



## STATE OF THE ART OF MRI IN THE DIAGNOSIS OF HEPATIC FOCAL LESIONS

Dr. Jayesh Solanki<sup>1</sup>, Dr. Deepak S. Howale<sup>2</sup>

<sup>1</sup>Senior Consultant Dept. of Radiology Shri Vinoba Bhave Civil Hospital, Silvassa

<sup>2</sup>Dean Govt. Medical College and Shri Vinoba Bhave Civil Hospital, Silvassa.

### Abstract:

One of the most commonly encountered lesions is liver lesions. Thousands of patients undergo imaging for the work up of suspected or known liver masses annually. A spectrum of lesions ranging from harmlessly benign to aggressively malignant whose characterization has prognostic and therapeutic implications in known as Focal liver lesions. The application of MDCT and thin collimation, it is likely more that liver lesions will be detected will need additional imaging for characterization, most likely with MR imaging. While USG remains the modality of choice for screening purposes in liver imaging CECT liver performed using multi-detector scanners with volumetric data acquisition and multi-planar reconstruction capabilities has been the preferred hepatic imaging modality. MR contrast media take advantage of liver specific the affinity of certain compounds to concentrate in Kupffer cells or hepatocytes. **Aim:** to designed the characterization potential of MRI to evaluate the utility of Gd-BOPTA as a liver specific enhanced sequences. **Material and methods:** This is the prospective cross-section study which is carried out on 50 patients between the age group 20 to 70 years old visiting the ultrasound section of Shri Vinoba Bhave Civil Hospital in the Department of Radiology in a period of one year. All the patients were referred to the Department of Radiology were diagnosed to have focal liver lesions by sonography were included in the study. In this studies MR imaging was used on 1.5 T systems (General electrical medical systems). A dedicated phased array body coil was used. Further imaging of the liver lesions by Gd-BOPTA enhanced MRI Liver. Exclusion criteria were pregnant women, patients less than 18 years. **Result:** Total 50 patients were included of which 30 were males (60%) and 20 were females (40%). The male female ratio was 2:1 approximately between the age group 20 to 70 years old with most patients falling between 30 to 60 years. The mean age for malignant lesions was 51 years. The right lobe of liver was involved in 26 cases (52%), left lobe in 7cases (14%) and both lobes in 9 cases (18%). There were 32 benign and 18 malignant lesions. MR Imaging diagnoses and accurately characterized 92% of lesions which is based on MR Imaging of which 90% were done on T1W Gadolinium enhanced images alone and 80% on DWI-b value, 62% on T2WI and 54% on LAVA sequences. **Conclusion:** Gd-BOPTA (Gadobenate Dimeglumine) has pharmacokinetics, extra-cellular distribution and clinical safety comparable to conventional MR contrast media. The common benign lesions were liver abscess followed by hemangiomas and the common malignant lesions were metastases. Thus MR imaging is a powerful tool for the judgement of focal liver lesions.

**Keywords:** Malignant, Benign, MRI Liver, Focal liver lesions, USG, Gadobenate dimeglumine,

### INTRODUCTION

One of the most commonly encountered lesions is liver lesions. Thousands of patients undergo imaging for the work up of suspected or known

liver masses annually. A spectrum of lesions ranging from harmlessly benign to aggressively malignant whose characterization has prognostic and therapeutic implications in known as Focal liver lesions<sup>1</sup>. ultrasonography (USG) have been

