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ORIGINAL ARTICLE

Analysis of Ultrasound as a Predictor of Renal Impairment in Patients with HCV Infection

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ABSTRACT

Background: Renal arterial waveform analysis done via renal Duplex Doppler Ultrasound gives a safe, trustworthy, and real time assessment of renal hemodynamics without any delay and ambiguity as it removes various components that make estimation of renal function problematic.

Objective: To evaluate the clinical validity of RI and to identify the relationship between RI and RFT's for evaluation of renal function in patient. Analytical cross sectional examination was done at DHQ teaching hospital Sargodha from 2020 to 2021. The it had 158 hepatitis C positive patients and 79 healthy volunteers following approval of summary. After validation of inclusion and exclusion criteria, patients were broken in into 4 groups (A to D) according to stage of disease and controls were kept in Group E. Grey scale ultrasonography test for renal measurements and renal echogenicity was done. Sagittal and axial scans was done in supine posture from anterior approach utilizing liver and spleen as an acoustic window. The size and texture of liver was also assessed. Color Doppler was done to calculate Resistive Index (RI) using conventional curvilinear probe.

Results: The serum creatinine and urea levels in the diseased groups were greater than those in the control group. It was individuals in Group-D who had the highest creatinine levels, which were followed by those in Groups C, B, and A, respectively. The greatest Urea level was found in Group-D, at 49.6714.19, while the lowest was found in Group-A. The mean RI in sick groups (the highest was in Group D, with values of 0.78 and 0.81 in the right and left kidneys, respectively) was similarly statistically substantially greater.

Conclusion: An important connection exists between RI and RFT. The use of Doppler duplex ultrasonography for the study of renal hemodynamics in cirrhotic patients with HCV is a reliable, non-invasive, simple, immediate, and cost-effective method for examining renal hemodynamics in these patients. It is not essential to have clinical symptoms or deviations from RFTs for this test to be more accurate than RFTs at predicting disease development.

Keywords: Renal Doppler Duplex Ultrasound, Renal Resistive Index (RI), Renal function tests, Urea, Creatinine, Cirrhosis, HCV

INTRODUCTION

Hepatitis C is a liver illness caused by infection with the hepatitis C virus. It is contagious and can be fatal (HCV). It is transmitted through contact with the blood and body secretions of an infected person[1]. According to recent WHO estimates, 130 – 170 million people per year are infected by HCV worldwide and Pakistan has third highest rate (4.9% of population)[2].

Hepatitis C does not only affect the liver, but also has extrahepatic manifestations. It has renal, neurological and dermatological complications due to a chronic immune complex – mediated process known as mixed cryoglobulinemia (MC). A link exists between HCV infection and mixed cryoglobulinemia, which is characterized by the development of vasculitis in small and medium-sized arteries and veins, which is a result of the deposition of complement, cryoglobulin, and antigen complexes in the vessel walls. It clinically presents as glomerulonephritis when kidneys are involved[3].

Domenico et al., 2009 reported the incidence of mixed cryoglobulinemia in patients with HCV infection to be varying from 10 – 15%[4].

Edgar et al., 2009 showed prevalence of mixed cryoglobulinemia related extrahepatic manifestations of HCV to be ranging from 10 – 70% depending upon population selection and lead time biases[5].

Type I membranoproliferative glomerulonephritis (MPGN) associated with type II cryoglobulinemia is the most frequent association when kidneys of HCV infected patients are involved. Among all, 30 – 36% patients with cryoglobulinemia develop membranoproliferative glomerulonephritis (MPGN) and it is the most relevant clinical manifestation[6]. Other nephropathies like non – cryoglobulinemic membranoproliferative glomerulonephritis (NC – MPGN) and membranous glomerulonephritis have also been reported in HCV infection but are less common[7].

Using renal Duplex Doppler Ultrasound, which is a non-invasive, easy, and efficient approach, it is possible to identify changes in renal hemodynamics even before clinical signs of renal failure are present8.

OBJECTIVES

The objectives of this study are

1- To assess the clinical validity of Renal Resistive Index to diagnose renal impairment in patients having Hepatitis C infection and to predict further outcomes.

