International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

MRI Evaluation of Focal Liver Lesions

Surabhi Derkar, Rounak Bagga

Abstract: ***The present study was done to study the characteristics and enhancement patterns of focal liver lesions associated with the importance of post-processing subtraction images, whenever required. MRI sequences with tissue-specific contrast agents helps in effective lesion detection and accurate tumour characterization. It is a retrospective and observational study of total 30 patients studied for 12 months to evaluate benign & malignant focal liver lesions referred to the department of Radiodiagnosis at LTMGH, Sion, Mumbai, Maharashtra, India. Basic protocols of MRI liver were obtained with hepatobiliary phase and also generated post-processing subtraction images, if required. MRI dynamic contrast study is the imaging of choice for diagnosis of focal liver lesions showing high-quality liver imaging with automated contrast-detection methods essential for the detection and characterization of many hepatic lesions.***

Keywords: MRI, hepatic lesions, enhancement patterns, post-processing subtraction images

1. Introduction

Hepatic lesions are one of the diagnostic challenges in daily practice (1). Magnetic resonance imaging (MRI) has emerged as an important imaging modality for the assessment of hepatic masses. A reliable detection and characterization of focal liver lesions is critical for optimal patient management (2). A comprehensive MRI examination in this setting includes T2-weighted & chemical shift T1-weighted imaging, diffusion weighted imaging and gadolinium-enhancement-pattern assessment, characteristic enhancement patterns that can be helpful in the diagnosis of most of these lesions.

This imaging modality demonstrates characteristic enhancement patterns that can be helpful in the diagnosis of benign and malignant focal hepatic lesions. The patterns of enhancement can be noted in various phases in the form of arterial, porto-venous or delayed-phase enhancement, peripheral washout, ring enhancement, nodule-within-a-nodule enhancement, true or pseudo central scar and pseudo capsule (3).

These imaging findings combined helps to pinpoint the etiology of a liver mass. Familiarity with these enhancement patterns and mass characteristics in various sequences can help in the identification of specific focal lesions of the liver. Sometimes large lesions can be diagnostically challenging as some benign lesions can masquerade as malignant masses.

MRI is the imaging of choice for characterization of the liver mass, demonstrating similar if not superior performance to CT. The majority of liver masses arising in non-cirrhotic livers are benign like hemangioma, focal nodular hyperplasias & hepatic adenomas and most commonly encountered malignant lesions in non-cirrhotic livers are metastases.

The accuracy in detecting the hepatic lesions is vital to avoid unnecessary biopsies, which may result in post-procedural complications. MRI plays a key role in management of liver lesions, using a radiation-free technique and a safe contrast agent profile (2).

2. Aims and Objectives

1) To study the characteristics of focal liver lesions.
2) To identify the various enhancement patterns of focal hepatic lesions.
3) To study the importance of subtraction images.

3. Materials and Methods

This is a retrospective and observational study carried out for a period of 12 months with cases undergoing MRI Liver referred to the department of Radiodiagnosis at LTMGH, Sion, Mumbai, Maharashtra, India. The following criterion was used for selection of target study.

Inclusion criteria: All patients referred for MRI with clinically suspected focal liver lesions and patients with indeterminate & incidentally detected liver lesions detected on USG or CT.

Exclusion criteria: Patients having cardiac pacemakers, prosthetic heart valves, cochlear or any metallic implants and also patients with history of claustrophobia & who do not consent to be a part of the study.

Imaging Protocol: Referred patients were subjected to MRI according to the following protocols:

a) Equipment: PHILIPS ACHIEVA 3T
b) Protocol:
   - Basic acquisitions: T2 axial, T2 coronal, T1 Axial, SPAIR axial
   - In-phase and out-phase
   - DWI/ADC
   - Dynamic pre-and post-contrast fat-suppressed T1-WI
   - 1 hr Delayed scan (hepatobiliary phase)

   If required, post-processing subtraction images are generated on workstation with standard software.
c) Interpretation of MRI Data in tabulated formula as all points should be covered:

Liver-	
• Size & Margin-	
• CRL ratio and caudate lobe-	
• Focal lesion-	
• IHBRD-	
• Gall bladder-	

	Diameter	Thrombus
• PV		
• SV		-
• SMV		-
• IVC		
• HVs		
• Portosystemic Collaterals		
• Aorta and its branches		

Spleen	
• Size	
• Enhancement and Focal lesion	

Ascites and (peritoneum mesentery and omentum)	
• Pancreas	
• Lymph nodes	

MRI Diagnosis:

4. Results

The present study was carried out to describe the different characteristics of the focal liver lesions. Only patients fulfilling the inclusion and the exclusion criteria were included in the study. Findings in the patients studied were tabulated using Microsoft Excel software. During the period of 12 months of the study, total 30 patients were studied and we obtained following observations and results:

(1) Age-Wise Distribution of Benign & Malignant Liver Lesions

Malignant lesions were most common in the age-group of 71-80 yrs seen in 7 cases (23%), followed by 61-70 yrs seen in 6 cases (20%), while benign lesions were 3 (10%) in number each in the age group of 41-50 yrs, 51-60 yrs & 61-70 yrs.

