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Diagnostic Contribution of Diffusion-Weighted Imaging in Liver Hemangiomas

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Research Article

History

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ABSTRACT

Objective: The purpose of this study is to evaluate the contribution of diffusion weighted (DWI) MRI and measured appearent diffusion coefficient (ADC) values in hepatic hemanjiomas.
Methods: The study population consisted of 70 patients with liver hemangiomas. DWI examination with a b value of 800 s/mm2 was carried out for all patients. After DWI examination, an ADC map was created and ADC values were measured for 70 liver masses and normal liver tissue (control group). ADC measurement of 70 normal liver parenchyma and, mean ADC values of 80 hemangiomas are performed.
Results: Eighty hemangiomas of 70 patients composed by 50 women and 20 men are evaluated in our study. Age of the patients who included to study are between 26 and 73 and the mean age was calculated 49.61 ± 10.96. Hemangiomas are shown most highly at segment 7 (%28.8) and segment 6 (%21.3), and least at segment 5 (%5). While the mean ADC measurement of normal livers of patientes are included to study was 1.06 ± 0.11 x 10-3 mm2 /s, the mean ADC value of hemangiomas was measured 1.70 ± 0.29 x 10-3 mm2/s.
Conclusion: DWI, and measurements of ADC values obtained from process are useful for the diagnosis of hemangioma. We think that DWI should be routinely added to convantional MR sequences.

Keywords: Liver, Diffusion weighted imaging, Magnetic resonance imaging, Apparent diffusion coefficient, Hemangioma

Karaciğer Hemanjiyomlarında Difüzyon Ağırlıklı Görüntülemenin Tanısal Katkısı

Araştırma Makalesi

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ÖZET

Amaç: Bu çalışmanın amacı, hepatik hemanjiomlarda difüzyon ağırlıklı (DAG) MR ve ölçülen görünen difüzyon katsayısı (GDK) değerlerinin katkısını değerlendirmektir.
Yöntem: Çalışma grubunu karaciğer hemanjiomlu 70 hasta oluşturdu. Tüm hastalara b değeri 800 s/mm2 olan DAG incelemesi yapıldı. DAG incelemesi sonrasında GDK haritası oluşturuldu ve 70 karaciğer kitlesi ve normal karaciğer dokusu (kontrol grubu) için GDK değerleri ölçüldü. 70 normal karaciğer parankiminin GDK ölçümü ve 80 hemanjiomun ortalama GDK değerleri yapıldı.
Bulgular: Çalışmamızda 50'si kadın, 20'si erkek olmak üzere 70 hastanın 80 hemanjiyomu değerlendirildi. Çalışmaya alınan hastaların yaşları 26 ile 73 arasında olup yaş ortalaması 49,61±10,96 olarak hesaplandı. Hemanjiomlar en fazla segment 7 (%28,8) ve segment 6'da (%21,3), en az ise segment 5'te (%5) görülmektedir. Çalışmaya dahil edilen hastaların normal karaciğerlerinin ortalama GDK ölçümü 1,06 ± 0,11 x 10-3 mm2/sn iken, hemanjiomların ortalama GDK değeri 1,70 ± 0,29 x 10-3 mm2/sn olarak ölçüldü.
Sonuç: DAG ve işlem sonrası elde edilen GDK değerlerinin ölçümü hemanjiyom tanısı için faydalıdır. Geleneksel MR sekanslarına DAG'nin rutin olarak eklenmesi gerektiğini düşünüyoruz.