widely used in past two decades, disparity enhanced computerized tomography (CECT) and magnetic resonance imaging (MRI)<sup>ii</sup>. The aim of imaging is to assess the size, number, location of the lesions relative to the vessels and nature of the lesions. There are some studies which suggest that liver lesion may be found in more than 20% of the general population although the exact prevalence of benign liver masses is unknown<sup>iii</sup>. Accordance to the studies, which suggest that small (<15 mm) lesions that are detected on CT are benign in more than 80% of the patients who have known malignancy<sup>iv</sup>. The application of MDCT and thin collimation, it is likely more that liver lesions will be detected will need additional imaging for characterization, most likely with MR imaging. While USG remains the modality of choice for screening purposes in liver imaging CECT liver performed using multi-detector scanners with volumetric data acquisition and multi-planar reconstruction capabilities has been the preferred hepatic imaging modality<sup>v, vi</sup>. For improving using of faster imaging sequences and improve software algorithms, anatomic detail and lesion-to-liver contrast can be most effective use by dynamic studies facilitating better detection and characterization of liver lesions than CECT / USG<sup>vii</sup>. It is also important for distinguish benign and malignant liver lesions. Several malignancies such as pancreas, breast and colorectal tumors metastasize to liver. The survival rate following abscission of isolated metastasis especially in colorectal malignancies can be as high as 38%<sup>viii</sup>. MR contrast media take advantage of liver specific the affinity of certain compounds to concentrate in Kupffer cells or hepatocytes. Gadobenate dimeglumine (Gd-BOPTA) is one like intravenously administered liver specific MRI contrast medium which has selective uptake by hepatocytes and subsequent biliary excretion attributed to its chemical composition<sup>2, 6</sup>. The main aim is to design the characterization potential of MRI to evaluate the utility of Gd-BOPTA as a liver specific enhanced sequence.

#### **Material and methods:**

This is the prospective cross- section study which is carried out on 50 patients between the age

group 20 to 70 years old visiting the ultrasound section of Shri Vinoba Bhawe Civil Hospital, in the Department of Radiology in a period of one year. All the patients were referred to the Department of Radiology were diagnosed to have focal liver lesions by sonography were included in the study. In this studies MR imaging was used on 1.5 T systems (General electrical medical systems). A dedicated phased array body coil was used. Further imaging of the liver lesions by Gd-BOPTA enhanced MRI Liver. Exclusion criteria were pregnant women, patients less than 18 years.

#### **Contrast medium and equipment**

Magnets of 1.5 Tesla (T) and 3T field strength are considered standard of reference in providing high-quality with the current state of the art technology consistent MR images.

Giant advances in MRI have been achieved in the last decade in regards hardware, software with new design sequence, new parallel imaging technology and acceleration techniques) and contrast agents (hepatocyte-specific agents) have made a major impact on imaging of the liver.

A power-injector was used for the gadolinium injections (Omniscan, GE health care, 0.1 m mol/kg body weight; injection rate 2 ml/s). In our clinical routine Liver-specific contrast agent agents were not included. In our study, an adequate imaging protocol as short, comprehensive, and standardized to allow reproducibility and consistency of image quality and diagnostic performance has used.

#### **Image analysis**

On the basis of signal characteristics, morphology, improvement patterns in arterial, portal, venous and delayed phases and diffusion/ ADC maps, the lesions were characterized. The solid lesions of liver were recorded as sizes and numbers of liver lesions as well as the hepatic segments involved. The anatomical proximities of the lesions as well as inferior vena cava or hepatic veins, hepatic hilum and the main portal branches were assessed. A scale for the lesion's proximity of less than 1 cm or more than 1 cm was used. Images were evaluate for image quality and graded as poor/satisfactory/ good. Lesion

sizes, segmental localization (Couinaude-Bismuth system) as well as enhancement characteristics were documented.

**Result:**

Total 50 patients were included of which 30 were males (60%) and 20 were females (40%). The male female ratio was 2:1 approximately between

the age group 20 to 70 years old with most patients falling between 30 to 60 years. The mean age for malignant lesions was 51 years. The right lobe of liver was involved in 26 cases (52%), left lobe in 7 cases (14%) and both lobes in 9 cases (18%). There were 32 benign and 18 malignant lesions. As shown below in following table 1, 2, 3 and 4.