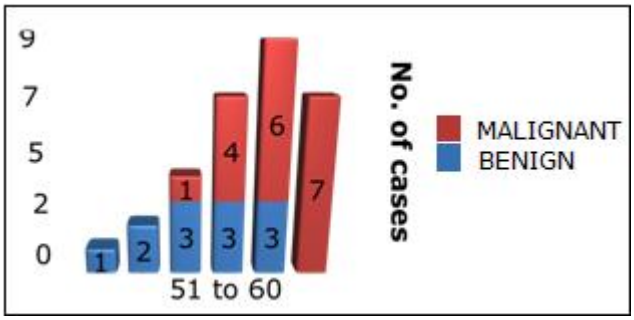


Chart 1: Age-Wise Distribution of Benign & Malignant Liver Lesions

(2) Sex Distribution:

In this study, majority of the focal hepatic lesions were found in males comprising of 19 patients (63%) & females about 11 patients (37%).

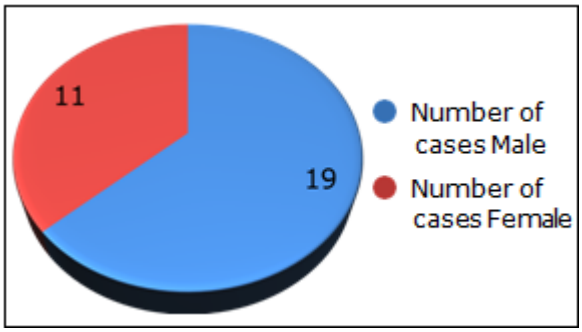


Chart 2: Sex Distribution

(3) Spectrum of Focal Hepatic Lesion:

In the present study, the malignant lesions (18 patients) include hepatocellular carcinoma, metastasis, intrahepatic cholangiocarcinoma and hybrid tumor whereas benign lesions (12 patients) include hemangioma, hepatic abscess, hydatid cyst, hematoma and hepatic cyst.

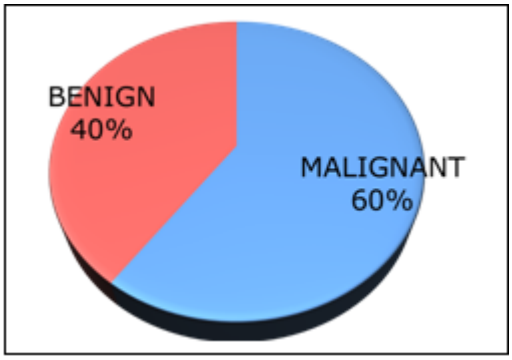


Chart 3: Spectrum of Focal Hepatic Lesions

(4) Diseases Spectrum of Focal Hepatic Lesion:

In our study, most common pathology detected was Metastasis seen in 8 cases (27%) followed by hepatocellular carcinoma seen in 7 cases (23%), 4 cases (13%) of haemangioma, 3 cases (10%) each of hepatic abscess & hepatic cyst, 2 cases (7%) of intrahepatic cholangiocarcinoma & one case each of hydatid cyst, hybrid tumour & hematoma.

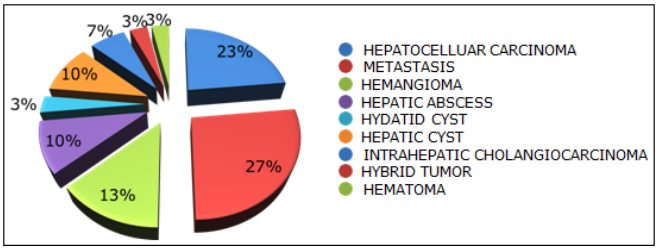


Chart 4: Diseases Spectrum Distribution Chart

5. Discussion

MRI is currently considered to be the most accurate noninvasive method in the evaluation of liver lesions. It is essential to distinguish between benign and malignant hepatic lesion because of their different clinical implications. With the advances in the surgery and local invasive therapies with a curative potential, it has put imaging into highlight when evaluating patients with liver

metastases (4). The utilization of tissue-specific contrast agents with various various sequences render MRI an attractive tool for liver imaging.

Liver tumour protocol beholds two equally important tasks: there is a need for ***effective lesion detection*** **(**high sensitivity), and a desire for ***accurate tumour characterization*** ***(***high specificity).

1) Lesion Characterization

In MRI, multiple sequences are required for accurate lesion characterization. A magnitude of research has been focused on finding methods for reliable differentiation between various liver foci. Nevertheless, liver biopsy is still sometimes warranted, especially if surgery is planned. Additionally, a variety of different MR features such as lesion signal characteristics (**Brown et al., 1991; Tang et al., 1998**) or contrast uptake patterns (**Mathieu et al., 1991; Mitchell et al., 1994)** have also been proposed in the lesion differentiation.

2) Lesion Detection

Numerous investigations have been conducted to compare the sensitivities of different imaging techniques in the detection of liver tumours. Research has been devoted to improve the effectiveness of any technique to increase the detection rate. In MRI, the use of various contrast agents has been the focus over the past decade. Liver-specific contrast agents play a special role when evaluating patients with liver lesions, especially when invasive treatment is considered.

3) Generation of subtraction images

Many a times the lesion is hyperintense on T1W1, thus it becomes difficult to study the enhancement patterns in such lesions. Hence, the post-processing subtraction images help us to identify the true enhancement pattern in the lesion.

