetom Avanto, Magnetom Aera Siemens Healthcare, Erlangen, Germany) and covered with a phased-array-coil. The routine MRI protocol consisted of unenhanced T1-weighted (W) gradient-echo [GRE; two-dimensional (2D) fast low-angle shot (FLASH)] sequences in- and opposed phased; a half-Fourier axial single-shot fast spin-echo (SSFSE) T2W sequence (HASTE); a T1W three-dimensional (3D) GRE sequence with fat suppression [volumetric interpolated breath-hold examination (VIBE)] before and 20, 50, 120 s (depending on patient circulation) after intravenous contrast medium injection (Gd-EOB-DTPA; Primovist, Eovist, Bayer Schering Pharma, Germany; 25 μmol/kg body weight); a multishot T2W turbo spin-echo sequence with fat saturation; DW sequences with b-values of 50 and 800 s/mm^2; and after a 15 min delay, a T1W GRE with fat saturation (2D FLASH) and the same T1W 3D GRE sequence with fat saturation (VIBE) as used in the dynamic phase. Parallel imaging with an acceleration factor of 2 was used for all sequences. The detailed sequence parameters are listed in Table 1.

Table 1
Sequence parameters (Magnetom Aera and Magnetom Avanto).

Sequence and parameters	T2W SSFSE	DW-MRI	T1W 3D GRE fs static & dynamic
Parallel imaging	2	2	2
Fat saturation	No	Yes	Yes
Respiratory state	Free-breathing	Respiratory gated	Inspiration
TR (ms)	800	2800 (2300)	3.35
TE (ms)	84 (54)	66 (70)	1.19
TI (ms)	–	–	–
FA (degrees)	180	180	15
FOV	380 mm 100% (380 mm 75%)	400 mm 75% (400 mm 65%)	360 mm 75% (400 mm 75%)
Matrix	320 × 320 (320 × 189)	192 × 130 (192 × 113)	256 × 154
Section orientation	Transversal	Transversal	Transversal
Section thickness (mm)	6	6	3
Section gap (mm)	0.6	0.6	No gap
No. of sections	35	30	64 (56)
Bandwidth (Hz/pixel)	710 (446)	1370	450
k-space ordering	Linear order	All k-space lines are measured in one rep. time	Line by line, time to centre 6.5 s
Acquisition time	[a]	[a]	21 s (19 s)
b-Value (s/mm^2)	–	50, 800	–

Parameters of Magnetom Avanto 1.5 T which differ from Magnetom Aera are in bold and in parentheses.
T2W, T2-weighted; DW-MRI, diffusion-weighted magnetic resonance imaging; T1W 3D GRE, T1-weighted three-dimensional gradient echo; TR, repetition time; TE, echo time; TI, inversion time; FA, flip angle; FOV, field of view.
[a] Acquisition time depends on the respiratory frequency of the patient.

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