Original Article

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Differentiation of Solid Liver Masses by Diffusion Weighted MRI as Benign and Malignant

Areij Fawzi Mousa Alzubaidi[1], Kassim AH Taj-Aldean[2]

Abstract

Background: Due to wide spread uses in clinical sitting of different image modalities for example as ultrasound (US), CT scan (CT), and magnetic resonance image (MRI), lead to discover of many hidden liver lesions in previously un able to diagnosed. Imaging is a critical decision making tool in the diagnosis of liver lesion, because it will discriminate in high degree between malignant and benign in a lot of cases. *Material and Methods:* A cross-sectional study were enrolled 67 patients with solid liver lesion whose admitted to Al-Hilla teaching Hospital between November 2018 and June 2019 with suspicion of solid live r lesion by ultrasound image or CT scan. *Results:* Sixtyseven patients (85 lesion) were included in this study. These patients aged between 25–70 years with mean age 52 ± 11 years. Study included 36 men (53.7%) and 31 women (46.3%). Male to female ratio 1.1:1. ADC values of 85 solid liver lesions were included in the study, an average of 1.2 lesion/patient. ADC range were 0.42–2.78 (10–3 mm^2 /s) and ADC mean 1.2 ± 0.51(10-3 mm^2 /s). The mean ADC and range for benign lesion was 1.7 ± 0.11 (0.72–2.78) and for malignant lesion was 0.61 ± 0.09 (0.42–1.68). Which is statistically significant difference between these value (p = 0.001). *Conclusion:* We concludes that quantitative assessment of solid liver lesion by DWI had best result in differentiate from benign and malignant lesion. The benign liver lesions had high ADC value than malignant lesion.

Keywords: MRI; Malignant; Ultra sound (US); Solid liver.

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Introduction

The important part of component for evaluation a liver lesion are a detail history, physical examination, radiological image, and pathological test.[1] The MRI or CT scan when appropriately reading will give the physician a many clinical detail about the lesions characters, site or liver side right or left and relation to other s structures for example gall bladder and also staging and grade of tumor in case of suspicion of malignant[2]. Imaging is a critical decision making tool in the diagnosis of liver lesion, because it will discriminate in high degree between malignant and benign in a lot of cases.[3] Most of solid liver lesion had a characteristics image detail allow for radiologist to give accurate diagnosis.[4] Magnetic resonance image is considering the best image modalities with high sensitivity and specificity for diagnosis of solid liver lesions. And in comparison with other such as US or CT scan, Magnetic resonance image have good sensitivity in discover of HCC (full form of HCC). In many study reported detected rate of MRI for HCC reach 72% as in comparison to CT scan and US 65% and 48% respectively.[5]

Presentation of liver could be as solitary lesion or multiple lesion which are seen in many patients like those with heamangima, non cirrhotic portal

Authors Affiliation: [1]Resident, [2]Professor, Department of Radiology, College of Medicine, University of Babylon, Hilla Teaching Hospital, Iraq.

Corresponding Author: Kassim AH Taj-Aldean, Professor, Department of Radiology, College of Medicine, University of Babylon, Hilla Teaching Hospital, Iraq.

E-mail: kassim33amir@gmail.com

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hypertension, hepatocellular carcinoma and metastasis tumor in liver.[6] The MRI consider the high quality test from all other images study in provide good resolution and definite diagnosis and non invasive process. Magnetic Resonance images diagnose depend up on the special signal intensity characteristic of a lesion on the T1-weight, T2-weight and diffusion weighted.[7] Thus MRI had superior advantage in diagnosis of solid liver lesion with high sensitivity and specificity in regard to other radiological modalities like as CT scan or ultrasound.[6] The type of MRI, Diffusion Weighted Image (DWI) which new approach with no contrast image study. Give high accurate visualize image with good resolution that will be help in definite diagnosis of lesion with shape and criteria.[5] Principle of action on measure random movement of water in tissues of body. It Supply quantitative data about histology and cells of tissues, to discrimination between healthy tissue and diseases one.

