Original Article

The Role of Diffusion-Weighted Magnetic Resonance Imaging in the Differential Diagnosis of Simple and Hydatid Cysts of the Liver

S Aksoy, I Erdil, E Hocaoglu, E Inci, GT Adas[1], O Kemik[2], R Turkay

Radiology Department, Bakirkoy Dr Sadi Konuk Research and Training Hospital, Bakırköy, [1]General Surgery Department, Taksim Research and Training Hospital, Istanbul, [2]General Surgery Department, University of YuzuncuYıl, Van, Turkey

Abstract

Introduction: The present study indicates that simple and hydatid cysts in liver are a common health problem in Turkey. The aim of the study is to differentiate different types of hydatid cysts from simple cysts by using diffusion-weighted images. **Materials and Methods:** In total, 37 hydatid cysts and 36 simple cysts in the liver were diagnosed. We retrospectively reviewed the medical records of the patients who had both ultrasonography and magnetic resonance imaging. We measured apparent diffusion coefficient (ADC) values of all the cysts and then compared the findings. **Results:** There was no statistically meaningful difference between the ADC values of simple cysts and type 1 hydatid cysts. However, for the other types of hydatid cysts, it is possible to differentiate hydatid cysts from simple cysts using the ADC values. **Conclusion:** Although in our study we cannot differentiate between type I hydatid cysts and simple cysts in the liver, diffusion-weighted images are very useful to differentiate different types of hydatid cysts from simple cysts using the ADC values.

Keywords: *Hydatid cyst, magnetic resonance, simple cyst, ultrasonography*

Date of Acceptance:
10-Mar-2017

Introduction

Liver cysts occur with a prevalence of 5% in the general population, increasing up to 7% in the population >80 years.[1,2] Most of them are benign and asymptomatic.[3] With the widespread use of medical imaging technologies, such as ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI), incidental findings of asymptomatic hepatic cystic lesions have been increased.[4] However, US is a significant technique used in the differentiation of cystic masses from solid ones. Computed tomography is a valuable tool in the diagnosis of cystic lesions especially in determining of calcification. Magnetic resonance imaging is better than CT in differentiating the cystic from solid-necrotic lesions. If there is a history of malignancy, we can use PET-CT for the evaluation of a newly diagnosed cystic mass.

There are a wide variety of treatment options depending on the type of cysts; hence, it is important to differentiate benign cyst from harmful cysts, such as echinococcosis, cystadenoma, and cystadenocarcinoma.[5,6] Human hydatid cysts can cause life-threatening complications such as cyst rupture with possible anaphylactic shock, spread of new cysts, and bacterial infection.[7] However, simple cysts are asymptomatic unless complication such as infection exists. Therefore, it is very important to differentiate simple cysts from hydatid cysts.

This is a retrospective study. Ultrasonography (USG) is very useful in the initial investigation of hepatic lesions. Magnetic resonance imaging is a preferred modality for the characterization of cystic lesions due to contrast resolution and nonionizing nature of MR in our clinic. Hence, we decided to analyze retrospectively our US and MRI findings of hepatic cysts. We preferred the Gharbi classification because this was used in US reports. The aim of this study is to differentiate simple hepatic cysts from hydatid cysts by comparing apparent

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_296_16

Address for correspondence: Dr. S Aksoy, Radiology Department, Bakirkoy Dr. Sadi Konuk Research and Training Hospital, TevfikSağlam Cad. No:11 Zuhuratbaba, Bakırköy, Istanbul, Turkey.
E-mail: semaaksoy2000@yahoo.com

How to cite this article: Aksoy S, Erdil I, Hocaoglu E, Inci E, Adas GT, Kemik O, *et al*. The Role of Diffusion-Weighted Magnetic Resonance Imaging in the Differential Diagnosis of Simple and Hydatid Cysts of the Liver. Niger J Clin Pract 2018;21:212-6.

diffusion coefficient (ADC) values in diffusion-weighted MRI.

