ОРИГИНАЛЬНАЯ СТАТЬЯ

THE ROLE OF DWI/ADC MRI IN THE DIFFERENTIATION OF BENIGN FROM MALIGNANT FOCAL LIVER LESIONS

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MRI is capable of providing comprehensive and highly accurate diagnostic information, with the additional advantage of lack of harmful ionizing radiation. These properties make MRI the mainstay for the noninvasive evaluation of focal liver lesions.

Purpose. This study was to assess the utility of diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) value in evaluating focal liver lesions to differentiate benign from malignant lesions.

Materials and methods. A cross-sectional study started from 1st August 2021 to 1st September 2022 in Babylon teaching hospital recruited patients with focal liver lesion diagnosed by other image modalities. Each patient underwent full assessment and history taken about disease guidance by personal questionnaire and complete clinical assessment. Magnetic resonance imaging examinations were performed on 1.5 T system (1.5 Tesla device). All patients were examined in the supine position throughout the examination. DWIs were obtained in transverse plane using single-shot echo-planar spin echo sequences.

Results. The study include 59 patients aged from 20-70 years old, mean age 57.2±10.4 years. Patients below 50 years age constituted 23.8% of sample and 76.2% of patients aged 50 years or more. Male to female ratio was 1.8:1. Pathological findings by MRI there were 38.7% haemangioma, 6.4% focal nodular hyperplasia (FNH), 4.8% hepatic adenoma, 13% hepatocellular carcinomas, 19.3% liver metastasis, 9.7% cyst and 8.1% cholangiocarcinoma.

Conclusions. Apparent diffusion coefficient (ADC) value is a reliable index for differentiation benign from malignant liver lesions. The mean ADC value for benign lesion was 1.8±0.7 (10-3 mm2/s) and for malignant was 1.3±0.4 (10-3 mm2/s) these difference was statistically significant, p-value <0.001. The ADC value of benign hepatic lesions was higher than the ADC value of malignant hepatic lesions.

Keywords: malignant hepatic lesions, diffusion-weighted imaging, magnetic resonance imaging, apparent diffusion coefficient.

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РОЛЬ ДИФФУЗИОННО-ВЗВЕШЕННОЙ МРТ В ДИФФЕРЕНЦИАЛЬНОЙ ДИАГНОСТИКЕ ДОБРОКАЧЕСТВЕННЫХ И ЗЛОКАЧЕСТВЕННЫХ ОЧАГОВЫХ ПОРАЖЕНИЙ ПЕЧЕНИ

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МРТ – высокоинформативный метод диагностики, позволяющий получать диагностическую информацию с высокой точностью без воздействия ионизирующего излучения. Для неинвазивной оценки очаговых поражений печени МРТ является одним из основных методов.

Цель. Оценить возможности диффузионно-взвешенной МРТ (DWI) с количественным определением кажущегося коэффициента диффузии (ADC) для дифференциальной диагностики доброкачественных и злокачественных очаговых поражений печени.

Материалы и методы. Поперечное исследование проводилось с 1 августа 2021 г. по 1 сентября 2022 г. в клинической больнице г. Вавилон. В исследование были включены пациенты с очаговым поражением печени, выявленным различными методами визуализации. Каждому пациенту выполнялось первичное обследование со сбором анамнеза, заполнения индивидуального опросника и оценкой клинической картины. Магнитно-резонансные исследования проводились на томографе с напряженностью поля 1,5 Тл. Все пациенты обследовались в положении лежа на спине. Диффузионные томограммы получались в поперечной плоскости с использованием однократных эхо-планарных последовательностей (single-shot EPI).

Результаты. В исследование было включено 59 пациентов в возрасте от 20 до 70 лет, средний возраст 57,2±10,4 года. Пациенты моложе 50 лет составили 23,8% выборки, 76,2% человек были в возрасте 50 лет и старше. Соотношение мужчин и женщин было 1,8:1. При выполнении МРТ были выявлены следующие очаговые изменения в печени: гемангиомы – в 38,7% случаев, фокальная узловая гиперплазия – в 6,4%, аденомы печени – в 4,8%, гепатоцеллюлярная карцинома – в 13%, метастазы – в 19,3%, кисты – в 9,7%, холангиокарциномы – в 8,1%.

