The Diffusion-Weighted Magnetic Resonance Imaging in Hepatic Hydatid Cysts

Hepatik Hidatid Kistlerde Difüzyon Ağırlıklı Manyetik Rezonans Görüntüleme

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Abstract
Hydatid cyst (HC) is a zoonotic infection caused by the larval stage of Echinococcus parasites. Although the liver is the most commonly affected organs, especially the lungs being primary, spleen, peritoneum, ovaries, and such as brain may be primary or secondary placement in organs. The diagnosis of HC is made by characteristic radiographic appearance and positive serology. Ultrasonography (US), computed tomography (CT) and magnetic resonance imaging (MRI) has been used with success in imaging. However, together with this, HC, which is not showing characteristic symptoms, can be mixed with other cysts. In recent years, diffusion-weighted MRI, distinguishing these cysts (DW-MRI) are to investigate the role publications are available. In this paper, the role of diffusion weighted MRI in the differential diagnosis of hydatid cyst are discussed.

Keywords: Diffusion-weighted magnetic resonance imaging, Hepatic, Hydatid cyst

Özet
Hidatid kist (HK), Ekinokokus parazit larvaları tarafından oluşturulan zoonotik bir enfeksiyondur. Karaciğer en çok etkilenen organ olmasına rağmen özellikle akciğer olmak üzere dalak, periton, overler, ve beyin gibi organlar primer ve sekonder olarak tutulabilir. HK tanısı karakteristik radyolojik görünüm ve pozitif serolojik testlerle konur. Ultrasonografi, bilgisayarlı tomografi ve manyetik rezonans görüntüleme görüntülemede başarıyla kullanılır. Ancak, bunlarla birlikte karakteristik semptomlar göstermeyen hidatid kist diğer kistlerle karışabilir. Son yıllarda difüzyon ağırlıklı görüntülemenin, bu kistlerin ayrımındaki rolünü araştıran yayınlar bulunmaktadır. Bu yazıda, difüzyon ağırlıklı MRG'nin hidatik kist ayırıcı tanısındaki rolü tartışılmaktadır.

Anahtar Kelimeler: Difüzyon ağırlıklı MRG, Hidatid kist, Karaciğer

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Introduction

Hydatid cyst (HC) is a zoonotic infection caused by the larval stage of Echinococcus parasites. People are intermediate hosts. The contaminated water and vegetables, and eggs, which were taken by direct contact, will be settled in the portal system and the liver (1). Although the liver is the most commonly affected organs, especially the lungs being primary, spleen, peritoneum, ovaries, and such as brain may be primary or secondary placement in organs (2). Which it usually grows very slowly, it does not create symptoms for many years. It is often to see of a single focus in 20-40% may be seen as multiple cases (3). The initial symptoms depend on the size of the cysts and settlement location. In the cyst in the liver, may lead to hepatomegaly, pain in right upper quadrant or epigastria, nausea and vomiting. Systemic immunologic responses such as anaphylaxis may occur according to the cyst rupture. If peritoneal rupture is present, secondary HC may occur.

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If it opens out to the portal vein or bile duct and develop pressure; it will create segmental or lobar atrophy (4). In 5-40% cases, HC could be swept (5).

Diagnosis

The diagnosis of HC is made by characteristic radiographic appearance and positive serology. Immune diagnostic methods are used in supporting radiologic, medical and/or surgical treatment after follow-up (6,7). Today, diagnostic methods such as ELISA and immunoblotting rather than traditional methods such as Casoni skin test is used (8). In HC diagnosis, imaging in the treatment planning and follow-up carries a critic importance. Ultrasonography (US), computed tomography (CT) and magnetic resonance imaging (MRI) has been used with success in imaging. According to the radiographic disease appearance of cystic form may change the form until it becomes a complete solid appearance (9). Liver hydatid cyst is often asymptomatic in the early stages; it usually is detected with ultrasound incidentally during investigation of other reasons. Ultrasonography is the gold standard method for determining, number, placement and size of cysts (10, 11).

In the classification of cysts including Gharbi and WHO-Informal Working Group of Echinococcosis (WHO-IWGE), two methods are used which are slightly different from each other (Table 1). MRI and CT are additional analysis method used in this case. In conventional MRG,

the hypointense appearance of the cyst wall, cyst membranes, which are floating inside, and monitoring daughter cysts are characteristics findings for HC (12). However, together with this, HC, which is not showing characteristic symptoms, can be mixed with other cysts. In recent years, diffusion-weighted MRI, distinguishing these cysts (DW-MRI) are to investigate the role publications are available (13,14).

Table 1. Gharbi and WHO-Informal Working Group of Echinococcosis (WHO-IWGE) classification of hydatid cysts

Gharbi	WHO	Ultrasonography characteristics
-	CL	Unilocular cyst, anechoic, no wall depicted
Type 1	CE1	CL characteristics+wall+mobile internal echogenicities
Type 2	CE2	Multivesicular, multiseptated cyst, daughter cysts, honeycomb pattern
Type 3	CE3	Detached-floating membrane (water-lily sign)
Type 4	CE4	Heterogeneous hypo/hyperechoic cyst, no daughter cyst
Type 5	CE5	Cyst with a partial or complete wall calcification

CL= Cystic lesion, **CE=** Cystic echinococcosis

Diffusion Weighted Magnetic Resonance Imaging (DW-MRI)

The diffusion of molecules is connected to the kinetic energy of random motion. MRI can measure the amount of these movements. With DW-MRI, the water molecules within cells, extracellular and intravascular movements in the space can be measured. In the diffusion-weighted imaging, (DWI) applying intravoxel phase changes to the water molecules, which undergo diffusion, creates a signal loss in the area. For this, pulse before and after 180 degrees, equal amplitude diffusion gradients will be applied. While response not observed in stable tissue, loss of signal occurs in the active tissue.