Materials and Methods

This is a retrospective study. We reviewed the medical records of the patients who had both USG and MRI examinations. All the information was obtained from the hospital records. There were 37 patients (25 females and 12 males) with a history of hydatid cysts in the liver, which were diagnosed by serological tests and surgery. Totally 36 simple cysts were obtained from 32 patients (22 females and 10 males) with a long-time history of simple liver cysts. We defined a long-standing (more than 2 years with the same dimensions and anekoik ultrasonographic appearance) liver cyst as a simple cyst if it was lesser than 3 cm, round shaped, and had no calcification or septation and no positive serology for the hydatid cyst. The mean ages for the simple cyst, type 1, type 2, type 3, type 4, type 5 were 58, 56±11, 74, 52, 33±26, 2, 44,11±17, 14, 53, 67±12, 97, 44±23, 66, 53, 83±10, 13 years, respectively. All the examinations were conducted in Radiology Department of Bakirkoy Sadi Konuk Research and Training Hospital, Istanbul, Turkey.

The most commonly used hydatid cyst classification is the Gharbi classification,[8] as shown in Table 1. We classified hydatid cysts by USG findings according to this classification.

The USG and MRI findings of the hydatid cysts are evaluated retrospectively. We also evaluated 37 lesions from 32 patients with a history of simple cysts. We compared USG and MRI findings of the simple cysts and hydatid cysts. All patients who had both USG and MRI examination of the abdomen were chosen retrospectively. The local ethics committee reviewed and approved the study protocol. All patients were examined by a 1.5-T MR system (Siemens and Magnetom Avanto) with phased-array bodycoils. Axial diffusion-weighted images were performed with a 1.5 T body scanner (Avanto; Siemens, Erlangen, Germany) using an 18-channel phased-array body coil: T1-weighted (axial turbo spin-echo T1-weighted (echo time [TE], 15 ms; repetition time [TR], 383, ms; slice thickness = 5 mm; interslice gap 30%; flip angle [FA], 150°; FOV, 36 cm; averages, 4; matrix, 384 × 201); T2-weighted (axial turbo spin-echo T2-weighted (TE, 120 ms; TR, 4500 ms; FOV, 36 cm; FA, 150, slice thickness = 5 mm; matrix, 512 × 205; inter-slice gap of 30%; averages, 4); fat-saturated T2-weighted (axial turbo spin-echo fat-saturated T2-weighted sequences (TE, 120 ms; TR, 4840 ms; slice thickness = 5 mm; matrix, 512 × 205; FA, 150; inter-slice gap of 30%; averages, 4; FOV, 36 cm). Then, the axial diffusion-weighted sequence was performed as a routine abdominal examination. Diffusion-weighted images (DWI) were applied with b-factors of 0, 500, and 1000 s/mm² (axial diffusion-weighted single-shot spin-echo echo-planar sequence with chemical shift selective fat-suppression technique; PAT factor, 2; matrix, 192 × 192; slice numbers, 36;. TR, 4738 ms, TE, 80 ms; slice thickness = 5 mm; averages, 5; inter-slice gap 30%; FOV, 40 cm; acquisition time, approximately 4 minutes). PAT mode generalized auto-calibrating partially parallel acquisition (GRAPPA) was performed with b-factors of 0–1000 s/mm². No oral or intravenous contrast agent was administered.

For ultrasound evaluation, a Toshiba Aplio device was used. A convex 3.5 megahertz probe was used for liver imaging. We preferred the USG examinations made by SA and İE, who had 6 and 4 years of abdominal imaging experience.

Image Interpretation: The DW images were used for postprocessing, and ADC maps were reconstructed. For the ADC mapping, the size of the region of interest (ROI) was chosen as large as possible. Calcifications were excluded from the ROI.

We searched for USG results for the patients with a history of hydatid or simple cyst.