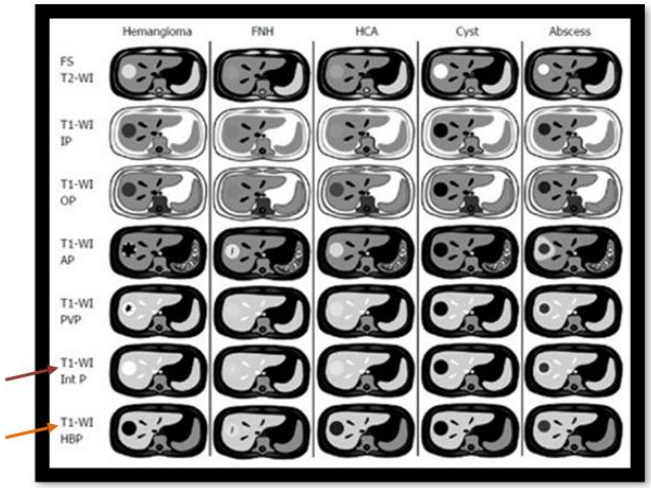
In the present study, total 30 patients were studied for various focal hepatic lesions with 19 (63%) male & 11 (37%) female patients. Various focal hepatic lesions were reported in which 18 patients (60%) had malignant nature of lesion with most common pathology detected was hepatic metastasis seen in 10 patients (33%) followed by HCC. On the other hand, benign lesions were evident in 12 patients (40%) with hemangioma as most common pathology in this category. The malignant lesions were most common in the age-group of 71 to 80 yrs seen in 7 (23%) patients, followed by 61 to 70 yrs seen in 6 (20%) patients, whereas the benign lesions were 3 (10%) in number each in the age group of 41 to 50 yrs, 51 to 60 yrs and 61 to 70 yrs.

A study done by **Hasan NM et. al** showed focal hepatic lesion in 26 male patients and 14 (36%) female patients out of 40 patients (5). A similar study by **Anaye A et. al** done on 145 patients with the focal hepatic lesion, male predominance was seen with 82 (56.1%) patients (6). The above-mentioned studies replicate well with our study. The study done by **Ahirwar CP et. al (**7) show 60 malignant patients and 40 benign patients which correlated with our study.

Matilde et. al (8) studied 100 patients with focal hepatic neoplasm. The study demonstrated the most common lesion as metastasis seen in 51 (51%) patients which were followed by the hepatocellular carcinoma seen in 31 (31%) and hemangioma noted in 9 % of cases. This spectrum of finding resembled with the findings drawn from our study. Another study performed by **Leeuvan et. al (**9) and **Glazer GM et. al (**10) also showed similarity with metastasis as there most common lesion accounting for 37 patients.

A simplified schematic representation of the typical imaging features of the most common benign and malignant hepatic lesions is as follows:

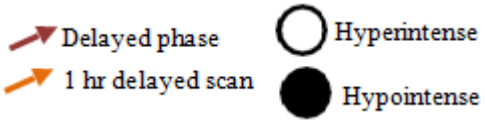
MRI features of benign focal liver lesions



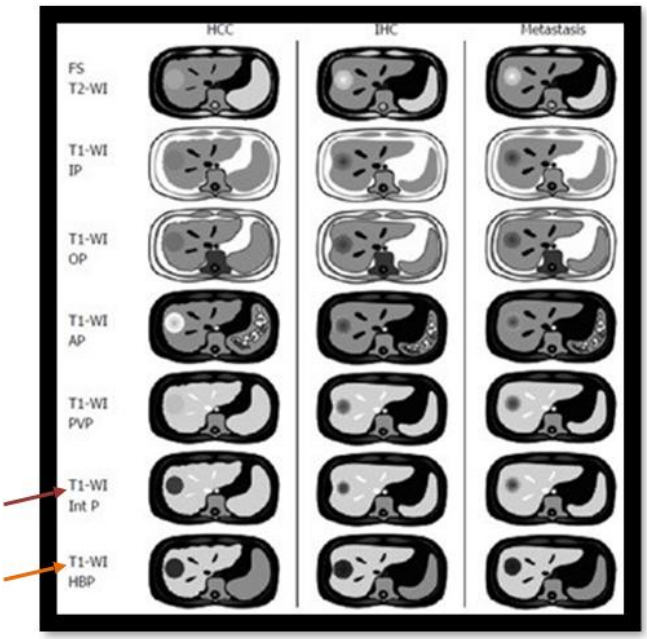
Reference*: Matos, António P et al. "Focal liver lesions: Practical magnetic resonance imaging approach. " World journal of hepatology vol.7, 16 (2015): 1987-2008. doi: 10.4254/wjh. v7. i16.1987*

FNH: Focal nodular hyperplasia; **HCA**: Hepatocellular adenoma

FS T2-WI: Fat-suppressed T2-weighted image; **T1-WI IP**: T1-weighted in-phase image; **T1-WI OP**: T1-weighted out-of-phase image; **T1-WI AP**: Arterial phase; **PVP**: Portal-venous phase; **Inter** P: interstitial (delayed) phase; **HBP**-Hepatobiliary phase i.e.1 hr delayed scan (with hepatocyte-specific contrast agent).



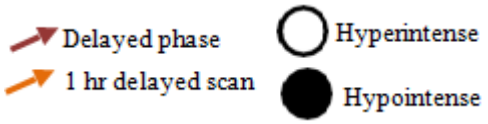
MRI features of malignant focal liver lesions



***Reference**: Matos, António P et al. "Focal liver lesions: Practical magnetic resonance imaging approach. " World journal of hepatology vol.7, 16 (2015): 1987-2008. doi: 10.4254/wjh. v7. i16.1987*

HCC: Hepatocellular carcinomas**; IHC:** Intrahepatic cholangiocarcinomas.