Anahtar Kelimeler: Karaciğer, Difüzyon ağırlıklı görüntüleme, Manyetik rezonans görüntüleme, Görünür difüzyon katsayısı, Hemanjiom

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Introduction

Hemangioma is the most common benign tumor of the liver.[1] Due to the asymptomatic nature, these are usually observed incidentally while routine imaging.[2] Hemangiomas represent a minor rate of complications and uncomplicated lesions do not require surgical resection. Therefore, it is important that hemangiomas are diagnosed by imaging.[1]

Magnetic resonance imaging (MRI) is the best imaging modality for diagnosing hemangiomas.[3] Diffusion-weighted imaging (DWI) offers better results for detecting and characterizing liver lesions than T2-weighted imaging. It can also provide additional contributions to contrast-enhanced sequences.[4] DWI is a technique that is measures the Brownian motion alterations of water molecules in the tissue. The apparent diffusion coefficient (ADC) is calculated from DW images.[5,6] Some studies in the current literature showed that ADC values can be used in the differential diagnosis of hepatic pathologies. [7, 8, 9, 10]

The aim of this study is to reveal the contribution of DWI and measure the ADC values of hepatic hemangiomas.

Materials and methods

Patient Group

The Institutional Review Board approved this retrospective study (Date: 16.04.2014 - No: 2014-04/13). PACS (Picture archiving and communication system) of our University, Department of Radiology was reviewed from August 2012 and March 2014, and 70 patients of over 18 age adults who were already diagnosed with hemangioma by computed tomography (CT), or ultrasonography (US), or directly imaged by MRI with suspicion of hemangioma. Patients with pathology other than liver hemangioma (hepatosteatosis, biliary obstruction, cirrhosis, etc.) were excluded from the study. Patients with poor general conditions, respiratory problems, and cases with a prosthesis, implants, or cardiac pacemakers were not included in the study. Lesions smaller than 8 millimeters were excluded, because the ADC value measurement would not be optimal. The diagnosis of the hemangioma was performed according to the previous characteristic US, CT, and dynamic liver MRI results. The atypical-looking hemangiomas were not included in the study.

MR Imaging Protocol

A 1.5 Tesla superconducting MR scanner (Magnetom Aera, Siemens Healthcare, Erlangen, Germany) was performed without sedation in a supine position for imaging. Fat-suppressed TSE T2-weighted (T2W), TSE heavy T2W, gradient echo in-phase and opposite-phase T1-weighted (T1W), contrast-enhanced dynamic T1W images were obtained in all patients routinely.

DWI examination was performed before contrast agent administration. DWI studies were independently reviewed by two experienced radiologists for all cases. Diffusion-weighted sequences were performed in the axial plane. Two different b values (b = 0 s/mm2 and b = 800 s/mm2) were used in diffusion-weighted imaging. To obtain ADC values, multiple Regions of Interest (ROI)s were marked within the hemangiomas and in normal-appearing liver parenchyma not involved by the hemangioma using the same ROIs for signal intensity calculation. The measured ROI diameter was set at approximately 1 cm. Three consequent measurements were made for each lesion, and normal liver parenchyma in consecutive sections, and the mean values were calculated. The mean ADC value was used for analysis.

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0 (IBM Corp., Armonk, NY, USA). When parametric test assumptions were fulfilled the significance test of the difference between the two means was used, and when the parametric test assumptions were not fulfilled, Man-Whitney U test, Chi-square test, and correlation analysis were applied. A value of $p<0.05$ is considered statistically significant.

Results

Eighty hemangiomas of 70 patients (50 female and 20 male) were evaluated in our study. The ages of the patients included in the study were between 26 and 73 and the mean age was 49.61 ± 10.96. Hemangiomas are shown most highly at segment 7 (%28.8) and segment 6 (%21.3), and least at segment 5 (%5). The mean ADC values of healthy liver parenchyma represented statistically significant difference for both genders (p<0,05). While the mean ADC measurement of healthy livers of female patients was 1.04 ± 0.11 x 10-3 mm2/s, the mean ADC value of male patients was measured 1.12 ± 0.13 x 10-3 mm2/s. When ADC values of hemangiomas were compared with healthy liver ADC values regarding age groups, the difference was not statistically significant (p> 0.05)

