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A CROSS-SECTIONAL STUDY IN EVALUATION OF SPLEEN USING DIFFUSION WEIGHTED IMAGING IN PATIENTS WITH CIRRHOSIS AND PH AT A TERTIARY CARE CENTRE, CHENGALPATTU DISTRICT, TAMILNADU

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ABSTRACT
Portal hypertension (PH) is a major complication of cirrhosis and is associated with considerable morbidity and mortality. Non-invasive imaging biomarkers for assessing disease severity are increasingly being investigated. Diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) measurements of the spleen may provide valuable insights into portal hypertensive changes. This study aimed to evaluate splenic apparent diffusion coefficient values using diffusion-weighted magnetic resonance imaging in patients with cirrhosis and portal hypertension and to assess their association with disease severity. This cross-sectional study included 70 participants, comprising 50 patients with cirrhosis and portal hypertension and 20 healthy controls. MRI examinations were performed using a 1.5-T system with Diffusion-weighted imaging acquired at b-values of 0, 500, and 1000 s/mm². Splenic apparent diffusion coefficient values were measured from apparent diffusion coefficient maps and correlated with clinical, laboratory, endoscopic, and radiological indicators of portal hypertension. Statistical analyses were performed using SPSS version 17. Splenic apparent diffusion coefficient values were significantly higher in cirrhotic patients than in controls. Elevated splenic apparent diffusion coefficient values were significantly associated with worsening esophageal varices, variceal bleeding, hypersplenism, increasing ascites severity, and advancing Child–Pugh class. Significant positive correlations were observed between splenic apparent diffusion coefficient values, portal vein diameter, and spleen size. Receiver Operating Characteristic (ROC) analysis demonstrated good diagnostic performance of the splenic apparent diffusion coefficient for predicting variceal bleeding. Splenic apparent diffusion coefficient derived from diffusion-weighted MRI is a promising non-invasive imaging biomarker for assessing portal hypertension severity.

KEYWORDS: Cirrhosis; Portal hypertension; Diffusion-weighted imaging; Apparent Diffusion Coefficient; Spleen.

1. INTRODUCTION
The final stage of chronic liver disease, cirrhosis, is characterised by persistent liver fibrosis, architectural deformity, and impaired liver function. The emergence of portal hypertension (PH), a significant cause of morbidity, is one, if not the most, clinically significant outcome and mortality due to esophageal varices, variceal hemorrhage, ascites, hypersplenism, and hepatic decompensation. Accurate PH assessment is therefore imperative for risk stratification, disease management planning and disease monitoring. While hepatic venous pressure gradient (HVPG) measurement is the gold standard in the evaluation of PH, it is an invasive procedure, and is not routinely performed in clinical practice, so there is a need for reliable, non-invasive imaging biomarkers (Kennedy et al., 2020).
Increased portal venous pressure causes significant structural and hemodynamic changes in the spleen. Chronic PH causes the spleen to enlarge, congest, remodel the splenic vessels, and change the perfusion of the splenic tissue. Such changes are closely associated with clinical features like thrombocytopenia and hypersplenism. Imaging studies have been performed in the past, which have shown that splenic parameters may also show useful indirect information regarding portal hemodynamics. The spleen is an important target for non-invasive evaluation, as demonstrated by several significant associations between physiological changes in the spleen and the severity of PH using advanced imaging techniques such as perfusion-based assessment (Talakić et al., 2017). In recent years, perfusion imaging studies have been described that

could be useful to diagnose severe PH with a good diagnostic performance when combined assessment of hepatic and splenic vascular characteristics is performed (Zhu et al., 2024).

A subset of functional magnetic resonance imaging (fMRI) called diffusion-weighted imaging (DWI) evaluates the minuscule movement of water molecules within tissues. The apparent diffusion coefficient (ADC) is able to quantify diffusion, and it is related to tissue cellularity, extracellular space and microvascular properties. Due to its non-invasive nature and the fact that there is no ionizing radiation, DWI is becoming more important in the evaluation of chronic liver disease. Several revisions have evidenced that diffusion parameters can give information on tissue changes related to fibrosis and PH. Moreover, normalization method based on splenic measurement has been suggested to enhance the diagnostic accuracy of liver ADC assessment in the evaluation of liver fibrosis (Shin et al., 2019).

There is growing evidence that splenic diffusion parameters are helpful indicators of PH severity. It has been shown that diffusion MRI can measure changes in splenic microcirculation in patients with chronic liver disease and hepatic fibrosis, highlighting the biological relevance of ADC measurements of spleen in portal hypertensive states (Zheng et al., 2022). In children with PH, an MRI technique called diffusion tensor imaging (DTI) has been found to predict and grade esophageal varices, suggesting that the DTI characteristics of the spleen correlate with clinically significant PH (Razek et al., 2021). Likewise, MRI evaluations using splenic tissue characteristics have proven to be useful in the evaluation of clinically important PH and the severity of disease (Catucci et al., 2021). Furthermore, dynamic contrast-enhanced MRI studies have been used to further reinforce the role of splenic imaging biomarkers in the non-invasive diagnosis of PH (Hectors et al., 2021). Recent studies also showed that splenic ADC values are related to the degree of cirrhosis and PH, and could be used in daily practice of clinical assessment (Siddhardha et al., 2026).

Although splenic diffusion imaging has gained more interest, there is limited literature evaluating the usefulness of the splenic ADC value as comprehensive biomarker of PH severity in adult cirrhosis patients. To date, the majority of studies have included only specific imaging methods, only a few paediatric patients, or only specific outcomes of PH. Moreover, studies assessing the correlation of splenic ADC with various other clinical, radiological and prognostic markers of PH are limited, especially in Indians. Therefore, more data is required to clarify the function of splenic ADC as a non-invasive imaging biomarker in patients with cirrhosis.

1.6 Study Aim and Objectives

Aim:

To evaluate the spleen using DWI in patients with cirrhosis and PH.

Objectives:

1. To assess spleen apparent diffusion coefficient (ADC) values in patients with cirrhosis and PH.
2. To compare splenic ADC values with those of healthy controls.
3. To evaluate the association between splenic ADC values and the severity of portal hypertension using clinical and radiological parameters.
4. To evaluate the potential utility of splenic ADC values as a non-invasive imaging biomarker for PH in cirrhotic patients.

2. METHODOLOGY

2.1 Study Design, Setting, Duration, and Participants

Over the course of eighteen months, this cross-sectional study was conducted in the Department of Radiodiagnosis of a tertiary care hospital situated in a rural Tamil Nadu district. Subjects with a diagnosis of cirrhosis of the liver, confirmed by clinical examination, biochemical and imaging investigation, with evidence of PH clinically and radiologically, were enrolled in the study if they were being referred for abdominal MRI with DWI. Inclusion criteria also included subjects 18 years old or older. A control group of individuals without a history of acute or chronic liver disease and with normal liver functions was chosen. Patients with any focal lesion involving the spleen affecting ADC measurements, any previous splenic surgery or treatment, any acute infection, hematological disorders affecting the spleen, pregnant women, claustrophobia or refusal to participate in the study were excepted from the study.