Quantitative assessment of lesion by MRI and DWI which is called apparent diffusion coefficient (ADC) values these coefficient measure the diffusion of water in tissues and evaluate magnitude of it.[8] This coefficient can be measure automatically by software and show as data maps.[9] These are control by drawing region of interest (ROI) on ADC map to permit to calculate ADC value.[10]

Different patterns of appearance for every types of tumors, for malignant solid liver lesion may appear hyperintense due to limited diffusion in tissue, malignant appear hypointense in ADC map.[8] On other hand benign lesion reveal characterize of hyperintense on both DWI at higher value and on ADC map, these thought to be due to high fluid content for example hemangioma or cyst lesions.[11] Now days apparent diffusion coefficient might be had a crucial role for differentiation benign from malignant lesions depend on characteristic of every lesion that will be quantitative measure, with many study support this issue.[10] Others author study these approach but not support the idea for effect of DWI in discrimination between benign and malignant, this a conflict reports regarding benefit of DWI.[12] These reported come from some solid liver benign lesion such as focal nodule hyperplasia hepatic adenoma and haemangioma could be give same ADC number count, these finding limited the task of DWI in differentiation type of lesions.[9] Also these seen in simple cyst that presents high ADC values than solid hepatic. When inclusions of cyst in study so reveal higher significance difference between malignant and benign in ADC values. Its provide idea to increase benefit of DWI in discrimination of lesion but in fact its due to cyst lesion.[11] With this objective the present study was aimed to assessthe beneficial role of DWI in patient with hepatic lesion to discriminate between solid focal liver lesions as benign or malignant.

Materials and Methods

Patients and methodology applied: A cross-sectional study were enrolled 67 patients with solid liver lesion whose admitted to Al-Hilla teaching Hospital between November 2018 and June 2019 with suspicion of solid live r lesion by ultrasound image or CT scan. A complete history was taken from each patient which included age, sex, residence and clinical examination. After this making an appointment and consent for MRI examination, a brief explanation of the examination for patient was done, mentioning the contraindications, advising how long it takes and how to dress for it, inform about the gradient noise will be heard while being immobilized in a narrow space and about the communication via the intercom, or video camera.

MRI was perform with a 1.5 Tesla systems (Achieva; Philips Medical Systems, the Netherlands) using a SENSE body coil. All patients were examined initially with a routine MRI protocol for the upper abdomen that included T2 weighted images, in and opposed phase T1 weighted images and dynamic T1 weighted images. All patients were examined in the supine position throughout the examination.

Diffusion weighted image (DWI) made by multi-slice single shot Echo planar image frequency (time-echo time: 5900 /96 milli seconds, view 250 × 250 mm, thickness of slice 5 mm, acquisation matrix: 128 × 128, B value 0,500 and 1000 s/mm^2).

The morphological features of each lesion were recorded included size, shape, margin and signal characteristics, as well as number and site of the detected focal lesions. The mean ADC of each detected focal lesion is measured by drawing a region of interest (ROI) over the lesion. The ADC was measure twice and the two measurements were averaged. To ensure that the same areas were measured, regions of interest were copied and pasted from DWMRI. Verbal and written consents were obtained from all patients. Data analysis by application of SPSS program version 20. Significance was set at the $p \leq 0.05$ levels in all analyses.

Results

Sixty seven patients (85 lesions) were included in this study. These patients aged between 25–70 years with mean age 52 ± 11 years, thirteen percent of them in age group 22–29 years 19.4% in age groups 30–39 years, 20.8% in age group 40–49 years, 31.4% in age 50–59 years and 15% in age group 60–70 years **(Table 1).** Study included 36 men (53.7%) and 31 women (46.3%). Male to female ratio 1.1:.

Table 1: Distribution of Cases According to Age groups.

Age in years	No	Percent
22–29	9	13.4%
30–39	13	19.4%
40–49	14	20.8%
50–59	21	31.4%
60–70	10	15%
Total	67	

Out of total 85 solid liver lesions taken 45% were haemangiomas, 6% focal nodular hyperplasia (FNHs), 3% hepatic adenoma, 21% hepatocellular carcinomas (HCCs), and 25% liver metastases as depicted in **Table 2**.

Table 2: Types of Liver Lesions

Liver lesion	No.	Percent
Hemangiomas	38	44.7%
Focal Nodular Hyperplasias (FNHs)	5	5.8%
Hepatic Adenoma	3	3.5%
Hepatocellular Carcinomas (HCCs)	18	21.2%
Liver Metastasis	21	24.8%
Total	85	

ADC values of 85 solid liver lesions were included in the study, an average of 1.2 lesion/patient. ADC range were 0.42-2.78 (10^{-3} mm^2 /s) and ADC mean 1.2 ± 0.51(10^{-3} mm^2 /s) as mentioned in **Table 3**.

The mean ADC and range for benign lesion was 1.7 ± 0.11 (0.72–2.78) and for malignant lesion was 0.61 ± 0.09 (0.42–1.68). Which is statistically significant difference between these value (p = 0.001).

