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Research Article

Diagnostic Acumen of Multiparametric Magnetic Resonance Imaging for Characterizing Focal Liver Lesions and Its Correlation with Histopathological Findings

Dr. K Tejasimha Reddy[1]*, Dr. Naveen Kumar Lanka[2], Dr. Giridhar Reddy D[3]

[1]Assistant Professor, Neelima Institute of Medical Sciences, Venkatapur (V), Ghatkesar (M), Medchal-Malkajgiri, Hyderabad
[2]Assistant Professor, ESI Medical College and Hospital, Sanathnagar, Hyderabad
[3]Assistant Professor, Neelima Institute of Medical Sciences, Venkatapur (V), Ghatkesar (M), Medchal-Malkajgiri, Hyderabad

*Corresponding Author
Dr. K Tejasimha Reddy

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Abstract: ***Background:*** Focal liver lesions (FLL) are an often incidental finding on imaging. Although most of FLL (including patients with primary malignancy) are benign in nature, managing these incidentalomas often poses a challenge to clinicians. Diagnostic workup of FLL involves both pathological and radiological examination. Histopathological examination (HPE) is considered as the gold standard test in differentiation of FLL. With multiparametric MRI (mpMRI) the efficient characterization of liver lesions is possible. In this study, diagnostic acumen of mpMRI for FLL was evaluated and correlation with HPE for confirmation was performed. ***Methods:*** This cross-sectional prospective, multi-centric study was performed for a period of 2 years (January 2024-December 2025). It included OPD and IPD patients presenting with FLL. mpMRI of these patients was performed and the results were correlated with HPE. Sensitivity, specificity, positive and negative predictive values and diagnostic accuracy of mpMRI were calculated. ***Results:*** A total of 96 FLL from 78 patients with FLL were evaluated. The incidence of FLL was significantly higher in men compared to women. Upon mpMRI of 96 FLL from a total of 78 patients, benign lesions were revealed in 65 (67.7%) cases whereas malignancy was noted in 31 (32.3%) lesions. Histopathological examination (HPE) confirmed malignancy in 32 (33.3%) lesions whereas 64 (66.7%) lesions were of benign nature. Diagnostic accuracy of mpMRI in differentiation of benign and malignant FLL was noted to be 98.96% and 98.48% respectively. ***Conclusion:*** It can be concluded that mpMRI has high diagnostic acumen for differentiation of FLL. It can be recommended as a non-invasive alternative to histopathological examination.

Keywords: Focal liver lesions, Diagnostic accuracy, Histopathological examination, multiparametric magnetic resonance imaging

INTRODUCTION

Focal liver lesions (FLL) are increasingly becoming a common finding upon abdominal imaging. With advancement in imaging modalities, the detection rate of FLL is significantly increased. As most of these lesions are often asymptomatic, FLL are often incidental finding on imaging. Hepatocellular adenoma, hemangioma, hepatic cystic lesions and focal nodular hyperplasia are common FLL.[1, 2] These lesions are incidentally revealed during diagnostic workup for abdominal pain.

A thorough clinical and diagnostic workup is extremely necessary in case of FLL as the management of each FLL requires a distinct approach.[2] As malignancy is often considered in differential diagnosis, healthcare professionals should be familiar with diagnostic and therapeutic modalities for FLL for better outcome of the patient.[1]

Radiological modalities for FLL include imaging techniques like ultrasound (with and without contrast), computed tomography and magnetic resonance imaging.[1, 2] Each of these techniques has its merits and demerits. Due to lack of specific guidelines, most of health care setups use almost all available imaging resources to diagnose FLL which at times may be time consuming and costly.

As magnetic resonance imaging (MRI) offers superior tissue contrast, it is considered as the most accurate imaging technique for characterizing hepatic lesions.[3] Most importantly, it is the only imaging modality that allows the combination of morphological and physiological information for evaluating the lesions.[4]

With multiparametric MRI (mpMRI) the efficient characterization of liver lesions is possible. In this study, diagnostic acumen of mpMRI for FLL was evaluated and correlation with histopathological findings for confirmation was performed.

MATERIAL AND METHODS

This cross-sectional prospective, multi-centric study was performed for a period of 2 years (January 2024-

December 2025). The study included both inpatients and outpatients referred for mpMRI. Written consent was obtained from each participant of the study. Following were the inclusion and exclusion criteria.