MATERIALS & METHODS

During the years 2020 to 2021, an analytic cross-sectional research was carried out at the DHQ teaching hospital in

Sargodha. In this study, the sample size was estimated using the following assumptions: a 6 percent margin of error, a 90 percent confidence level, and an expected proportion of renal impairment in patients with Hepatitis C of 30% 5.

Inclusion Criteria: Patients diagnosed as case of Hepatitis C using PCR.

Exclusion Criteria

Diagnosed cases of hepatitis C with

- Hepato-renal Syndrome (Rapid deterioration of renal function within less than 2 weeks in patients with liver cirrhosis)
- Diabetes Mellitus (Random Blood Sugar ≥ 200mg/dl)
- Hypertension (Systolic B.P ≥ 160mmHg and Diastolic B.P ≥ 100mmHg)
- Nephrolithiasis (Diagnosed on Ultrasound)
- Renal cysts (Diagnosed on Ultrasound), ACE Inhibitors, NSAIDs, Aspirin, Cocaine, Heroine)

Data Collection Procedure: Total 158 patients having hepatitis C infection and 79 healthy individuals (visiting hospital for routine physical examination and serving as control group) were included in this study after approval of synopsis. First encounter was considered as Screening Stage and History (medical, surgical and drug), Clinical Examination, Renal Function Test (including Serum Creatinine, Blood Urea and Urinary Protein), Random Blood Sugar level, Blood Pressure and grey scale Ultrasound was performed for all patients as well as healthy controls to validate the inclusion and exclusion criteria. Patients along with healthy controls were called again after 2 weeks (after arrival of lab results) and those meeting exclusion criteria were excluded from this study.

There are four groups of patients: those without liver cirrhosis (group A), those in the compensatory stage of liver cirrhosis (group B), those in the decompensation stage of liver cirrhosis with non-refractory ascites (group C), and those in the refractory stage of liver cirrhosis with ascites (group D) (group E). All patients and healthy controls were subjected to grey scale ultrasound assessment of renal measurements and renal echogenicity using real-time ultrasound equipment with a standard 3.5-5.0 MHz curvilinear transducer. The liver and spleen were used as acoustic windows in the sagittal and axial planes in the supine posture. The left and right lateral decubitus postures were used as needed. For each kidney, its size, cortical thickness, and relative echogenicity (I, II and III grades) were assessed separately. Aside from that, researchers examined the liver's shape and feel. To find vessels and compute the Resistive Index, color Doppler ultrasonography with a typical curvilinear probe was performed on all patients and healthy controls (RI). Waveform patterns obtained using lowest pulse repetition frequency without aliasing were measured. RI value of inter lobar or segmental intra-renal arteries was calculated in each kidney. A mean RI value for each kidney was taken after obtaining three reproducible waveforms. RI value of ≤ 0.6 was considered as normal and RI value of 0.7 was taken as an upper limit. Values above 0.7 were noted as high Resistive Index (RI). RI values were co-related with Renal Echogenicity, Serum Creatinine and Urinary Protein levels. The renal cortex's echogenicity in contrast to the spleen was measured and classified into three classes. It was determined that the echogenicity of the renal cortex was lower than that of the splenic parenchyma. Grade II was assigned to renal cortex echogenicity, which was found to be equivalent to that of spleen parenchyma. Grade III was assigned to the renal cortex because its echogenicity exceeded that of the splenic parenchyma. Grade I was taken as normal, Grade II and Grade III were considered as abnormal. Value of Serum Creatinine and Proteinuria was noted while keeping the standard reference range and any deranged values were taken as abnormal.

Data Analysis Procedure: SPSS version 20 was used to compile and analyses the data. It was decided to show the quantitative data in the form of mean S.D. and the qualitative data in frequency (e.g., age, hemoglobin, serum creatinine, resistive index (RI), renal cortex echogenicity (RCE), renal size (RL), liver size (L), etc.).

RESULTS

Mean age of HCV patients was 44.39±8.60 years. While among controls mean age of patients was 38.22±10.54 years. Gender distribution of study population showed that there were 136(57.38%) male and 101(42.62%) females were included. i.e., HCV Cases: Male:77 & Female:81 & Controls: Male:59 & Female:20

Table-1: Descriptive statistics for age

	HCV Patients	Controls
N	158	79
Mean	44.39	38.22
SD	8.60	10.54
Minimum	23.00	20.00
Maximum	68.00	66.00

Table-2: Descriptive statistics for Hemoglobin

	HCV Patients	Controls
N	158	79
Mean	12.97	13.86
SD	1.61	1.89
Minimum	5.30	9.00
Maximum	18.40	16.70

Mean HB level of HCV patients was 12.97±1.61 while among controls mean HB level was 13.86±1.89.