2.2 Sampling Method and Sample Size

When all eligible respondents were available, a consecutive sampling technique was employed, during the period of the study were enrolled until the required number of respondents had been obtained. In this way, any form of selection bias was eliminated, thus ensuring that a representative sample of the respondents would be used. The sample size was determined to be 64.08 respondents. By increasing the sample size by 10%, the final sample size was 70.48, rounded up to 70 respondents.

2.3 MRI Acquisition Protocol

Both MRI and DWI scans were done with the use of a 1.5 Tesla MRI machine (Philips Achieva, Philips Medical Systems). Scans were made with patients lying down in a supine position with the body coil surrounding the abdomen. The first set of scans done was the coronal T2 weighted scans. These were then followed by DWI which produced ADC maps with the aid of a dedicated workstation. DWI scans with fat suppression respiratory triggering with SE-EPI sequence were done using GRAPPA with a two-fold acceleration factor. Along each of the three orthogonal axes, the diffusion gradient was calculated independently. EPI factor 95, TR/TE 1600/62 ms, FA 90°, slice thickness 7 mm, distance factor 30%, six signal averages, receiver bandwidth 1735 Hz/pixel, field of view 249 × 380 mm, matrix size 94 × 192, and acquisition time 2-4

minutes based on the respiratory cycle were the imaging parameters. Diffusion weighting images were acquired at 0, 500, and 1000 s/mm². Navigator-gated respiratory triggering with prospective acquisition correction (PACE) was the method used for respiratory gating. Navigator echoes were used to estimate diaphragmatic position on a regular basis. Each voxel's trace diffusion weighted images and ADC maps were automatically computed, and the resulting images were of excellent quality across all subjects.

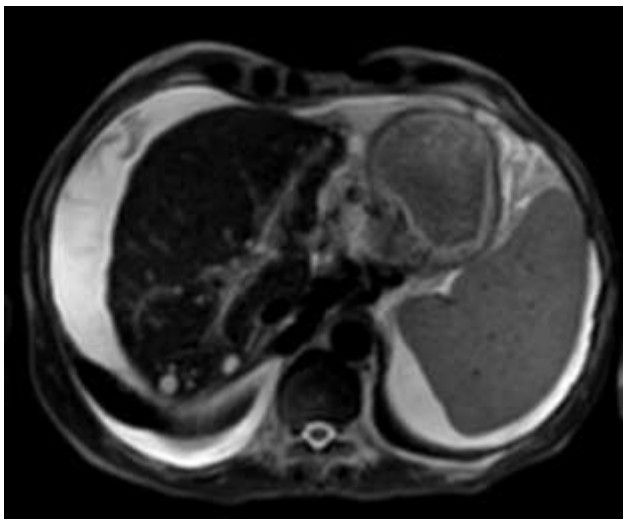

Figure 1. MRI Abdomen showing portal hypertension features with ascites, liver nodularity, splenomegaly, portosystemic collaterals

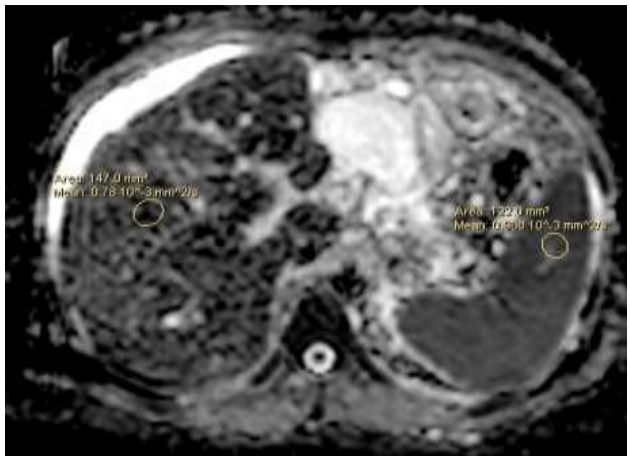

Figure 2. ADC MAPPING OF A CIRRHOTIC PATIENT

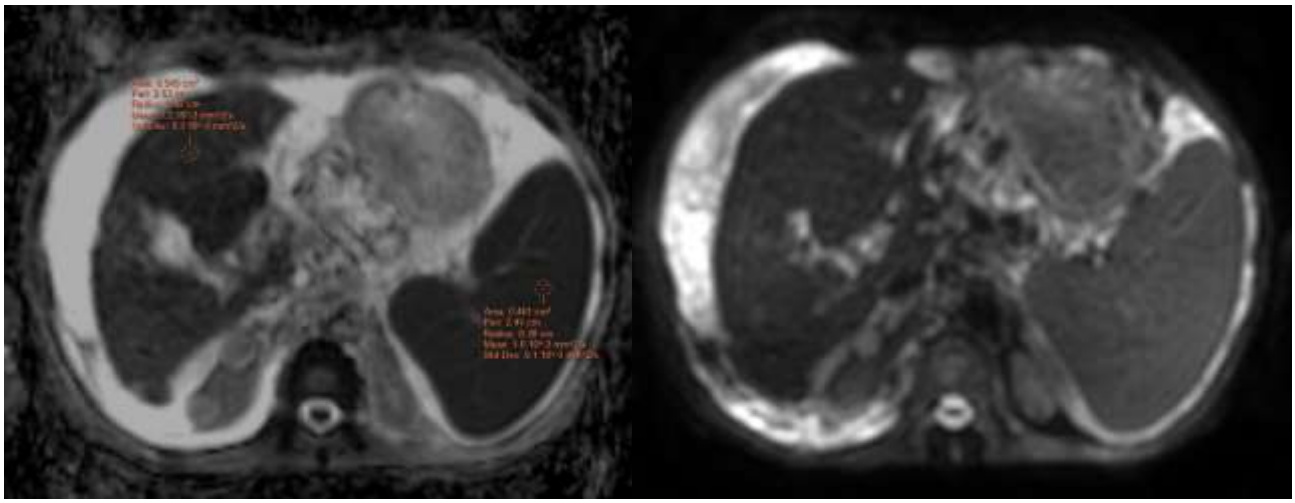

Figure 3. DWI and ADC MAPPING OF A CIRRHOTIC PATIENT

2.4 ADC Measurement and Study Variables

ROIs were selected in the splenic parenchyma, excluding any vessels and imaging artifacts. The ADC maps were then analyzed, and the mean splenic ADCs were obtained. The demographic factors studied include the patient's age and sex; cirrhosis and PH clinical diagnosis; laboratory data; MR findings; DWI technique; splenic ADCs; and the presence of

splenomegaly with related symptoms. Clinical and imaging findings, including the presence and severity of oesophageal varices, history of variceal bleeding, hypersplenism, ascites, and Child-Pugh classification, were used to assess the severity of PH.