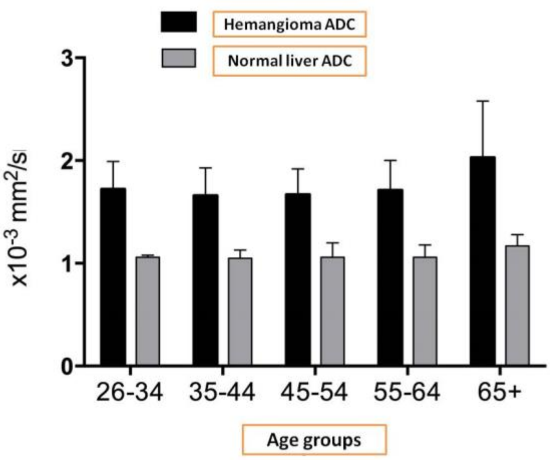

Figure 1. Comparison of hemangioma and normal liver ADC values by age groups.

No significant difference was observed when the two genders were compared (p>0.05). The mean ADC measurements of hemangiomas were 1.72 ± 0.30 x 10-3 mm2/s in females and 1.76 ± 0.32 x 10-3 mm2/s in males. Figures 2 and 3 show the MR images of the cases. In this current study, the mean ADC values of hemangiomas were not significantly different between gender groups. In addition, the mean ADC values of healthy liver parenchyma showed no statistically significant. difference between gender groups.

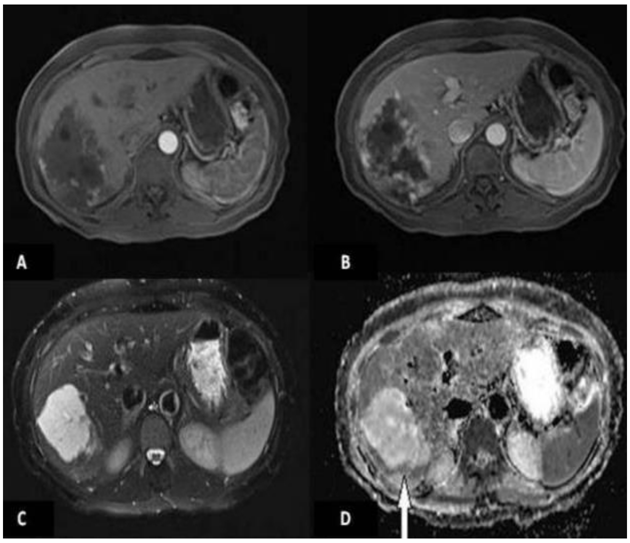

Figure 2. The female patient in 49-year-old. In the dynamic liver MRI of the patient, it is seen that the hemangioma shows peripheral nodular enhancement and progresses towards the center (a, b, c). The giant hemangioma observed in segment 6 in the fat-suppressed T2W image (d) is significantly hyperintense compared to the liver parenchyma. In ADC mapping (e), the mean ADC value of the lesion (arrow) was 1.15x10-3 mm2/s, while the average ADC values obtained from the healthy liver were measured as 1.02x10-3 mm2/s.

