

Original Article

A Study of Renal Doppler Indices in Chronic Liver Disease and It's Role in Predicting Hepatorenal Syndrome

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Abstract

Background : Patients with Chronic Liver Disease (CLD) are often prone to develop Renal impairment. Due to this Renal impairment patient may also develop serious complications like Hepatorenal syndrome. Renal impairment is mainly caused due to Renal arterial vasoconstriction. Renal arterial vasoconstriction can be assessed using Duplex Doppler Ultrasonography of kidney.

Aims & Objective : To know the Renal Doppler Indices in CLD patients and its role in predicting Hepatorenal syndrome.

Materials and Methods : This study was a hospital based prospective cross sectional study, conducted at General Medicine Department, VMKV Medical College and Hospitals, Salem. Patients of age more than 18 years with ultrasound showing evidence of chronic liver disease were included in the study. A simple random sampling was used to select the patients for the study.

Results : Majority of the subjects were aged 41-50 years (38.0%) followed by 26.0% of the subjects were aged 31-40 years. Majority of the patients nearly 20.0% of the cases had fever, 62.0% of the cases had abdominal distension and 42.0% of them had pain abdomen. In the present study, 46.0% of the cases were of cirrhosis, 54.0% of the cases had coarse texture and 12.0% of the subjects had splenomegaly.

Conclusion : Renal duplex Doppler ultrasonography can non-invasively identify a subgroup of non-azotemic patients with liver disease that is at significantly higher risk for subsequent development of kidney dysfunction and the hepatorenal syndrome.

Key words : Chronic Liver Disease, Hepatorenal syndrome.

Chronic Liver Disease (CLD) refers to the steady loss of liver functionality over a period exceeding six months. This decline affects vital processes such as the production of clotting agents and essential proteins, the removal of toxic metabolic byproducts, and the elimination of bile. The condition involves ongoing inflammation, damage and repair within the liver tissue, ultimately resulting in scarring (fibrosis) and, over time, cirrhosis¹. Patients with Chronic Liver Disease are usually prone to develop Renal impairment. Hepatorenal Syndrome (HRS) represents the most severe form of kidney impairment seen in individuals with CLD and is linked to a markedly reduced life expectancy².

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Editor's Comment :

- Renal Doppler ultrasonography is a simple, reliable and non-invasive tool for assessing renal circulation in chronic liver disease.
- Elevated Resistive Index (RI) values significantly correlate with disease severity and risk of hepatorenal syndrome.
- Early detection with Doppler can help predict and manage renal dysfunction in cirrhotic patients ?

Renal impairment is mainly caused due to Renal arterial vasoconstriction. This vasoconstriction can persist even weeks to months prior to elevation of Blood Urea and Serum Creatinine³. Renal arterial vasoconstriction can be assessed using Duplex Doppler ultrasonography of kidney. Duplex Doppler ultrasound of the kidneys offers a simple, non-invasive technique for evaluating renal blood circulation and measuring arterial resistance, which serves as an indicator of vasoconstriction^{4,5}.

The Resistance Index (RI) is the most commonly applied measurement for assessing resistance within the arteriolar blood vessels. This RI can be assessed by analysing a simple Doppler Waveform. Normal value of RI is 0.5-0.7 and is calculated at the Arcuate arteries of interlobar arteries⁶.

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To better understand how measuring the Resistance Index (RI) might help predict kidney dysfunction in individuals with Chronic Liver Disease (CLD), we conducted an analysis of intrarenal arterial RI values in such patients. These values were then compared with serum creatinine levels, which serve as an indicator of renal impairment severity. The primary objective of our research was to assess how effectively renal duplex ultrasonography can aid in diagnosing and anticipating the early onset of hepatorenal syndrome.