Inclusion criteria

- Adult patients (>18 years)
- Suspicion of FLL upon ultrasonography or computed tomography
- Follow up imaging for cases of chronic liver diseases
- Preoperative/follow up imaging in cases with extra hepatic tumors

Exclusion criteria

- Patients of age < 18 years
- Liver lesions < 1cm
- Patients with history of chemoembolization/radioembolization/ radio-frequency ablation
- Patients with contraindications for MRI.
- Patients unwilling to participate in the study

MRI examination:

Patients satisfying the inclusion criteria underwent MRI examination by 1.5-T system (Magnetom Aera, Siemens Healthcare, Erlangen, Germany). The patients were advised for fasting for 5-6 hours before MRI examination. Using a 30 channel array body coil, the patient was scanned in supine position. The examination started with a 3-plane localization gradient echo sequence. The examination was performed according to the standard protocol for liver MRI. This included in-phase and out-of-phase sequences, coronal T2 HASTE (Half-Fourier Acquisition Single-shot Turbo spin-Echo), axial fat-suppressed T2, Diffusion-weighted Imaging (DWI), axial 3D dynamic T1, and axial and coronal hepatobiliary phase images obtained at the 20th minute after gadolinium-ethoxybenzyl-diethylenetriamine pentaacetic acid (Gd-EOB-DTPA) (Primovist; Bayer-Schering Pharma AG, Berlin, Germany) administration.

DWI and Apparent Diffusion Coefficient (ADC) mapping were performed at b-values of 50, 400, and 800 s/mm^2. Following were the sequence parameters:

- Repetition time (TR): 6200 ms.
- Echo time (TE): 54 ms.
- Flip angle: 60°
- Field of view (FOV): 380 × 300 mm^2
- Slice thickness: 8 mm
- Matrix size: 192 × 144
- Number of excitations (NEX): 3
- Total acquisition time: 3 minutes

A B1 inhomogeneity-corrected method with variable flip angles was used for conducting T1 mapping. It was performed as per following sequence parameters:

- TR: 4.4 ms
- TE: 2.1 ms
- Flip angles: 3°& 15°
- Matrix size: 256 × 156
- FOV: 380 × 300 mm
- Slice thickness: 4 mm
- Acquisition time: 1.5 minutes.

Several TEs with the Steady-State Free Precession (SSFP) based true fast imaging with steady precession sequence and an exponential signal decay model were utilized for T2 mapping, Following were the parameters:

- TR: 166 ms.
- TEs: 0, 25 & 55 ms.
- flip angle: 70°
- FOV: 420 × 260 mm.
- Slice thickness: 10 mm.
- Matrix size: 192 × 192.
- NEX: 1
- Acquisition time: 1.2 minutes.

Additionally, for evaluation of hepatic iron load, T2* mapping was performed using following parameters:

- TR: 200 ms.
- TEs: 0.93, 2.1, 3.35, 4, 4.56, 5.77, 6.98, 8.19, 9.4, 10.61, 11.82, 13.03, & 14.24 ms.
- Flip angle: 20°.
- Slice thickness: 10 mm.
- FOV: 400 × 300 mm
- Matrix size: 160 × 85.

Following parameters were used to perform magnetic resonance elastography (MRE). Active driver generating mechanical waves and a modified 2D gradient-recalled echo sequence was used to perform MRE. The sequence parameters followed were:

- TR: 50 ms
- TE: 21 ms
- Flip angle: 25°
- Bandwidth: 31.25 kHz
- Matrix size: 256 × 128
- Acquisition time: 2.5 minutes.

Four slices each of 10-mm thickness were obtained from the largest portion of the liver during a breath-hold depending on the size of liver. All MRI, mpMRI, MRE and DWI sequences were performed during the same imaging session. After MRI examination, for analysis, data were transferred to a workstation (Syngo.via Siemens, Erlangen, Germany). MRI images were reviewed by experienced radiologists. Free-hand region of interest (ROI) was performed for lesion measurements that included a sufficiently large part of the hepatic lesion. In order to avoid partial volume artifacts, a thin margin was maintained outside the lesion's periphery.[4]

The contrast enhancement ratio (CER) was calculated as per the method suggested by Yoshimura *et al* (2013).[5] CER was the average T1 relaxation time values before and after contrast–pre-contrast (pre-T1 value) and at 20 minutes post-contrast on hepatobiliary phase images (post-T1 value). According to the method suggested by Peng et al. (2017), the decrease in T1 relaxation time [T1

relaxation time reduction (T1D)] and the percentage reduction in T1 relaxation time [T1D (%)] was calculated.[6] ADC was calculated for the lesions using diffusion-weighted images (DWI).[4] The findings of mpMRI were correlated with histopathology report of the patients with FLL.

