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Colour Doppler Ultrasound For Renal Resistive Index As A Predictor Of Early Renal Impairment In Patients With Liver Cirrhosis

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ABSTRACT

Background: Liver cirrhosis, a chronic liver disease, leads to the formation of fibrous tissue and abnormal liver nodules, disrupting liver tissue and blood flow. Hepatorenal syndrome (HRS) is a serious complication of liver cirrhosis, affecting 8-40% of patients and characterized by rapid kidney dysfunction. Early diagnosis of renal impairment in these patients is crucial. This study aims to assess the role of renal resistive index (RI) as a predictor of early renal dysfunction in liver cirrhosis patients using Doppler ultrasonography.

Methods:A time-bound, cross-sectional study was conducted at the Department of Radiodiagnosis, M.G.M. Medical College, Indore, from September 2022 to September 2023. A total of 150 clinically diagnosed liver cirrhosis patients referred for abdominal ultrasound were included. After obtaining informed consent, patients underwent sonographic evaluation of the liver and kidneys. Doppler ultrasonography was performed to measure the renal resistive index (RI). A renal RI > 0.7 was considered indicative of increased renal vascular resistance. Data were analyzed using appropriate statistical tests, and a p-value < 0.05 was considered statistically significant.

Results: Among the 150 patients, 35.3% had an increased renal resistive index, while 64.7% had a normal renal resistive index. Increased serum creatinine levels were observed in 28% of patients. A significant correlation was found between increased renal resistive index and elevated serum creatinine levels (p=0.001). Additionally, 41.5% of patients with ascites had an increased renal resistive index (p<0.0001). The renal resistive index showed a high sensitivity (96%) and specificity (95%) for predicting renal dysfunction.

Conclusion: The study demonstrates that Doppler ultrasonography is a valuable tool for early detection of renal dysfunction in liver cirrhosis patients. An elevated renal resistive index is strongly associated with early-stage renal impairment, allowing timely intervention to mitigate further renal damage. Incorporating renal resistive index assessment into routine clinical practice can enhance patient management and prognosis in liver cirrhosis.

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Keywords: Liver cirrhosis, Hepatorenal syndrome, Renal resistive index, Doppler ultrasonography, Renal dysfunction, Early diagnosis, Non-invasive imaging, Renal impairment, Clinical management, Patient prognosis.

BACKGROUND

Liver cirrhosis is a chronic liver disease where the liver undergoes a widespread process marked by the formation of fibrous tissue and conversion of normal liver architecture into structurally abnormal nodules. Cirrhosis of liver is defined by significant disruption of liver tissue and blood flow inside the liver. Liver cirrhosis causes vascular alterations in both the splanchnic and systemic circulation, which influence the renal vascular system and impair renal function.

Hepatorenal syndrome refers to occurrence of kidney failure in patients with advanced liver cirrhosis, without any recognized cause of kidney damage. Hepatorenal Syndrome is a serious complication of liver cirrhosis, this condition affects 8-40% of liver cirrhosis patients.

Hepatorenal syndrome is a life-threatening complication of advanced liver disease particularly liver cirrhosis, characterized by the rapid development of kidney dysfunction. Patients with liver cirrhosis have significant dilatation of the splanchnic arteries and hyperdynamic circulation and inadequate blood flow to the kidneys. Renal vasoconstriction occurs due to decreased blood flow, which is caused by activation of compensatory mechanism such as the sympathetic nervous system (SNS), renin angiotensin system (RAS) and antidiuretic hormone (ADH). Hepatorenal syndrome is a serious and potential life-threatening complication of advanced liver cirrhosis. It involves kidney dysfunction due to change in blood flow to kidneys often as a result of cirrhosis related complications such as portal hypertension.

Hepatorenal syndrome poses a significant clinical challenge due to its rapid progression and high mortality rate. Early recognition prompt intervention is crucial in improving outcome in individuals affected with hepatorenal syndrome.

