Profile of focal liver lesions by diffusion weighted magnetic resonance imaging

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Abstract
Background: Focal liver disease is a common diagnostic problem referred to radiologists for evaluation owing to its nonspecific clinical presentation and marked inter-observer variation on clinical examination. Focal hepatic lesions include a large gamut of both benign and malignant lesions such as hepatic cysts, liver abscesses, haemangioma, adenoma, focal nodular hyperplasia, hepatocellular carcinoma, hepatoblastoma, metastases etc. Therefore, the determination of liver lesion count, and the nature of the lesion is important. Thus a study design for evaluation and diagnosis of focal liver lesions by diffusion weighted imaging (DWI) is conducted. **Aims and Objectives:** Detection and characterization of focal liver lesions, differentiation of benign from malignant liver lesions, differentiation of liver metastasis from primary liver lesions. **Methods:** Total 60 Patients were studied during period of October 2010 to August 2012. Diagnosis on MRI was made with background of clinical context. Final diagnosis was reached in consensus with biopsy/FNAC, wherever applicable, or clinical, laboratory, other imaging modality findings and follow up. **Results:** A total of 60 patients with 267 focal liver lesions were studied. Age range was of 16-95 years. Mean age was 52.75 years. Out of 60 patients 31 patients had benign lesions and 29 patients had malignant lesions. 28.33% of patients were in age group of less than 40 years. Most malignant lesions were seen in the age group of 61-70 years. Most of the HCC were seen in the age group of 61-70 years. All lesions were common in males namely HCC (66.67%), metastasis (58.82%), simple cysts (71.42) except haemangiomas and hydatid cysts which were equally seen in males and females. Out of 267 focal liver lesions in 60 patients, 101(37.83%) were benign lesions and 166(62.17%) were malignant lesions. Most common lesion was metastasis (52.8%). Maximum numbers of lesions were between 2.1-5.0cm. Average size of lesion was 3.72 ± 2.39 cm. **Conclusion:** Diffusion-weighted (DWI) MR imaging can be used for liver lesion detection and characterization, with better results with potential additional value to routine MRI sequences.
Key Word: Diffusion-weighted (DWI) MR imaging, Focal liver lesions, HCC, Metastasis.

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INTRODUCTION

Liver diseases have been known to affect mankind since the dawn of civilization and have steadily gained recognition as a major health problem principally because of their world-wide distribution. The symptoms of liver disease such as jaundice, fever, abdominal distension and encephalopathy are striking phenomena that bring the patient to the physician. Clinical and biochemical examination provide information regarding liver size and functions but the assessment of the exact pathology is grossly inadequate. Focal liver disease is a common diagnostic problem referred to radiologists for evaluation owing to its nonspecific clinical presentation and marked

inter-observer variation on clinical examination. Focal hepatic lesions include a large gamut of both benign and malignant lesions such as hepatic cysts, liver abscesses, haemangioma, adenoma, focal nodular hyperplasia, hepatocellular carcinoma, hepatoblastoma, metastases etc. Therefore, the determination of liver lesion count, and the nature of the lesion is important. Today, focal liver lesions are diagnosed using ultrasonography (USG) and/or computed tomography (CT). Additionally, magnetic resonance imaging (MRI) is preferred when further characterization of these masses is needed. With introduction of MRI contrast agents, MRI with contrast material enhancement has potential to become the leading imaging modality in evaluation of liver. MRI is currently considered to be the most accurate noninvasive method in the evaluation of liver lesions.[1] Diffusion weighted imaging (DWI) is another mechanism for developing image contrast and relies on changes in the diffusion properties of water molecules in tissues. DWI is thought to be capable of predicting the response to therapy of malignant tumors.[2] Thus a study design for evaluation and diagnosis of focal liver lesions by diffusion weighted imaging (DWI) is conducted.

AIMS AND OBJECTIVES
Detection and characterization of focal liver lesions, differentiation of benign from malignant liver lesions, differentiation of liver metastasis from primary liver lesions.

MATERIAL AND METHODS
Sample size: Total 60 Patients were studied during period of October 2010 to August 2012. Diagnosis on MRI was made with background of clinical context. Final diagnosis was reached in consensus with biopsy/FNAC, wherever applicable, or clinical, laboratory, other imaging modality findings and follow up.

Inclusion Criteria: All patients referred to the department of Radio diagnosis, Byramjee Jeejeebhoy Medical College and Sassoon General Hospitals, Pune. Patients of all age groups referred to MRI clinically suspected of focal liver lesions. Patients with indeterminate lesions detected on USG or CT.

Exclusion Criteria: All patients having cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic implants. Patient having history of claustrophobia. All patients who do not consent to be a part of the study.

Data Analysis: Patients with more than ten lesions, only larger ten lesions were considered in the study. Results expressed as mean, standard deviation, number and percentages. One-way ANOVA was used for multiple group comparison and student unpaired 't' test for 2 group comparison. Categorical data was analyzed by chi-square test. p-value of 0.05 or less was considered for statistically significant.

Machine: 1.5 Tesla GE – SignaHdxt MRI machine.