Выводы. Значение кажущегося коэффициента диффузии (ADC) является надежным показателем для дифференциации доброкачественных и злокачественных поражений печени. Среднее значение ADC для доброкачественных образований составило 1,8±0,7 (x10-3 мм2/с), для злокачественных – 1,3±0,4 (x10-3 мм2/с). Значение ADC доброкачественных поражений печени было статистически значимо выше, чем значение ADC злокачественных поражений печени, p<0,001.

Ключевые слова: злокачественные поражения печени, диффузионно-взвешенная томография, магнитно-резонансная томография, кажущийся коэффициент диффузии.

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Introduction. The magnetic resonance imaging (MRI) consider the most specific and sensitive in evaluation of focal liver lesion, in comparison to other modalities such as computed tomography (CT scan) and ultrasound (US) [1]. Advance technique in MRI was diffusion weighted image (DWI) is non-contrast magnetic resonance imaging sequence which used to comprehension assessment of focal liver lesion [2].

DWI at beginning was used in neuroradiology investigation then – in abdominal imaging. It was introduced in mid of 1990 and it acquired a greater role in clinical evaluation of human pathology [3].

The DWI work on principal of diffusion restriction within tissues of lesions the variation in diffusion give variables image permit to quantitatively assess of pathological lesions by measurement of ADC map inside lesion of interest.it depend mainly on motion of water molecules between two spaces intra and extra cellular [4].

Many studies stated that the malignant tissues have various features from normal tissues for example in cell structures consistency of cells and extracellular compartment structures [5]. These differences made water molecules diffusion variable from normal tissue and thus give different pictures in analysis and comparison by DWI. More over various stages of tumors also show inconstant images of diffusion [6].

Focal liver including hemangioma, congenital biliary cyst, hepatocellular adenoma, focal nodular hyperplasia, hepatocellular carcinoma (HCC), cholangiocarcinoma and liver secondary lesions have different presentation such as cysts, vascular lesion, infection lesion, primary solid tumor and metastasis lesions. The challenges in diagnosis and evaluation are great [7]. DWI is a good modality in diagnosis of focal liver lesion and differentiated between benign and malignant tissues, but have questionable reliability criteria of test, another limitation in DWI are cutoff point that used in distinction between various lesion types, cut off value calculated from apparent diffusion coefficient (ADC) map for quantitative assessment of lesion [8, 9].

The aim of this study is to assess the utility of diffusion-weighted imaging (DWI) in evaluating focal liver lesions for trying to differentiate benign from malignant lesions.

Materials and methods.

Study design. A cross-sectional study conducted from 1st August 2021 to 1st September 2022 in Teaching Hospital recruited patients with focal liver lesion was diagnosed by other image modalities.

Inclusion criteria:

1 – Patients had lesion size more than 10mm,

2 – Good quality of images,

3 – Age > 18 years.

Exclusion criteria:

1 – Patients with hepatic lesion less than 10mm in diameter,

2 – Unstable clinical patients,

3 – Contraindications to MRI such as claustrophobia or patients with pace maker or metal implants,

4 – Patients had prior chemotherapy or radiotherapy for hepatic neoplasm,

5 – Patients with hepatic coma.

Data collection. Each patient underwent full assessment and past history was taken by questionnaire prepared for this aim that consisted from socio-demogrphic character such as age, sex, residence, and occupation. Then history of present illness with examination finding by physician lastly image result.

Before MRI session every patients give a brief explanation of the examination, revealing the contraindication, guiding how extended it take and in what way to dresses for it, notify around the gradient sound would be received whereas being immobilize in a slender space and around the communicated through the intercoms, or video cameras. Patients were subjected to Laboratory investigations such as liver biochemical profile, and renal function tests.

MRI examination technique. MRI test was achieved by 1.5 tesla systems Philips medical systems. The following criteria: weighted image T2 in axial fast spine echo image, TR 3501m/sec TE 100m/sec, 90 angle flips, 3.5 slice thickness, gap thickness 0.4 matrixes 322×225, view field 16×15cm, train echo length 13, band width 31kHz. Weighted image of T2 achieved in axial and coronal planes. T1 weighted image performed before DWI. All patients were examined in the supine position throughout the examination.

Entirely DWI procedures performed in transverse planes by single shotecho plane sequence. Diffusion weighted images need a sum of 95s to scan by MRI. The array spatial sensitivities encoding techniques were used by way of parallels image techniques.

The assessment of findings was done clearly and cautiously. For various mass discover the ADC value was measured and detected on MRI and DW images stated by gray scales ADC map for every lesions at 1500 s/mm2 gradients unite by measure region of interest. Then mean of ADC value was report

Table №1. Age and gender distribution.