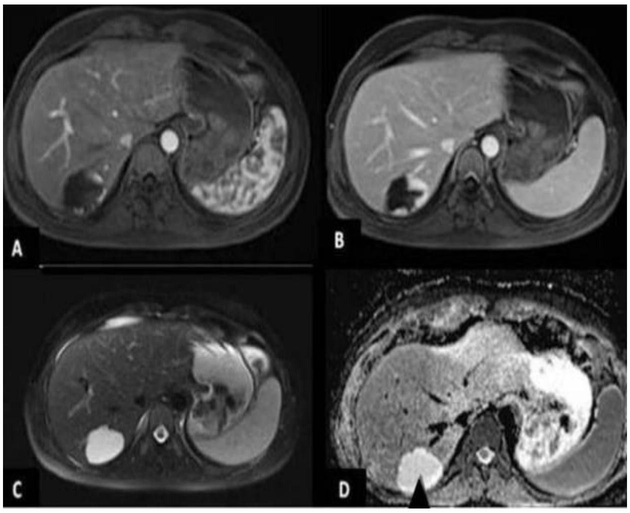

Figure 3. The male patient in 38-year-old. In the dynamic liver MRI of the patient, it is seen that the hemangioma shows peripheral nodular enhancement and progresses towards the center (a, b). The giant hemangioma observed in segment 6 in the fat-suppressed T2W image (c) is significantly hyperintense compared to the liver parenchyma. In ADC mapping (d), the mean ADC value of the lesion (arrow) was 1.85x10-3 mm2/s, while the average ADC values obtained from the healthy liver were measured as 1.07x10-3 mm2/s.

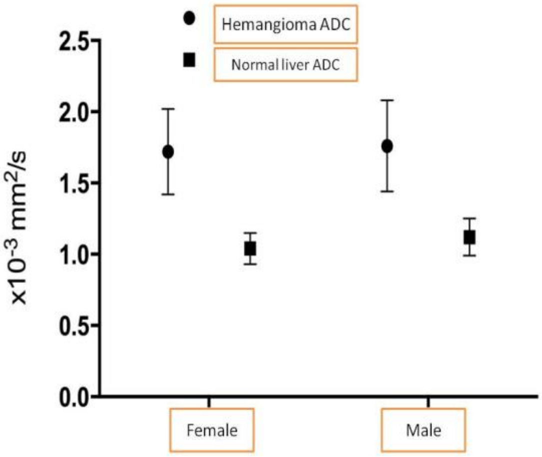

Figure 4. Comparison of hemangioma and normal liver ADC values by gender.

When comparing the mean ADC value of both hemangiomas and healthy liver parenchyma; the mean ADC value of the hemangiomas was significantly higher than the mean ADC value of healthy liver parenchyma ($p<0,05$). While the mean ADC value of healthy livers was measured 1.06 ± 0.11 x 10-3 mm2/s, the mean ADC value of hemangiomas was measured 1.70 ± 0.29x10-3 mm2/s.

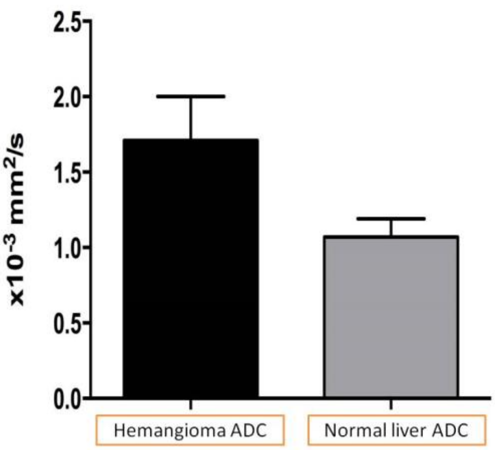

Figure 5. The distribution of the study groups according to the average ADC values with the box-plot chart.

Discussion

In some cases, it can be difficult to distinguish malignant liver tumors from hemangiomas in routine MRI. Because some hemangiomas may show atypical patterns on postcontrast MRI series, or decreased signal intensity on T2W images.[11, 12]

DWI has been shown to help identify focal liver lesions.[13,14] Furthermore, some previous studies at the literature have shown that ADC measurements are significantly different in benign and malignant liver lesions.[9,15-19] Hemangiomas contain a wider extracellular distance than normal tissue. Therefore, hemangiomas have with free diffusion and elevated apparent diffusion coefficient (ADC) values.[20]

The sensitivity of the image is determined by chancing b values in DWI. High b values should be selected to best evaluate liver masses and common liver diseases in abdominal imaging.[4, 21, 22] However, because of the healthy liver parenchyma has short T2 relaxation time, the b value should not be higher than 1000 s/mm2.[4] In our study, ADC measurements were obtained from diffusion imaging with b-800 s/mm2 value.

