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# Differentiating Benign and Malignant Focal Hepatic Lesions Using Diffusion Weighted MRI and ADC Values: A Comparative Research

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**Abstract**

Introduction: Proper clinical management of "focal hepatic lesions (FHLs)" depends on their classification into benign and malignant categories. Promising methods for this purpose include the computation of "Apparent Diffusion Coefficient (ADC)" values and "diffusion-weighted MRI (DW-MRI)".

Techniques: A retrospective examination of 35 patients who had DW-MRI and were suspected of having FHLs was done. ADC values were computed, and lesion features assessed in order to differentiate benign from malignant lesions.

Findings: Of the cases examined, hemangioma and metastases accounted for 28.57% of the lesions. Hepatocellular carcinoma, simple hepatic cysts, and other uncommon diseases were also found. ADC values differed according to the kind of lesion; malignant lesions showed diffusion limitation with lower ADC values, whereas hemangiomas showed greater values suggestive of benign origin.

Conclusion: In conclusion, DW-MRI and ADC values offer important information about FHL characterization, making it possible to distinguish between benign and malignant lesions. These non-invasive techniques should be further validated in bigger prospective trials as they have important therapeutic implications for directing suitable management methods.

Keywords: Diffusion-weighted MRI, Apparent diffusion coefficient (ADC), Focal hepatic lesions, Benign, Malignant

## Introduction

Abnormalities in the liver's parenchymal tissue, which can appear as solid or cystic structures, are indicative of a range of benign and malignant disorders. These lesions may develop from secondary involvement brought on by systemic problems elsewhere in the body, or they may begin within the liver itself [1-3]. Focal hepatic lesions cover a wide range of conditions, from single-cell hepatic cysts to many metastatic growths. The identification and diagnosis of these lesions have been made easier by the growing availability and use of imaging modalities such “computed tomography (CT)”, “magnetic resonance imaging (MRI)”, and “ultrasonography (USG)” [4-6].

For the identification and description of focal hepatic lesions, MRI has become a useful tool. It is possible to distinguish between damaged and normal liver parenchyma more clearly by using alternative MRI sequences, either with or without contrast enhancement [7, 8]. The increased popularity of MRI in liver imaging can be attributed to its benefits, which include faster scanning sequences, higher resolution, no ionising radiation, and enhanced sensitivity and specificity [9–11].

“Diffusion-weighted imaging (DWI)” is one of the MRI sequences that has shown to be especially helpful in describing hepatic abnormalities. DWI provides information on tissue microstructure by utilising the concepts of Brownian motion of water molecules across tissue membranes [8,9]. Diffusion restriction is caused by the higher cellular density in tumours, and this can be seen on DWI [10,11].

While DWI was originally mainly used in neuroradiology to evaluate diseases such as cerebral and cerebellar ischemia, demyelinating illnesses, and neural tumours, it is now also used in liver imaging. DWI has the advantages of shorter imaging times and not requiring exogenous contrast agents [12,13].

DWI makes it possible to evaluate membrane integrity and cellular content in liver imaging. One way to quantify the diffusion of water molecules across cell membranes is to use the ADC, which is obtained from DWI. ADC values for various types of focal hepatic lesions have been published in a variety of studies [7,8,14]. These values can change based on the particular case and the b-values used during the imaging process.

Diffusion limitation and therefore poor ADC values are common in malignant lesions. As a result, computing mean ADC values can help differentiate between benign and malignant localised hepatic lesions, offering important data for patient care and clinical decision-making.

## Materials And Methods

Over the course of 18 months, from January 2021 to June 2022, this observational research was carried out in tertiary care center. An observational strategy was used in the research design, which lasted for 18 months among 35 subjects.

Research Period: The research was carried out over an 18-month period, beginning in January 2021 and ending in June 2022.

Selection Standards:

The research's inclusion criteria encompassed individuals who were referred for MRI because of focal liver lesions that were clinically suspected, as well as those whose focal liver lesions on USG or CT scans were ambiguous or incidentally discovered. All age groups and genders of patients were welcome to participate.

Patients having pacemakers, metallic implants, cochlear implants, or metallic foreign entities that are generally contraindicated to MRI were excluded. Patients having a history of claustrophobia were also not allowed to take part.

Ethical and consent approvals were obtained.

Techniques:

Data collection: A pre-made proforma was given to patients who met the selection criteria in order to gather demographic data, such as age and sex. To guarantee the best possible collaboration throughout the scan, patients were also given information regarding the MRI process.

Scan Protocol: A set of parameters, such as field of view, slice thickness, matrix size, and sequences recorded, were used to perform MRI scans. ADC values were obtained from several locations of interest using diffusion-weighted MRI sequences. A p-value of less than 0.05 was considered statistically significant.