RESULTS

During the study period a total of 78 patients with FLL were evaluated. These included 31 (39.7%) females and 47 (60.3%) male patients. The incidence of FLL was significantly higher in men compared to women (Z test, $P = 0.01$*).

The mean age of the patients was 56.2±14.1 years (range 42 to 71.5 years). The age wise distribution of patients with FLL is shown in figure 1. The mean age of male and female patients was 56.7±13.6 and 54.2±13.2 years respectively. Although the mean age of male patients was higher than females, this difference was not statistically significant (Mann Whitney U test, P>0.005).

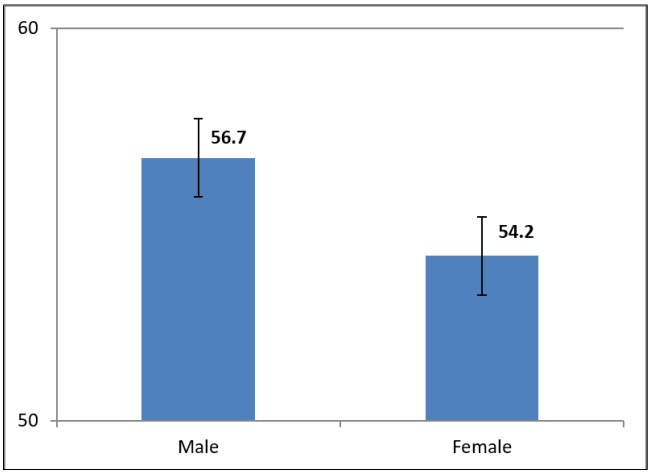

Figure 1. Age of patients with focal liver lesions

A total of 11 patients presented with multiple FLL. Out of these 11 patients with multiple FLL, 4 patients had two lesions whereas 7 patients had three lesions. Upon mpMRI of 96 FLL from a total of 78 patients, benign lesions were revealed in 65 (67.7%) cases whereas malignancy was noted in 31 (32.3%) lesions. Histopathological examination (HPE) confirmed malignancy in 32 (33.3%) lesions whereas 64 (66.7%) lesions were of benign nature.

When the diagnostic accuracy of mpMRI for differentiation of benign FLL was compared with gold standard HPE, it was noted that diagnostic accuracy of mpMRI in differentiation of benign FLL is 98.96% (Table 1) whereas it was found to have diagnostic accuracy of 98.48% for differentiation of malignant FLL (Table 2).

Table1. Diagnostic accuracy of mpMRI for differentiation of benign focal liver lesions.

Parameter	Result
Sensitivity	100%
Specificity	96.88%
Positive predictive value (PPV)	78.05%
Negative predictive value (NPV)	100%
Diagnostic accuracy	98.96%

Table 2. Diagnostic accuracy of mpMRI for differentiation of malignant focal liver lesions.

Parameter	Result
Sensitivity	96.97%
Specificity	100%
Positive predictive value (PPV)	100%
Negative predictive value (NPV)	99.66%
Diagnostic accuracy	98.48%

In this study, among various benign lesions, hemangioma (83.1%) was predominant whereas metastases (54.8%) were the most common malignant FLL noted (Figure 2 and Figure 3).