MATERIALS AND METHODS

The present study was a hospital based prospective cross sectional study, conducted at General medicine Department, VMKV Medical College and Hospitals, Salem. The study period was performed between February, 2021 and December, 2022. Patients above 18 years with ultrasound showing evidence of chronic liver disease were included in the study. Patients with Systemic hypertension and Type 1 or 2 diabetes mellitus, patients on treatment with drugs causing nephrotoxicity and patient with acutely ill infections, Malignancy disorders, nephron diseases were excluded for the study. A simple random sampling was used to select the patients for the study. Before taking part in the study, every participant gave their informed consent in writing. A semi-structured and pre-formulated questionnaire served as the tool for conducting interviews with the participants. Collected responses were documented using Microsoft Excel 2019 and statistical evaluation was carried out with SPSS version 16.0. Numerical data were summarized as means along with their standard deviations, while categorical data were represented as percentages. The Chi-square test was employed to compare differences in proportions, with statistical significance determined at a p-value threshold of below 0.05.

RESULTS

In the present study, majority of the subjects were aged 41-50 years (38.0%) followed by 26.0% of the subjects were aged 31-40 years and 84.0% of the participants were male and 16.0% of the cases were female. Majority of the patients nearly 20.0% of the cases had fever, 62.0% of the cases had abdominal distension, 42.0% of them had pain abdomen, 8.0% of the cases had loss of appetite and 28.0% of the cases had pedal edema. In the present study, 46.0%

of the cases were of cirrhosis, 54.0% of the cases had coarse texture, 12.0% of the subjects had splenomegaly and 6.0% of the cases had portal hypertension. Renal artery doppler finding was between 0.5-0.7 in 42.0% of the cases and 58.0% of the cases had >0.71 and the mean RAD was 0.71 ± 0.05 (Tables 1-6).

Table 1 — Socio-demographic profile and clinical presentation of study subjects (n=50)

Variables	Frequency (n)	Percentage (%)
Age	31-40	13
	41-50	19
	51-60	13
	>60	5
Gender	Male	42
	Female	8
Clinical presentation	Fever	10
	Abdominal distension	31
	Pain abdomen	21
	Loss of appetite	4
	Pedal edema	14
	Breathlessness	2
	Vomiting	3
	Altered sensorium	5

Table 2 — Clinical findings of study subjects (n=50)

Variables	Frequency	Percentage
Ascites	36	72
Edema	25	50
Jaundice	27	54
Urine output- Decreased	22	44
Alcoholic	37	74
Hepato Renal Syndrome	13	26

Table 3 — Laboratory findings

Variables	Minimum	Maximum	Mean $\pm$ SD
T Bilirubin	0.9	16.6	4.43 3.42
D Bilirubin	0.2	16.9	2.32 2.92
I Bilirubin	0.2	18.3	2.31 3.15
SGOT	17	470	95.94 84.43
SGPT	6	432	53.0 64.16
ALP	60	310	154.78 63.19
Albumin	1.9	3.5	2.62 0.45
Urea	8	153	34.70 22.87
Creatinine	0.6	4.4	1.34 0.73
Sodium	112	141	131.36 6.34
Potassium	2.4	6.2	3.90 0.70

Table 4 — Ultrasound abdomen, Renal artery Doppler and Child PUGH Grade of study subjects

Variables	Frequency	Percentage
Ultrasound abdomen	Cirrhosis	23
	Coarse echotexture	27
	Splenomegaly	6
	Portal Hypertension	3
Renal artery	0.5-0.70	21
Doppler-Resistive Index	>0.71	29

Table 5 — Association of RI with Child Pugh grade

	Mean ± SD
A	0.63 ± 0.04
B	0.69 ± 0.06
C	0.73 ± 0.04

ANOVA F value = 8.02, $p < 0.0001^*$, Statistically significant

Table 6 — Association of RI with Hepato Renal syndrome

HRS	Minimum	Maximum	Mean ± SD
Yes	0.63	0.78	0.74 ± 0.04
No	0.58	0.79	0.70 ± 0.06

T VALUE= 2.22, $P=0.001^*$, Statistically significant

DISCUSSION

Hepatorenal Syndrome (HRS) represents a life-threatening complication arising in individuals with advanced liver disease. Reliable indicators for timely detection and identification of patients at heightened risk are currently insufficient. This study aimed to assess the utility of renal Duplex ultrasonography as a tool for early detection and diagnosis of HRS.