FS T2-WI: Fat-suppressed T2-weighted image; **T1-WI IP**: T1-weighted in-phase image; **T1-WI OP**: T1-weighted out-of-phase image; **T1-WI AP**: Arterial phase; **PVP**: Portal-venous phase; **Inter** P: interstitial (delayed) phase; **HBP**-Hepatobiliary phase (1 hr delayed scan with hepatocyte-specific contrast agent).



MRI is under a continuous progress, meaning better coils, higher magnetic field strengths with the capability of motion 'freezing' and above all, advanced techniques for increased lesion detection and improved characterization potential.

6. Conclusion

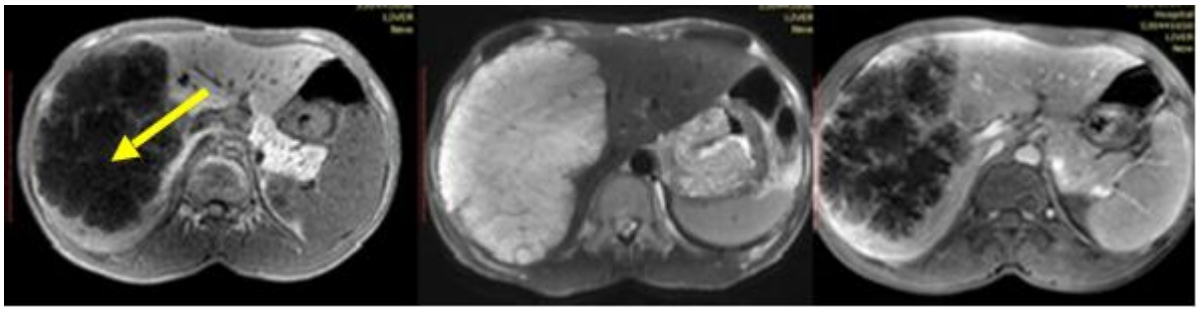
MRI with dynamic contrast is an excellent tool for diagnosis of the focal liver lesions and with the help of their characteristic appearances on different sequences and their specific enhancement patterns has better detection ability**.** Also it helps better picking up of the contrast enhancement in the cases with controversial enhancement by the help of post-processing subtraction images thus helping in early diagnosis of a focal lesion in the presence of diffuse liver condition.

References

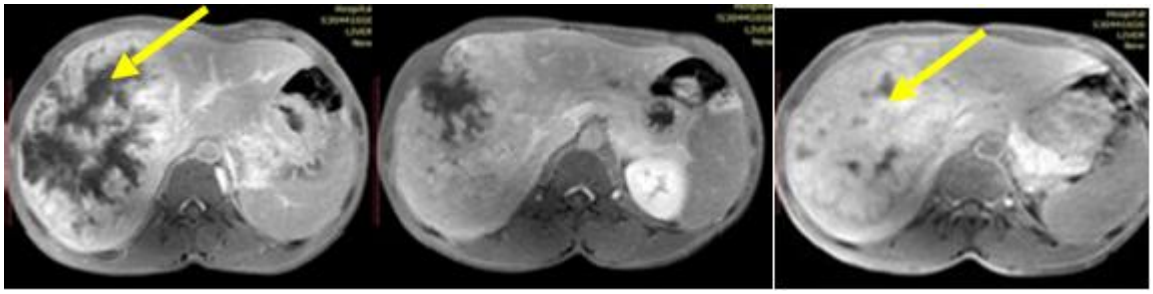
[1] Liu et al. American Journal of Roentgenology.2008; 190: S65-S68.10.2214/AJR.07.7076
[2] Matos, António P et al. "Focal liver lesions: Practical magnetic resonance imaging approach. " World journal of hepatology vol.7, 16 (2015): 1987-2008. doi: 10.4254/wjh. v7. i16.1987
[3] Focal Hepatic Lesions: Diagnostic Value of Enhancement Pattern Approach with Contrast-enhanced 3D Gradient-Echo MR Imaging, Khaled M. Elsayes, Vamsidhar R. Narra, Yuming Yin, Govind Mukundan, Markus Lammle, and Jeffrey J. Brown, RadioGraphics 2005 25: 5, 1299-1320
[4] IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 14, Issue 7 Ver. I (July.2015), PP 10-22
[5] Mohamed N, Hasan A, Zaki KF, Alam-eldeen MH. Benign versus malignant focal liver lesions: Diagnostic value of qualitative and quantitative diffusion weighted MR imaging. The Egyptian Journal of Radiology and Nuclear Medicine.2016; 47 (4): 1211–20.
[6] naye A, Perrenoud G, Rognin N, Arditi M, Mercier L, Frinking P, Ruffieux C, Peetrons P, Meuli R MJ. Differentiation of focal liver lesions: usefulness of parametric imaging with contrast-enhanced US. Radiology.2011; 261 (1): 300–10.
[7] Ahirwar CP, Patil A, Soni N. Role of triple phase computed tomography findings for evaluation of hepatic lesions. International Journal of Research in Medical Sciences.2016; 4 (8): 3576–83.
[8] Nino-Murcia M, Olcott EW, Jeffrey Jr RB, Lamm RL, Beaulieu CF JK. Focal liver lesions: pattern-based classification scheme for enhancement at arterial phase CT. Radiology.2000; 215 (3): 746–51.
[9] van Leeuwen MS, Noordzij J, Feldberg M a, Hennipman a H, Doornewaard H. Focal liver lesions: characterization with triphasic spiral CT. Radiology.1996; 201 (2): 327–36.
[10] Glazer GM, Aisen AM, Francis IR, Gross BH, Gyves JW EW. Evaluation of focal hepatic masses: a comparative study of MRI and CT. Abdominal Imaging.1986; 11 (1): 263–8.