**Results**

Distribution of Focal Hepatic Lesions: A variety of lesion forms were found in the current research, which looked at 35 individuals' FHLs. With 10 cases each, Hemangioma and metastasis accounted for 28.57% of the total cases and were the most common lesions. The next most frequent condition after these, accounting for 17.14% of the cases with 6 occurrences, was simple hepatic cysts. Four cases, or 11.42% of the patients, had hepatocellular carcinoma found. Each of the less common liver abnormalities, including hepatic abscess, hydatid cyst, focal nodular hyperplasia, intrahepatic cholangiocarcinoma, and biliary cystadenocarcinoma, was observed in 2.86% of the patients as individual occurrences. Table 1

In the current research, the diffusion properties of focal hepatic lesions were assessed for each kind of lesion. Interestingly, diffusion limitation was present in every case of metastasis, suggesting a common pattern for this type of malignant lesion. Conversely, in just one out of every ten cases did hemangiomas exhibit diffusion limitation, indicating a more variable presentation in this lesion. Diffusion limitation was consistently absent in all six of the patients that were examined for simple hepatic cysts. Diffusion limitation was seen in all cases of hepatocellular carcinoma and other malignant liver lesions, including intrahepatic cholangiocarcinoma and biliary cystadenocarcinoma, highlighting the distinctive diffusion patterns linked to these diseases. Table 2

In the current research, the ADC values were carefully assessed across the different localised hepatic lesions. The average DC value of hemangiomas was 1.66 +/- 0.10 x 10-3 mm2/sec, with a range of 1.43 to 1.85 x 10-3 mm2/sec. ADC values for metastasis ranged from 0.95 to 1.33 x 10-3 mm2/sec, with an average of 1.11 +/- 0.11 x 10-3 mm2/sec. The ADC values of simple hepatic cysts were 2.71 +/- 0.12 x 10-3 mm2/sec on average, with a range of 2.60 to 2.92 x 10-3 mm2/sec. Lower ADC values, indicating diffusion restriction, were seen in malignant lesions such as hepatocellular carcinoma, intrahepatic cholangiocarcinoma, and

biliary cystadenocarcinoma. For hepatocellular carcinoma, the ADC values ranged from 1.03 to 1.29 x 10-3 mm2/sec, whereas for intrahepatic cholangiocarcinoma and biliary cystadenocarcinoma, they were 1.20 to 1.24 x 10-3 mm2/sec. Table 3

In the present research, the diffusion properties and the mean ADC values were evaluated over the range of focal hepatic lesions. Diffusion restriction was not observed in most hemangiomas, with a mean ADC value of 1.66 +/- 0.10 x 10-3 mm2/sec. On the other hand, metastasis, with a mean ADC value of 1.11 +/- 0.11 x 10-3 mm2/sec, showed diffusion limitation in every instance. Diffusion limitation was continuously absent in simple hepatic cysts, with a mean ADC value of 2.71 +/- 0.12 x 10-3 mm2/sec. All malignant lesions, including biliary cystadenocarcinoma, intrahepatic cholangiocarcinoma, localised nodular hyperplasia, and hepatocellular carcinoma, showed diffusion limitation. The hepatic lesions that were malignant displayed mean ADC values ranging from 0.65 to 1.24 x 10-3 mm2/sec, highlighting the ability of ADC values to distinguish between benign and malignant lesions. Table 4

**Discussion**

To distinguish between benign and malignant lesions, the current research examined the characterization of FHLs using DW-MRI and the computation of ADC values. The current research provides insightful information about the function of ADC values and DW-MRI as possible diagnostic tools in the clinical context of hepatic pathologies.

Distribution and Prevalence of Lesions

According to recent studies, there is a wide range in the distribution of FHLs, with metastasis and Hemangioma showing up as the most frequent lesions. These results are consistent with earlier research indicating that hemangiomas and metastases are common liver abnormalities [1]. Even though hemangiomas are usually benign, they can occasionally exhibit unusual characteristics that call for them to be distinguished from malignant lesions2. Similarly, imaging characteristics of metastatic lesions frequently occur, requiring a precise diagnosis to initiate appropriate treatment [3].

ADC Values and Characterization of Lesion

The ADC values found in this research offered vital details for characterising lesions. Higher ADC values were seen in hemangiomas, which is in line with their free diffusion and benign nature [4]. On the other hand, because of diffusion limitation, metastatic lesions showed reduced ADC values, supporting their malignant nature [5]. The benign nature of simple hepatic cysts was highlighted by their greatest ADC values, which were devoid of diffusion restriction [6].

The diffusion restriction characteristic of malignant lesions, such as hepatocellular carcinoma, intrahepatic cholangiocarcinoma, and biliary cystadenocarcinoma, was further emphasised by the ADC values [7]. Increased cellularity, the nuclear-to-cytoplasmic ratio, and fibrosis have all been linked to this pattern of diffusion restriction in malignant lesions [8]. These unique patterns of ADC values present a viable way to distinguish between benign and malignant liver lesions.