Renal hemodynamic changes with intrarenal vasoconstriction begin early in course of liver disease before changes in the level of serum urea and serum creatinine. In liver cirrhosis serum creatinine is inaccurate in diagnosis of renal dysfunction as it overestimates renal function due to decrease creatinine production by liver, protein calorie malnutrition and muscle wasting. Therefore, there is a need for more accurate method to diagnose early renal impairment in these patients.

Doppler Ultrasonography is a simple and non-invasive technique to evaluate renal doppler indices to asses renal vascular resistance. Elevated renal resistive index > 0.7 suggest increased renal vascular resistance which may indicate renal dysfunction in liver cirrhosis patients.

This study aims to assess the role of renal resistive index as a predictor of early renal dysfunction in patients with liver cirrhosis. Monitoring of renal resistive index can help to asses the risk of renal impairment and help the clinicians to tailor treatment strategies, including potential interventions like vasoconstrictor therapy, liver transplantation evaluation and supportive measures to improve outcome in patient of liver cirrhosis.

METHODS

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A time-bound, Cross-sectional study, was conductedin the Department of Radio-diagnosis, M.G.M. Medical College Indore,MadhyaPradesh,Indiaafterreceivingapproval from the Institutional Scientific and Ethical Committee with approval letter no Ec/MGM/Dec-22/03. The duration of thestudy was from September 2022 to September 2023. A total of 150 patients who werereferred to the Department of Radiodiagnosis for Abdominal ultrasound for liver cirrhosis by the other departments in M.Y hospital and MGMMC and associated hospitals who are clinically diagnosed.
After followed by informed consent and after a complete description of the study to patients and handing over the patient information sheet. Detailed history was taken and a clinical examination was performed.

Patients who were enrolled in the study were subjected to sonographic evaluation of the liver and the kidneys and the Doppler ultrasound was done on each kidney. All patients were made to fast for at least 6 hours prior to the examination. All examinations were done using 3.5-5 MHz transducer.

Patients were made to lie in supine position, right lateral and left lateral position.

PSV and EDV were taken from the renal arteries at the hilum, and interlobar arteries at upper, mid and lower pole of each kidney. Then mean RI was calculated for each right and left kidney and finally. Mean values was calculated as the RI by the formula.

Renal RI - (Peak systolic velocity– End diastolic velocity/Peak systolic velocity)

Renal RI value of more than 0.7 was taken as the cut off.

The meanandstandarddeviationofthequantitativevariableswere calculated.Appropriate tests of significance were applied to correlate clinicaland ultrasound finding. P-values of <0.05 wereconsidered statisticallysignificant.