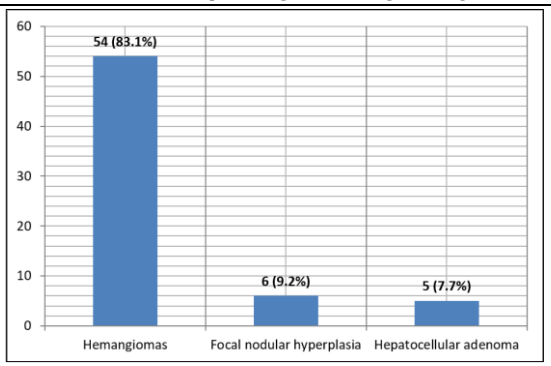

Figure 2. Benign focal liver lesions

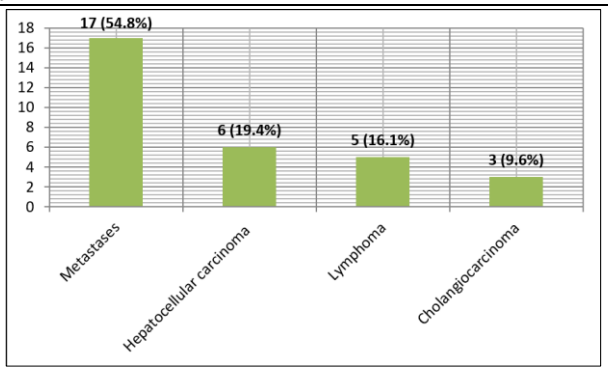

Figure 3. Malignant focal liver lesions

As shown in Table 3, the mean pre-T1 and post-T1 values in this study were 1356.6 ± 421.4 and 784.3 ± 264.2 ms, respectively. The mean T2 value was 76.4 ± 18.4 ms. The mean CER was 2.06 ± 0.5, the mean T1D was 689.32 ± 347.34 ms, and the mean percentage T1D was 48.63% ± 18.20%. The mean ADC value was 1.35 ± 0.56 × 10^{-3} mm^2/s, and the mean lesion stiffness was 5.6 ± 1.8 kPa. Malignant FLL had significantly lower T2, CER, T1D, T1D (%), and ADC values whereas stiffness values were significantly higher ($P < 0.05$).

Table 3. Magnetic resonance imaging features of focal liver lesions.

Parameter	Focal liver lesions (FLL) (N=96)	Benign FLL (N=65)	Malignant FLL (N=31)	Mann Whitney U test, *P* value
Pre-T1 value (ms)	1356.6 ± 421.4	1482 ± 465.4	1217.9 ± 464.6	0.12
Post-T1 value (ms)	784.3 ± 264.2	721.6 ± 251.2	762.2 ± 285.2	0.15
T2 value (ms)	76.4 ± 18.4	89.3 ± 22.5	65.0 ± 15.4	<0.001*
Contrast enhancement ratio (CER)	2.06 ± 0.5	2.99 ± 0.76	1.32 ± 0.32	<0.001*
T1 relaxation time reduction (T1D) (ms)	689.32 ± 347.34	992.0 ± 409.6	561.3 ± 292.4	<0.001*
T1D (%)	48.63% ± 18.20	62.4 ± 12.8	34.2 ± 11.7	<0.001*
Apparent Diffusion Coefficient (ADC) (×10-3 mm2/s)	1.35 ± 0.56	2.50 ± 0.21	1.15 ± 0.40	<0.001*
Magnetic resonance elastography (MRE) (kPa)	5.6 ± 1.8	4.2 ± 1.0	6.2 ± 1.8	<0.001*

*statistically significant

DISCUSSION

FLL are abnormal lumps or masses within the liver. As FLL are either solid or cystic masses that are differentiated from normal hepatic tissue, the term "lesion" is preferred over "masses" to better describe a broad range of abnormalities.[7] As patients with FLL are usually asymptomatic and these lesions are often incidentally picked up on imaging studies, FLL are also referred to as "incidentalomas".[8] As per clinical criteria, FLL can be classified as benign with or without requirement of any treatment and malignant lesions. [9, 10]

Although most of FLL (including patients with primary malignancy) are benign in nature, managing these incidentalomas often poses a challenge to clinicians.[11] Even though most of FLL are likely to be of benign nature, the accurate diagnosis and management of incidental FLLs is of utmost clinical importance.[7]

Diagnostic modality of FLL involves both pathological and radiological examination. Pathological investigations that supplement FLL workup include α-fetoprotein (AFP), cancer antigen 9-19 and complete blood count (CBC). HPE is considered as the gold standard test in differentiation of FLL.[7] For HPE, core biopsy is preferred over fine needle aspiration as it allows evaluation of both architectural and cytological features.[12]

With recent advancement in the field of medical imaging technology, FLL are better characterized, enabling selection of more precise therapeutic modality. In this study, a total of 96 FLL from 78 patients with FLL were evaluated. It was observed that the mean age of the patients with FLL was 56.2±14.1 years. Out of 78 patients, 31 were (39.7%) females and 47 (60.3%) were male patients. Our observation regarding age and gender wise distribution coincides to that of Jia et al (2024).[13]

Standardization of imaging techniques has a crucial role in diagnosis of FLL. Imaging when performed with the appropriate method aids in not only to characterize the lesion but also facilitate in accurate evaluation of the size, localization, and relationship of the lesion with surrounding anatomical structures.[7]

