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INTRA RENAL ARTERY RESISTIVE INDEX ALTERATIONS IN CHRONIC LIVER DISEASE, COMPARISON WITH OTHER HEPATIC SCORING SYSTEMS

Radio-Diagnosis

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ABSTRACT

Chronic kidney disease (CKD) is a major public health challenge. Increased morbidity and death are linked to advanced chronic kidney disease. As a result, measuring severity of CKD is crucial. The degree of intra-renal fibrosis relates to the severity of the disease, making it the last common pathway for all forms of chronic kidney disease. **Materials And Methods:** A cross sectional hospital based observational study was conducted for a duration of 3 months on 25 subjects and 20 healthy controls. Inclusion criteria for subjects with CKD included: age greater than 18 years, eGFR less than 60 mL/min or known diagnosis of CKD, and consent to undergo renal ultrasound. Exclusion criteria included body mass index (BMI) greater than 35 kg/m2, pregnancy or nursing status, or any condition that impeded visualization of the kidney by ultrasound. **Conclusion:** Compared to healthy controls, patients with CKD had increased intra-subject estimated stiffness variability and renal stiffness estimations determined from SWE. The observed variation in YM can be explained by renal fibrosis. Shear wave elastography might be an inexpensive method of offering more CKD diagnostic data.

KEYWORDS

Chronic Liver Disease (CLD), Intra-renal Artery Resistive Index (RRI), Hepatic Scoring Systems, Child-Pugh Score, MELD Score, Liver Cirrhosis, Ultrasonography in Liver Disease

INTRODUCTION

Patients with liver cirrhosis frequently develop renal dysfunction. Hepatorenal syndrome (HRS), is characterized by renal arterial vasoconstriction, which may precede clinically manifest renal dysfunction (1).

Cirrhotic patients with elevated intrarenal RIs tend to develop the HRS, leading to a poor prognosis. In the current study, we prospectively investigated the course of intrarenal RIs in patients with liver cirrhosis and compared its prognostic impact with those of the MELD and the Child-Pugh scores.

Child-Pugh score has been the most widely used specific scoring system in liver disease. In 2002, the Model for End-Stage Liver Disease (MELD) was introduced for patients undergoing trans jugular intrahepatic portosystemic shunt. However, it is only based on three laboratory variables, and thus does not take into account all prognostic factors that will impact on the survival of cirrhotic patients, notably complications due to portal hypertension.

There is still a need for improvement of prognostic markers that could be easily integrated into the clinical management of these patients.

AIM OF STUDY

To evaluate the alterations in intrarenal artery resistive index (RI) in patients with liver cirrhosis and to compare its prognostic value with established hepatic scoring systems, specifically the Child-Pugh and MELD scores, for predicting renal dysfunction and overall prognosis.

MATERIALS AND METHODS:

A total of 50 patients diagnosed with liver cirrhosis were admitted to the medical ward of JJM Medical College Hospital, Davangere, between June 2024 and October 2024. These patients, aged between 17 and 75 years, were included in this hospital-based prospective study.

Inclusion Criteria

The diagnosis of liver cirrhosis was established based on clinical evaluation, biochemical tests, and imaging findings. Subgrouping was done into patients with compensated cirrhosis (absence of ascites, hepatic encephalopathy, upper gastrointestinal bleeding) and decompensated cirrhosis (presence of one or more of these features).

Exclusion Criteria

Patients with comorbidities such as diabetes, hypertension, recent intake of nephrotoxic medications, acute gastrointestinal bleeding with shock, sepsis, or ultrasonographic evidence of obstructive or parenchymal renal disease were excluded.

Ultrasound Doppler evaluation was performed to measure the resistive index (RI) of intra-renal arteries. The Doppler study was conducted using the GE LOGIQ P10 ultrasound machine. Measurements were obtained from the segmental artery (in the upper, middle, and lower poles), the interlobar artery (in Bertin's column), and the interlobular artery (in the middle renal cortex). RI was calculated using the standard formula: RI = (PSV – EDV)/PSV. The independent variables included chronic liver disease, severity of cirrhosis, and presence of ascites, while the dependent variable was the resistive index of the intra-renal arteries.

Informed Consent

All adult participants, as well as the parents or guardians of pediatric participants, provided written informed consent for their involvement in the study.

Statistical Analysis

Type of Study

Hospital based Prospective study conducted in JJM Medical college, Davangere (June to October 2024).

