

Role of Dynamic Contrast Enhanced MRI in Evaluation of Focal Hepatic Lesions.

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ABSTRACT

Background: C Most of the focal hepatic lesions in day to day practice can be diagnosed by cross sectional contrast enhanced studies. The present study evaluates the role of dynamic contrast enhanced MRI for detection & characterization of these lesions commonly found in our area. **Methods:** It's a perspective study of 50 patients with all age groups who were suspected clinically to have focal hepatic lesions or diagnosed so by ultrasonography or computed tomography. The patients underwent MRI including dynamic contrast enhanced sequences, which included i.v. administration of the contrast material (Gadopentate dimeglumine). The results of the MRI were confirmed by various confirmatory methods depending upon the lesion in question. **Results & Conclusions:** Overall sensitivity of MRI in detection of focal hepatic lesions was 100% while its specificity was 98%. Comprehensive MR imaging examination yields characteristic enhancement patterns that can be used to diagnose or at least narrow the differential diagnosis for most of these lesions.

Keywords: Biliary cystadenocarcinoma, Hemangioma, Hepatocellular carcinoma, Magnetic resonance imaging.

INTRODUCTION

Focal hepatic lesions constitute a daily challenge in the clinical setting. However, noninvasive methods can be useful in the detection and characterization of these lesions. The noninvasive diagnosis of hepatic lesions can be achieved with contrast enhanced computed tomography and magnetic resonance (MR) imaging. Dynamic MR imaging provides dynamic contrast-enhanced thin-section images and is excellent for the evaluation of various focal hepatic lesions.

MATERIALS & METHODS

The proposed study was planned to as a prospective study of fifty patients of all age groups with focal hepatic lesions suspected clinically or diagnosed so by ultrasonography or computed tomography for evaluation of the focal hepatic lesion by Magnetic Resonance Imaging (MRI). The patients included in the study were those attending OPD or admitted to our hospital and referred to our department.

Patients who were able to undergo Magnetic Resonance Imaging (MRI) and had no contraindication to it were included in the study. A prior informed consent was taken from all the patients. A prior approval from college ethical committee was taken before starting the study.

MR Imaging Protocol

All patients underwent MRI examinations with 1.5 Tesla unit on Philips Gyroscan Achieva 1.5 Tesla the Netherlands. Following axial sequences were used:

T1W TSE (turbo spin echo)

T2W TSE

Short T1 inversion recovery (STIR)

BTFE

Pre and post contrast triple phase imaging was done with THRIVE

Gadopentate dimeglumine 0.1 mmol/kg was used as contrast administered intravenously.

Additional coronal and saggital sequences were performed in some patients to better delineate a lesion. GRE was performed in some patients for delineation of hemorrhage.

Each MRI image was analyzed for specific features that were relevant to the evaluation of focal hepatic lesions. Based on the MRI imaging findings a provisional diagnosis was made. The findings of MR were correlated with FNAC/ histopathological, biochemical, surgical and clinical findings.

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RESULTS & DISCUSSION

In the study, 51-60 years age group accounted for maximum no. of cases i.e. 15 (30%) out of 50 patients while 41 - 50 years age group was the second largest in the series with 12 (24%) patients. The youngest patient in the study was 14 years old and the oldest being 70 years old. Out of the total 50 cases in our study, 26 patients (52%) were males and 24 patients (48%) were females.

The largest group [Table 1] is comprised by hepatocellular carcinoma seen in 13 patients (26%) followed by metastases and abscesses which contributed 8 cases (16%) each to our study group. There were 7 patients (14 %) with hydatid cysts and 5 patients (10 %) with simple hepatic cysts. Four patients had hepatic hemangioma (8%) and two cases of hepatocellular adenoma. One case each of focal nodular hyperplasia and biliary cystadenocarcinoma were also included.

Hepatocellular Carcinoma (n=13)

In our study the age range of the patients was 22-70 years out of which ten were males while three were females. All cases diagnosed by MRI to be HCC in our study had either raised AFP levels or were FNAC proven or both. Twelve out of thirteen (92.3 %) cases had cirrhosis. Five (38.5 %) patients were positive for hepatitis C, while one patient was positive for hepatitis B virus. Six (46.1%) patients were chronic alcoholics.