Table-3: Descriptive statistics for Creatinine & Urea

	HCV Patients		Controls	
	Creatinine	Urea	Creatinine	Urea
N	158		79	
Mean	0.83	35.74	0.73	27.51
SD	0.16	9.76	0.08	3.67
Minimum	0.60	17.00	0.60	19.00
Maximum	1.60	76.00	1.10	40.00

Mean urea and creatinine level in HCV patients was 0.83±0.16 and 35.74±9.76. While among controls mean urea and creatinine level was 0.73±0.08 and 27.51±3.67. Proteinuria was seen in 9(3.80%) patients while rest of the study population proteinuria was not present. All these 9 cases were from HCV patients group while none of them were from controls.

Table-4: Descriptive statistics for Random Blood Sugar Level

	HCV Patients	Controls
n	158	79
Mean	122.13	118.10
SD	10.19	9.47
Minimum	96.00	90.00
Maximum	149.00	138.00

Mean random blood sugar level in HCV patients was 122.13±10.19 while among controls mean random blood sugar level was 118.10±9.47.

Table-5: Descriptive statistics for Systolic & Diastolic blood pressure

	HCV Patients		Controls	
	Systolic	Diastolic	Systolic	Diastolic
n	158		79	
Mean	118.41	78.13	118.86	78.06
SD	4.55	4.49	4.38	4.35
Minimum	110.00	70.00	110.00	70.00
Maximum	130.00	85.00	125.00	85.00

Mean systolic and diastolic blood pressure in HCV patients was 118.41±4.55 and 78.13±4.49 mmHg. Among controls mean systolic and diastolic blood pressure was 118.86±4.38 and 78.06±4.35 mmHg.

Table-6: Descriptive statistics for Live & Spleen Size

	HCV Patients		Controls	
	Liver	Spleen	Liver	Spleen
N	158		79	
Mean	12.84	14.02	14.41	10.15
SD	1.718	2.27	0.64	0.66
Minimum	9.60	8.20	13.00	8.70
Maximum	20.00	18.60	15.80	11.60

DISCUSSION

Renal arterial waveform analysis done on Doppler ultrasound serves as a non-invasive method for renal hemodynamic assessment and resistive index (RI) which is calculated from peak systolic and end diastolic renal arterial volumes helps in detection of alteration in blood flow to the kidneys.[9]

With recent advancements in imaging techniques it is now possible to achieve superior visualization of renal artery and its distribution across the kidneys. Meanwhile, improved parameter testing also facilitates provision of vital information regarding renal blood flow dynamics in patients with cirrhosis.[10]

Literature from previous studies in this regard have highlighted the importance of resistive index in order to assess renal blood flow in various pathological conditions of the kidneys.[11] It is well known that in comparison to healthy population, generally there is increased RI in cirrhotic patients. Furthermore, RI is observed to be higher in cirrhotic population with ascites in contrast to those without ascites.[12] It has been shown that patients with refractory type of ascites show further increase in RI values as compared to those with non-refractory ascites. Hence, it would be safe to say that value of renal RI varies with the degree of decompensation and type of ascites.[13]

Many studies carried out in past have not focused on variability in blood flow dynamics in different parts of the kidney rather more attention was paid to renal and segmental arteries.[14-16]

CONCLUSION

The use of renal Doppler duplex ultrasonography in cirrhotic patients with chronic liver disease (CHD) is a reliable method for measuring renal hemodynamics that is non-invasive, simple, quick, and cost-effective. Even before the beginning of clinical symptoms and the appearance of anomalies in routinely performed renal function tests, it is possible to detect renal impairment and the progression of the illness towards hepatorenal syndrome. The resistance index may be calculated in real time from arterial waveforms captured with a renal Doppler, providing for a more precise and safer evaluation of renal hemodynamics than the more popular but less accurate approach of assessing blood creatinine levels.

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ANNEXURE-I (PATIENTS DOPPLER IMAGES)

Case-1	
	
Right Side	Left Side
Case-2