2.5 Statistical Analysis

Microsoft Excel was used for data entry, and the Statistical Package for Social Sciences version 17 was used for analysis. Descriptive statistical analyses involving means, standard deviations, frequencies, and percentages were performed on the data. Tabulation and representation of data through tables and graphs were done. Splenic ADC measurements were correlated with indicators of PH to establish associations.

2.6 Ethical Consideration

The Institutional Ethics Committee granted ethical clearance before the study began. Prior to taking part in the experiment, each subject provided written informed consent. Confidentiality of the data of patients was ensured during the research. Since the process of imaging is a routine process, no extra costs were incurred, nor were there any extra risks for the subjects involved.

3. RESULTS

3.1 Baseline Features

This study involved 70 participants in total, 50 of whom were patients with PH and cirrhosis, and the other 20 formed the control group. Demographic details, etiology, laboratory investigations, parameters of DWI, MRI signals, and radiological measurements are showed in Table 1 below.

Table 1. Baseline Study Population Features and Cirrhosis Aetiology

Variable	Cases (n=50)	Controls (n=20)	p-value
Age (years), mean ± SD	56.2 ± 10.5	54.8 ± 9.7	0.584
Male, n (%)	34 (68.0)	15 (75.0)	0.548
Female, n (%)	16 (32.0)	5 (25.0)	
Alcohol-related cirrhosis, n (%)	24 (48.0)	NA	NA
NAFLD-related cirrhosis, n (%)	13 (26.0)	NA	NA
HBV-related cirrhosis, n (%)	7 (14.0)	NA	NA
HCV-related cirrhosis, n (%)	6 (12.0)	NA	NA

The distributions of age and sex are illustrated in Figure 4 below. There is no notable difference in age distribution among the cases and controls.

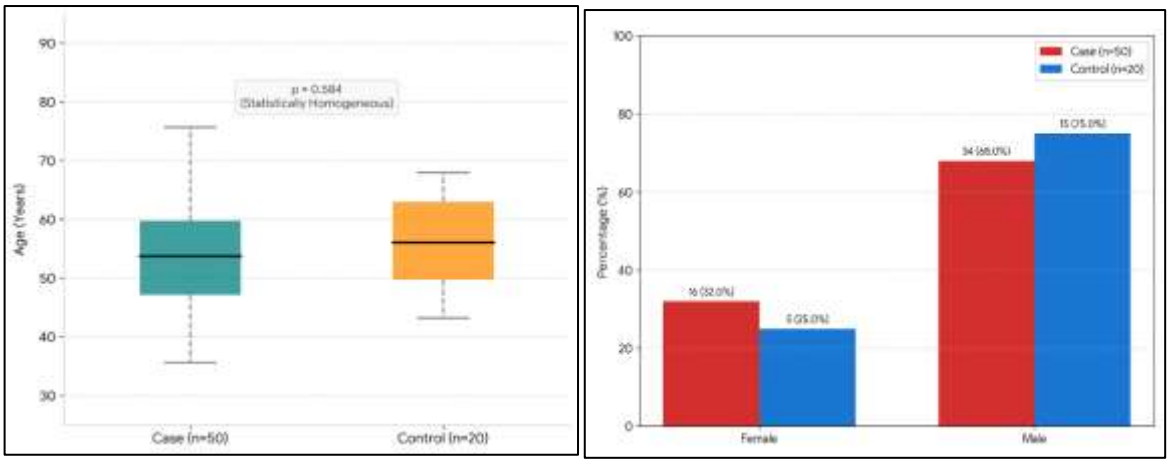

Figure 4. Distribution of the study population's age and sex

As shown in Figure 1, both the cases and controls were similar regarding the distribution of age and sex. There were no substantial differences in these variables between the two groups, suggesting that they were demographically balanced. Figure 5 shows the etiology of cirrhosis among the subjects.

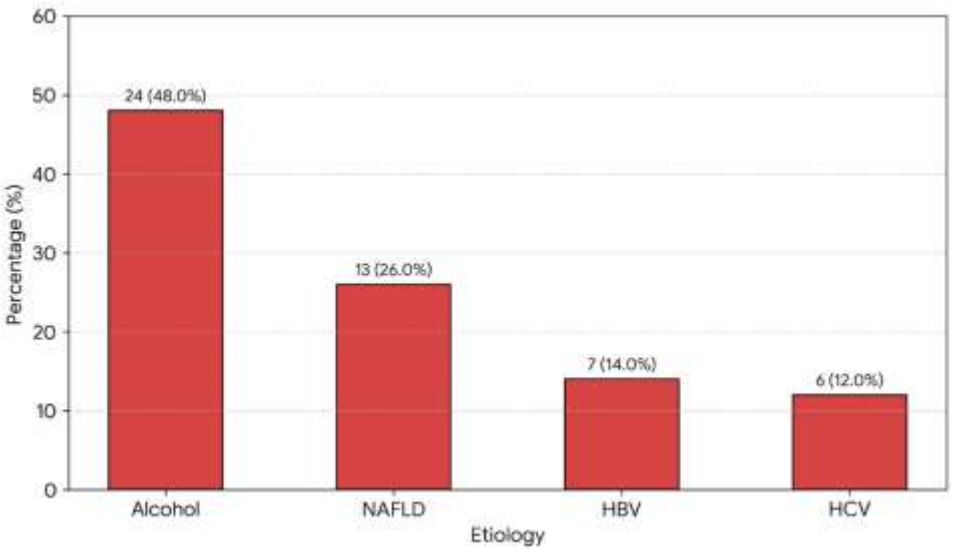

Figure 5. Etiological distribution of cirrhosis among study participants

Cirrhosis was primarily caused by alcoholic liver disease, among the participants of the study, with NAFLD following it, while hepatitis B- and C-induced cirrhosis comprised a smaller percentage.

3.2 Comparison of Laboratory, MRI, and Radiological Parameters

The differences in the clinical, biochemic and imaging features of cirrhotic patients suffering from PH and control subjects are described on the basis of comparison of their hematological indices, biochemical indicators of liver function, DWI measures, and MRI signal intensity. These findings are shown in Table 2.