Variables		No.	%
Age	<50 years	14	23.8
	≥50 years	45	76.2
Gender	Male	38	64.5
	Female	21	35.5

Table №2. The pathological types by MRI.

Liver lesion	No.	%
Haemangioma	24	38.7
Focal nodular hyperplasia (FNHs)	4	6.4
Hepatic Adenoma	3	4.8
Hepatocellular carcinomas (HCCs)	8	13
Liver metastasis	12	19.3
Cyst	6	9.7
Cholangiocarcinoma	5	8.1

ed, in multiple lesion the largest one was measured.

After this the mean ADC value of benign lesion such as focal nodular hyperplasia and lesion of malignant features for example cholingiocarcinoma were evaluated and compared. ADC value for each lesion was assessed to study the characters of each lesions and if can defined the types.

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.

ADC map was calculated by the implement of equation in soft- ware which as follow: ADC (mm2s−1) = [l n (S0/ S1000)] / 1000, where S0 and S1000 represented the signal intensity of image.

The part of tumor of large diameter were assigned for calculate of ADC. In these figure a polygonal area of interest which is the biggest one manually draw on ADC map along boundary of masses. Every image taken we measure the ADC map, ADC value range and mean.

ADC calculation. Calculation of ADC of every identified focal lesion by means of region of interest was performed. The measurement was done twice time for every lesion then the two measurement were averaged. The region of interest was copied and saved for insurance we calculated the same area.

Ethical approval. This study was approved by ethical committee of scientific research College of Medicine, University of Babylon (ID: 2021/30), and verbal consent was taken from each participants in the study.

Statistical analysis. Data was collected and included in a data based system and analyzed by statistical package of social sciences (SPSS, Inc., Chicago, IL, USA) version 23. Parametric data were expressed as mean± standard deviation (SD), it was analyzed statistically using student t-test such as difference in mean ADC between benign and malignant. While non-parametric data were expressed as percentages and were analyzed using chi square, such as comparison of gender in according to type of lesion. P-value < 0.05 was considered statistically significant.

Results.

Our study include patient with age range from 20-70 years old, mean age 57.2±10.4. Patients below 50 years age constituted 23.8% of sample and 76.2% of patients of age 50 or more. Male to female ratio was 1.8:1, female 35.5% and male 64.5% form the sample under study (Table №1).

Pathological findings by MRI: there were 38.7% haemangioma, 6.4% focal nodular hyperplasia (FNH), 4.8% hepatic adenoma, 13% hepatocellular carcinomas, 19.3% liver metastasis, 9.7% hepatic cyst and 8.1% cholingiocarcinoma (Fig. 1-4) (Table №2).

Males were predominance in presentation of lesions, 54% of benign in male and 46% in female. Otherwise malignant lesion, there were 68% male and 32% female (Table №3).

On other hand heamangioma presented in male more than female same figure show by hepatocellular carcinoma, liver metastasis, cyst and cholingicarcinoma. While focal nodular hyperplasia and hepatic adenoma were seen in female more than in male (Fig. 5).

The mean ADC value for benign lesion was 1.8±0.7 (10-3 mm2 /s) and for malignant was 1.3±0.4 (10-3 mm2/s) these difference was statistically significant, p-value < 0.001 (Fig. 6). Meanwhile the mean ADC value for

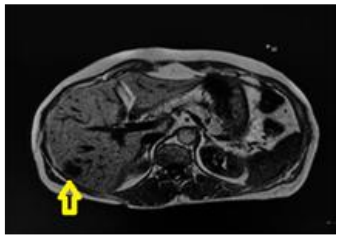

Fig. 1 a (Рис. 1 а)

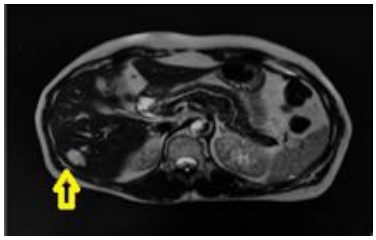

Fig. 1 b (Рис. 1 б)

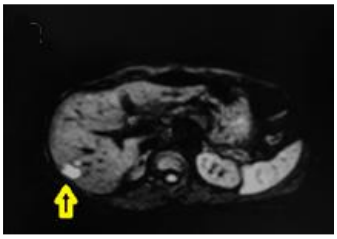

Fig. 1 c (Рис. 1 в)