In present study multifocal lesions were seen in ten cases while isolated solitary tumors were seen in three cases. Portal vein or its branches were involved in five cases (38.47%) in our study. The significance of portal venous invasion has been emphasized by Mathieu et al as venous invasion is more common with higher grade and larger tumors and is associated with a poorer patient prognosis while biliary invasion is uncommon.^[2]

All but one lesion in our study were predominantly hypointense on T1 weighted images, few hyperintense foci were seen in three cases while in one case the lesion was iso to slightly hyperintense. On T2 weighted images, the lesions were predominantly hyperintense with hypointense foci seen in three cases. According to Elsayes et al on T1-weighted MR images,^[3] HCC is most often hypointense relative to the liver, although hyperintense lesions or areas of hyperintensity within hypointense lesions may be seen. On T2-weighted images, HCC is generally hyperintense [Figure 1].

All lesions in our study showed enhancement in arterial phase, and washout in portal or hepatic venous phases. Sangiovanni et al studied 64 patients with HCC and found that all the lesions showed enhancement in arterial phase and washout in venous or portal phases.^[4] A pseudocapsule was found in nine (69.23%) cases and a mosaic pattern was seen in eight cases (61.54%) in our study. Kadoya et al in

their study observed that pseudocapsule was present in 77% and a mosaic pattern was present in 50 % of the cases.^[5] In one case in our study a lesion was iso to slightly hyperintense with hypointense centre on T1WI. The lesion was hypointense with hyperintense centre on T2WI. The findings are consistent with dysplastic nodule with central transformation into HCC as described by Michell et al giving a "nodule within a nodule" appearance.^[6] FNAC done from centre of the lesion revealed HCC.

Secondary Malignant Hepatic Tumors (n=8)

Assessment of the liver is a critical part of the clinical evaluation of most cancer patients.^[7] In our study all the cases of metastatic liver disease had known primary malignancies, the common being carcinoma breast and carcinoma pancreas which accounted for 37.5% & 25% cases each. It was contrary to incidence mentioned in literature according to which the most common source of hepatic metastases is gastro-intestinal tumors (65%).^[8] the cause for this discrepancy could be explained by less number of patients included in this study.

In our study hypovascular metastases were more common (75 %). Six out of eight exhibited the characteristics of hypovascular metastases as hyperintense rim in arterial phase while remaining hypointense on all phases of contrast study. The primaries included breast in two cases, pancreas in another two cases and gall bladder and colon in one case each. Rim-enhancement in arterial phase images, has been reported to be highly specific for hypovascular metastases.^[9]

Two out of eight cases (25%) showed characteristics of hypervascular metastases as heterogeneous enhancement on arterial phase and peripheral washout in portal & hepatic venous phases. One case had a primary in breast and other had primary in kidney. Marked enhancement of hypervascular metastases during arterial phase has been described in literature.^[10]

Danet et al had found that hypovascular lesions (64.24 %) were more common than hypervascular lesions (35.75 %) which was observed in our study also.^[11] They also observed that most common pattern was peripheral ring seen on the arterial dominant phase images, with central progression seen on the delayed phase images. A peripheral hypointense ring seen during the delayed phase was the most common appearance in hypervascular metastases. Perilesional enhancement was common, mostly seen in hypovascular metastases (92%). Generally, large lesions tended to show a peripheral ring or heterogeneous enhancement, and small lesions showed homogeneous enhancement.

Pyogenic Abscesses (n=5)

The most common presenting complaints were fever and right upper quadrant pain which was also observed by Moshen et al and Tellez et al in their

studies.^[12,13] In our study the size of the lesions ranged from 3.2cm to 12.7 cm. The size range detected by Kuligowska et al was 3-20 cm while Bazan et al¹⁵ gave a diameter of 3-18 cm.^[14]

The present study showed right lobe involvement in 62.5%, left lobe involvement 12.5% and both lobes involvement in 25% of cases.

All lesions were hypointense on T1 weighted images and hyperintense on T2 weighted images. Wall thickness ranged from 2-7 mm. Perilesional signal alteration in the form of hypointensity on T1 weighted images and hyperintensity on T2 weighted images was seen in 2 cases. Peripheral enhancement in arterial phase images with persistence in delayed images was seen in all cases. Internal septations were seen in 3 lesions [Figure 2].

Amoebic Abscesses (n=3)

The size range in the present study varied from 4.8 cm to 13.4 cm. Predominantly the lesions were single (66.7%) and all the lesions were located in the right lobe (100%). This correlates well with the study conducted by Redin et al.^[16]

The lesions in all three cases were round to oval. They were hypointense on T1 weighted images and hyperintense on T2 weighted images. The walls showed enhancement in early arterial phases with persistence of enhancement in late phases in all three cases. Only in one case multiple layering of wall was seen however no characteristic feature was observed in other two cases to differentiate them from pyogenic abscesses. These findings are consistent with previous studies (Ralls et al).^[17]

Hydatid Cysts (n=7)

Right lobe was the commonest site of involvement (85.71%) with extra hepatic involvement seen in two cases. All the lesions were hypointense on T1 WI & hyperintense on T2 WI.