Statistical Methods

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 17.0.

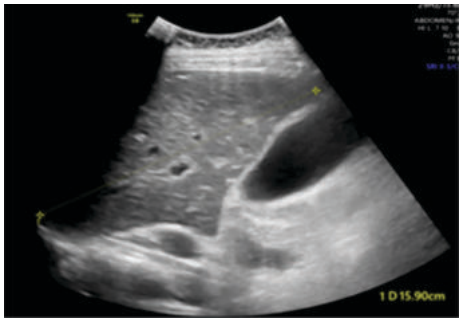


Fig 1. A Case of 35-year-old Male, Liver Appears Enlarged in Size, with Coarsened and Nodular Echotexture

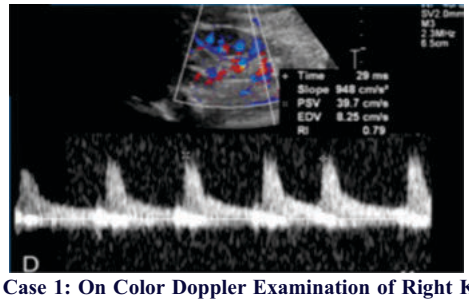


Fig 2: Case 1: On Color Doppler Examination of Right Kidney, Renal RI Appears Increased Measures 0.79

Fig 3: Free Fluid Noted in Subhepatic and Inter Bowel Region

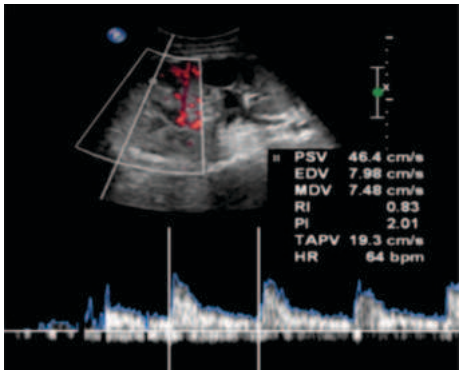


Fig 4: Case 2: On Color Doppler Examination of Right Kidney, Renal RI Appears Increased Measures 0.83

DEMOGRAOHIC DATA AND RESULTS:

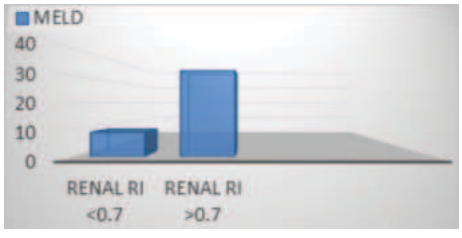
1. 40% of the study population were in the group of 36-40 years.
2. 34% of the study population were in the group of >40 years.
3. 14% of the study population were in the group of 31-35 years.
4. 2% of the study population were in the group of <30 years.
5. 72% of the study population were males and 28% were females.
6. Alcohol was the most common cause of cirrhosis in the study population (58%), Followed by hepatitis B(20%). Other cryptogenic causes predominate next to alcohol and hepatitis B which was followed by autoimmune hepatitis and Wilson's disease.

Resistive Index (RI) vs Meld Score:

Mean MELD in patients with RI <0.7 was 9.0 and in patients with RI >0.7(20 patients) was 31.8.

- Correlation coefficient was 0.903 indicates very good correlation. P value was <0.001.

Table 1: Resistive Index (RI) vs Meld Score

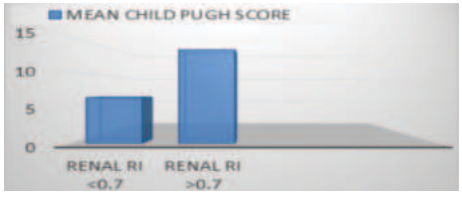


Renal Resistive Index (RI) vs Child-pugh Score

Mean CHILD-PUGH SCORE in patients with RI <0.7(32 patients) was 6.23 and in patients with RI >0.7(18 patients) was 12.9.

- Correlation coefficient was 0.873 indicates very good correlation. P value was <0.001.

Table 2: Renal Resistive Index (RI) vs Child-pugh Score



Compensated vs Decompensated Form

RI was >0.7 in 19 liver cirrhosis patients with decompensated form while RI > 0.7 in only 2 patients with compensated form. - P value was <0.001.