**Table 1: Distribution of liver lesions according to gender.**

Sex	No	Percentage	No of cases	Percentage
Male	30	60	28	56
Female	20	40	22	44

**Table 2: Age distribution of liver lesions.**

Age group	No of patients	Percentage
20-30	6	12
31-40	13	26
41-50	11	22
51-60	16	32
61-70	4	8

**Table 3: Location of lesions in right versus left lobes.**

Lesion	Number	Percentage
Right lobe	26	52
Left lobe	7	14
Both lobe	9	18

**Table 4: Type and number of benign versus malignant lesions**

Type of lesion	No	Percentage
Benign lesion	32	64
Malignant lesion	18	36

Hemangiomas and abscess were predominant in benign whereas hepatocellular carcinomas and metastases were predominant in malignant lesions. The mean ADC value of benign lesions was  $2.092 \times 10^{-3}$  sec/mm<sup>2</sup> and that of malignant lesions was  $1.241 \times 10^{-3}$  sec/mm<sup>2</sup>. The difference in mean ADC values in both the groups was significant ( $p < 0.0001$ ). MRI could characterize 94% cases.

MR Imaging diagnoses and accurately characterized 92% of lesions which is based on MR Imaging of which 90% were done on T1W Gadolinium enhanced images alone and 80% on DWI-b value, 62% on T2WI and 54% on LAVA sequences.



Fig 1: CT image on axial Liver abscess: a hypodense lesion in the liver with peripherally enhancement.



Fig 2: CT (C+ portal venous phase) Hydatid cyst of the liver

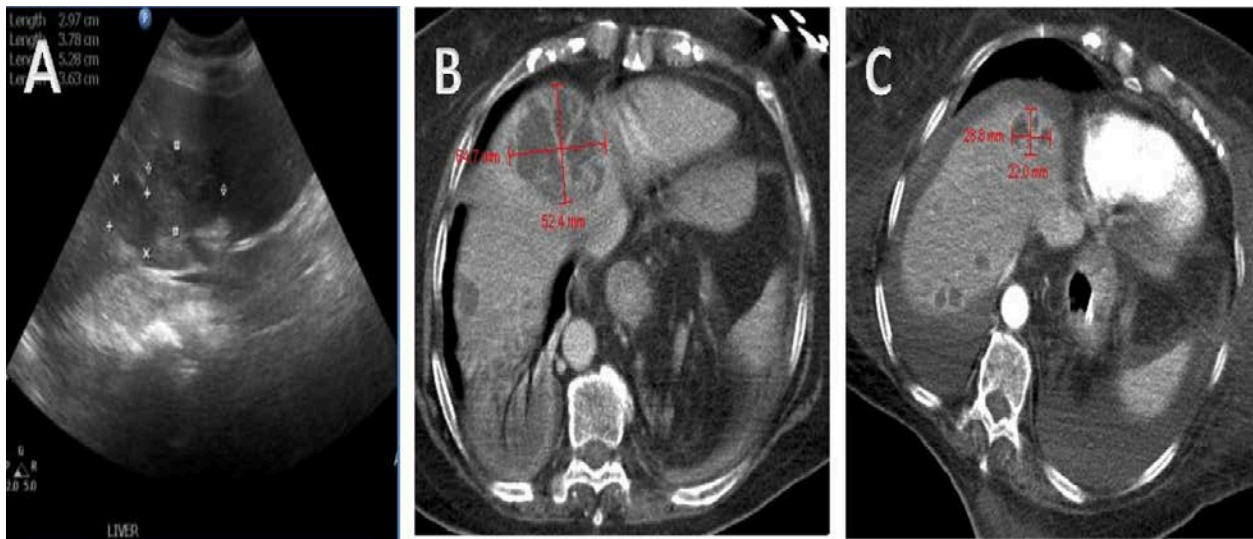


Figure 3: Hepatic abscess caused by Streptococcus constellatus or hepatic metastasis. (A) US of abdomen showing two hypodense heterogenous right hepatic lobe lesions measuring 3 × 3.8 cm and 5.3 × 3.6 cm. (B) CT scan enhancing initial contrast demonstrating multifocal multi-septated enhancing lesions. (C) C CT showing contrast enhanced improvement in hepatic multi-septated abscesse.