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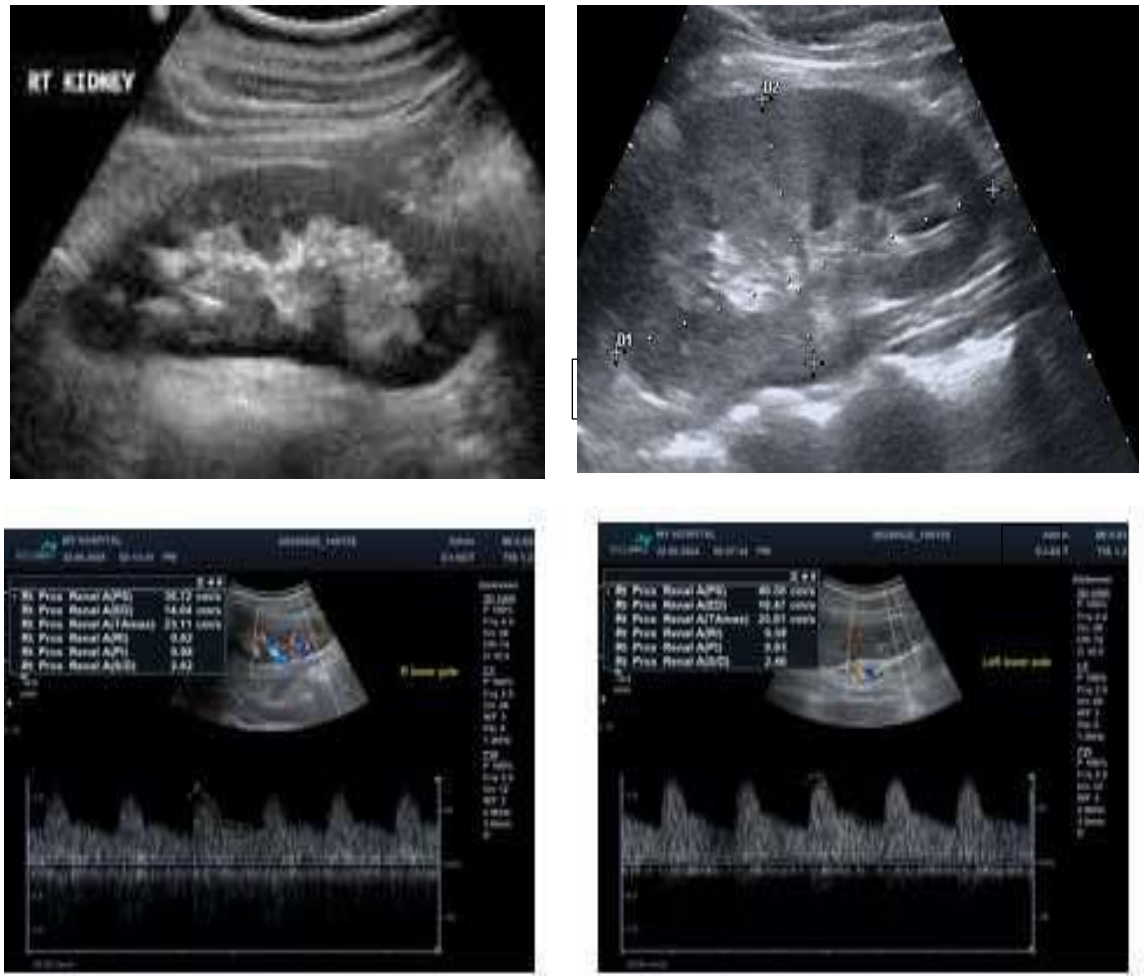
Figure 1



Abdominal ultrasound- Bilateral kidney appears normal in size, shape and echotexture.