Statistical analysis

NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) was used in this study. The Kruskal–Wallis test was used to compare the findings of the groups. Dunn's comprehensive test was used to compare the findings of subgroups. A statistical difference was considered significant at $P < 0.05$.

Results

With a *b* factor of 1000 s/mm2, however, the average ADC value was 3.08±0.34 s/mm2 for the simple cysts and 3.10 ± 0.04 s/mm2 for the type 1 hydatid cysts. The mean ADC values of the nine type-2 cases hydatid cysts were 2.64 s/mm2, nine type-3 cases 2.78 s/mm2, six type-4 hydatid cysts 2.52 s/mm2, and six type-5 hydatid cysts 2.56 s/mm2 [Table 2].

There was no statistically significant difference between the ADC values of simple cysts and type 1 hydatid cysts (P=0.893). However, a statistically significant difference was noted between the ADC values of hydatid cysts and type 2 hydatid cysts (P = 0.010), type 3 hydatid cysts (P = 0.033), type 4 hydatid cysts (P = 0.001), and type 5 hydatid cysts (P = 0.001) [Table 3].

Table 1: The Gharbi classification of hydatid cysts[8]

Gharbi classification	
Type I	Pure fluid collection
Type II	Fluid collection with a detached membrane
Type III	Fluid collection with daughter cysts and/or multiple septa
Type IV	Hyperechoic fluid collection with high internal echoes
Type V	Cyst with a calcified thick wall

Table 2: Adc values of cysts

		N	Mean ± SD	P
ADC	Simple cyst	37	3088, 35±345, 15	0.02
	Type 1 hydatid	6	3108, 5±275, 47	0.893
	Type 2 hydatid	9	2648, 89±717, 26	**0.010**
	Type 3 hydatid	9	2783, 11±475, 07	0.033
	Type 4 hydatid	6	2520, 83±436,94	0.001
	Type 5 hydatid	6	2567, 83±227,67	0.001

Table 3: Demographic features and localization of the cysts

	Gender				Side					
	Male		Female		Right		Left		Junction	
Simple cyst	10	31.25%	22	68.75%	16	43.24%	21	56.76%	0	0.00%
Type 1 hydatid	3	50.00%	3	50.00%	4	66.67%	1	16.67%	1	16.67%
Type 2 hydatid	1	11.11%	8	88.89%	5	55.56%	3	33.33%	1	11.11%
Type 3 hydatid	4	44.44%	5	55.56%	6	66.67%	3	33.33%	0	0.00%
Type 4 hydatid	1	16.67%	5	83.33%	4	66.67%	1	16.67%	1	16.67%
Type 5 hydatid	3	50.00%	3	50.00%	4	66.67%	2	33.33%	0	0.00%
P	0.434				0.194					

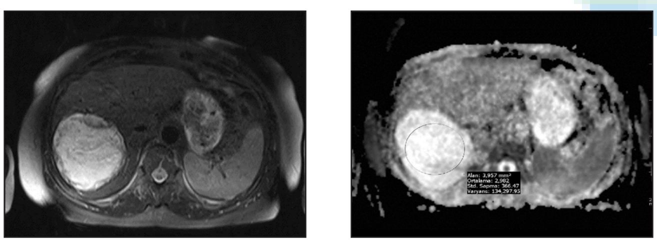

Figure 1: Simple cyst. An axial T2 turbo spin echo image shows a huge round cystic lesion with thin septa in the left lobe of the liver. (b) ADC map shows an ADC value of 3.3 s/mm2.

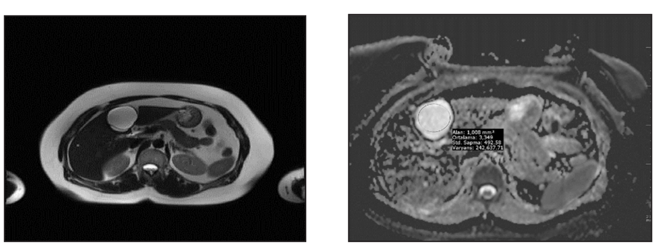

Figure 2: (a) Type II of HC. An axial T2 turbo spin echo image shows a cystic lesion in the right lobe of the liver. (b) ADC map shows an ADC value of 2.9 s/mm2.