Table 2. Comparison of laboratory, diffusion, MRI signal, and radiological parameters

Parameter	Cases (n=50)	Controls (n=20)	p-value
Hematological Parameters			
Haemoglobin (g/dL)	10.9 ± 1.4	13.3 ± 1.1	<0.001
WBC (/mm³)	7245 ± 1860	6812 ± 1490	0.331
Platelet count (/mm³)	108540 ± 28420	228640 ± 35120	<0.001
Biochemical Parameters			
Bilirubin (mg/dL)	3.48 ± 1.52	0.79 ± 0.20	<0.001
Albumin (g/dL)	2.98 ± 0.39	4.31 ± 0.26	<0.001
Creatinine (mg/dL)	1.28 ± 0.27	0.84 ± 0.13	<0.001
INR	1.66 ± 0.34	0.94 ± 0.10	<0.001
DWI Parameters			
ADC Liver (×10⁻³ mm²/s)	0.98 ± 0.11	1.24 ± 0.07	<0.001
ADC Spleen (×10⁻³ mm²/s)	1.43 ± 0.17	1.16 ± 0.06	<0.001
Radiological Parameters			
Liver size (cm)	12.4 ± 1.5	14.8 ± 0.8	<0.001
Spleen size (cm)	16.1 ± 2.8	11.0 ± 1.1	<0.001
Portal vein diameter (mm)	14.4 ± 1.8	10.9 ± 0.9	<0.001
MRI Signal Intensity Parameters			
In-phase liver	132.8 ± 51.4	206.4 ± 11.8	0.001
In-phase spleen	79.6 ± 20.4	147.2 ± 13.1	0.002
Opposed-phase liver	126.9 ± 44.2	204.8 ± 27.5	0.008
Opposed-phase spleen	71.5 ± 22.1	156.4 ± 9.8	0.011

Graphical comparisons of hemoglobin levels, white blood cell count, and platelets count have been used to illustrate how the study groups' haematological parameters differed, as seen in Figure 6.

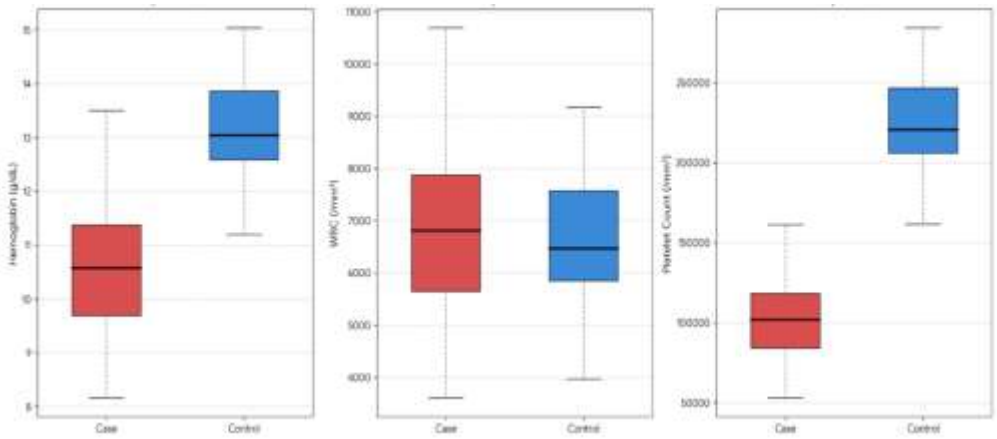

Figure 6. Haematological parameter comparison between cases and controls

For further assessment of biochemical alterations associated with PH and cirrhosis, the following liver function and biochemical factors were compared between cases and controls. The comparative graph of bilirubin, albumin, creatinine, and INR levels is shown below in Figure 7.

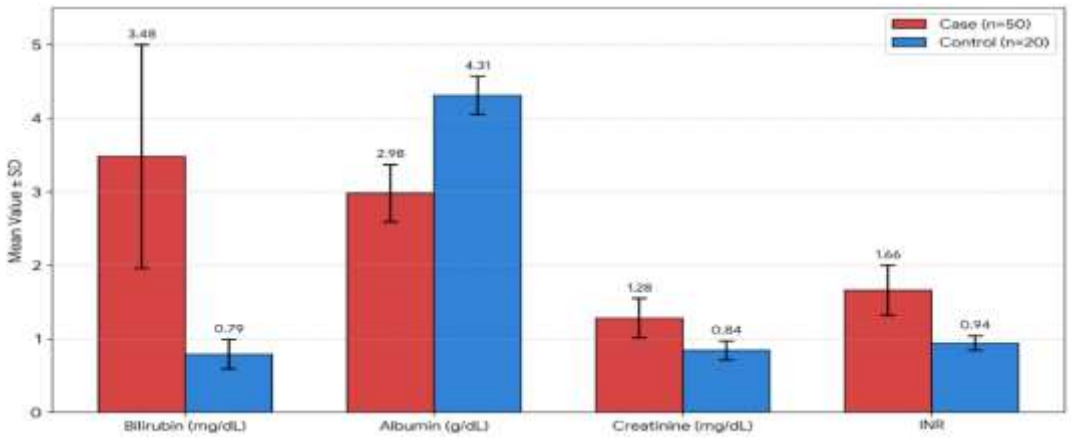

Figure 7. Comparison of biochemical parameters between cases and controls

In addition to that, radiological markers of cirrhosis and PH were also examined in cases versus control subjects. The comparison of liver size, spleen size, and portal vein diameter is presented in Figure 8.

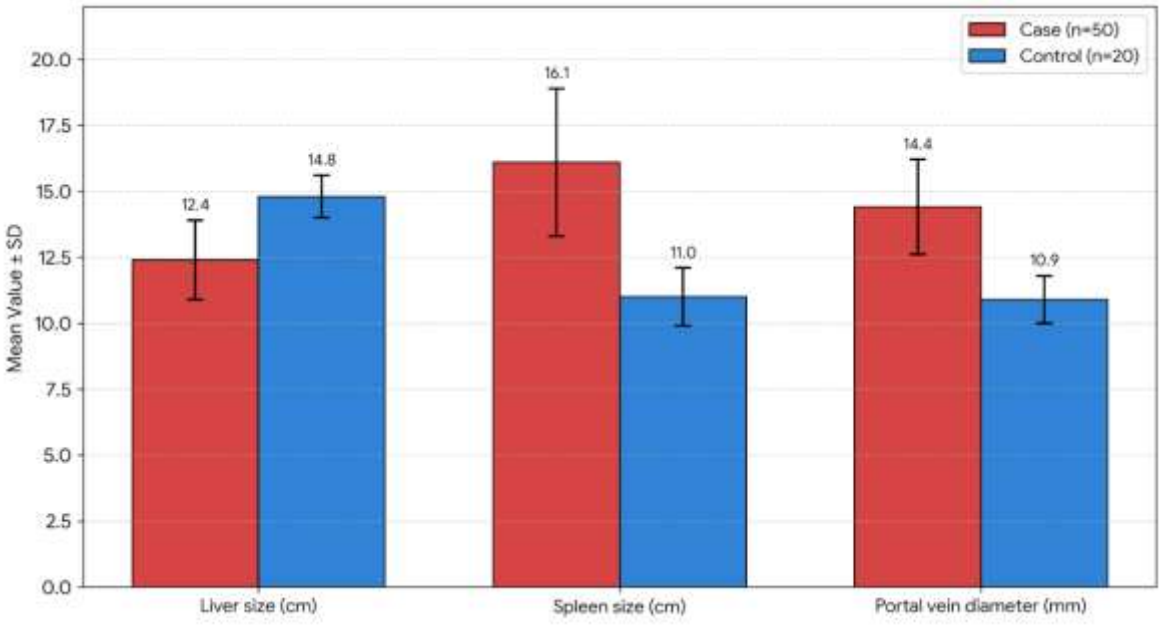

Figure 8. Radiological parameter comparison between cases and controls

The comparison of in-phase and opposed-phase MRI signal intensity measurements is shown in Figure 9.