Cases

Case 1: Hemangioma

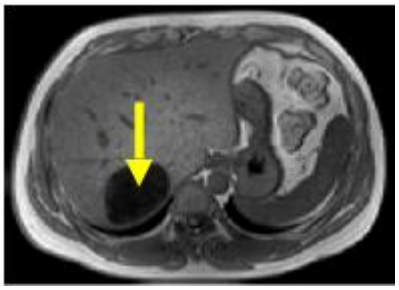


(a) T1WI hypointense (b) T2WI hyperintense with multiple septae (c) Plain

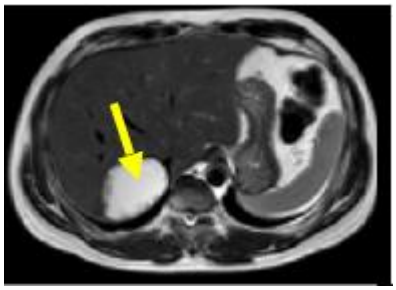


(d) Dynamic contrast imaging –peripheral arterial enhancement with progressive filling-in in venous and near complete homogeneous enhancement on delayed phase

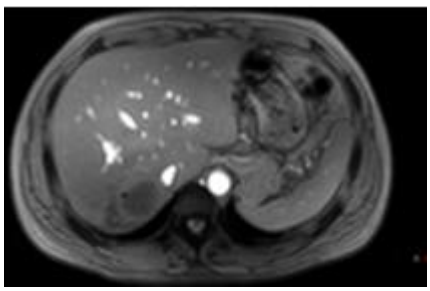
Case 2: Chronic hematoma in liver



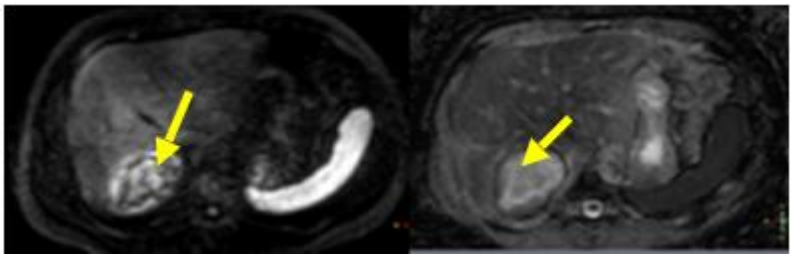
(a) T1WI hypointense



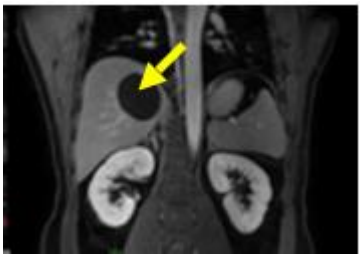
(b) T2WI hyperintense with few hypointense areas within, predominantly along its periphery