OBSERVATIONS AND RESULTS
In the present study maximum numbers of patients were in the age group below 40 years of age, followed by patients in the age group of 61 to 70 years, mean age was 52.75 years, male preponderance (65%), when compared to females (35%), Male: Female- 1.85: 1.

Table 1: Distribution Of Patients According To Diagnosis

Diagnosis	No. of patients	Percentage
HCC	9	15.0
METS	17	28.3
CholangioCa	1	1.7
CholangioCa + Mets	2	3.3
Haemangioma	8	13.3
Simple hepatic cyst	14	23.3
Abscess + Simple hepatic cyst	1	1.7
Hydatid cyst	2	3.3
Abscess	6	10.0

In the present study, most common lesion studied was metastasis in 17(28.3%) patients, followed by simple hepatic cyst in 15 patients.

Table 2: Distribution Of Patient According To Multiplicity Of Focal Liver Lesions

	Number of patients	Percentage
Single lesion	15	25.00
Multiple lesion	45	75.00
Total	**60**	**100.0**

In the present study 75% of patients had multiple focal hepatic lesions.

Table 3: Distribution Of Lesions According To Liver Lobe Involvement (267)

	Number of Focal liver lesions	Percentage (%)
Hilum	1	0.40
LL	123	46.10
RL	143	53.60
Total	**267**	**100.0**

In present study most of patients had involvement of right lobe 53.6%.

Table4: Age Wise Distribution Of Cases

Diagnosis	Age group					Total
	<40	41-50	51-60	61-70	>70	
HCC	0	2	2	5	0	9
METS	6	0	5	6	0	17
CholangioCa	0	0	0	1	0	1
CholangioCa + Mets	0	0	1	0	1	2
Haemangioma	2	1	2	1	2	8
Simple hepatic cyst	5	4	1	2	2	14
Abscess + Simple hepatic cyst	0	0	0	0	1	1
Hydatid cyst	0	2	0	0	0	2
Abscess	4	1	0	1	0	6
Total	17	10	11	16	6	60
Percentage (%)	28.33	16.67	18.33	26.67	10.00	100.00

In the present study out of 60 patients 31 patients had benign lesions and 29 patients had malignant lesions. 28.33% of patients were in age group of less than 40 years, followed by 26.67% in the age group of 61-70 years. Most malignant lesions were seen in the age group of 61-70yrs.

Table 5: Sex Wise Distribution Of Diagnosis Of Focal Liver Lesions

Diagnosis	Gender				
	No of cases	Male	Percentage (%)	Female	Percentage (%)
HCC	9	6	66.67	3	33.33
METS	17	10	58.82	7	41.18
Cholangio Ca	1	0	0.00	1	100
CholangioCa + Mets	2	2	100	0	0.00
Haemangioma	8	4	50	4	50
Simple hepatic cyst	14	10	71.42	4	28.58
Abscess + Simple hepatic cyst	1	1	100	0	0.00
Hydatid cyst	2	1	50	1	50
Abscess	6	5	83.33	1	16.67
Total	60	39	100.00	21	100.00

In the present study overall there were 39 males (65%) and 21 females (35%). Male: Female- 1.85: 1. All lesions were common in males namely HCC (66.67%), metastasis (58.82%), simple cysts (71.42) except haemangiomas and hydatid cysts which were equally seen both in males and females.

Table 6: Distribution Of Patients According To Benign Or Malignant Lesions

	Number of patients	Percentage (%)
Malignant	29	48.3
Benign	31	51.70
Total	**60**	**100.00**

In the present study 29 (48.30%) patients had malignant lesions and 31 (51.70%) patients had benign lesions.

Table 7: distribution of the total flls according to malignant or benign lesions (267)

Group	No. of lesions	Percentage
Malignant	166	62.17
Benign	101	37.83
Total	**267**	**100.0**

Out of 267 focal liver lesions in 60 patients, 101(37.83%) were benign lesions and 166(62.17%) were malignant lesions.

Table 8: Distribution Of Each FIls According To Diagnosis

Diagnosis	No.of lesions	Percentage
HCC	23	8.6
Mets	140	52.43
CholangioCa	3	1.12
Haemangioma	32	12.0
Simple cyst	51	19.1
Hydatid cyst	3	1.1
Abscess	13	4.9
Dysplastic nodule	2	0.7
Total	**267**	**100.0**

Most common lesion was metastasis(52.8%).

Table 9: Distribution Of Lesions According To Size

Size of lesions (cm)	No. of lesions	Percentage (%)
≤ 2	68	25.5
2.1 – 5.0	145	54.3
>5.0	54	20.2
Total	**267**	**100.0**

In the present study, maximum 145(53.9%) number of lesions were between 2.1 to 5.0cm. Average size of lesion was **3.72 ± 2.39**cm.