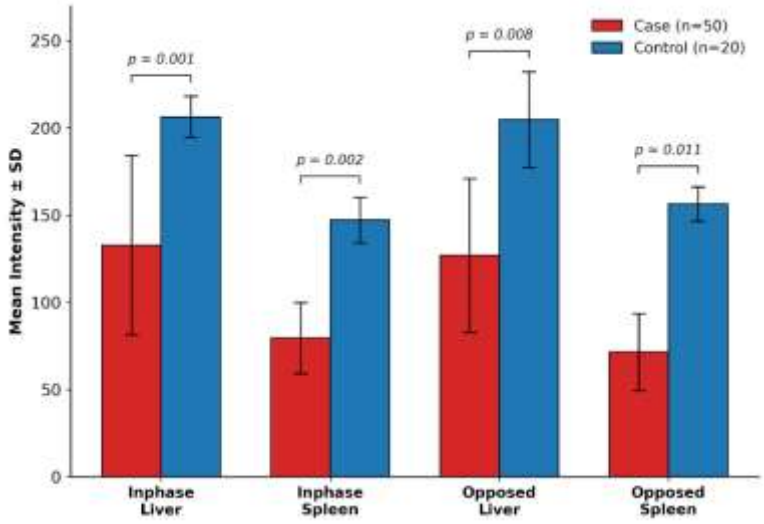

Figure 9. Comparing the MRI signal intensity parameters in-phase and opposed-phase between cases and controls
As demonstrated in Figure 6, remarkable differences were found in all MRI parameters related to signal intensity. The values for both liver and spleen obtained utilising both opposed-phase and in-phase sequences were much lower in cirrhosis compared to healthy subjects.

3.3 Splenic ADC and Disease Severity

In order to assess the association between spleen diffusion properties and the severity of PH, ADC measurements were correlated with the clinical and endoscopic indices used for grading disease severity, such as esophageal varices, variceal bleeding, and hypersplenism. The results are presented in Table 3.

Table 3. Association of ADC Values with Markers of PH Severity

Parameter	Category	ADC Liver (×10⁻³ mm²/s)	ADC Spleen (×10⁻³ mm²/s)	p-value
Esophageal varices	Grade I (n=13)	0.96 ± 0.12	1.34 ± 0.15	0.015* / 0.026†
	Grade II (n=25)	1.00 ± 0.10	1.43 ± 0.14	
	Grade III (n=12)	1.11 ± 0.09	1.54 ± 0.13	
Variceal bleeding	Present (n=34)	-	1.46 ± 0.15	0.008
	Absent (n=16)	-	1.32 ± 0.18	
Hypersplenism	Present (n=35)	-	1.45 ± 0.16	0.013
	Absent (n=15)	-	1.31 ± 0.17	

*ADC liver comparison across variceal grades.†ADC spleen comparison across variceal grades.

Progressive increases in the values of ADC in the spleen were observed at higher variceal grades. The frequency distribution of the ADC values based on variceal grades is shown in Figure 10.

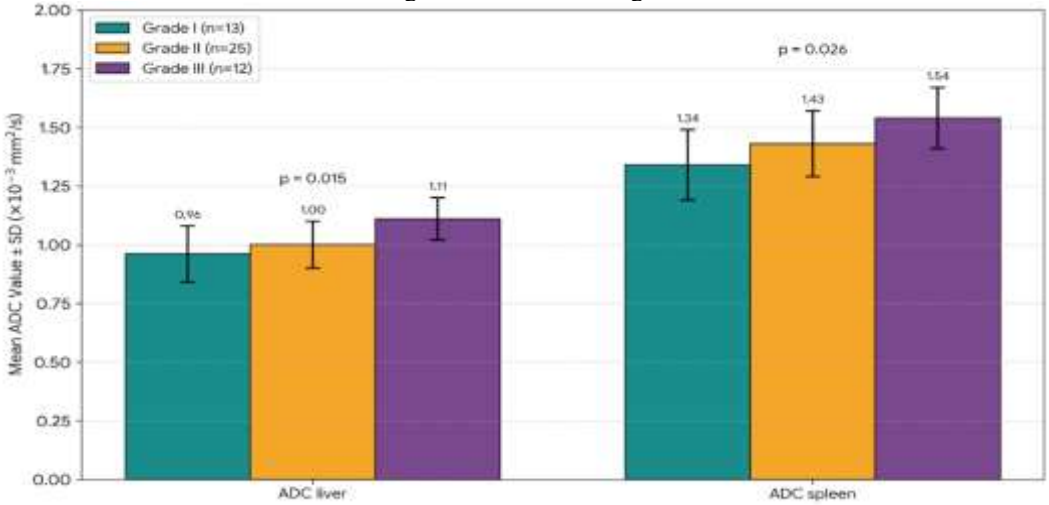

Figure 10. Comparison of hepatic and splenic ADC values across esophageal varices grades

According to oesophageal varices grades, patients' liver and spleen ADC values varied significantly, as shown in Figure 8. ADC values in the spleen based on variceal bleeding are presented in Figure 11.