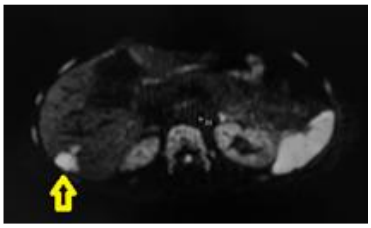

Fig. 1 d (Рис. 1 г)

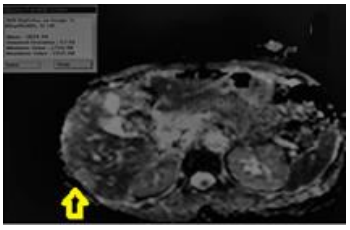

Fig. 1 e (Рис. 1 д)

Fig. 1. MRI of 40-years-old women with hemangioma.

a – T1 weighted image show low signal lesion; b – T2 weighted image show high signal lesion; c – DWI b500, show high signal lesion;d – DWI b1000, also show high signal lesion; e – on ADC map the lesion show low signal with ADC value 1.824×10-3 mm2/s.

Рис. 1. МР-изображения печени пациентки 40 лет с гемангиомой печени.

а – Т1-взвешенное изображение, очаг со сниженной интенсивностью сигнала;б – Т2-взвешенное изображение, гиперинтенсивный очаг; в – при DWI b500, очаг имеет повышенную интенсивность сигнала; г – при DWI b1000, очаг так же имеет повышенную интенсивность сигнала; д – на карте ADC очаг гипоинтенсивный со значением ADC 1,824×10-3 мм2/с..

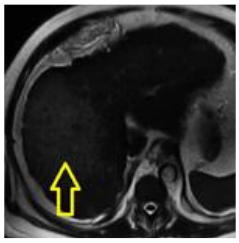

Fig. 2 a (Рис. 2 а)

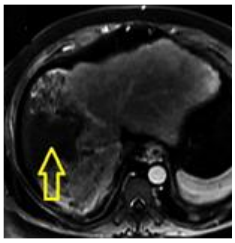

Fig. 2 b (Рис. 2 б)

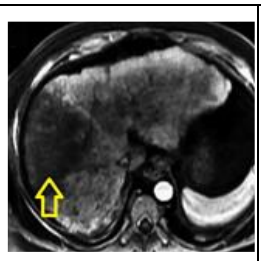

Fig. 2 c (Рис. 2 в)

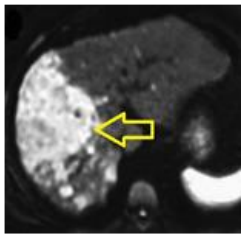

Fig. 2 d (Рис. 2 г)

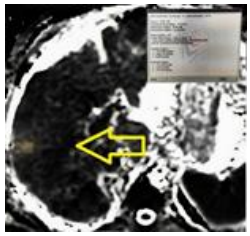

Fig. 2 e (Рис. 2 д)

Fig. 2. MRI of 65-years-old man with hepatocellular carcinoma.

a – T2 weighted image show hyperintense lesions; b – T1 C+ arterial phase show heterogeneous enhancement; c – T1C+ portal venous phase show washout appearance; d – DWI b 500 show high signal lesion; e – on ADC map the lesion show low signal (restricted diffusion) with ADC value 9.65 × 10-3 mm2/s.

Рис. 2. МР-изображения печени 65-летнего мужчины с гепатоцеллюлярной карциномой.

а – очаг имеет повышенную интенсивность сигнала на Т2-взвешенном изображении; б – в артериальную фазу контрастирования имеет гетерогенное накопление контрастного препарата; в – с вымыванием в венозную фазу; г – при DWI b500 очаг гиперинтенсивный; д – на карте ADC имеет сниженную интенсивность сигнала со значением ADC 9,65 × 10-3 мм2/с.

