**ORIGINAL ARTICLE**

# Comparison of Positive Predictive Value of Multiphasic Dynamic Contrast Enhanced MRI with Dynamic Contrast Enhanced CT for the Detection of Hepatocellular Carcinoma

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## ABSTRACT

**Background:** Hepatocellular carcinoma (HCC) is the sixth most common cancer worldwide (1), developing within a cirrhotic background in up to 90% of cases. HCC has a 5-year survival rate of less than 10% as it is an aggressive and rapidly growing tumor.
**Aim:** To compare the positive predictive value of DCEMRI (dynamic contrast enhanced MRI) with DCECT (dynamic contrast enhanced CT-Scan) in the diagnosis of Hepatocellular carcinoma.
**Methods:** This comparative study was carried out on one hundred patients (Mean age, 52 years; age range, 36–80 years) who fulfilled the inclusion criteria. Fifty patients were included in each groups (CT, MRI). CT/ MRI findings of intense arterial uptake followed by a ''washout'' of contrast in the venous -delayed phases was taken as suspicion of HCC. Histopathology was taken as a gold standard for diagnosis.
**Results:** Out of 100 patients, 61 patients (61%) were males while 39 patients (39%) were females. The age of the patients ranged from minimum age of 36 years to maximum age of 80 years with a mean age of 52 years. The positive predictive value of dynamic contrast enhanced MRI was 94%, while that of dynamic contrast enhanced CT-Scan was 86%.
**Conclusion:** Dynamic contrast enhanced MRI (DCEMRI) is a superior modality for diagnosis of hepatocellular carcinoma as compared with dynamic contrast-enhanced CT-scan (DCECT).
**Keywords:** Hepatocellular Carcinoma, Positive predictive value of MRI for HCC. Dynamic contrast enhanced MRI (DCMRI).

## INTRODUCTION:

Hepatocellular carcinoma (HCC) is the sixth most common cancer worldwide [(1)], developing within a cirrhotic background in up to 90% of cases[2]. Regardless of the etiology, cirrhosis is strongest predisposing risk factor for HCC. The 5-year cumulative incidence of HCC has been shown to be 8-30% in patients with cirrhosis[3]. Conversely, the annual incidence of HCC is < 0.5% in patients without cirrhosis.

HCC is usually associated with poor prognosis and outcome, with a 5-year survival rate of less than 10% as it is an aggressive and rapidly growing tumor[4]. Early diagnosis of HCC make it eligible for potentially curative therapies, including thermal ablation treatment, such as radiofrequency or microwave ablation, surgical resection and liver transplantation[5]. Hence, diagnosing HCC in the early stages is critical for the outcome of treatment[6].

Computed tomography (CT) and magnetic resonance (MR) imaging are effective non-invasive imaging techniques that can be used to diagnose HCC. A single dynamic technique showing intense arterial uptake followed by a ''washout'' of contrast in the venous -delayed phases is valid to diagnose HCC by the guidelines of the American Association for the Study of Liver Diseases (AASLD)[7]. These guidelines have been adopted by the European Association for the Study of the Liver (EASL) and also by the European Organization for Research and Treatment of Cancer (EORTC)[8].

CT is commonly used imaging technique for diagnosing HCC because of its short acquisition time and high spatial resolution. MR imaging, which offers several beneficial characteristics such as the combination of various sequences and absence of X-ray radiation, is also often used independently or in combination with CT to improve the detection and diagnosis of HCC.

Several studies have compared the efficacy of dynamic contrast enhanced MR imaging to that of CT for the detection of HCC. Some studies suggested that Gd-DTPA (Gadolinium Diethylenetriaminepenta-acetic acid)-enhanced MR imaging shows better diagnostic performance than CT[9,10], whereas other studies suggested that there are no significant differences between the two techniques[11,12].

Finding the best suited imaging technique for detection and characterization of hepatic lesions on the background of cirrhotic liver is still a challenge. In the present study, we have compared the positive predictive value of multiphasic dynamic contrast enhanced magnetic resonance imaging (MRI) with dynamic contrast enhanced computed tomography (CT) for the diagnosis of HCC.

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## PATIENTS AND METHODS

This comparative study was undertaken in Department of Radiology at Chaudhry Muhammad Akram Teaching hospital Lahore, Islam central hospital Sialkot and Department of radiology a life-line imaging center Lahore from November 2018 and August 2019. Informed consent, approved by the Institutional Clinical Research at our Institutes, was obtained from all patients. We included one hundred patients (Mean age, 52 years; age range, 36–80 years) who fulfilled the inclusion criteria. Fifty patients were included in each groups (CT, MRI). Histopathology report was taken as a gold standard for diagnosis. The collected data was analyzed statistically by using SPSS version 10. Inclusion criteria were suspicious findings on screening Ultrasound and whose CT/ MRI findings raised the suspicion of HCC (intense arterial uptake followed by a ''washout'' of contrast in the venous-delayed phases). Exclusion criteria were renal failure, allergy to contrast agents, hyperthyroidism, pregnancy and for the MRI examination, pacemaker or other non-compatible implants and claustrophobia.

**CT Imaging:** CT examinations were performed using 16-detector row CT scanner (Aquilion 16, Toshiba Medical Systems). Unenhanced baseline scan of the liver was obtained then hepatic arterial phase (HAP) started 30–35 seconds after the administration of contrast material. A portal venous phase (PVP) of the abdomen and pelvis started 40 seconds and equilibrium phase of the upper abdomen, at 180 seconds. Nonionic iodinated contrast agent (Iopromide, Ultravist 370 mgI/mL Schering AG, Berlin, Germany) was injected at a rate of 3 mL/sec.