Table 10: Stratification Of Lesions By Size

Diagnosis	<2cm	2.1-5cm	>5cm	No. of lesions	Percentage
HCC	7	5	11	23	8.6
Mets	39	81	20	140	52.4
Cholangio Ca	0	1	2	3	1.1
Haemangioma	3	23	6	32	12.0
Simple cyst	17	32	2	51	19.1
Hydatid cyst	0	1	2	3	1.1
Abscess	0	2	11	13	4.9
Dysplastic nodule	2	0	0	2	0.7
Total	**68**	**145**	**54**	**267**	**100.0**

In the present study most of the HCC and abscesses were more than 5cms. Most of the metastasis haemangiomas, and simple cysts were in the range of 2 to 5cm.

Table 11: Showing sex and age distribution comparison between our study and various similar studies.

	Demir et al[1]	Iman Abbas Hosny[3]	Kim et al[4]	DM Yang et al[5]	Our study
Total No Patients	30	38	126	45	60
Age Range (years)	18-88	35-75	19-87	31-75	16-95
Mean age (years)	54.4	48	60	56	52.75
No. of Male Patients	15(50%)	27(71.05%)	86(68.25%	30(66.67%)	39(65%)
No. of Female patients	15(50%)	11(28.95%)	40(31.75%)	15(33.33%)	21(35%)

Table 12: Comparison of total number of lesions that includes benign and malignant focal liver lesions and average size with various similar studies and our study

	Demir et al[1]	Kim et al[4]	DM Yang et al[5]	Xi-Jie Sun et al[6]	Our study
Total No. lesions	41	92	97	149	267
Benign Lesions.	24	38	46	78	101
Malignant Lesions	17	54	51	71	160
Size Range(cm)	1-17	0.7-10	0.5-5.5	0.8-25.8	0.8-13.5
Average size(cm)	7.4	3.7	1.76	-	3.72

DISCUSSION

A total of 60 patients (267 focal liver lesions) were studied. Diagnosis on MRI was made with background of clinical context. Final diagnoses was reached in consensus with biopsy/ FNAC, wherever applicable, or clinical, laboratory, other imaging modality findings and follow-up. Patients with more than ten lesions, only larger ten lesions were considered in the study. In our study, age range was of 16-95 years. In the present study maximum numbers of patients were in the age group below 40years of age (28.33%), followed by patients in the age group of 61 to 70 years (26.67%).

Mean age of patients in the study was 52.75 years. In the present study overall there were 39 males (65%) and 21 females (35%). Male: Female- 1.85: 1. In present study most malignant lesions were seen in the age group of 61-70 years. Most of the HCC were seen in the age group of 61-70 years. Our study is comparable with most of the above mentioned studies. In the present study 75% of patients had multiple focal hepatic lesions. In present study most of patients had involvement of right lobe 53.6%. In the present study out of 60 patients, 31 patients had benign lesions and 29 patients had malignant lesions. In the present study, most common lesion studied was metastasis in 17(28.3%) patients, followed by simple hepatic cyst in 15 patients. Out of 267 focal liver lesions in 60 patients, 101(37.83%) were benign lesions and 166(62.17%) were malignant lesions. Our study closely matches with Kim et al[4] study with respect size range and average diameter. Most common malignant lesion studied was metastasis in Demir et al[1], and Xi-Jie Sun et al[6] studies which is comparable with our study. There were total 267 lesions in 60 patients, there were 23 HCCs, 140 metastasis, 3 cholangio carcinoma, 32 haemangiomas, 51 simple cysts, 3 hydatid cyst, 13 abscesses and 2 dysplastic nodules. All lesions were common in males namely HCC (66.67%), metastasis (58.82%), simple cysts (71.42) except haemangiomas and hydatid cysts which were equally seen in males and females. Most common lesion was metastasis(52.8%).

Regarding size distribution of focal liver lesions in our study: Out of 267 focal liver lesions, 54.3% of lesions (145 lesions) were in the range of 2.1-5.0cm. In the present study most of the HCC and abscesses were more than 5cms. Average size of lesion was **3.72 ± 2.39** cm. Most of the metastasis, haemangiomas, and simple cysts were in the range of 2 to 5cm.

Missed lesions: Total 11 lesions were missed on DWI including 1 HCC, 3 Mets, 5 Simple cysts, and 2 Dysplastic nodules. This could be due to their location in left lobe or subdiaphragmatic region because of distortion artifacts and most of them were smaller than 1cm. 2 dysplastic nodules were isointense and could not be visualized. These findings are comparable to Kim etal[4].

Lesions detection rate stratified by size: The detection rate was stratified according to the lesion size. In lesion less than 2 cm range, DWI detected 57 of 68 (83.82%) lesions. Parikh et al[7] study showed that DW MR imaging significantly improved detection of small malignant lesions less than 2 cm (78.5%). Several publications have reported the use of DW MR imaging for liver lesion detection.[7,8,9] Few of these studies have compared DW MR imaging and T2-weighted imaging in terms of lesion detection, generally showing improved detection with DW MR imaging,[8,10] in terms of image quality, findings showed comparable image quality with that of DW MR imaging by using low b values.[11]

CONCLUSION

Diffusion-weighted (DW) MR imaging can be used for liver lesion detection and characterization, with better results with potential additional value to routine MRI sequences.

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