(c) GRE-No e/o blooming

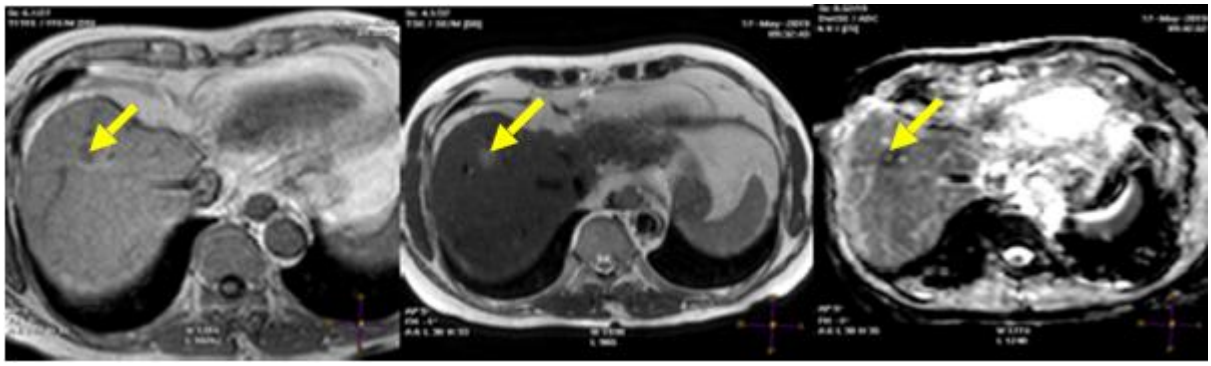


(d) Patchy restricted diffusion on DWI with corresponding low ADC values

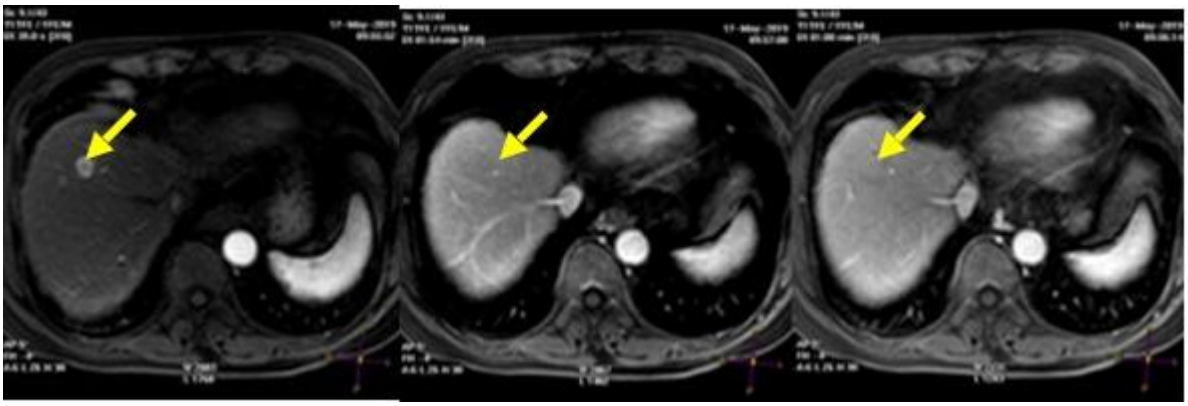


(e) Post-contrast peripheral enhancement

Case 3: Hepatocellular Carcinoma



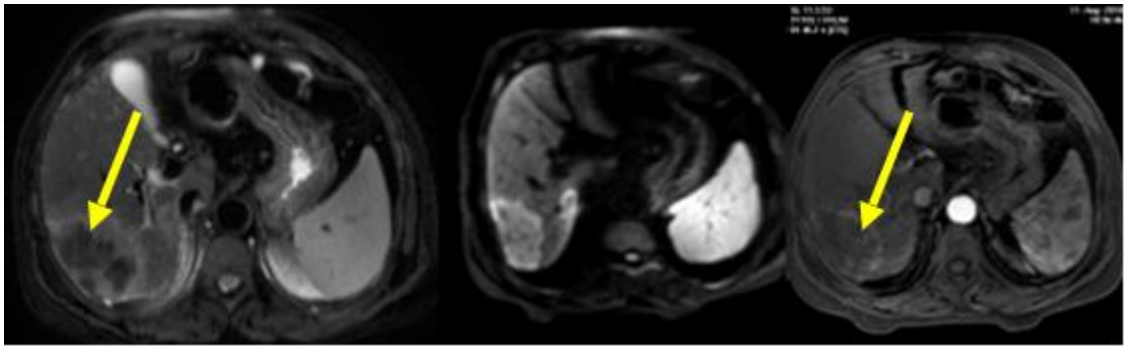
(a) T1W1 hypointense **(b) T2W1 hyperintense** **(c) Low ADC values**



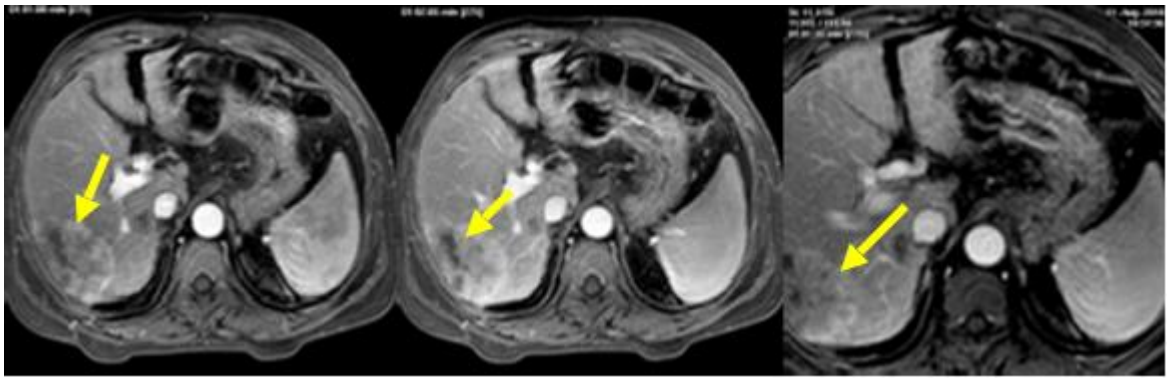
Arterial Porto-Venous Delayed

(d) Dynamic contrast imaging-early arterial phase enhancement which becomes isointense to liver in porto-venous phase and washout in delayed phases

Case 4: Intrahepatic cholangiocarcinoma with hepatic metastases



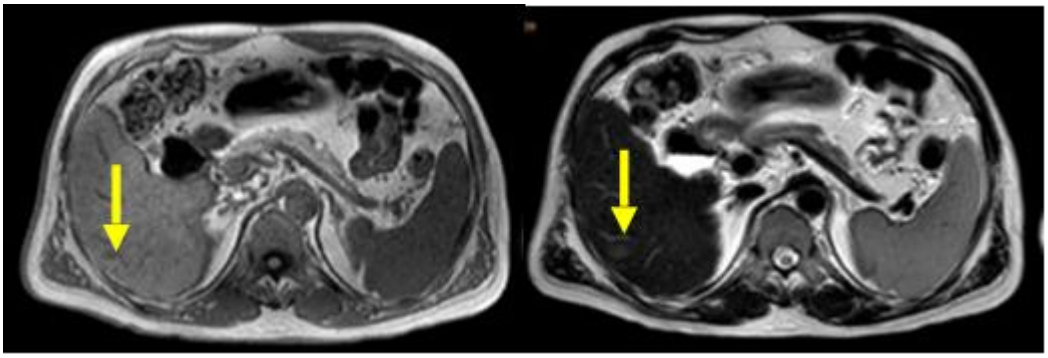
(a) T2WI heterogeneous signal **(b) Restricted diffusion on DWI ARTERIAL**