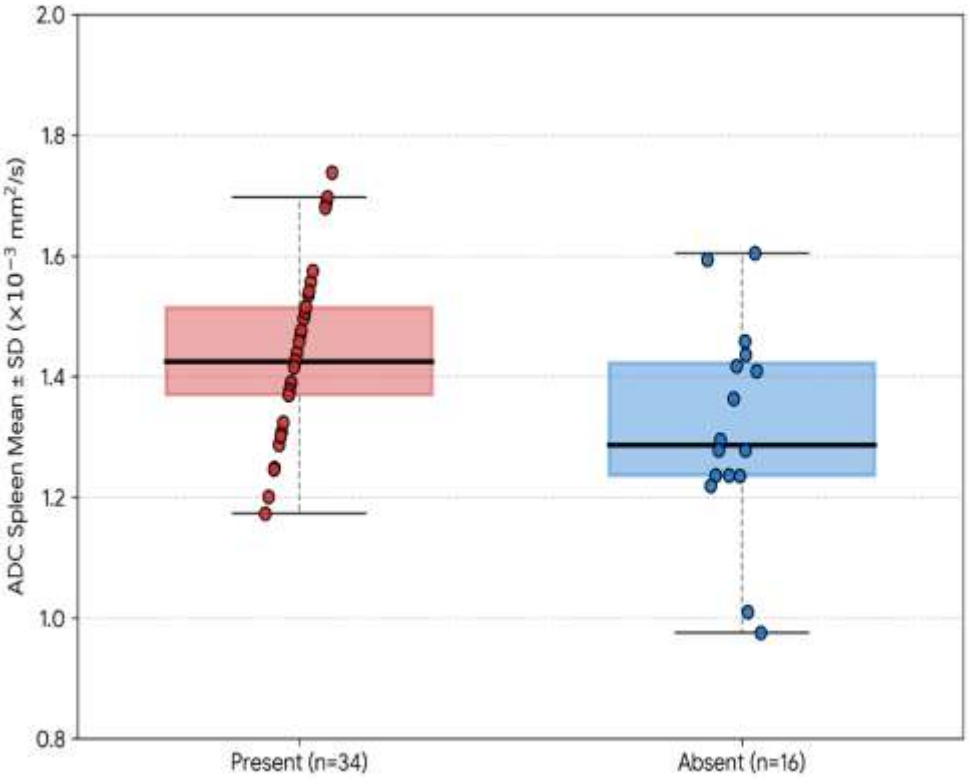

Figure 11. Comparison of splenic ADC values according to variceal bleeding status

In order to evaluate the relationship between splenic diffusion properties and hypersplenism, the splenic ADCs of the two groups of subjects were compared. This information is depicted in Figure 12 below.

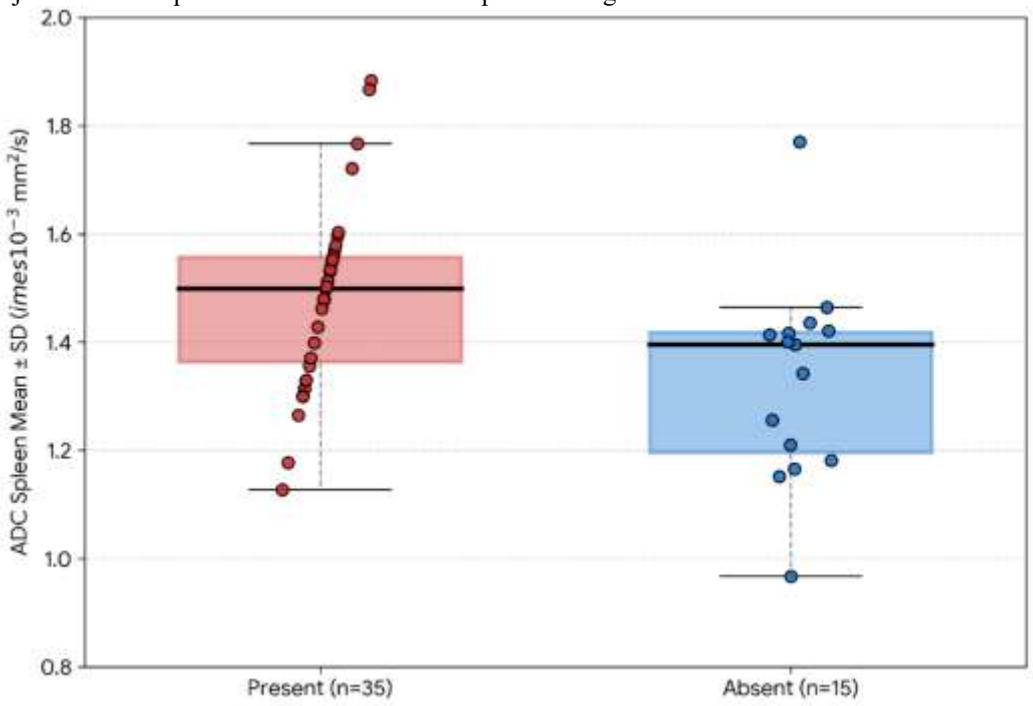

Figure 12. Comparison of splenic ADC values according to hypersplenism status

Figure 12 shows that splenic ADC was significantly higher in patients suffering from hypersplenism.

3.4 Association of Splenic ADC with Hepatic Decompensation and Liver Function Severity

To analyze the correlation between splenic diffusion properties and clinical disease severity, splenic ADCs were examined in relation to both ascites severity grades and Child-Pugh staging criteria. These data have been compiled in Table 4.

Table 4. Association of Splenic ADC Values with Ascites Severity and Child–Pugh Class

Variable	Category	ADC Spleen (×10⁻³ mm²/s)	p-value
Ascites Severity	None (n=14)	1.31 ± 0.14	0.011
	Mild (n=17)	1.42 ± 0.15	

	Moderate (n=19)	1.53 ± 0.16	
Child–Pugh Class	A (n=11)	1.24 ± 0.13	0.019
	B (n=25)	1.41 ± 0.15	
	C (n=14)	1.52 ± 0.15	

Splenic ADC values correlated significantly both with the grade of ascites and the Child-Pugh score, as evident from Table 4. Splenic ADC values based on the degree of ascites are illustrated in Figure 13.

