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A prospective study of resistive index in patients of liver cirrhosis

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Abstract
Background: It is very important to diagnose renal impairment in cirrhosis patients at an early stage before overt HRS develops. In patients with cirrhosis the early renal impairment or renovascular vasoconstriction can be predicted by renal arterial resistance index (RI).
Aims and Objectives: To calculate and compare RI in patients of compensated and decompensated cirrhosis and its prognostic significance.
Materials and Methods: Hundred liver cirrhosis patients were studied in J.A. Group of Hospitals, Gwalior from November 2014 to September 2016. Study cohort was divided into Group A (patients with compensated liver cirrhosis), Group B (patients with decompensated cirrhosis responsive to diuretics), Group C (patients with decompensated cirrhosis resistant to diuretics) and Group D (patients with hepatorenal syndrome). Child Pugh Score was used to classify cirrhosis of liver as Grade A (Total score of 5–6; well compensated disease), Grade B (Total score of 7–9; disease with significant functional compromise) and Grade C (Total score of 10–15; decompensated liver disease).
Results: Most of the patients were male (84%) with mean age of 45.34±13.98 years. In patients with compensated and decompensated cirrhosis mean RI value was 0.56 and0.69 respectively. Out of 3 compensated cirrhosis patients none had RI >0.7 whereas out of 97 decompensated cirrhosis patients 44.33% patients had RI > 0.7 (P >0.05). In Group A, most of the patients had RI <0.60 (n=2; 66.67%), in Group B, most of them had RI range 0.61-0.70 (n=23; 46%), in Group C, most of them had RI range 0.71-0.80 (n=23; 67.64%) and in Group D, most of the patients had RI range >0.80 (n=8; 61.54%) (p<0.05).Out of 27 patients with blood urea ≥ 40, 66.67% patients had RI >0.7 (P<0.05) and out of 24 patients with serum creatinine ≥ 1.5, 70.83% patients were having RI > 0.7 (P< 0.05). Out of 57 patients who had RI <0.7, 2 (3.51%) patients expired whereas out of 43 patients who had RI >0.7, 10 (23.25%) patients expired.
Conclusion: RI increases with degree of hepatic decompensation. Higher value of RI helps in early detection of subsequent kidney dysfunction, and hepatorenal syndrome. Mortality was higher in patients having RI >0.7.

Keywords: resistive index, decompensated cirrhosis, liver cirrhosis, child pugh score

Introduction
Cirrhosis is a result of advanced liver disease. It is characterized by replacement of liver tissue by fibrosis and regenerative nodules. These changes lead to loss of liver function. Cirrhosis is most commonly caused by alcoholism, hepatitis B and hepatitis C, but has many other possible causes [1].
Ascites is the most common complication of cirrhosis. Other potentially life-threatening complications are bleeding from oesophagealvarices, hepatic encephalopathy and hepatorenal syndrome etc [2].
Resistive index (RI) is the most widely used index for estimation of intrarenal vascular resistance [1]. An elevated renal RI has been observed in various conditions associated with elevated renal vascular resistance like kidney obstruction, acute tubular necrosis and hemolytic uremic syndrome and is detected in liver disease related functional kidney failure [2]. Kastelan *et al*, have demonstrated that renal duplex Doppler of interlobar arteries is a simple, effective and non-invasive method and enables the early detection of renal hemodynamic disturbances in patients with liver cirrhosis even before renal dysfunction becomes clinically evident. Moreover it makes possible the identification of a subgroup of patients with liver cirrhosis who are at higher risk for developing hepatorenal syndrome [3].

This non-invasive method may be applied to pathophysiological and clinical studies of the renal functional impairment in patients of cirrhosis [4].
The present study was planned to calculate and compare RI in patients of compensated and decompensated cirrhosis and its prognostic significance.