In recent literature, there are many studies comparing normal liver parenchyma with hemangioma. Moteki et al.[8] reported that the mean ADC value of healthy liver parenchyma was 1.16 x 10-3 mm2/s, the mean ADC value of hemangiomas was 2.23 x 10-3 mm2/s. Hemangiomas had significantly higher ADC values than healthy liver parenchyma ($p < 0.05$). Tokgoz et al.[17] reported that the mean ADC value of healthy liver parenchyma was 1.61 x 10-3 mm2/s, the mean ADC value of hemangiomas was 2.70 x 10-3 mm2/s. Hemangiomas had significantly higher ADC values than healthy liver parenchyma ($p < 0.001$). Taouli et al. reported that the mean ADC value of healthy liver parenchyma was 1.83 x 10-3 mm2/s, the mean ADC value of hemangiomas was 2.95 x 10-3 mm2/s. Hemangiomas had significantly higher ADC values than healthy liver parenchyma ($p < 0.01$).[23] Namimoto et al. [24] reported that the mean ADC value of healthy liver parenchyma was 0.69 x 10-3 mm2/s, the mean ADC value of hemangiomas was 1.95 x 10-3 mm2/s. Hemangiomas had significantly higher ADC values than healthy liver parenchyma ($p < 0.01$). Bozgeyik et al.[25] reported that lower ADC values were obtained in higher b values (b=1000) in normal liver tissue and hemangiomas. The mean ADC value of healthy liver parenchyma was 1.14x10-3 mm2/s, the mean ADC value of hemangiomas was 1.60 x 10-3 mm2/s. Hemangiomas had significantly higher ADC values than healthy liver parenchyma ($p < 0.01$). These results were consistent with our study. In our study, the Mean ADC value of healthy liver parenchyma was significantly lower than hemangiomas. The mean ADC values of healthy liver parenchyma was 1.06 ± 0.11 x 10-3 mm2/s and hemangiomas were 1.70 ± 0.29 x 10-3 mm2/s. Significant statistical difference in ADC values between hemangiomas and healthy liver parenchyma was demonstrated. ($P < 0.05$). Parikh et al.[26] reported that the mean ADC value of hemangiomas 2.04 x 10-3 mm2/s. Similarly, Kim et al.[27] reported the mean ADC value of hemangiomas was 2.04 x 10-3 mm2/s.

The ADC value of hemangiomas is higher than solid malign lesions but are lower than cysts. This is probably related to the vascular structure of hemangiomas that are more viscous than cystic fluid. Furthermore, the ADC value of malign lesions are lower than benign lesions which is probably due to their tumoral cellular content.[23, 24, 28]

In our study, there was no significant difference between lesion size and ADC values. Lesion size did not alter ADC values significantly. Similarly to our results, Bozgeyik et al.[25] and Goshima et al. [29] found no statistical correlation between lesion size and ADC values. In addition to in our study, the mean ADC values of hemangiomas were not significantly different between age groups.

There are few limitations in our study. Firstly, our study population was relatively small. Second limitation was related with the examination technique. DDWI was done with sequences sensitive to physiological movements such as respiratory, cardiac, and intestinal peristalsis. Therefore, the image quality is affected. Thirdly, our study was performed on a 1.5 T MR device. Another limitation, a separate ADC value was not calculated for each b value. It is also a limitation that ADC values are not compared with malignant lesions.

Conclusion

DWI, and measurement of ADC values may be useful both in the differential diagnosis of benign and malignant liver lesions and in the diagnosis and differentiation of hemangiomas. Hemangiomas have higher ADC values than malignant lesions and healthy liver parenchyma, but they have lower ADC values than cysts. DWI and ADC values may be helpful in primary and differential diagnosis of hemangiomas. DWI also has the advantage that it does not require contrast material and is a fast sequence.

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