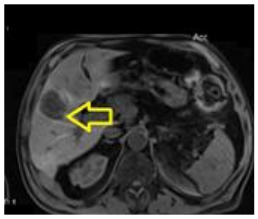

Fig. 3 a (Рис. 3 а)

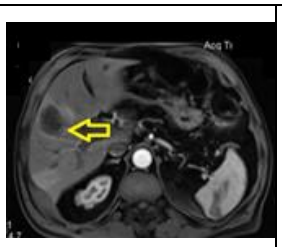

Fig. 3 b (Рис. 3 б)

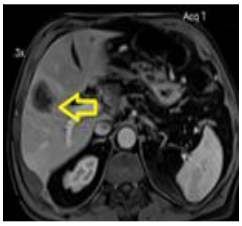

Fig. 3 c (Рис. 3 в)

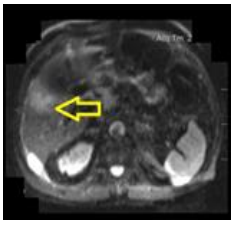

Fig. 3 d (Рис. 3 г)

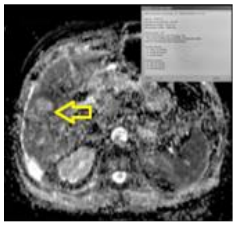

Fig. 3 e (Рис. 3 д)

Fig. 3. MRI of 58- years-old man with metastatic prostate cancer in liver.

a – T1-weighted image show hypointense lesion; b – arterial phase T1-weighted image the lesion show ring enhancement; c – venous phase T1-weighted image the lesion show ring enhancement; d – DWI show restriction; e – on ADC map the lesion with ADC value 7.49 × 10-3 mm2/s.

Рис. 3. МР-изображения печени мужчины 58 лет с метастазами рака предстательной железы.

а – на Т1-ВИ очаг имеет сниженную интенсивность сигнала; б – в артериальную фазу контрастирование кольцеобразно накапливает контрастный препарат; в – в венозную фазу сохраняется кольцевое накопление; г – на изображениях DWI имеется ограничение диффузии; д – на карте ADC очаг со значением ADC 7,49 × 10-3 мм2/с.

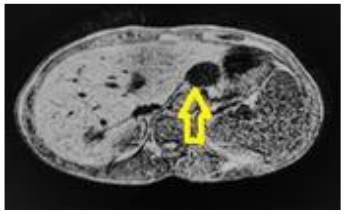

Fig. 4 a (Рис. 4 а)

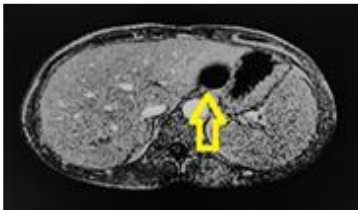

Fig. 4 b (Рис. 4 б)

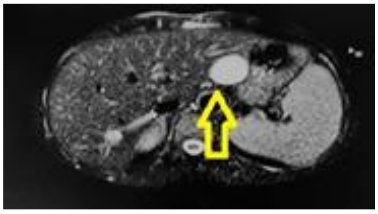

Fig. 4 c (Рис. 4 в)

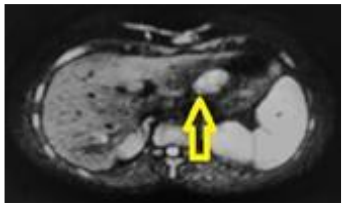

Fig. 4 d (Рис. 4 г)

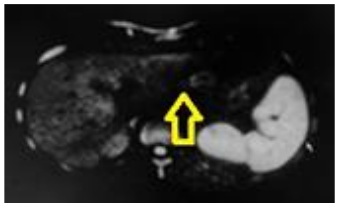

Fig. 4 e (Рис. 4 д)

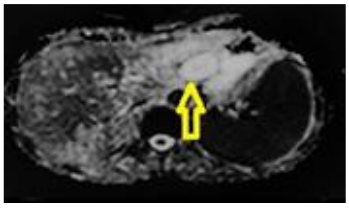

Fig. 4 f (Рис. 4 е)

Fig. 4. MRI of 44-year-old man with hepatic cyst.

a – T1 weighted image show homogeneous very low signal lesion; b – T1 C+ the lesion not enhance; c – T2 weighted image show very high signal lesion; d – DWI b500 show moderate signal lesion; e – DWI b 1000 show moderate signal lesion; f – on ADC map the lesion show high signal with ADC value 3.425 ×10-3 mm2/s..

Рис. 4. МР-изображения печени 44-летнего мужчины с кистой.