On color doppler of Bilateral kidney-

Mean renal resistive index of Right kidney was 0.64

Mean renal resistive index of Left kidney was 0.61

Mean renal resistive index of bilateral kidney was 0.63

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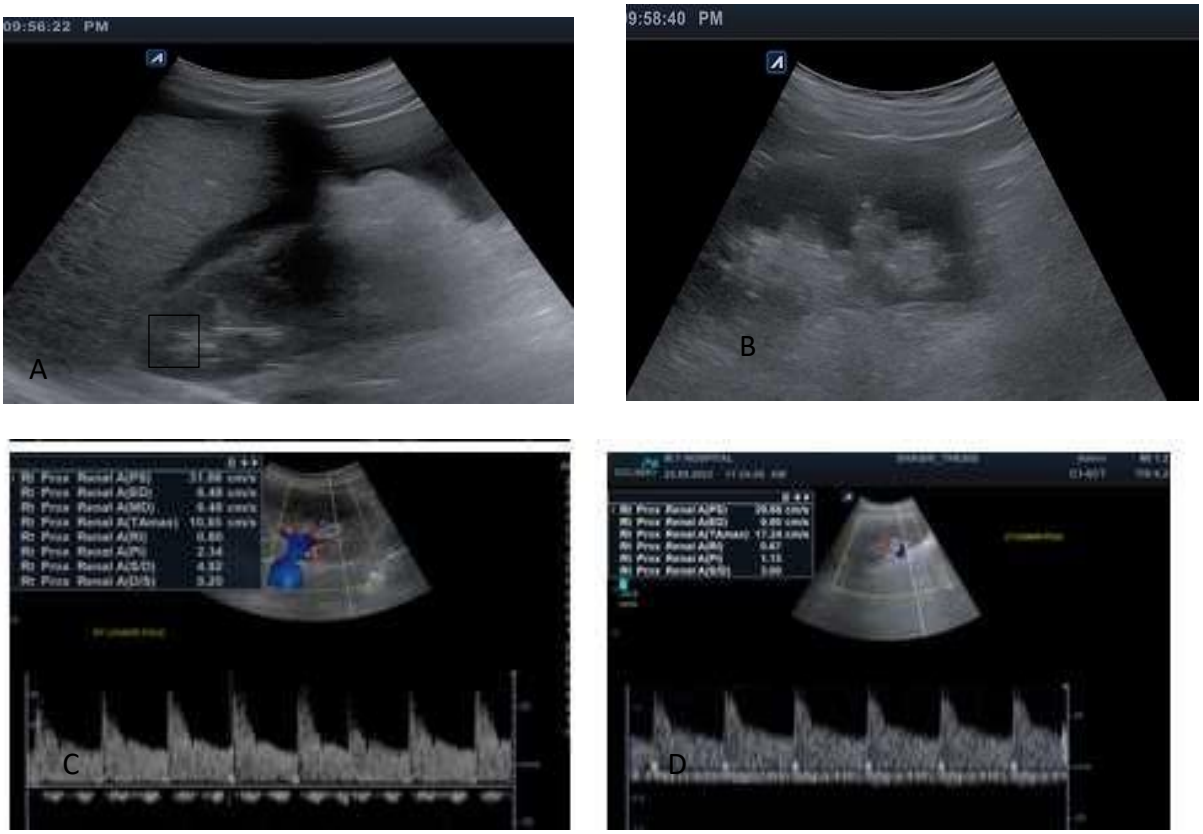
Figure 2



Abdominal ultrasound- Bilateral kidney appears normal in size, shape and echotexture.

On color doppler of Bilateral kidney-

Mean renal resistive index of Right kidney was 0.76

Mean renal resistive index of Left kidney was 0.80

Mean renal resistive index of bilateral kidney was 0.78

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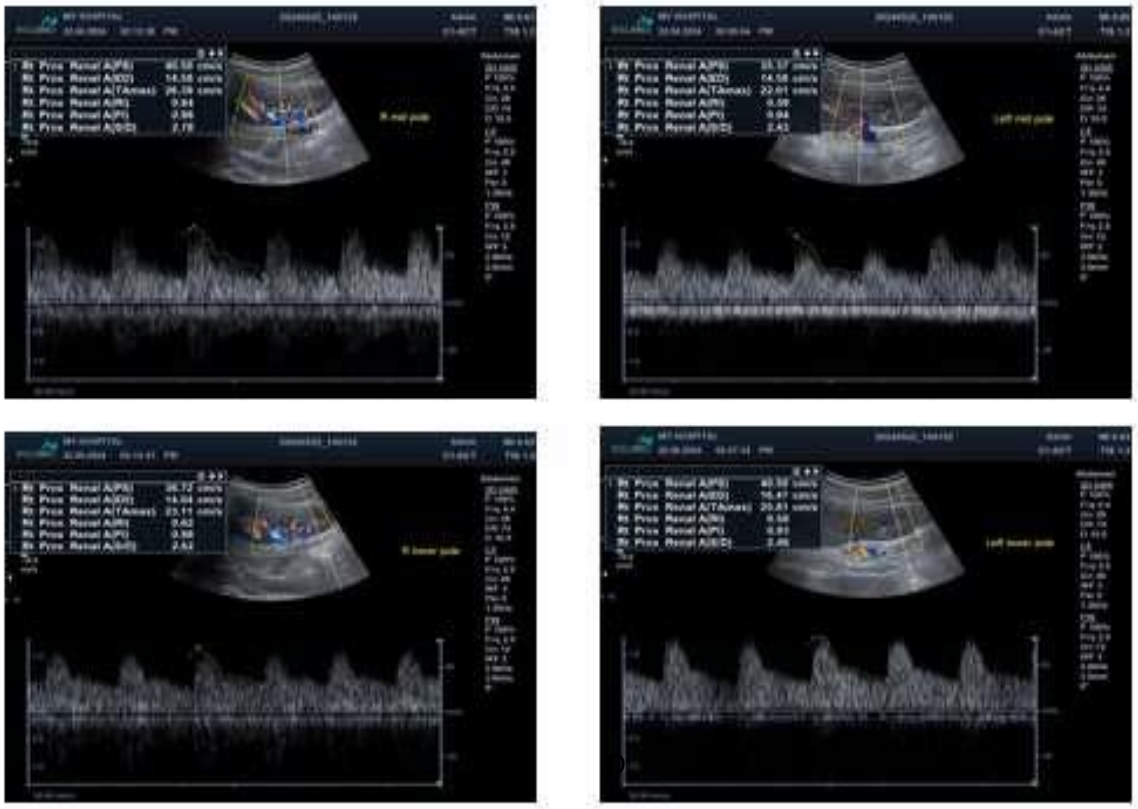
Figure 3



