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ORIGINAL ARTICLE

Comparing Diameter of Hepatic Portion of Inferior Vena Cava During Normal Breathing in Normal Individuals Versus Cirrhotic Patients: Case Control Study

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ABSTRACT

A non invasive ultrasound technique has been proposed as a mean of detection of early fibrosis by measuring changes in the diameter of the hepatic inferior vena cava (IVC).

Objectives: To determine the mean diameter of hepatic portion of inferior vena cava and mean reduction in its diameter by inspiration in normal and cirrhotic patients using USG.

Study Design: Case control study.

Methodology: This study (n=60) was conducted after ethical review committee's (ERC) approval from April-October 2018 at Department of Radiology, Military Hospital Rawalpindi. Patients with stage 5 and 6 of cirrhosis were taken as cases. Controls had sonographically normal livers. The maximal diameter of IVC was measured during normal breathing first followed by a deep breath.

Statistical analysis: Data was analyzed by SPSS, v-20. Parameters were measured by applying t-test with p≤0.05 as significant.

Results: The IVC diameter during deep inspiration was 1.217±0.168 cm and 1.711±0.422 cm among controls and cirrhotic cases respectively (p= 0.00). The mean IVC diameter decrease was 1.02±0.25 cm and 0.03±0.02 cm by inspiration among controls and cases respectively having statistically significant p-value (<0.05).

Conclusion: We concluded that stiffness of the hepatic parenchyma have caused the physiological changes in the diameter of IVC enhanced by deep respiration. Thus, it can be used as a tool for evaluation of cirrhotic patients.

Key Words: Cirrhosis, Hepatic Portion of Inferior Vena Cava, Liver and Sonography.

INTRODUCTION

Hepatitis C (HCV) is a major health issue globally.[1] It is commonly transmitted through blood transfusions thus a blood borne infection. Its estimated prevalence is around 3% thus affecting almost 170 million patients globally according to one estimate.[2] Unfortunately this disease has a high prevalence developing countries like Pakistan. According to various studies conducted in Pakistan have shown that almost 10 million (6%) people have it.[3] Its adverse effects are lethal ultimately lead to chronic hepatitis if untreated or undiagnosed. Due to poor health facilities in our setups, most patients with acute HCV develop persistent infection and majority of them (75-85%) develop chronic hepatitis. Chronic hepatitis predisposes patients to develop various irreversible adverse effects like progressive fibrosis, cirrhosis and hepato-cellular carcinoma. According to previous literature review patients with hepatic fibrosis are at higher risk of developing cirrhosis over a period of about 10–20 years if untreated. Thus they require treatment with antiviral therapy in-order to prevent its complications. Its early and accurate assessment is thus highly significant for both diagnostic and therapeutic purposes.[4]

According to literature review, liver biopsy is taken as gold standard for its proper diagnosis as well as in predicting its outcomes till today.[5] However, its an invasive procedure linked with various adverse effects like pain. Although it may fail to diagnose hepatic cirrhosis if obtained sample is too small or fragmented unfortunately.[6] Moreover liver biopsy is prone to inter-observer variability and sampling errors and is relatively expensive.[7]

Different Doppler ultrasound indices related to portal vein, hepatic vessels and superior mesenteric arteries have been used to assess hepatic fibrosis but studies have shown that none of them was reliable due to technical errors and intero-bserver variability. Newer techniques like Transient elastography (fibroscan) and magnetic resonance elastography make it possible to measure the elasticity (fibrosis) of tissue painlessly but these methods are expensive and not readily available.[8]

In light of above description, a non invasive ultrasound technique has been proposed as a means of detection of early fibrosis by measuring changes in the diameter of the hepatic inferior vena cava (IVC).[9] Thus, impaired change in venous diameter are linked with cirrhosis or fibrosis due to parenchymal stiffness. It is a non invasive method, easy to measure, reliable, less time consuming and cost-effective. Thus we planned the current project to determine the mean diameter of hepatic portion of inferior vena cava during inspiration among enrolled subjects using USG.

Objectives: To determine the mean diameter of hepatic portion of inferior vena cava and mean reduction in its diameter by inspiration in normal and cirrhotic patients using USG.

Methodology: This case controlled study (n=60) was conducted after ethical review committee's (ERC) approval from April-October 2018 at Department of Radiology, Military Hospital Rawalpindi. Patients (both genders above 18years) with stage 5 and 6 of cirrhosis were enrolled. Controls had sonographically normal livers. Patients with any health issue like obesity, right heart failure and bowel

gases making visualization of IVC poor were excluded. The diameter of IVC was measured during different breathing patterns. Consent was taken at the start of procedure.

Statistical Analysis: Data was analyzed by SPSS v.20. Parameters like gender was expressed as percentage while age and mean diameter of IVC were expressed as mean ± SD. Parameters were measured by applying t-test with p≤0.05 as significant.

RESULTS

Distribution of parameters like age, gender, IVC diameter during normal and deep inspiration among enrolled subjects in present study was presented as frequency, percentage as well as mean± SD in table-1. Each group had 30 subjects.

Table-1: General Features Of Enrolled Subjects (n=60)			
Variables	Categories	Control Group	Case Group
Gender	Males	13 (43.3%)	12 (40%)
	Females	17 (56.7%)	18 (60%)
Age (years)	Mean ± SD	49.43±7.98	50.03±6.77
IVC Diameter (cm) During Normal Breath	Mean ± SD	2.239±0.26	1.746±0.425
IVC Diameter (cm) During Deep Insp.	Mean ± SD	1.217±0.168	1.711±0.422
Mean IVC Diameter Reduction (cm)	Mean ± SD	1.02±0.25	0.03±0.02

Results showed statistically insignificant difference between groups with respect to age having p-value > 0.05. Hence two groups were similar with respect to age distribution as shown in table-2.