**MRI Imaging technique:** MRI was performed with a 1.5-T system (Siemens Medical Systems, Erlangen, Germany) using a phased-array torso coil for signal detection. All patients underwent transverse T1-weighted and T2-weighted MRI and multiphasic contrast-enhanced dynamic 3-dimensional MRI of the whole liver with fat suppression. Dynamic MRI was performed with a 3-dimensional Volumetric Interpolated Breath-hold Examination (VIBE) sequence in axial plane by using the following parameters: 4.3/2, 25° flip angle, 256 × 106 matrix, slice thickness of 3 mm. Gadolinium was injected at a dose of 0.2 mL/kg at a rate of 2 mL/s. Bolus tracking technique was used to obtain arterial-phase images, approximately 20 seconds after contrast injection. Portal venous and delayed venous phase images were acquired 60 to 65 and 100 to 110 seconds thereafter. A breath-hold T1-weighted 2-dimensional gradient echo with fat suppression MRI (160/2.6 TR/TE, 256 × 115 matrix) was performed 5 minutes after contrast injection.

**Image analysis:** MRI and Ct images were evaluated.Vascular pattern was qualified as "conclusive" for HCC if contrast washout occurred, defined as the presence of hypervascularity during the arterial phase followed up by a hypodense/hypointense appearance in later phases defining washout. The final diagnosis was obtained by Histopahological report of the biopsy taken, which is a gold standard for diagnosis.

## RESULTS

This study was conducted on 100 patients who fulfilled the inclusion criteria. Out of these 100 patients 48 (48%) were female and 52 (52%) were male.

Table 1: Frequency distribution of patient gender

| | n | Male | Female |
|---|---|---|---|
| MRI | 50 | 31 (62%) | 19 (38%) |
| CT | 50 | 30 (60%) | 20 (40%) |
| Total | 100 | 61 | 39 |

Table 2; Statistics of age

| | n | Age Range | Mean Age |
|---|---|---|---|
| MRI | 50 | 36-78 years | 51 years |
| CT | 50 | 39-80 years | 53 years |
| Total | 100 | 36-80 years | 52 years |

The age of the patients ranged from minimum age of 36 years to maximum age of 80 years with a mean age of 52 years.

The patient who were included in the study, were then had biopsies of their suspected lesions. Following formula was used to calculate the positive predictive value.

$$PPV = \frac{\text{Number of True positive cases}}{\text{Number of True positives} + \text{Number of False Positives}}\ x\ 100$$

**DCEMRI – dynamic contrast-enhanced MRI:** Histopathology revealed that out of 50 patients, who shown findings of HCC on DCEMRI, 47 patients (94%) were True Positive, while 3 patients (6%) were declared negative on histopathology so we labelled them as False Positive.

Table 3; Positive predictive value of DCEMRI – dynamic contrast-enhanced MRI.

$$\text{Positive Predictive Value} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \times 100$$

$$= \frac{47}{47+3} \times 100 = 94\%$$

**DCECT – dynamic contrast-enhanced:** On the other handhistopathology reports revealed that out of 50 patients, who shown findings of HCC on DCECT-Scan, only 43 patients (86%) were True Positive, while 7 patients (14%) were declared negative on histopathology so we labelled them as False Positive.

Table 4; Positive predictive value of DCECT – dynamic contrast-enhanced CT.

$$\text{Positive Predictive Value} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \times 100$$

$$= \frac{43}{43+7} \times 100 = 86\%$$

## DISCUSSION

CT has been the primary imaging modality for evaluating the focal liver lesions for many years, it has improved diagnostic accuracy due to recent advances in technology such as MDCT[13]. However, MRI offers several advantages over CT, including non-ionizing radiation, superior soft tissue contrast resolution and a variety of sequences with their different image weighting. MRI uses extracellular contrast media, to provide a detailed evaluation of the biliary tree with a higher safety profile of contrast agents. MRI better characterizes the occasional problematic pseudo-lesions identified on US or CT, such as focal fatty infiltration and focal fatty sparing, as well as showing better overall accuracy in the detection and characterization of focal lesions [14].

Several studies have suggested that CT has a lower sensitivity than MRI for detecting dysplastic nodules, small HCCs, and diffuse HCCs [(15, 16)]. Some other authors have also demonstrated that the sensitivity , specificity and positive predictive value of dynamic MRI is greater than that of dynamic CT for the detection and characterization of HCC of all sizes, reporting sensitivities of 61-90% for MRI, compared with 52-78% for CT[17-18].

MRI has gained an increasingly central role in evaluating patients with chronic liver disease because of its higher diagnostic accuracy for the detection and characterization of HCCs, together with technical advancements ensuring superior and more reproducible image quality. For the evaluation of liver nodules, many physicians including hematologists and radiologists currently prefer dynamic contrast-enhanced MRI over CT.

In this study we have objectively compared and shared our experience regarding MRI and Ct scan for the accurate detection of hepatocellular carcinoma. Our results are also in line with previous studeis [17-19]. We compared the positive predictive value of multiphasic dynamic contrast enhanced MRI with dynamic contrast enhanced CT-Scan for the detection of Hepatocellular carcinoma. The suspicion of HCC raised by CT/MRI was finally confirmed by histopathology. We found that positive predictive value of DCEMRI was 94% while that of DCECT was 86%. So we also believe that whenever available, MRI should be preferred over CT-Scan to diagnose HCC.

## CONCLUSION

Our study concludes that Dynamic contrast enhanced MRI (DCEMRI) is a superior modality for diagnosis of hepatocellular carcinoma as compared with dynamic contrast-enhanced CT-scan (DCECT). We also recommend that MRI should be preferred over CT-Scan in patients of suspected HCC.

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