Fig 4: Axial C+ portal venous phase: Pyogenic liver abscess



Fig 5: showing the portal venous phase image with metastases as negative defects against the normally enhancing liver.

### Discussion:

Focal liver lesions have always been an imaging challenge because of the wide separation in management strategies based on lesion etiology. In this study total 50 patients of detected focal liver lesions for whom MRI was done in all the lesions. Focal liver lesions were examined based on clinical findings, laboratory investigations and MR imaging.

**MR imaging:** For all 50 patients MR imaging was done. In malignant lesion Metastases are the most common and abscesses are the most common benign lesions. The size of the lesions varied from 0.7cm to 14 cm with an average of 6.3 cm for malignant lesions and 5.5cm for benign lesions. According to the size of the

lesions the malignant character of the lesion is not predictive. From surgical excision or interventional therapy, Malignant neoplastic lesions may benefit whereas there do not require any treatment 'benign' neoplastic lesions often and infective lesions respond to medical therapy or surgical drainage<sup>1</sup>. Therefore, the ability to accurately differentiate between malignant lesions and benign would form the cornerstone of any form of hepatic imaging<sup>2</sup>. Most diagnostic centers are use CECT and USG increase with USG/CT guided biopsy, MRI used as a problem solving modality in selected patients<sup>5</sup>. It can detect focal liver lesions, with the advantage of tissue characterization and multi-planar anatomy, thus obviate need for other imaging modalities<sup>ix</sup>. Hence concept of using MRI as a first-line

modality for 'cost-effective' hepatic imaging to enable accurate diagnosis in worldwide<sup>9</sup>. The liver has a unique dual blood supply the hepatic artery receiving 20-30% flow and 70-80% supply from the portal vein. Focal liver lesions can therefore potentially be differentiated on the basis of their selective source of blood supply reflected in the time intensity contrast enhancement curves on dynamic postgadolinium<sup>x, xi</sup>. With increasing size of the lesions statistical significance is lost. In this study the average size of the malignant lesions was 6.3cm. Hence the detection rates of the lesions were higher as well as the significance of DW imaging is decreased. In study done by Obuz F et al overall MR imaging sensitivity for detection of small lesions (3 cm) it was 100%<sup>xii</sup>. the solid tumors tend to appear larger on DWI than on T2 weighted images. This phenomenon may contribute to the high detection rate of small solid tumors on DWI<sup>xiii, xiv</sup>. Intrahepatic vessels may be seen as false positive lesions on T2 weighted images. Small benign solid tumor might not be detected on T2 weighted images because of less conspicuity of the solid lesions by the magnetization transfer effect<sup>xv</sup>. The results show that the classification into benign and malignant liver lesions. When all sequences were collectively evaluated the assessment of specific diagnosis were most reliably achieved. The use of a combination of sequences in lesion diagnostics several previous investigations also advocate. According to Coulam et al reported a sensitivity of 97% and a specificity of 95% in revealing clinically relevant focal liver lesions using a T1-weighted multiphase contrast-enhanced 3D sequenc<sup>xvi</sup>. Similar results are experience in the present study. The differentiation of abscess Hydatid cysts and simple cysts was possible with diffusion weighted imaging and calculating the ADC values. The mean ADC value of simple cysts and Hydatid cysts ( $3.02 \times 10^{-3}$ ) was significantly higher than the mean ADC value of the abscesses ( $1.1 \times 10^{-3}$ ) in this study. These results were in similar with the studies by Inan et al<sup>xvii</sup> and Chan et al<sup>xviii</sup>.

## Conclusion:

Gd-BOPTA (Gadobenate Dimeglumine) has , pharmacokinetics, extra-cellular distribution and clinical safety comparable to conventional MR contrast media. From total 50 patients, 32 lesions were benign and 18 lesions were malignant. The age group ranged from 20 to 70 years with majority between 40 to 60 years. 52 % of the lesions are located in right lobe of the liver. The common benign lesions were liver abscess followed by hemangiomas and the common malignant lesions were metastases. Thus MR imaging is a powerful tool for the judgement of focal liver lesions.

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