Table-2: Comparison of Age Among Enrolled Groups (n=60)			
Variables	Categories	Mean ± SD	*P-value*
Age	Controls	49.43±7.986	0.755
	Cases	50.03±6.770	

There was statistically insignificant difference between groups with respect to gender having p-value > 0.05. Hence two groups were similar with respect to gender distribution as shown in table-3.

Table-3: Comparison of Gender Among Enrolled Groups (n=60)				
Variables	Categories	Males	Females	P-value
Gender	Controls	13 (43.3%)	17 (56.7%)	0.793
	Cases	12 (40%)	18 (60%)	
	Total	25	35	

Results showed significant difference between groups with respect to different breathing patterns having p-value < 0.05 as shown in table-4. During normal breathing the mean IVC diameter was significantly less among cirrhotic cases as compared to controls.

Table-4: IVC Diameter During Different Breathing Patterns Among Groups (n=60)			
Variables	Categories	Mean ± SD	*P-value*
IVC Diameter During Normal Breath	Controls	2.239±0.263	0.00*
	Cases	1.746±0.425	
IVC Diameter During Deep Insp.	Controls	1.21±0.168	0.00*
	Cases	1.71±0.422	
Mean IVC Diameter Reduction	Controls	1.021±0.258	0.00*
	Cases	0.035±0.026	

*****Statistically significant

DISCUSSION

Radiological evaluation plays a vital role in diagnosis as well as follow-up of cirrhotic patients but unfortunately, conventional radiological aids lack diagnostic accuracy as revealed byy various studies.[10,11] In our setups, contrast-based methods are not accepted yet due to various reasons like lack of awareness and false beliefs related to treatment. According to literature review, liver biopsy is taken as gold standard for its proper diagnosis as well as in predicting its outcomes till today[5] but has problems of morbidity and sampling errors.[12,13] However, many different sonographic parameters have been used but have low sensitivity.

The mean age of patients was 49.73±7.34 years. There were 25 (41.7%) males and 35 (58.3%) were females. The two groups were similar with respect to age and gender distribution. The IVC diameter during normal breathing was 2.239±1.21 cm among controls and 1.746±0.425 cm among cirrhotic cases. The IVC diameter during deep inspiration was 1.217±0.168 cm among controls and 1.711±0.422 cm among cirrhotic cases. Among the controls the mean IVC diameter decrease was 1.02±0.25 cm whereas among the cases the mean IVC

diameter decrease was 0.03±0.02 cm. This reduction was significantly different between the two groups; p=0.00. The reduction of IVC diameter was significantly less in the cirrhotics as compared to normal controls. These results reveal that the reduction of hepatic portion of IVC diameter was significantly less in the cirrhotics as compared to normal controls. It can be a valuable new parameter in the assessment of patients with cirrhosis.

Our results compared well with the results of Kitamura et al.[14] who proposed this new sonographic technique for detecting parenchymal stiffness of the liver for the first time. In his study he measured the major axis of the IVC during normal breathing. Then patients took deep breath to produce negative intra-thoracic pressure thus same measurement was repeated immediately. He observed that reduced diameter of IVC by 1.30 ± 0.67 cm during deep inspiration in healthy group while cirrhotic group showed maximal diameter of 1.74 ± 0.35 cm, that was reduced by 0.03 ± 0.09 cm during deep inspiration having *P-value* < .0001. Hence they suggested that IVC diameter changes enhanced by deep respiration are indicators of hepatic stiffness. Thus our results were in line with their findings.

Nafees et al.[15] carried out a study to determine the validity of ultrasound in diagnosis of liver fibrosis due to hepatitis. He calculated parameters like sensitivity, specificity and accuracy of ultrasound as a diagnostic tool for hepatic fibrosis as 86.48%, 69.23% and 82% respectively. Thus he suggested that it can be used as a diagnostic tool but its lack specificity. Paradoxically, our results showed it as an inexpensive and useful diagnostic aid for fibrosis in our setups.

Chronic hepatitis virus B or C infection results in damage to hepatocytes thus predisposes patients to develop various irreversible adverse effects like progressive fibrosis, cirrhosis and hepato-cellular carcinoma.[16,17] Its early and correct diagnosis is of therapeutic and prognostic importance.[18] A liver biopsy is considered to be the gold standard for diagnosing liver fibrosis stage and predicting the outcome of diseases. Although a percutaneous liver biopsy is relatively safe, it is still associated with a risk of complications, patient discomfort and a high cost.[19] Filly et al.[20] looked at the deep (visceral) surface of the liver for nodularity, which provided sensitivity and specificity of 86% and 64%, respectively.

Limitations: Our study had limitations like financial constraints, lack of resources and small sample size. We did not formally set out to investigate comparison with other known sonographic parameters in our study.

CONCLUSION

We concluded that during normal breathing the mean IVC diameter along-with reduction of IVC diameter was significantly less among cirrhotic cases as compared to controls. However, during deep inspiration the mean IVC diameter was significantly less among controls as compared to cirrhotic cases. However, stiffness of the hepatic parenchyma have caused the physiological changes in the diameter of IVC enhanced by deep respiration. Thus, it can be used as a tool for evaluation of cirrhotic patients.

Authors' Contribution:

AI & SSK: Conception and design of work

SA: Collecting and analyzing the data

TL: Drafting and revising the manuscript for intellectual content.

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