Discussion

Cystic hydatid disease is a widespread human infection caused by the larval stage of the tapeworms of echinococcus.[9-11] Diagnosis of the hydatid cyst disease relies on epidemiologic and clinical findings and the results of radiologic studies and immunologic tests.[12] Ultrasonography is the gold standard for the classification of the hydatid cysts.[12,13] It is helpful for defining the internal structure, number and location of the cysts, and the presence of complications, having a specificity of 90%. [12] However, it is impossible to differentiate type I hydatid cysts from simple cysts and type IV hydatid cysts from the other solid lesions in the liver. In these conditions, CT or MRI might be performed to differentiate the cystic lesions of the liver.[13]

The aim of the study is to evaluate cystic form of ecchinococcal disease using various imaging modalities such as USG and MRI.

Diffusion-weighted imaging is different from the conventional MR imaging techniques; it can sensitively detect randomized molecular motion, known as diffusion or Brownian water motion. Quantitative measurements are defined by the ADC. ADC maps provide a quantitative measure that reflects intravoxel incoherent movement and some physiological properties, such as cellular density and tissue viability.[14]

Hydatid cyst disease is a common health problem in Turkey. In our clinical practice, it is important to classify a cystic lesion in the liver. The most common problem for us is to identify if the lesion is a simple cyst. The contents of hydatid cysts are also different from the simple cysts and differ from type I to type V. Hence, we decided to measure the ADC values of different types of hydatid cysts and compared them to the values of simple cysts [Figures 1 and 2]. There are a few studies addressing this problem.[13,15] In one of these studies, there was no statistically significant difference between the ADC values of simple cysts and those of type 1 HCs.[13] In the other study with *b* factors of 0 and 500 s/mm2, no difference of statistical significance was achieved ($P > 0.05$). With a *b* factor of 1000 s/mm2, the signal intensities and signal intensity ratios of the hydatid cysts were significantly higher than those of the simple cysts ($P < 0.001$). The ADCs and ADC ratios of hydatid cysts were significantly lower than those of simple cysts ($P < 0.001$).[12] In our study, there was no statistically difference between the ADC values of type I hydatid cysts and simple cysts. The results of our study correlate with the results of the study by Oruc *et al*. However, in our study, there were statistically differences between the ADC values of simple cysts and the other types of hydatid cysts.

The ADC values were used for differentiation of other cystic lesions in the body. In a study, Nakayama *et al.*[16] detected that mature cystic teratomas tended to show higher signal intensity and had areas of lower ADC values than endometrial cysts and other benign and malignant neoplasms ($P < 0.005$). *In vitro* scanning of the cystic contents of mature cystic teratomas confirmed that high signals on DWI or low ADC values were attributable to the keratinoid substance within the tumors.[16]

There are many studies that focus on the differentiation of focal liver lesions using DWI.[16-21] Also, there are few studies that examine diffuse liver lesions using the same method.[22-24] The mechanism is the same. If the content of cell material changes, the ADC values of the lesions also change.

Our study has some limitations. We could not find any statistical difference between type 1 hydatid cysts, the reason being low number of type 1 cyst hydatid patients-only six patients. We want to continue this study with a large number of type 1 cyst hydatid patients using 3 Tesla MR imaging.

Conclusion

Although in our study we cannot differentiate type I hydatid cysts from simple cysts in the liver, diffusion-weighted images are very useful to differentiate different types of hydatid cysts from simple cysts using the ADC values. However, it seems that ultrasonography is still gold standard to differentiate hydatid cysts from simple one.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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