а – на Т1-ВИ очаг со сниженной интенсивностью сигнала; б – Т1-ВИ с к/у, очаг не накапливает контрастный препарат; в – на Т2-ВИ очаг повышенного сигнала, г – на DWI b500, киста имеет промежуточную интенсивность сигнала; д – DWI b1000, киста имеет промежуточную интенсивность сигнала; е – на карте ADC очаг гиперинтенсивный со значением ADC 3,425 × 10-3 мм2/с.

variable lesion was recorded in (10-3 mm2/s), high value presented by cyst lesion was 2.95±0.98, haemangioma was 2.2±1.4, focal nodular hyperplasias (FNHs) was 1.8±0.7, hepatic adenoma was 1.73±0.8, hepatocellular carcinoma 1.3±0.5 and liver metastasis 1.03±0.4 the difference was also statistical significant (Table №4).

In table 5 show the appearance of various lesion in different stages of examinations, cyst and hemangioma in usual MRI T1 appear hypo intense and in T2 hyper intense, in contrast cyst not enhance while hemangioma nodular. Hepatocellular carcinoma and metastasis appear in T1 and T2 hyper intense and early enhance in contrast.

The mean ADC value to differentiate from benign and malignancy was 1.2, these give high sensitivity 91%, specificity was 72% area under curve 0.88 (0.79-0.91) and p-value 0.001 (Table 6) (Fig. 6).

Discussion.

Magnetic resonance images are of great benefit in given comprehension and biggest accuracy in diagnosis of focal liver lesion with additional advantages that have not ionizing radiation, MRI characters makes the strength non- invasive assessment tool [10].

Thought the MRI study play important role in focal liver lesion management by means of safe contrast test and technique that free from radiation [11].

Regarding demographic characters of our study, our patients with age range from 20-70 years old, mean age 57.2±10.4. Patients below 50 years age constituted 23.8% of sample and 76.2% of patients age 50 years or more. Male to female ratio was 1.8:1, female 35.5% and male 64.5% form the sample, this in line of study by Testa et al. and Mohammed et al. [12, 13].

In addition Abdelsamed et al., thesis done include thirty patient 20 male and 10 female, with range of age from 33-60 year [14]. Elma et al., in Vienna reported more high boundary of age from 19 to 82 because different in population composition [15].

Other study by Jain et al. found female predominant 66% female, 34% male [16]. These differences because nature of cross sectional study depend on visitors in determine period [15].

Our MRI result of liver lesion were 38.7%

Table №3. Liver lesion according to gender.

Liver lesion	Male	Female	Total	p-value
Benign	20(54%)	17(46%)	37	
Malignant	17(68%)	8(32%)	25	0.4
Total	37	25	62	

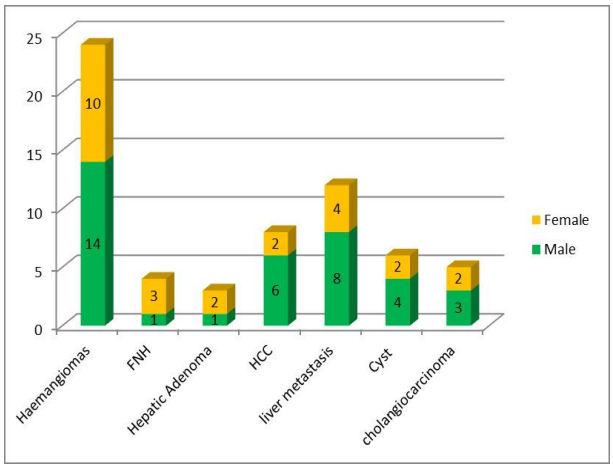

Fig. 5 (Рис. 5)

Fig. 5. Diagram.

Liver lesion according to gender.

Рис. 5. Диаграмма.

Количество очагов в печени в зависимости от пола.

presented haemangioma, 6.4% focal nodular hyperplasia FNH, 4.8% hepatic adenoma, hepatocellular carcinomas 13% liver metastasis were 19.3% cyst appear in 9.7% and cholingiocarcinoma in 8.1%, it consisted with prior studies by Latif et al. and by Alzubaidi et al. but it differ from study by Elma et al. reported malignant more than benign in his sample [15, 17, 18].

Testa et al. study also presented 21% hemangioma, 23% cyst, 1% hepatic adenoma and 1% focal nodular hyperplasia [12]. While the other study show out of 25 focal liver lesion, 36% hepatocellalr carcinoma, 3.5% FNH, 3.5% cyst, 13% hemangioma, 6.8% cholangiocarcinomas, 16.8% regenerative nodules and 7 metastatic lesion [14].

The difference in result of studies may be due to variation in risk factors and chronic diseases that epidemic in his population that differs from our sample [10].