Material and Methods

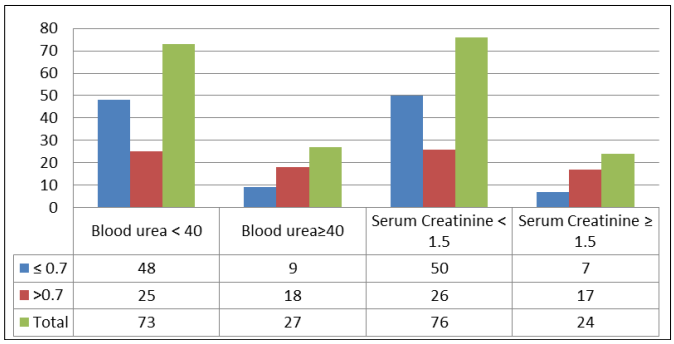
Present prospective cross-sectional study was performed on 100 patients with cirrhosis of liver in J.A. Group of Hospitals, Gwalior between November 2014 to September 2016.
This study was approved by Ethical Committee and written informed consent from patients or legal guardians was obtained before starting the study.
Patients with age >18 years and patients who have reported cirrhosis of liver on abdominal ultrasonography were included. Patients not giving consent, with other co-existing illness such as chronic renal disease, with sepsis and patients with diabetes, renal stone, hypertensive patients, nephrotoxic drug intake were excluded.
Detailed history, chief complaints, history of present and past illness, personal history, occupational history, family history, drug and addiction history was taken. General and systemic examination of patients was done. All routine investigation like - CBC, RFT, LFT, ECG, RBS, urine R/M, USG abdomen, renal color doppler were performed.
All patients of cirrhosis of liver were categorized in various groups, Group A (patients with compensated liver cirrhosis), Group B (patients with decompensated cirrhosis responsive to diuretics), Group C (Patients with decompensated cirrhosis resistant to diuretics) and Group D (patients with hepatorenal syndrome).
Child Pugh Score was used to classify cirrhosis of liver as Grade A (Total score of 5–6; well compensated disease), Grade B (Total score of 7–9; disease with significant functional compromise) and Grade C (Total score of 10–15; decompensated liver disease)
All the data was analyzed using IBM SPSS ver. 20 software. Cross tabulation and frequency distribution was used to prepare tables. Chi square test was used to obtain p value. P value <0.05 is considered as significant.

Results

Mean age of study cohort was 45.34±13.98 years which ranged from 19 to 81 years. Maximum patients were in group of 36-45 years (34%). Majority were male (84%).In patients with compensated cirrhosis the mean RI value was 0.56 whereas in patients with decompensated cirrhosis mean resistive index value was 0.69. The resistive index value increased with degree of decompensation in cirrhotic patients.
In 3 patients with compensated cirrhosis, no patient found to have RI more than 0.7. In 97 patients with decompensated cirrhosis, 44.33% patients found to RI more than 0.7(P >0.05).

Table 1: Showing Resistive Index in various Groups

Resistive Index	Group				Total (n=100)
	A	B	C	D	
<0.60	2	13	1	1	17
0.61-0.70	1	28	10	1	40
0.71-0.80	0	8	23	3	34
>0.80	0	1	0	8	9



Graph 1: Comparing blood urea and serum creatinine level with Resistive Index

Table 2: Correlation of resistive index with blood urea and serum creatinine values in various groups

Groups	Blood Urea<40		Blood Urea>40		Serum Creatinine<1.5		Serum Creatinine>1.5	
	RI ≤0.7	RI >0.7	RI <0.7	RI >0.7	RI <0.7	RI >0.7	RI <0.7	RI >0.7
A	2	0	1	0	2	0	1	0
B	35	6	6	3	38	7	3	2
C	11	18	0	5	10	19	1	4
D	0	1	2	10	0	0	2	11

RI; Resistive Index, Group A; patients with compensated cirrhosis, Group B; patients with decompensated cirrhosis responsive to diuretics, Group C; patients with decompensated cirrhosis resistant to diuretics, Group D; patients with hepatorenal syndrome

Out of 13 patients with Hepatorenal syndrome, 11 (84.61%) patients have RI value >0.70.RI was more than 0.7 in 43 patients, out of them 10 (23.25%) patients expired, whereas RI was <0.7 in 57 patients and 2 (3.51%) patients expired from them.