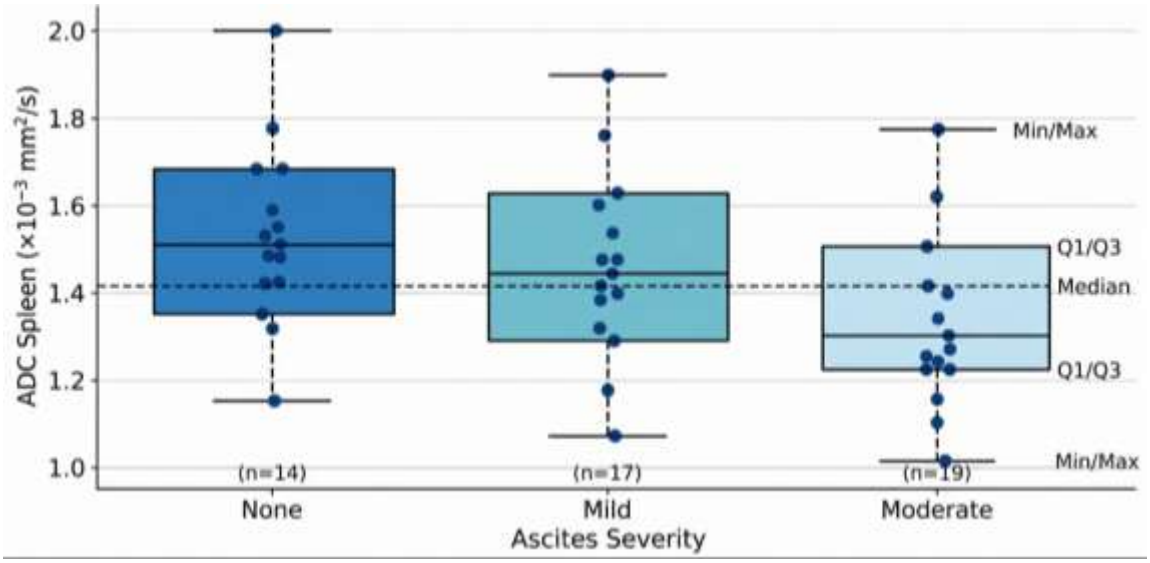

Figure 13. Comparison of splenic ADC values according to ascites severity

As depicted in Figure 13, there were wide variations in the splenic ADC values between the groups according to ascites grade. Distribution of splenic ADC values for Child-Pugh classification is shown in Figure 14.

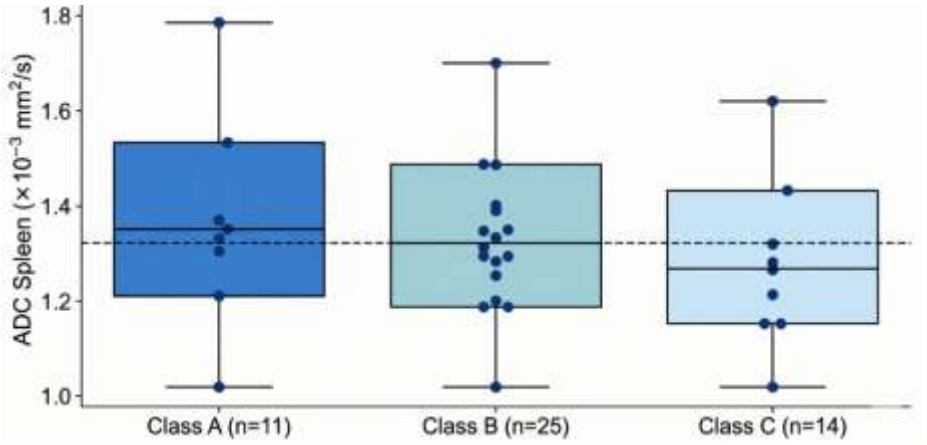

Figure 14. Comparison of splenic ADC values according to Child–Pugh class

3.5 Correlation of Splenic ADC With Radiological Parameters

To assess any correlation between splenic diffusion features and radiological signs of PH, a correlation analysis was conducted on splenic ADC measurements, portal vein diameter, and splenomegaly. This is summarized in Table 5.

Table 5. Splenic ADC correlation with radiological indicators of PH

Variable	Correlation coefficient (r)	p-value
Portal vein diameter	0.75	<0.001
Spleen size	0.72	<0.001

In order to graphically show this correlation, Figure 15 present scatter plots of correlations between splenic ADC values and imaging measurements.

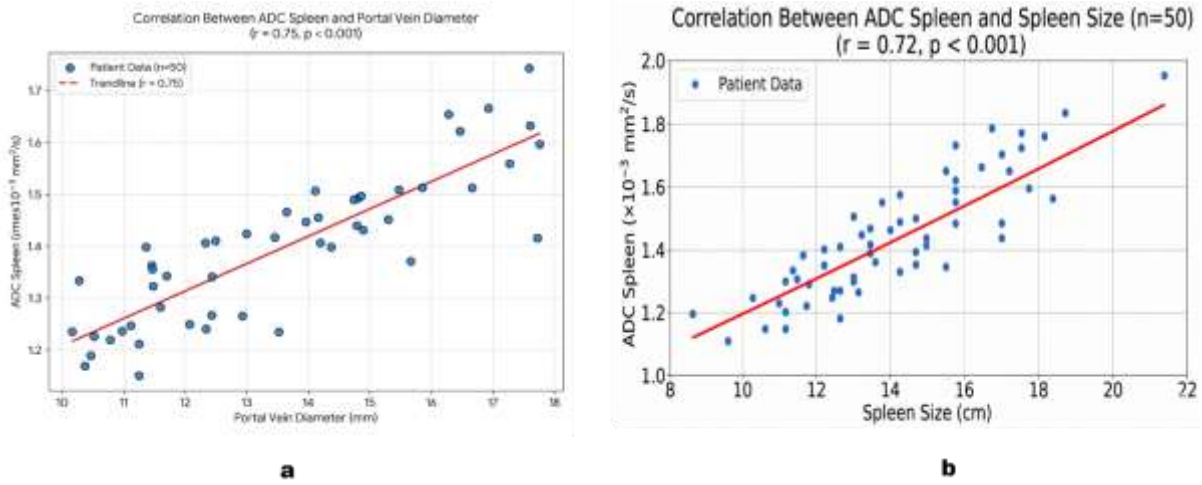

Figure 15. Correlation of splenic ADC values with radiological markers of PH: (A) portal vein diameter and (B) spleen size

The portal vein diameter and the spleen's ADC value are significantly positively correlated, as shown in Figure 15A. Similarly, Figure 15B demonstrates a strong positive correlation between the spleen's size and ADC value.

3.6 Diagnostic Performance of Splenic ADC

Diagnostic accuracy for detecting cases of variceal bleed in splenic ADC was determined by receiver operating characteristic analysis. Diagnostic parameters are given in Table 5.

Table 5. Diagnostic performance of splenic ADC for prediction of variceal bleeding

Parameter	Cut-off Value	Sensitivity (%)	Specificity (%)	AUC	95% CI	p-value
ADC spleen	1.38	74.5	69.2	0.82	0.69–0.91	<0.001

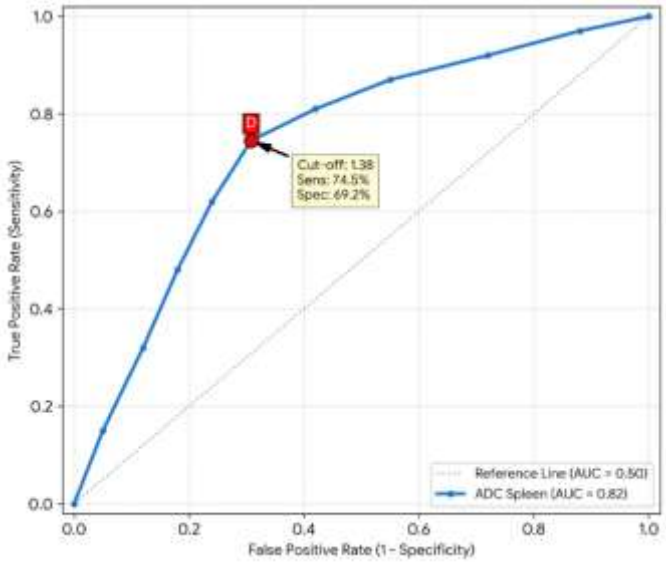

Figure 16. Receiver operating characteristic curve illustrating splenic ADC's diagnostic efficacy in predicting variceal haemorrhage

As shown in Figure 16, splenic ADC showed good discrimination power for predicting variceal bleeding.