Our result showed male predominance in presentation of benign and malignant, 54% of benign was male and 46% was female. From malignant, there were 68% male and 32% fe-

Table №4. The mean of ADC value of various liver lesion.

Liver lesion	ADC mean (10-^{3} mm^2 /s)±SD	p-value
Haemangioma	2.2±1.4	0.001
Cyst	2.95±0.98	
Focal nodular hyperplasias (FNHs)	1.8±0.7	
Hepatic Adenoma	1.73±0.8	
Hepatocellular carcinomas (HCCs)	1.3±0.5	
Liver metastasis	1.03±0.4	
Cholangiocarcinoma	1.02±0.3	

Table №5. The appearance of various lesion in different stages of examinations.

Lesion	T1	T2	Contrast	ADC
Cyst	Hypo intense	Hyper intense	Not enhanced	2.95
Hemangioma	Hypo intense	Hyper intense	Nodular enhanced	2.2
HCC	Hyper intense	Hyper intense	Early enhanced	1.3
Metastasis	Hyper intense	Hyper intense	Early enhanced	1.03

Table №6. The cut value of ADC.

Variables case	Cutoff	Sensitivity	Specificity	AUC(95%CI)	p-value
Mean ADC	1.2	91%	72%	0.88(0.79-0.91)	0.001

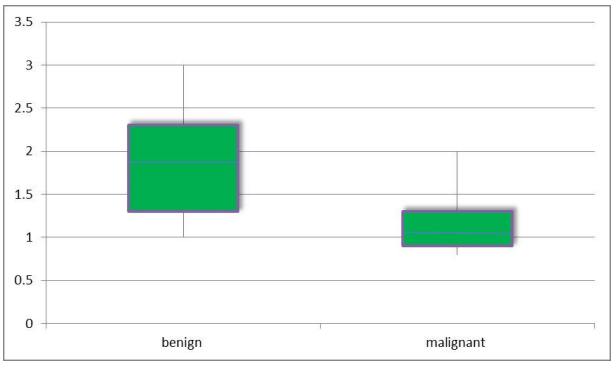

Fig. 6 (Рис. 6)

Fig. 6. Diagram.

Box plot of the difference between benign and malignant mean ADC value.

Рис. 6. Диаграмма.

Различия между средними значениями коэффициента ADC при доброкачественных и злокачественных образованиях.

male. Our result with line of prior studies which are show predominance of male the cause appear related to both behavioral risk factors and biologic factor [12, 18].

Hemangioma presented in male more than female same figure show by hepatocellular carcinoma, liver metastasis, cyst and cholingicarcinoma. While focal nodular hyperplasia and hepatic adenoma were seen in female more than in male. It agreement with Alzubaidi et al. study and differ from study by Latif et al. and Jain et al. these might be variable gender distribution in their study or geographical variation according to site of studies [16-19].

In present study the average ADC value of benign lesion were 1.8±0.7 (10-3 mm2/s) and for malignant were 1.3±0.4 (10-3 mm2/s), these difference were statistically significant, (p-value <0.001). Meanwhile, high value presented by cyst lesion was 2.95±0.98 (10-3 mm2/s), haemangioma was 2.2±1.4 (10-3 mm2/s), focal nodular hyperplasias (FNHs) was 1.8±0.7 (10-3 mm2/s), hepatic adenoma was 1.73±0.8 (10-3 mm2/s), hepatocellular carcinoma 1.3±0.5 (10-3 mm2/s) and liver metastasis 1.03±0.4 (10-3 mm2/s), the difference was also statistical significant. These result are close to study by Alzubaidi et al. study [18].

In similar findings Elma et al. demonstrated the mean ADC value is consistent method for distinction between benign and malignant focal liver lesion [15]. He stated the mean ADC value for benign liver lesion was 1.79 (1.23-2.37 ×10-3 mm 2/s, and for malignant lesion value are 1.14 (1.03-1.33) ×10-3 mm2/s, these value showed significant difference (p= 0.002) [15].

Mohammed et al. concluded the ADC values of benign lesions are significantly higher than those of malignant lesions, with variable degrees of overlap between the pathological entities [13].

Other study reported the ADC values of the 11 benign lesions were 1.78 ×10-3 mm 2/s. The mean ADC value of benign lesion was range from 1.2×10-3 to 2.5 ×10-3 mm2/s. The uppermost ADC values were for simple cyst. The ADC values of the 19 malignant lesions were 1.05×10-3 mm2/s. Among the malignant lesions, the lowest ADC value was for metastasis hepatic lesion 1.04×10-3 mm2/s. The difference between the ADC values of benign and malignant lesions was statistically significant (p <0.0001) [14].