HRS frequently develops in the context of end-stage liver cirrhosis and is primarily caused by intense vasoconstriction within the renal circulation, ultimately resulting in a reduced Glomerular Filtration Rate (GFR). It remains a prevalent issue among patients with severe cirrhosis. According to a significant five-year investigation, approximately 40% of cirrhotic individuals who developed ascites eventually progressed to HRS⁷.

In the present study, majority of the subjects were aged 41-50 years (38.0%) followed by 26.0% of the subjects were aged 31-40 years and 84.0% of the participants were male and 16.0% of the cases were female. A study done by Francoz C, *et al*⁸ observed that the mean age of the participants was around 49.56 years and 80.0% of them were males and 20.0% were females.

In the current study, 62.0% of the cases had abdominal distension followed by 42.0% of the cases had pain abdomen, 28.0% of the cases had pedal edema and 20.0% of the cases had fever. Majority of them had (72.0%) ascites and 50.0% of the cases had edema. Similarly, a study done by Kellum JA, *et al*⁹ reported that ascites was seen among 80% of the cases, 36.0% had fever and 13.0% had pedal edema.

In the present study, T Biliubin ranged from 0.9-6.6 and the mean was 4.43 ± 3.42 , D Biliubin ranged between 0.2-16.9 and the mean was 2.32 ± 2.92 , I.

Biliubin ranged between 0.2-18.3 and the mean was 2.31 ± 3.15 , SGOT ranged between 17-470 and the mean was 95.94 ± 84.43 , SGPT ranged between 6-432 and the mean was 53.0 ± 64.16 , ALP was ranged between 60-310 and the mean was 154.78 ± 63.19 .

Similarly, in a study done by Belcher JM, *et al*¹⁰, notable differences were reported in prothrombin concentration, serum albumin, and serum bilirubin levels between the two patient groups, with the second group exhibiting more pronounced abnormalities in these parameters. In contrast, another study by Ruiz del, *et al*¹¹ concluded that individuals suffering from cirrhosis, Hepatorenal Syndrome (HRS), and significant ascites may experience impaired kidney function due to elevated Intra-abdominal Pressure (IAP). Lowering IAP through paracentesis combined with albumin administration appears to enhance creatinine clearance, likely as a result of improved renal perfusion, which is indicated by a reduction in the Resistive Index (RI) on Doppler ultrasound.

In the present study, 46% of the cases had cirrhosis, 54% of the cases had coarse texture, 12% of the subjects had splenomegaly and 6% of the cases had portal hypertension. A study by Arroyo V, *et al*¹² observed that 65% of the cases had irregular liver surface, heterogenous, homogenous and fatty echo texture was seen among 78% of the cases.

In this study, the mean RI value with grade A was 0.63 ± 0.04 , with grade B was 0.69 ± 0.06 and with grade C was 0.73 ± 0.04 . It was observed that there was a statistically significant association between RI and Child PUGH score and the RI was significantly higher among cases with increased grade. Similarly, a study done by Belcher JM, *et al*¹⁰ observed that individuals with cirrhosis but without ascites had markedly higher intrarenal Resistive Index (RI) values compared to healthy subjects. Moreover, patients with ascites exhibited even greater RI levels, despite having normal serum creatinine concentrations.

The present study observed a significant positive correlation ($r=0.27$, $p<0.05^*$) between Serum creatinine and Renal arterial resistance index. Similarly, study done by Belcher JM, *et al*¹⁰ reported that the levels of serum creatinine did not have a statistically significant association with the value of RI, a finding which was discordant to the observation made in the present study.

CONCLUSION

Duplex-Doppler ultrasound serves as a simple, dependable, and non-invasive approach for evaluating blood flow within intralobar arteries, particularly in patients with liver cirrhosis. It enables early identification of alterations in renal circulation, frequently preceding any noticeable symptoms of kidney dysfunction. Additionally, this imaging technique aids in recognizing cirrhotic individuals who may be at an increased likelihood of developing hepatorenal syndrome.

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Conflict of interest : None

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