Discussion

Duplex ultrasonography is a widely used non-invasive method to assess vascular patency and blood flow in many sites. Duplex Doppler can be used to assess vascular resistance in the small intraparenchymal vessels through simple analysis of Doppler waveform by a parameter termed the resistive index (RI) [1]. An elevated renal RI has been observed in various conditions associate with elevated renal vascular resistance such as kidney obstruction, acute tubular necrosis and hemolytic uremic syndrome and should be detected in liver disease related functional kidney failure [3].
Most common age group in our study was 36-45 years of age followed by 26-35 years of age. Mean age of the patient was 45.34±13.98. Majority were males (84%), with male to female ratio of 5.2:1. In Wang *et al*, [5] study, mean age of the patient was 50.54±10.49 years and author also reported male preponderance (74%). Similar to present study Moustafa *et al*, [6] also reported male preponderance (67.5%).
In present study patients with decompensated cirrhosis were more (97%) as compared to compensated cirrhosis. In patients with compensated cirrhosis, the mean RIwas 0.56

whereas in patients with decompensated cirrhosis, it was 0.69. None of the compensated cirrhosis patients had RI >0.7 whereas in decompensated cirrhosis, 44.33% patients had RI >0.7.Sikarwar *et al* reported that RI was significantly higher in patients with refractory ascites than in patients with diuretic responsive ascites, and also in patient with diuretic responsive ascites than in patients with compensated cirrhosis ($p < 0.05$) [7]. Maroto *et al* did asimilar study and reported that Resistive index was significantly increased in patients with kidney failure (0.74 ± 0.01) compared with those in the other three groups (0.64 ± 0.01, 0.64 ± 0.02 and 0.67 ± 0.01) and correlated significantly with glomerular filtration rate, arterial pressure, plasma renin activity and free water clearance in the cirrhotic patients. The sensitivity and specificity of the resistive index in detecting kidney failure in patients with ascites were 71% and 80%, respectively [8].

Wang *et al* [5] in a similar study, reported that patients with decompensated cirrhosis were more (60%) compared to compensated cirrhosis (40%). Mindikoglu *et al*, [9] also reported that RI was found to be higher in decompensated cirrhosis than in compensated cirrhosis. It was further more in diuretic resistant decompensated cirrhosis than in diuretic responsive decompensated cirrhosis. Similarly Gotzberger *et al*. [10] reported that, RI was found to be higher in decompensated cirrhosis than in compensated cirrhosis. Similar reports were generated by Amer *et al* [11].

In present study patients with blood urea > 40, 66.67% patients had RI > 0.7 ($p < 0.05$) and patients with serum creatinine >1.5, 70.83% patient had RI >0.7 ($p<0.05$) that means in patients with raised blood urea and serum creatinine, the value of RI was found to be higher and most of the patients of hepatorenal syndrome have raised blood urea and serum creatinine levels. Pompili *et al* [12] reported that RI value was higher in patients with raised blood urea and serum creatinine. In Kastelan *et al* [13] study, RI value found to be higher in patients with raised blood urea and serum creatinine. Similar results were obtained by Goetzberger *et al*, [10] and Fouad *et al* [13].

In present study, 57% patients had RI ≤0.7 and 43 % patients had RI > 0.7.Hepatorenal syndrome developed in 13% patients. In patients with RI >0.7, 25.58% patients developed hepatorenal syndrome. In a similar study among patients with RI > 0.7, 26% patients developed hepatorenal syndrome. Epstein *et al*, [14] reported that hepatorenal syndrome developed in 26% patients with RI >0.7.Goyal *et al* studied 100 cirrhotic patients and reported that in patients with cirrhosis, RI was significantly greater in patients with ascites than those without ascites (0.70 vs. 0.62, $p < 0.01$). RI >0.70 was significant independent predictor of subsequent HRS development ($p = 0.006$) [15].

Most of the patients with increased blood urea and serum creatinine have raised RI and patients with hepatorenal syndrome also have raised RI. Not all the patients with raised RI values showed poor kidney outcome. It is therefore presumed that an additional insult such as sepsis, bleeding or nephrotoxic drugs may be responsible for development of hepatorenal syndrome in patients at risk i.e. those already with renal vasoconstriction reflected by elevated RI. Combining the clinical and resistive index allows identification of subgroup of patients at risk for kidney dysfunction and hepatorenal syndrome.

Conclusion

Resistive index increases with degree of hepatic decompensation. Renal duplex USG is a noninvasive, single and easily method to study intrarenal hemodynamics in patients with liver cirrhosis. Higher value of RI helps in early detection of subsequent kidney dysfunction, and hepatorenal syndrome. Most of the patients of hepatorenal syndrome had RI>0.7 and 25.58% patients with RI>0.7 developed hepatorenal syndrome. Most of the expired patientsin this study had RI>0.7. In future, renal RI measurement may be of value in early detection of patients who are at risk of hepatorenal syndrome and in these patients, early liver transplant can be planned.

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