Abdominal ultrasound- Bilateral kidney appears normal in size, shape and echotexture.

On color doppler of Bilateral kidney-

Mean renal resistive index of Right kidney was 0.62

Mean renal resistive index of Left kidney was 0.56

Mean renal resistive index of bilateral kidney was 0.59

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RESULTS

More than one third of patients(39%) patients enrolled in our study were of age group between 41-50 year of age with group 51-60 year of age being second most populated group. There were 34(22.7%) females and 116 (77.3%.) males and in this study,showing a male predominance.

In our study, alcohol intake in patients was the most common etiology in 69 % of patients followed by Hepatitis B and Hepatitis C.

In our study, increased renal resistive index was seen in (35.5%) patients and (64.7%) patients have normal renal resistive index.

Our study shows increased serum creatinine level was seen in 42(28%) patients and 108 (72%) patients have normal serum creatinine level.

In our study among patients with increased renal resistive index, increased serum creatinine level was seen in (75.5%) and serum creatinine level normal in (24.5%) patients. Among patients with normal renal resistive index, increased serum creatinine level was seen in (2.02%) patients and normal serum creatinine level was seen in (97.98%) patients.

Our study shows increased renal resistive index was seen in 51(41.5%) of patients and normal renal resistive index seen in (58.5%) patients. P-value is <0.0001, showing significant association between ascites and increased renal resistive index.

In our study, considering the RI as continuous variable and increased renal resistive index as the event variable, significant ROC curve was observed. RI score and a cutoff value of 0.7 or above, the Area under the curve is 99.0% with a sensitivity of 96% and specificity of 95.0%the which is statistically significant.

Table 1 : Distribution of patients according to etiology

Etiology	Number of patients	Percentage (%)
Alcohol intake	104	69.3
Hepatitis B	24	16
Hepatitis C	12	8
others	10	6.7
Total	150	100(%)

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Table 2: Distribution of patient according to Renal resistive index
Table no.-2

Renal resistive index	Number of patients	Percentage (%)
Increased	53	35.3
Normal	97	64.7
Total	150	100.0

Table 3: Distribution of patient according to Serum creatinine
Table no.-3

Serum creatinine	Number of patients	Percentage (%)
Increased	42	28
Normal	108	72
Total	150	100(%)

Table no.- 4 Correlation of Renal resistive index and serum creatinine
Table no.- 4

Renal resistive index	Serum creatinine		Total	p-value
	Increased	normal		
Increased	40(75.5%)	13(24.5%)	53(100%)	0.001
Normal	2(2.02%)	95(97.98%)	97(100%)	
Total	42	108	150	