A hypointense rim was observed in all (100%) cases on T2 WI. This low-signal intensity rim on T2-weighted magnetic resonance (MR) images has been proposed as a characteristic sign of hydatid disease.^[18,19] Intracystic membranes were seen in 2 cases (28.57%) in our study appearing as hyperintense on T2 WI and showing variable degree of enhancement on post contrast images. These membranes are considered highly specific for hydatid disease.^[19] Daughter cysts were seen in one case as more hypointense than parent cyst on T1 WI & more hyperintense than parent cyst on T2WI. When present, daughter cysts are seen as cystic structures attached to the germinal layer and are hypointense relative to the intracystic fluid on T1-weighted images and hyperintense on T2-weighted images [Figure 3].^[19] Calcification in the wall /septations is common and was present in 71.42% cases in our study.^[20]

In the presence of typical imaging features like T2 hypointense rim, multiple daughter cysts, floating membrane and peripheral calcification, it was easy to diagnose hydatid cysts on MRI.

Simple Hepatic Cysts (n=5)

These lesions are asymptomatic and usually detected incidentally. They exhibited typical MRI features as hypointense on T1 WI, hyperintense on T2WI and no enhancement on post contrast images.

Hemangioma (n=4)

All the lesions were of a size range 2-3 cm. All the lesions were solitary and located in the right lobe of the liver. The lesions in all the cases were hypointense on T1 WI, markedly hyperintense on T2 WI with roughly rounded shape and well demarcated from surrounding parenchyma. The lesions did not cause any displacement of the surrounding hepatic vessels. On contrast administration, all the lesions exhibited peripheral enhancement in arterial phase, progressive centripetal filling and puddling of contrast in portal & hepatic venous phases. In delayed images there was persistent & complete enhancement of the lesions. These findings correspond to that of McFerland et al and Semelka et al who had studied MRI features of hemangiomas.^[21,22]

Hepatocellular Adenoma (n=2)

In our study we found two cases of hepatocellular adenoma. In both cases the lesions were single, heterogenous on T1 WI and heterogeneously hyperintense on T2WI. In one case hyperintense foci were seen on T1 WI, which were hypointense on T2 WI & showed blooming on GRE suggestive of hemorrhage. On contrast administration the lesions showed mild enhancement in arterial phase and washout in portal venous phase [Figure 4].

Focal Nodular Hyperplasia (n=1)

On MRI a lesion was seen arising from left lobe of the liver with a predominant exophytic component. The lesion was hypointense on T1 WI & hyperintense on T2WI. A central stellate area was seen in the lesion appearing as hypointense on T1WI & hyperintense on T2 WI [Figure 5]. A pseudocapsule was seen appearing as hyperintense on T2WI. On contrast administration the lesion showed enhancement on arterial phase with nonenhancement of the scar. The scar showed gradual enhancement on delayed phases. The pseudocapsule showed mild enhancement in delayed images. The lesion in our study demonstrated typical MRI features as described by Hussain et al.^[23]

Biliary Cystadenocarcinoma (n=1)

MRI revealed a lesion in segment VI. The lesion was oval, cystic with multiple nodular projections along its wall. The lesion was hypointense on T1 WI, while the nodular projections were iso to hypointense. On T2WI, the lesion was intensely hyperintense while the nodular projections were only mildly hyperintense as compared with background liver parenchyma. On post contrast images the lesion showed enhancement of the nodular projections only.

On MRI it was diagnosed as biliary cystadenoma. But on FNAC it was found to be biliary cystadenocarcinoma.

Biliary cystadenoma and cystadenocarcinoma are rare solitary, multilocular cystic masses. Cystadenoma is a large cystic tumor with internal septations and papillary projections. The locules are lined with papillary projections and benignity and malignancy cannot be grossly differentiated. Papillary projections are more frequently present in malignant cases. Cystadenoma is considered a premalignant condition (Haaga et al).^[24] Solid nodular projections, although common in biliary cystadenocarcinoma, are rare in cystadenoma (Korobkin et al).^[25] Cystadenocarcinoma should be suspected when there is elevated mass or nodule in the wall or foldings, or thickened cystic wall on imaging. But it is extremely difficult to differentiate between cystadenoma and cystadenocarcinoma by imaging alone (Kim HG).^[26]

The apparent high incidence of hepatocellular carcinoma in our study group may be attributed to the Rotary Cancer Hospital attached with our hospital. Malignant lesions i.e. summation of hepatocellular carcinoma, metastases and biliary cystadenocarcinoma together contribute 22 patients, while benign lesions that is summation of all other lesions in the study group comprise 28 patients. The patients with benign lesions are more than the patients with malignant lesions.