"B" value is to create DWI which is a factor to show the gradient strength and time and it is defined with the equation$B = \gamma^2 x G^2 x \delta^2 x (\Delta - \frac{\delta}{3})$. In this equation "γ" gyromagenetic ratio, "G" used gradient strength, "δ" gradient time and represents the time in both gradients "Δ". As B value increases, the weight of the diffusion image will increase but a reduction in signal will be monitored, in accordance, suitable B value should be selected for the analyzed location.

Quantitative analysis of diffusion-weighted MR images of apparent diffusion coefficient (ADC) will be done over maps. ADC map images, for each voxel, in different "b" valued DWI's signal intensity values obtained according to the "b" value by calculating the slope of the relationship to be established by calculating the natural logarithm. Thus, two different DWI with different "b" values with co-extruded parameters are required. MR devices usually do this process automatically. ADC eliminates the effect of T2-shine, will give a pure diffusion of knowledge. In addition, the "b" value of mm^2/s gives the numerical value for the diffusion speed.

DWI in Liver Hydatid Cyst

DWI, with the reason of sensitive movement, at first, together with the evaluation of cerebral process such as initial stroke, with the development of rapid sequences such as echo-planar imaging, it is started to be used in common extra cerebral areas. The use of HC of liver is relatively new. In fact, in cases of HC, except of purcystic ones, conventional methods seem sufficient for diagnosis. But purcystic HC's does not seem sufficient to distinguish with the conventional MRI sequences from simple cyst (13, 15). One of the first reports in the literature with the two cerebral hydatid cyst cases in DWI cases was presented by Kitiş and his colleagues. One of these cases is isointense with BOS and the second case is hypointense according to BOS (13). Demir *et al.* have compared the differential diagnosis of focal liver lesions in the DWI's contribution to the ADC measurements in two studies that investigated with simple cysts in HC and have reported no significant difference (15). However, that only two of the studies to be taken as the number of cases are a phenomenon known phases of HC is the weaknesses of this study. In the literature, the first and most significant study of the distinction between simple cyst and liver was done by Inan *et al.* (14). In this study, the majority is entirely in liquid form which a total of 39 types 1-2-3 HC (25 cases) and 43 simple cyst was taken into study. In DWI, most of the HC hyperintense compared to the liver (37/39, 95%), while most of the simple cyst (40/43, 93%) appear as isointense. As quantitative, the cysts intensity compared to ratio of liver intensity was found to be significantly higher in HC ($p<0.001$). The sensitivity of determined ratio of 1.5 percentage of cysts/liver intensity is 77%, specificity 86%, and the PPV is 83%. Except for type 3 cases (n=4) in all groups, between HC and simple cysts were reported one significant difference in accordance of ADC measurement. However, there is no

statistical comparison between HC subgroups in this study. Researchers have argued that DWI and ADC measurement could be useful to distinguish HC and a simple cyst. In 2010, Oruç and his colleagues have done a similar study with 27 HK (13).

In this study, while ADC is 3.08 ($\pm 0.17 \times 10^{-3}$) mm^2/s simple cysts, in type 1 HC's 2.84 ($\pm 0.38 \times 10^{-3}$) mm^2/s is measured and the difference between as statically were not to be found a significant difference.In this study, while there were no significant difference were found in between type 1 and type 3 HC ADC measurements, in type 4 HC cases ADC was measured under 2.17×10^{-3} mm^2/s, there was a significant difference between other types. Sönmez *et al.* made a study in the year of 2012, and have argued that they have found a significant difference statically between type 1 HC and simple cysts according to ADC measurements (16). They have measured the ADC for type 1 HC as 2.27×10^{-3} mm^2/s and measured for simple cysts as 2.67×10^{-3} mm^2/s.

Cece *et al.* have only investigated the success of DWI and ADC measurements in the differentiation of HC's subtype (17). As being different from other studies, five different HC stages were included. ADC values, type 1, type 2 and type 5, the HC's were found to be significantly different as statically measured except for type 3. Type 3 was measured significantly differently from type 4. The measurement from this study and ADC measurement which belongs to the other study have been summarized in the Table 2 in order to compare.

Table 2: ADC values in four different studies

	ADC Value (mm^2/s)				
Study	**Type 1**	**Type 2**	**Type 3**	**Type 4**	**Type 5**
Oruç (2010)	2.84±0.38	N/A	3.05±0.17	1.78±0.17	N/A
Sönmez (2012)	2.27	N/A	2.15	N/A	N/A
İnan (2007)	2.5±0.9	3.1±0.5	2.8±0.2	N/A	N/A
Çeçe (2013)	2.48±0.16	2.8±0.34	2.7±0.26	2.02±0.01	2.18±0.10

In cases which conducts partial cystectomy, in the study investigating the DWI's activities in the evaluation of recurrence, the ADC measurements of 1 HC cases, the results of DWI done after one year of operation of residual cavity was compared and there was no statistical difference between the two measurements (18). Researchers have reported that the DWI was not useful in evaluating the HK recurrence.

In most of liver hydatid cysts differential diagnosis, morphological features such as US, BT and MRI-specific must be evaluated. With these methods, there are difficulties to distinguish the complete liquid HC's from simple cysts available. Although there is no consensus, DWI in this distinction seems that may be useful. However, the number of cases in the current release does not yet have a clear perspective in terms of this distinction. There is a need for a new work to be done on a wider measurement.

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