Table 3: Status of ADC lesions in Benign and Malignant Livers.

sLesion Status of	ADC range(10^{-3} mm^2/s)	ADC mean (10^{-3} mm^2/s) ± SD	p-value
Benign	0.72–2.78	1.7 ± 0.11	0.001
Malignant	0.42–1.68	0.61 ± 0.09	

The difference in mean of ADC between all types of solid liver lesions were statistically significant p < 0.001. The mean ADC for haemangima, FNHs, adenoma, HCCs and liver metastasis were 2.88 ± 1.14, 1.7 ± 0.93, 1.64 ± 0.51, 1.41 ± 0.62, 1.02 ± 0.46 respectively as mentioned in **Table 4.**

Table 4: Show ADC mean in different types of liver lesions

Liver lesion	ADC mean (10^{-3} mm^2/s) ± SD	p-value
Haemangiomas	2.88 ± 1.14	
focal nodular hyperplasias (FNHs)	1.7 ± 0.93	
Hepatic Adenoma	1.64 ± 0.51	0.001
hepatocellular carcinomas (HCCs)	1.41 ± 0.62	
liver metastases	1.02 ± 0.46	

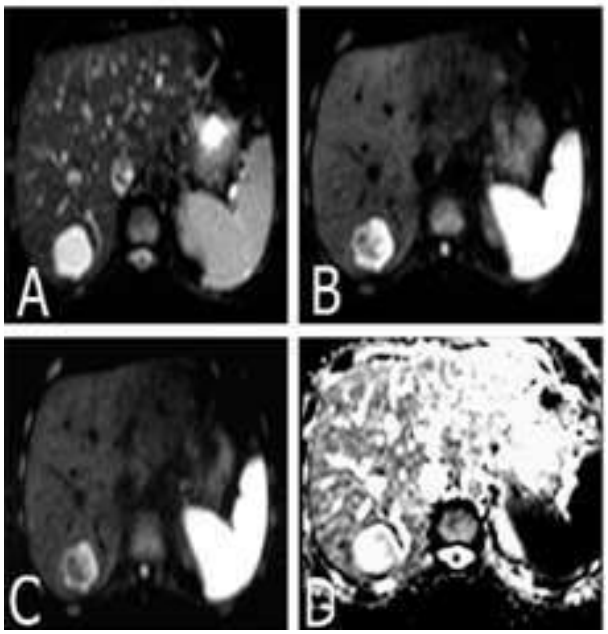

Fig. 1: Showed diffusion weighted MRI of 45 years old male patient with haemangioma, DWI, at b0(A), DWI at b500(B), DWI at b1000(C) and ADC map(D) shows mixed high SI with high mean ADC value at b1000 =2 10 A3 mm 2/s.

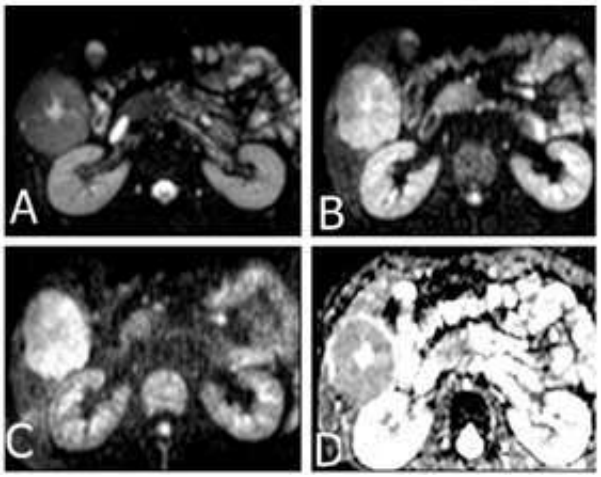

Fig. 2: This figures showed that the diffusion weighted MRI of 50 years old female patient with FNH, DWI at b 0 (A), DWI at b500 (B), DWI at b1000 (C). ROI is located peripherally in the lesion since central part represent vascular scar tissue. Mean ADC value at b1000 (B)=1.3 10 A3 2/s. though lesion is hyperintense at DWMRI, it shows high ADC value.

Discussion

In our study we found male predominant, 53.7% male, 46.3% female, which is go with study by Amr Abdelsamed[13], other study by T. Pankaj Jain[8], found female predominant, 66% female, 34% male, the study by Caraiani for eighty patients were included in the study reported 42 men (52.5%) and 38 women (47.5%)[5]. Regarding age of patients 20.8% were in age group of 40–49 years, 19.4% patient in age groups 30–39 year, 31.4% for age 50–59 year, 13.4% of patient age in 24–29 years and lastly 60–70 years. 15% of patients with mean age equal to 52 ± 11. These figures of age distribution slightly differ from other study in previous years which had mean age more than this study 54 ± 8[8] and other worker reported average age of the patients was of 59.84 ± 11.48.[5] While study by Mohammed had lower mean age of patients 50 ± 12 years.[14]