In this study, mpMRI was used for characterization of FLL. It was observed that 67.7% of FLL were benign in nature and 32.3% were malignant. Hemangioma (83.1%)

was predominant among benign FLL whereas metastases (54.8%) were the most common malignant FLL. FLL are common with reported prevalence of 5-18% on imaging studies and 20% in autopsy findings. Although, majority of FLL are benign in nature and do not require HPE, treatment or follow-up, it is paramount to identify and characterize the pre-malignant and malignant lesions for initiation of early and most appropriate treatment. [14]

Upon comparison of mpMRI for differentiation of benign FLL was compared with gold standard HPE, it was noted that diagnostic accuracy of mpMRI in differentiation of benign FLL is 98.96% whereas it was found to have diagnostic accuracy of 98.48% for differentiation of malignant FLL. Hence mpMRI can be used as an efficient alternative for diagnosis of FLL that would reduce the need of invasive HPE.

CONCLUSION

From this study, it can be concluded that multiparametric magnetic resonance imaging has high diagnostic acumen for differentiation of FLL. It can be recommended as a non-invasive alternative to histopathological examination.

Conflict of interest: Nil

REFERENCES

1. Frenette C, Mendiratta-Lala, Mishal; Salgia, R, Wong R, Sauer B, Pillai A. ACG Clinical Guideline: Focal Liver Lesions. The American Journal of Gastroenterology 2024; 119:1235-1271.
2. Algarni AA, Alshuhri AH, Alonazi MM, Mourad MM, Bramhall SR. Focal liver lesions found incidentally. World J Hepatol. 2016; 8:446-451.
3. Jabiyev A, Karçaaltıncaba M, Karaosmanoğlu AD, Akata D, Özmen MN, İdilman IS. Multiparametric magnetic resonance imaging, diffusion-weighted magnetic resonance imaging, and magnetic resonance elastography: differentiating benign and malignant liver lesions. Diagn Interv Radiol. 2026; 32:133-138.
4. AL-abdali R, AL-Zahrani M, Alotaibi S, Altayari R, Ali I, Thrwi A, et al. Role of Multi parametric MRI in Differentiating Focal Liver Lesions: A Comparative Study with Contrast-Enhanced Ultrasound. The Review of Diabetic Studies. 2025; 21(S6):944-954. doi: 10.70082/8bepf356.
5. Yoshimura N, Saito K, Saguchi T, Funatsu T, Araki Y, Akata S, et al. Distinguishing hepatic hemangiomas from metastatic tumors using T1 mapping on gadoxetic-acid-enhanced MRI. Magnetic Resonance Imaging. 2013; 3:23-27.
6. Peng Z, Li C, Chan T, Cai H, Luo Y, Dong Z, Li ZP, Feng ST. Quantitative evaluation of Gd-EOB-DTPA uptake in focal liver lesions by using T1 mapping: differences between hepatocellular carcinoma, hepatic focal nodular hyperplasia and cavernous hemangioma. Oncotarget. 2017; 8(39):65435.
7. Kahraman G, Haberal KM, Dilek ON. Imaging features and management of focal liver lesions. World J Radiol 2024; 16: 139-167.
8. Mostbeck GH. Ultrasound screening examination of the abdomen: of value or senseless? Ultraschall Med. 1996; 17:175–178.
9. Latife MA, Hawary GE, Badrawy AE, Alfy HE. The role of MR diffusion in differentiation of malignant and benign hepatic focal lesions. Egyp J Radiol Nuc Med. 2014; 45: 299–308.
10. Roberts LR. Clinical approach to liver mass lesions. Mayo Clinic Scientific Press. 2011:281–294.
11. Cogley JR, Miller FH. MR imaging of benign focal liver lesions. Radiol Clin North Am. 2014; 52:657-682.
12. International Consensus Group for Hepatocellular Neoplasia. Pathologic diagnosis of early hepatocellular carcinoma: a report of the international consensus group for hepatocellular neoplasia. Hepatology. 2009; 49:658-664.
13. Jia, Tabassum S, Haider S, Haania. Diagnostic accuracy of diffusion weighted MRI in differentiating malignant from benign liver lesions taking histopathology as gold standard. Pak J Med Sci. 2024;40:669-673.
14. Sawatzki M, Husarik D, Semela D. Assessment of focal liver lesions in non-cirrhotic liver – expert opinion statement by the Swiss Association for the Study of the Liver and the Swiss Society of Gastroenterology. Swiss Med Wkly [Internet]. 2023 Sep. 12 [cited 2026 Jul. 15];153(9):40099.