Our result supports similar previous findings where Onura et al. stated that the mean ADC values of benign lesions were higher than malignant lesions [20]. In study of Miller et al reported the mean of ADC for liver malignant lesion were statistically lower than that of liver benign lesions (p=0.04) [21].

A study by Vergara et al, show the mean of benign liver lesion were higher than of malignant hepatic lesion (p=0.05) [22].

Latif et al., illustrated the frequent measure of ADC at two different b value one at 500 and second at 1000 diffusion gradient was very beneficial to discrimination between benign liver and malignant lesion. He was stated cut off value for ADC at b 500 and 1000 diffusion gradient which are show increase sensitivity and specificity in variation. In his work the average ADC value for benign hepatic lesion as follow, focal nodular hyperplasia 1.78×10-3 mm2/s, for adenomas 1.81×10-3 mm2/s, hemangiomas show 2.4×10-3 mm2/s and for cyst was 2.5×10-3 mm2/s. Whereas the average ADC value of malignant in his work presented for hepatocellular carcinoma 1.25×10-3 mm2/s, ADC for metastasis 1.12×10-3 mm2/s and cholangiocarcinomas 1.04×10-3 mm2/s [17].

A systemic review by Taouli and Koh study of DW images for assessment of liver lesion, they stated the mean ADC value for malignant lesion range from 0.91 to 1.45×10-3 mm2/s, while for benign lesion the ADC range from 1.5 to 2.89×10-3 mm2/s. On other hand the cyst lesion showed ADC value 2.45 to 3.7×10-3 mm2/s [23].

In Testa et al. study demonstrated the most critical cut off point was 1.23×10-3 mm2/s to distinction metastasis from solid benign and had sensitivity 72% and 73% specificity with accuracy 70% [12].

But in previous study reported lower cut off value and low accuracy in differentiation of solid liver lesion from metastasis however still significant difference also present [24].

The higher ADC value was seen in cyst and hemangioma might be due to free distribution of water molecule inside it contents, whereas for hepatocellular carcinoma and metastasis had low ADC value due to higher cellularity than benign lesion [15].

These differences between variable studies in calculation of ADC values might be many reasons such as various types of hard ware where used in different equipment, use changed b value because absence of standard protocol of work in images acquisition and variables sample of population under the studies [12]. With increasing use of DW images and important of finding will definitely prospect of uniformities parameters will be developed in images acquisition. Still of benefit ADC of DWI in monitoring of oncology therapy [10]. And since visual interpretation of images and characterization of lesions depending on diffusion appearance of lesions has its limitation, therefore the calculation of the ADC values was of importance in lesions assessment [14].

The appearance of various lesion in different stages of examinations, cyst and hemangioma in usual MRI T1 appear hypo intense and in T2 hyper intense, in contrast cyst not enhance while hemangioma nodular. Hepatocellular carcinoma and metastasis appear in T1 and T2 hyper intense and early enhance in contrast. These results agree with studies of Elma et al. Mohammed et al. and Alzubaidi et al., Iraqi study [13, 15, 18]. Our mean ADC value used to differentiate between benign and malignant was 1.2×10-3 mm2/s. These give high sensitivity 91%, specificity was 72% area under curve 0.88 (0.79-0.91) and (p= 0.001). These result it close to study by Elma et al. [15].

A study of Testa et al found in their result cutoff value were 1.2 ×10-3 mm2/s used to distinction between benign from malignant liver lesion with accuracy reach to 70% and these figure was statistically significant [12]. Some authors used cut off point reach to 1.4 [25, 26].

Taouli and Koh on the work used value of mean ADC cutoff range from 1.41-1.73 ×10-3 mm 2/s [23]. These difference in cutoff point of mean ADC between authors may be due type of instruments and experience of worker, or to variable lesions under study [17].

Conclusions.

The ADC value of benign hepatic lesions was higher than the ADC value of malignant hepatic lesions. Diffusion weighted MR imaging is a good imaging modality for diagnosis and differentiated benign and malignant hepatic focal lesions. We recommend adding DWI and ADC to liver imaging protocols of focal liver lesion as it aids in the differentiation and discrimination between benign and malignant focal hepatic lesions through measurements of

ADC values.

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