Our study revealed haemangioma in 44.7% of patients while FNH 5.8% and hepatic adenoma 3.5% on other hand our study reported 21.2% hepatocellular carcinomas and 24.8% liver metastasis by this figure benign lesions constituent 54.1% and malignant 45.9%. Others have reported that the 99 analyze liver lesions were as follow 39 haemangiomas, four focal nodular hyperplasia (FNH), 26 hepatocellular carcinomas (HCCs), and 23 liver metastases.[5] While study by Amr Abdel samed there were found 24 liver lesions 36.7% HCC 3.3% focal nodular hyperplasia 13.3% haemangiomas and 20% metastatic lesions.[13] In our result found mean of ADC values of hepatic lesions were 1.2 ± 0.51 × 10-3 mm^2/sec. These data are close to result by Caraiani.[5]

When classified lesions according to benign and malignant, benign had mean ADC value 1.7 ± 0.11× 10-3 mm^2/sec, and malignant 0.61 ± 0.09 × 10-3 mm^2/sec. These are statistically significant difference with P value 0.001. These findings were similar to result by Amr Abdelsamed in which stated that ADC measurements of benign and malignant hepatic masses were statistically different (p<0.001).[13] Similar observations reported by Onura MR that were reported the mean ADC number of benign lesions are more than malignant lesions.[15] Demir also reported that the average ADC number of benign hepatic lesions were largely more than of malignant liver lesions, p< 0.05.[16] Other researcher Vergara mention that average ADC value obtained for benign lesion differed hugely from the mean for malignant lesions with a p-value <0.05.[17]

Pankaj Jain reported the mean ADC value for benign liver tumor was 1.3 and for malignant liver tumor was 0.9, in turn its statistically distinct p < 0.001. He had concluded all lesion less than 0.9 considered malignant and lesion more than 1.5 were benign.[8] A study conducted by Demirand found that the average ADC number of benign lesion was 2.75 ± 0.21 x $10^{-3}$$mm^2$/sec, whereas for the malignant lesion had an average ADC count of 0.87 ± 0.13 × 10^{-3} mm^2/sec. It is state that the difference between the average ADC number of benign and malignance lesions was statistically apparent with p value <0.01. DW MRI with quantitative ADC measure can be useful tool in the discrimination of benign from malignant liver lesion.[16] In opposite to our result, scientist Testa mention new approach by excluded simple cyst from their data set, by this the difference between mean ADC value of benign and malignant lesions were diminished.[18]

An another study done by T. Pankaj Jain found that all lesions had mean ADC count < 0.9 may had malignant feature, on other hand lesion that had mean ADC count >1.5 goes with benign feature[8]. In theory, malignant lesions by virtue of their increased cellularity are expected to display restricted diffusion and can consequently be differentiated from less cellular, benign lesion.[19]

Our study revealed that the mean ADC value of haemangioma 2.88 ± 1.14 x10-^{3} mm^2 /sec. This result consist to other studies by Elbadrway[20] and turkbey.[21] But slightly different from works by Gomshima, these difference in mean ADC value of haemangioma in variables study may be due to used different b value of DWI or may be distinct sub type of diseases pathology.[22] The mean ADC value for focal nodular hyperplasia (FNHs) 1.7 ± 0.93x10-^{3} mm^2 /sec. and for hepatic adenoma 1.64 ± 0.51x10-^{3} mm^2 /sec. which is lower than of haemangiomas and more than that of malignant tumors, the explanation to that, may be due to FNH and hepatic adenoma had higher cellularity than haemangiomas, which are not as solid lesions. These results concomitant to what reported by Elbadrawy[20] and Kele.[23] For malignant lesion the mean ADC value for hepatocellular carcinomas (HCCs) 1.41 ± 0.62 x10-^{3} mm^2 /sec and for metastases 1.02 ± 0.46 x10-^{3} mm^2 /sec. HCCs had higher than of metastasis and the two types are much lower than of benign lesion. These finding consist to study reported by Taouli[12] and Demir.[16]

The findings of the present study may be useful for a clinicians as well as forensic experts in interpretations of the findings in cases where an expert opinion seek by any patients or agency.

Conclusion

1. Quantitative assessment of solid liver lesion by DWI had best result in differentiate from benign and malignant lesion.
2. The benign liver lesions had high ADC value than malignant lesion.
3. There is superimpose in ADC value between different types of benign lesion also between metastasis and malignant tumor.

Recommendation

1. Due to the best result of DWI use the DWI test may be used in differentiate between different types of solid focal liver lesion through calculate ADC value.
2. further studies need to put cut off point of ADC value variant liver lesions.

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