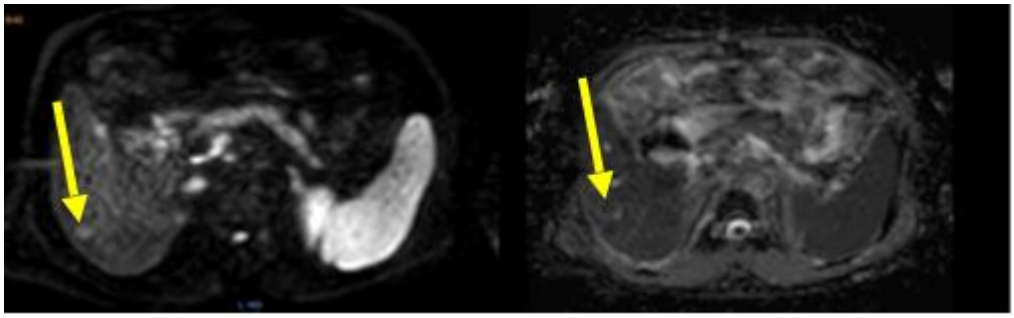
Porto-Venous Delayed 1 hr DELAYED (hepatobiliary phase)

(c) Dynamic post-contrast imaging with 1 hr delayed scan – peripheral nodular arterial enhancement with progressive filling-in on porto-venous, delayed and hepatobiliary (1 hr delayed) phase.

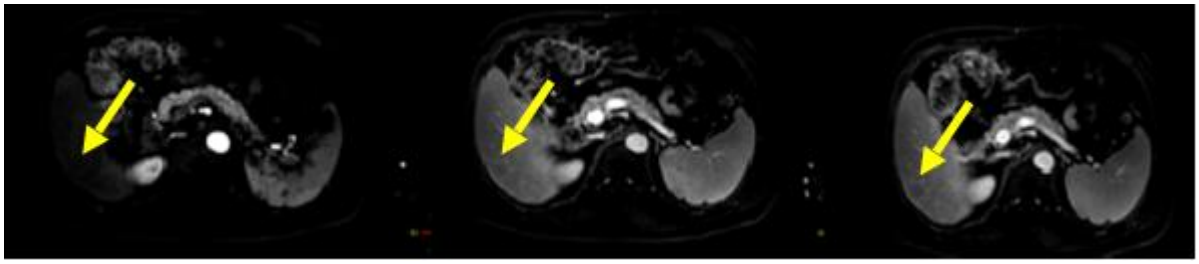
Case 5: Low-grade dysplastic nodule in a cirrhotic liver



(a) T1W1 hypointense **(b) T2WI hyperintense**



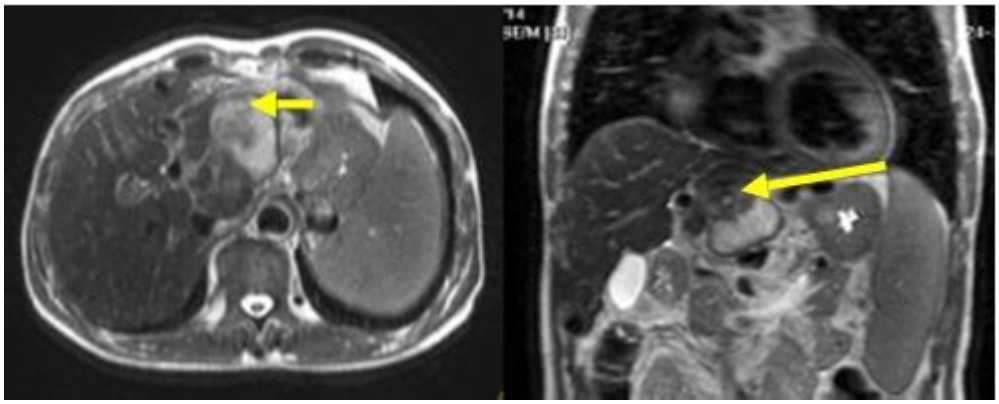
(c) Restricted diffusion on DWI with corresponding low ADC values



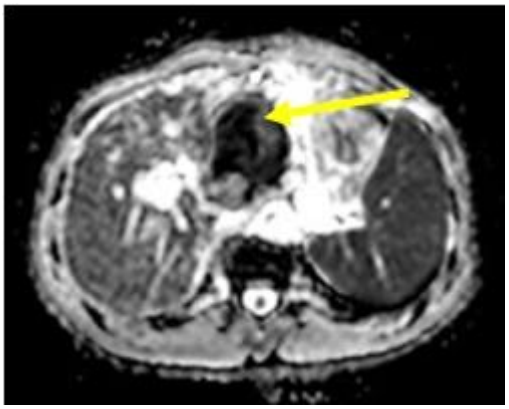
Arterial Porto-Venous Delayed

(c) Dynamic Contrast Imaging – no arterial enhancement with peripheral enhancement on porto-venous which is persistent on delayed phase