Table 3: Compensated vs Decompensated Form

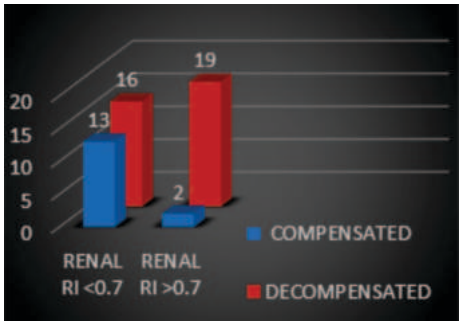


Fig 6: T2 SPAIR sequence in axial section, medial patellar retinaculum appears thickened, edematous, wavy, with mid-substance hyperintensity and discontinuity at the patellar attachment.

DISCUSSION

A total of 50 patients diagnosed with liver cirrhosis were included in this study. The average level of bilirubin in the participants was 3.25 mg/dL, indicating varying degrees of liver dysfunction. The average serum creatinine level among the study population was 1.4 mg/dL, which is slightly elevated and may suggest early signs of renal impairment, particularly in the context of chronic liver disease.

Among the study population, 70% of patients were found to have ascites, a condition characterized by the accumulation of fluid in the abdominal cavity, which is a common clinical manifestation of decompensated liver disease.

Three months after the patients were enrolled in the study, their health outcomes were reassessed. During this follow-up period, 8 patients had unfortunately passed away. Notably, all of these patients had a renal resistive index (RI) greater than 0.70, which reflects increased resistance to blood flow in the kidneys. This finding was statistically significant, with a p-value of less than 0.001, indicating a strong correlation between elevated RI values and mortality in patients with liver cirrhosis.

Furthermore, patients who had a higher intrarenal resistive index also showed higher values on both the Model for End-Stage Liver Disease (MELD) score and the Child-Pugh score. These scoring systems are widely used to assess the severity and prognosis of chronic liver disease. This correlation supports the use of intrarenal RI as a non-invasive marker to predict poor outcomes and worsening renal function in patients with advanced liver disease.

This study's findings are consistent with international literature, Regmi B et. Al, evaluated seventy subjects, 50 with Chronic Liver Disease (CLD) and 20 healthy control and examined RI with color and spectral doppler sonography analysis. The mean RI among healthy controls was compared with patients with CLD and concluded that mean RI value in patients with CLD was significantly higher than in healthy controls (0.71 ± 0.05 vs 0.55 ± 0.28). (2)

J.S. Sikarwar et al, evaluated RI in various stages of liver cirrhosis and to determine its significance in developing hepatorenal syndrome in a study which included 60 cirrhotic patients divided into 4 groups (15 patients each): Compensated liver cirrhosis (group A), diuretic responsive ascites (group B), refractory ascites (group C), hepatorenal syndrome (group D) and ten healthy persons as control group (E). They demonstrated that the RI of interlobar and arcuate arteries were significantly higher in all patient groups than in control group ($p < 0.05$), in patient with hepatorenal syndrome than in patient with diuretic responsive ascites and patients with compensated cirrhosis. (3)

Götzberger M et al, demonstrated that RI was significantly higher in ascitic patients compared to non-ascitic patients (0.74 vs. 0.67, $p < 0.01$) and in non-ascitic patients with liver cirrhosis than in control subjects (0.67 vs. 0.62, $p<0.01$). (4)

However, there are certain limitations to this study. First, the grayscale ultrasound imaging of the liver and Doppler evaluation of the intrarenal arteries were performed and interpreted by a single radiologist. This introduces a degree of subjectivity and may lead to inter-observer variability if repeated by other examiners. Secondly, liver biopsy, which is considered the gold standard for the diagnosis and grading of chronic liver disease, was not performed in any of the patients. Instead, the diagnosis was based on clinical, biochemical, and imaging findings, which, while widely accepted, may lack the histopathological confirmation provided by biopsy.

CONCLUSIONS

Sensitivity and specificity of RI are comparable to those of the current hepatic scoring systems, such as MELD and CTP SCORE. One sign of compromised renal function is serum creatinine. However, because it relies on muscle mass and physical exercise, it has drawbacks. Therefore, in individuals with advanced cirrhosis, renal function based on serum creatinine may be exaggerated. Therefore, the development of better prognostic indicators that are practical for everyday use is still required.

Our research demonstrates that the RI, which is based on sonographic measurements of intrarenal resistance, is a practical, cost-effective, noninvasive test that offers valuable insights for the management and prognosis of patients with cirrhosis. Increased RIs may potentially reveal the liver disease's progression before any changes.

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