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Table no. –5 Correlation of Renal resistive indexwith Ascites
Table no.- 5

Ascites	Renal resistive index		Total	p-value
	Increased	Normal		
Present	51(41.5%)	72(58.5%)	123(100%)	< 0.0001
Absent	2 (7.4%)	25(92.6%)	27(100%)	
Total	53	97	150	

Table no. – 6 Comparison of Biochemical (serum creatinine) levels with Renal resistive index

Parameter	Increased Renal resistive index (n=53)		Normal Renal resistive index (n=97)		p-value
	Mean	SD	Mean	SD	
S. Creatinine	1.4	0.19	0.74	0.17	0.042

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DISCUSSION

Cirrhosis is the most common cause of morbidity and mortality worldwide. In India, liver cirrhosis is the 10th leading cause of death. Kidney function can be affected in 8–40% of patients with liver cirrhosis due to renal hypoperfusion, leading to renal dysfunction. Hepatorenal syndrome is a lethal complication of liver cirrhosis, making early diagnosis and treatment of kidney dysfunction crucial. The clinical features of liver cirrhosis and hepatorenal syndrome often overlap, complicating the diagnosis of renal failure. Physicians frequently rely on various laboratory parameters to diagnose renal dysfunction, but these parameters typically detect renal dysfunction at a later stage. Ultrasound with colordoppler plays a crucial role in diagnosing renal dysfunction.

Therefore, we took this study to evaluate the early diagnosis of renal impairment by using Color Doppler ultrasound and assessing the renal resistive index in cirrhotic patients.

In our study, among 150 patients, an increased renal resistive index was seen in (35.3%) patients, and (64.7%) patients had normal renal resistive index.

In our study,(28%) had increased serum creatinine levels, while (72%) had normal serum creatinine levels. In our study, among 53 patients with increased renal resistive index, increased serum creatinine level was seen in 40(75.5%) and serum creatinine level was normal in 13(24.5%) patients. Increased serum creatinine levels indicate renal impairment.

In ourstudy, among 150 patients, most of the patients 123 (82%) presented with ascites, followed by icterus in 106 (70.6%) patients, abdominal pain in 103 (68.6%) patients, pedal edema in 86 (57.3%) patients, and dizziness in 33 (22%) patients.

In our study, the most common cause of liver cirrhosis was alcohol consumption in 104(69.3%) patients followed by hepatitis B virus in 24(16%), hepatitis C virus in 12(8%) and cause was not known in 10(6.7%) patients.

In our study, patient with increase renal resistive index had a mean serum creatinine level of 1.4 whereas those with normal renal resistive index had a mean serum creatinine level of 0.74.

CONCLUSION

In conclusion,This study looked into how ultrasound can help us measure the renal resistive index in liver cirrhotic patients. By looking at a lot of past research and doing our own detailed study with ultrasound, we found out how important this non-invasive way of imaging has significant impact on enhancing the outcomes in liver cirrhosis patients.

Colour doppler ultrasound play significant role in evaluating the renal resistive index as a reliable predictor of early renal impairment in patients with liver cirrhosis. The findings in our study indicate that elevated renal resistive index is strongly associated with early stage of renal dysfunction, providing a non-invasive, accessible and efficient tool for early detection of renal dysfunction.
By early identification of renal impairment, clinicians can implement timely interventions to mitigate further renal damage and improve patient outcomes. This study highlights the importance of incorporating renal resistive index assessment into routine clinical practice for patients with liver cirrhosis, emphasizing its potential to enhance patient management and prognosis through early intervention strategies.

Acknowledging the limitations of this study, such as its sample size and potential biases, is important, as they could have affected the results. But this gives us ideas for future research. If we do studies in larger cohort, this can confirm its diagnostic accuracy and prognostic value.

In summation, our study demonstrates a positive correlation between increase renal resistive index and renal impairment. our study suggest as renal resistive index increases, renal function deteriorates.

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