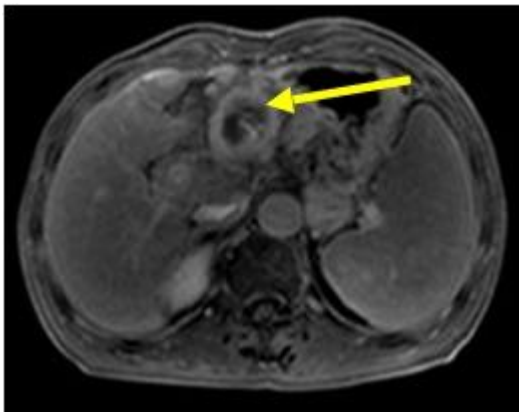
Case 6: Hybrid tumour-HCC with intrahepatic cholangiocarcinoma



(a) T1WI hypointense with hyperintense contents within (b) T2WI heterogeneously hyperintense

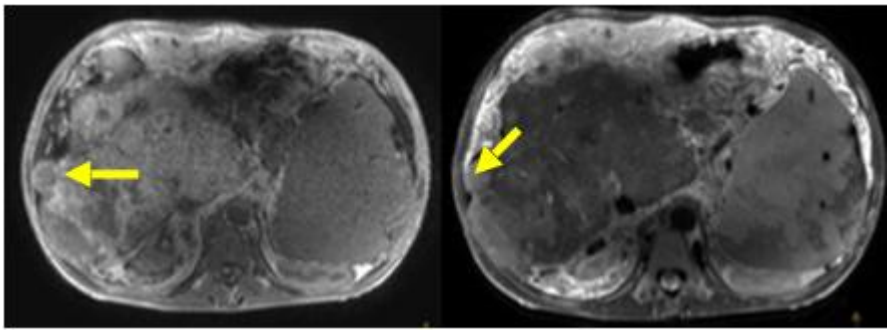


(c) Low ADC values

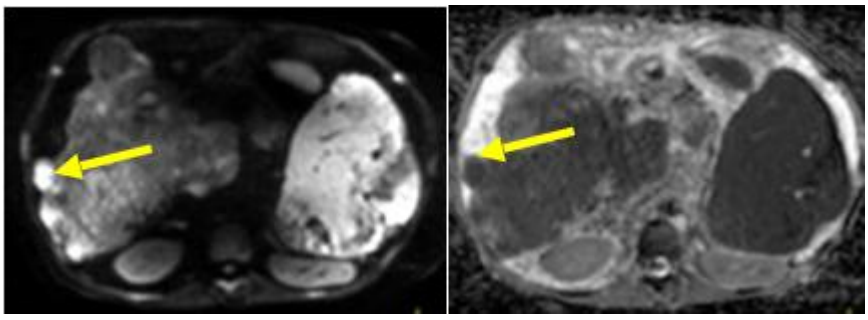


(d) Peripheral post-contrast enhancement in portal, venous phase & delayed phase with extracapsular extension

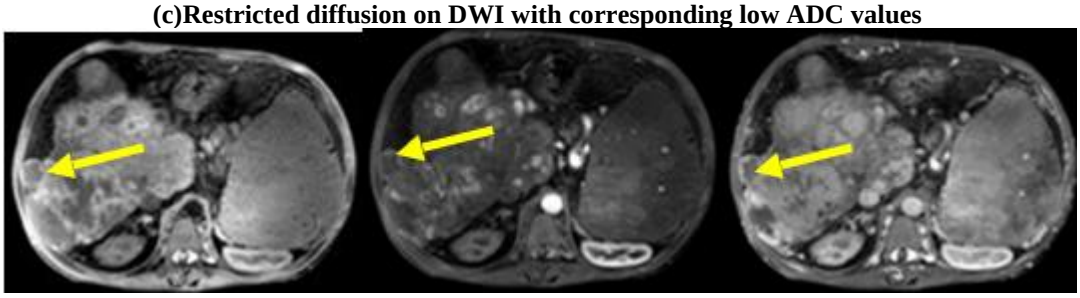
Case 7: Hepatic metastasis



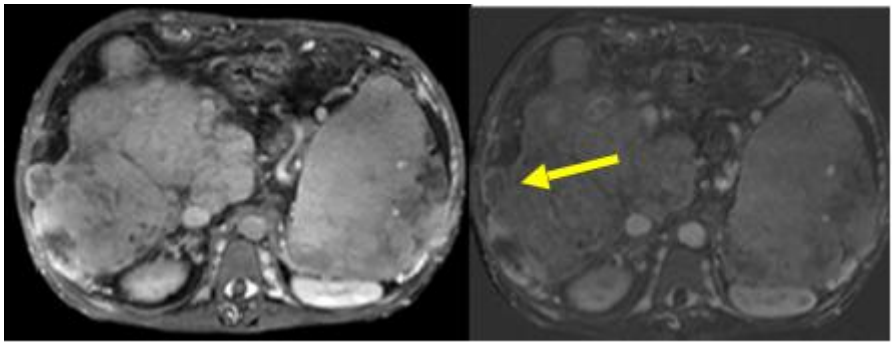
(a) T1WI hypointense with hyperintense rim **(b) T2WI hyperintense**



(c)Restricted diffusion on DWI with corresponding low ADC values



Plain **Arterial** **Porto-venous**



Delayed **Subtraction**

(d) Dynamic contrast imaging with post-processing subtraction images-peripheral arterial phase enhancement persistent on porto-venous and delayed phase.