4. DISCUSSION

This study evaluated the value of splenic ADC values from diffusion-weighted magnetic resonance imaging (MRI) in cirrhosis patients as a non-invasive method for determining the degree of PH. The findings revealed significant variations in the ADC of splenic tissue in patients with cirrhosis versus healthy controls and that splenic ADC was highly correlated with various clinical, endoscopic, and radiological parameters reflecting the degree of PH.

Among the study's most significant conclusions was the much higher splenic ADC value for patients with cirrhosis. The results indicate a possible role of PH-related splenic congestion, vascular remodelling, and microstructural changes on water molecule diffusion in splenic tissue. This is consistent with previous MRI-based studies showing that quantitative splenic imaging parameters are associated with hemodynamic abnormalities of PH and could be useful surrogate markers of the severity of the disease (Mesropyan et al., 2021). Moreover, there is growing interest in splenic imaging biomarkers

due to the close parallelism of splenic changes of portal venous pressure with the progressive changes in the portal venous pressure in chronic liver disease (Kutaiba et al., 2024). The present study also revealed statistically significant differences between the conventional laboratory, radiological and DWI parameters of cirrhotic patients and healthy individuals. The outcomes are in line with the hypothesis that PH is linked to complex systemic, hepatic and splenic changes that can be identified by sophisticated imaging modalities. A similar effect has been seen in the study of imaging features of portal hypertensive disorders, which found that splenic morphology and tissue characteristics played a significant role in the evaluation and differential diagnosis of the disease (Zhao et al., 2020).

The severity of each grade of oesophageal varices was positively correlated with the spleen's ADC values. This relationship suggests that the splenic diffusion characteristics can reflect the level of portal pressure disturbance, since the varices are an outcome of the increase in portal pressure. Similar studies that have assessed diffusion-based MRI methods in chronic liver disease (CLD) have also shown that quantitative diffusion parameters can reliably predict the severity of fibrosis and the PH associated with CLD (Charatcharoenwitthaya et al., 2021). In a similar fashion, the signal intensity of the liver, spleen and portal venous system derived from MRI have been found to have strong correlations with liver functional impairment and PH severity (Yang et al., 2020). Patients with variceal bleeding and hypersplenism had significantly higher ADC values than those without variceal bleeding and hypersplenism. The results are clinically relevant, both of these are advanced routes of PH. This is the same for imaging studies assessing quantitative MRI to predict clinically relevant PH, where splenic parameters showed robust diagnostic accuracy and clinical utility (Dillman et al., 2019). Besides, advanced DWI diffusion modelling has been demonstrated to enhance the characterization of fibrosis-related microstructural changes and could also further aid the diagnostic value of DWI in chronic liver disease (CLD) (Ren et al., 2021).

Strong positive correlation between splenic ADC values, portal vein diameter and spleen size was also shown in the present study. These associations suggest that the higher the splenic diffusion value the more the radiological signs of PH became more severe. In line with this, previous investigations based on elastography and quantitative imaging have also shown strong correlation between splenic imaging markers and the severity of PH, which suggests the potential of splenic-based markers as prognostic markers (Zhang et al., 2017). Experimental studies have also demonstrated that imaging-derived parameters can accurately predict portal pressure changes, and may be useful alternatives to invasive hemodynamic assessment (Ma et al., 2021). The other significant finding was the ability of splenic ADC to accurately diagnose variceal bleeding. The cut-off identified showed acceptable sensitivity and specificity, which could be useful in clinical risk stratification. While technical, tissue, and imaging factors may affect diffusion measurements, previous studies have demonstrated the role of ADC-based assessment for the characterisation of chronic liver disease and PH using standardised acquisition protocols (Kahraman et al., 2022). These results are consistent with those of diffusion imaging studies, which have shown that changes in splenic perfusion and tissue architecture significantly affect diffusion parameters (Del Chicca et al., 2019).

The major strength of the current study is the extensive assessment of splenic ADC in various clinical parameters for PH, such as when oesophageal varices are present, variceal bleeding, hypersplenism, ascites severity, Child–Pugh class, portal vein diameter, and spleen size. A healthy control group was used to enhance the value of the comparative analysis.

There are, however, a few points to be noted. The study's findings might not be broadly applicable because it was conducted in a single institution and had a small sample size. Hepatic venous pressure gradient values were not directly compared. Further, the cross-sectional design did not allow for the evaluation of longitudinal changes in ADC values and its prognostic relevance over time.

To validate the diagnostic thresholds established in this study, additional multicenter studies involving a greater patient population are required. Longitudinal studies of changes in splenic ADC values as a function of disease progression and response to treatment have the potential to further elucidate their clinical value. Combination of DW imaging with elastography, quantitative MRI mapping and other advanced imaging biomarkers can give more holistic assessment of PH without invasive procedures. Recent data indicate that PH diagnosis may be more effective and risk stratification more useful when using both liver and spleen quantitative imaging parameters in the clinical setting (de Margerie-Mellon et al., 2026).

5. CONCLUSION

The current study demonstrates that diffusion weighted MRI of the spleen is a helpful method for determining the degree of PH in patients with cirrhosis. Compared to healthy controls, the cirrhotic patients' spleen's apparent diffusion coefficient (ADC) was noticeably higher and was strongly associated with well known clinical, endoscopic, and radiological parameters of disease severity. The worse the esophageal varices, the greater the ADC value of the spleen when there was variceal bleeding, increasing the severity of hypersplenism, increasing ascites severity, and increasing Child–Pugh class, the more progressive the ADC values were. The additional finding of significant positive correlations between splenic ADC value, portal vein diameter and spleen size indicated a close association between splenic diffusion characteristics and portal hypertensive changes. The diagnostic performance analysis also showed that splenic ADC has good discriminatory ability for predicting variceal bleeding, which may lead to the use of ADC as a tool for recognizing patients with high risk of clinically significant complications. These results confirm the idea that splenic ADC is related to both hemodynamic and structural changes in the PH. All things considered, splenic ADC measurement is a promising non-invasive imaging biomarker to gauge the degree of PH in patients with cirrhosis. Integration of DWI into standard MRI may lead to better disease characterisation, risk stratification and clinical decision making, and decrease the need for invasive disease diagnosis.

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