The final diagnosis was made by surgery, histopathology, FNAC, or microscopy in 26 patients, by biochemistry in 15 patients and clinical follow up in 9 patients. The biochemical tests included serum AFP levels for hepatocellular carcinoma, serology for hydatid disease, CA 19.9 marker for carcinoma pancreas. MRI correctly diagnosed all benign lesions. MR was erroneous in giving provisional diagnosis of biliary cystadenoma in one case, which on FNAC proved to be biliary cystadenocarcinoma. However MR diagnosed all other malignant lesions including hepatocellular carcinoma & metastatic lesions.

Table 1: Comparison of MRI Diagnosis and Final Diagnosis in 50 Patients.

S. No	MRI Diagnosis	Number (n)	% Age	Final Diagnosis
1.	Hepatocellular carcinoma	13	26	Hepatocellular carcinoma
2.	Metastases	8	16	Metastases
3.	Abscesses	8	16	Abscesses
4.	Hydatid Cysts	7	14	Hydatid Cysts
5.	Simple Cysts	5	10	Simple Cysts
6.	Hemangioma	4	8	Hemangioma
7.	Adenoma	2	4	Adenoma
8.	Focal Nodular Hyperplasia	1	2	Focal Nodular Hyperplasia
9.	Biliary Cystadenoma	1	2	Biliary Cystadenocarcinoma

The overall sensitivity for identifying a focal hepatic lesion was 100 %, and the specificity for correctly

making the diagnosis was 98%. The high sensitivity in our study could be attributed to the fact that many patients were diagnosed on ultrasound and CT scan to have focal hepatic lesions where MRI was done for characterization.

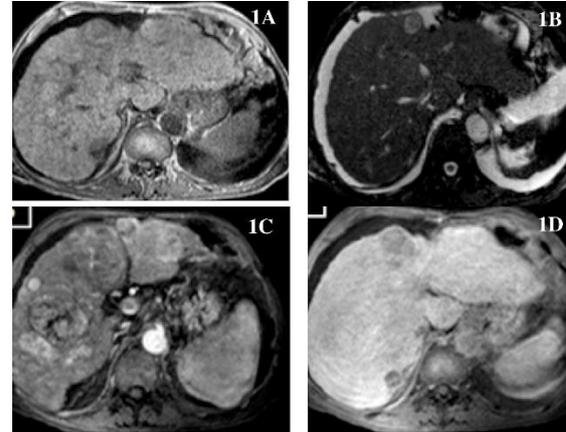


Figure 1: (A to D): HCC appearing as hypointense on T1 W Image (A), hyperintense on T2 W image (B), early arterial phase enhancement (C) & portal venous phase washout (D).

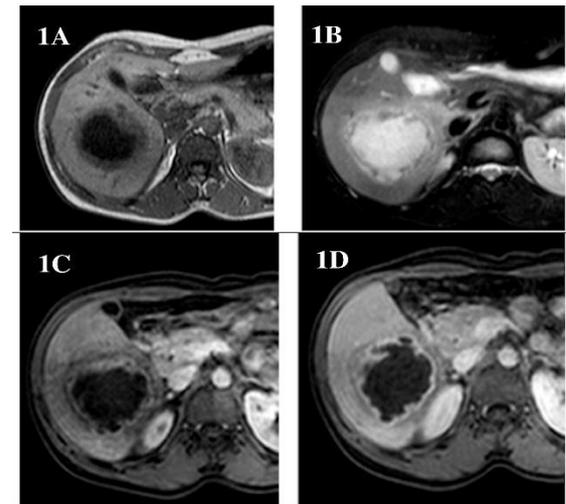


Figure 2: (A to D): A thick walled abscess appearing as hypointense on T1W image (A), hyperintense on T2 W image (B), Enhancement on arterial phase image (C), which persists in portal phase image (D).