Correspondence with Earlier Research

The present results are consistent with earlier studies that support the use of DW-MRI in the evaluation of hepatic abnormalities [9]. Hepatic imaging is one of the medical specialties that

has benefited from DW-MRI's capacity to show changes in molecular mobility in tissues [10]. Moreover, numerous investigations have shown a link between ADC values and lesion type, underscoring its potential as a trustworthy quantitative biomarker [11].

Clinical Consequences

There are important therapeutic ramifications when benign from malignant hepatic lesions may be distinguished non-invasively utilising DW-MRI and ADC values. When making treatment decisions, such as whether to undergo surgical resection, ablation, or conservative care, accurate lesion definition is essential [12]. Furthermore, the danger of needless procedures can be reduced by differentiating benign lesions like hemangiomas from malignant lesions like metastases or hepatocellular carcinoma [13–15].

Limitations

Even while recent research provides insightful information, there are still gaps in the field. The current findings may not be as broadly applicable due to the comparatively small sample size. Furthermore, selection bias could be introduced by the research's retrospective design. Further research utilising larger cohorts and prospective designs is necessary to corroborate present findings and delve deeper into the possibilities presented by DW-MRI and ADC values.

## Conclusion

To sum up, recent studies have demonstrated the critical importance of ADC values and diffusion-weighted MRI in precisely identifying focal hepatic lesions. By helping to distinguish between benign and malignant lesions, these non-invasive techniques provide insightful information that helps clinicians treat patients appropriately. The unique patterns of ADC values found in different hepatic diseases highlight their potential as trustworthy quantitative biomarkers. The current research adds to the increasing body of evidence supporting the integration of DW-MRI into standard clinical practice for hepatic lesion assessment, even though more research is necessary to validate these findings.

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**Tables**

Table 1: Distribution of Focal Hepatic Lesions

| **Diagnostic Category** | **Number of Cases** |
|---|---|
| Biliary cystadenocarcinoma | 1 |
| Hepatocellular carcinoma | 4 |
| Intrahepatic cholangiocarcinoma | 1 |
| Hemangioma | 10 |
| Focal nodular hyperplasia | 1 |
| Simple hepatic cyst | 6 |
| Metastasis | 10 |
| Hepatic abscess | 1 |

| | |
|---|---|
| Hydatid cyst | 1 |

Table 2: Diffusion Characteristics of Different Focal Hepatic Lesions

| Diagnosis | Diffusion characteristic | Diffusion characteristic | Total |
|---|---|---|---|
| Hemangioma | Present | Absent | 10 |
| Metastasis | 1 | 9 | 10 |
| Simple hepatic cyst | 10 | 0 | 6 |
| Hepatocellular carcinoma | 0 | 6 | 4 |
| Hepatic abscess | 4 | 0 | 1 |
| Hydatid cyst | 1 | 0 | 1 |
| Focal nodular hyperplasia | 0 | 1 | 1 |
| Intrahepatic cholangiocarcinoma | 1 | 0 | 1 |
| Biliary cystadenocarcinoma | 1 | 0 | 1 |
| Total | | | 35 |

Table 3: ADC Value of Different Focal Hepatic Lesions

| Focal hepatic lesion type | Range of ADC value (x 10-3 mm2/sec) | Mean ADC values (x 10-3 mm2/sec) | Standard deviation |
|---|---|---|---|
| Hepatocellular carcinoma | 1.03-1.29 | 1.17 | 0.10 |
| Hemangioma | 1.43-1.85 | 1.66 | 0.10 |
| Hydatid cyst | 2.9 | 2.9 | - |
| Metastasis | 0.95-1.33 | 1.11 | 0.11 |
| Biliary cystadenocarcinoma | 1.20 | 1.20 | - |
| Focal nodular hyperplasia | 1.59 | 1.59 | - |
| Simple hepatic cyst | 2.60-2.92 | 2.71 | 0.12 |
| Hepatic abscess | 0.65 | 0.65 | - |
| Intrahepatic cholangiocarcinoma | 1.24 | 1.24 | - |

Table 4: Diffusion Characteristics and Mean ADC Values of Different Focal Hepatic Lesions

| Focal hepatic lesion | Diffusion restriction | Mean ADC value (x 10-3 mm2/sec) |
|---|---|---|
| Hemangioma | Absent | 1.66 +/- 0.10 |
| Metastasis | Present | 1.11 +/- 0.11 |
| Simple hepatic cyst | Absent | 2.71 +/- 0.12 |
| Hepatocellular carcinoma | Present | 1.17 +/- 0.10 |

| | | |
|---|---|---|
| Hepatic abscess | Present | 0.65 |
| Hydatid cyst | Absent | 2.9 |
| Focal nodular hyperplasia | Present | 1.59 |
| Intrahepatic cholangiocarcinoma | Present | 1.24 |
| Biliary cystadenocarcinoma | Present | 1.20 |