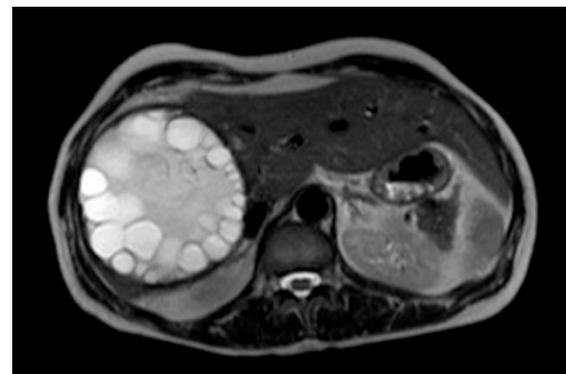


Figure 3: Hepatic hydatid cyst on T2 W image showing daughter cysts.

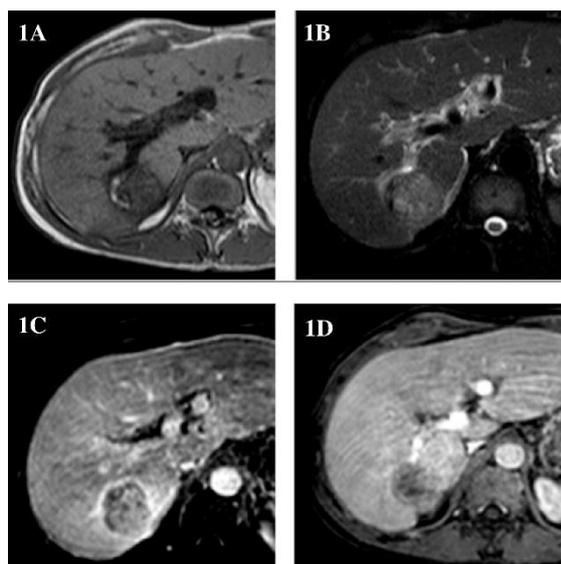


Figure 4: (A to D): Hepatic adenoma appearing as heterogeneously hypointense on T1W image (A), heterogeneously hyperintense on T2 W image (B), mild enhancement on arterial phase (C) and isointense on portal phase image (D); Areas appearing as hyperintense on T1 W & hypointense on T2W image suggestive of hemorrhage.

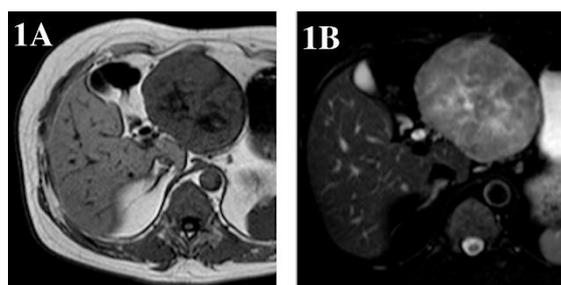


Figure 5: (A & B): focal nodular hyperplasia appearing as hypointense on T1W (A) image & hyperintense on T2W image (B).

SUMMARY & CONCLUSION

Most common clinical presentation was pain abdomen followed by fever and jaundice. Cirrhosis, chronic alcoholism, HCV infection, HBV infection are important associated factors with Hepatocellular carcinoma. Among HCC cases multiple lesions were more common than solitary. Mosaic pattern, portal vein invasion and characteristic arterial phase enhancement & portal or hepatic venous phase washout are important features. MRI identified all cases of HCC and proved to be an important tool in characterizing the HCC lesions.

The MRI could diagnose all cases of metastases and was able to differentiate the lesions into hypervascular & hypovascular on the basis of characteristic enhancement pattern.

Pyogenic abscesses were more common in the right lobe and were more commonly multiple. Amoebic abscesses were mostly solitary and located in the posterior segments of right lobe. Hydatid cysts can

be correctly diagnosed in the presence of characteristic features like T2 hypointense rim, hydatid sand, daughter cysts, floating membranes and peripheral calcification. Hemangiomas were mostly detected as an incidental finding. All detected lesions were solitary and were equally distributed in the anterior and posterior segments of the right lobe and exhibited typical enhancement features.

MR provides a comprehensive and non-invasive imaging work-up of patients with suspected hepatocellular adenomas.

FNH has a central scar, which is hyperintense on T2WI, and on contrast administration it shows filling in delayed images. Though there are some features, which point towards malignant nature of the lesion, but it is difficult to differentiate biliary cystadenoma and cystadenocarcinoma on imaging alone.

Dynamic contrast enhanced MR imaging examination yields characteristic enhancement patterns which can be used to diagnose or at least narrow the differential diagnosis for wide range of these lesions.

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