Khan, Nouman, Hussain, Izhar, Alam, Iftikhar, Bacha, Raham, Rehman, Abdul, Mikrani, Makbul, Fatima, Mehreen, Farooq, S. Muhammad Yousaf, Malik, Sajid Shaheen, and Gilani, Syed Amir. (2018), Sonographic Comparison of Mean Velocity of Portal Vein in Liver Cirrhosis and Normal Individuals. In: Journal of Health and Medical Sciences, Vol.1, No.1, 101-107.

ISSN 2622-7258

DOI: 10.31014/aior.1994.01.01.12

The online version of this article can be found at: https://www.asianinstituteofresearch.org/

Published by:
The Asian Institute of Research

The Journal of Health and Medical Sciences is an Open Access publication. It may be read, copied and distributed free of charge according to the conditions of the Creative Commons Attribution 4.0 International license.

The Asian Institute of Research Journal of Health and Medical Sciences is a peer-reviewed International Journal. The journal covers scholarly articles in the fields of Medicine and Public Health, including medicine, surgery, ophthalmology, gynecology and obstetrics, psychiatry, anesthesia, pediatrics, orthopedics, microbiology, pathology and laboratory medicine, medical education, research methodology, forensic medicine, medical ethics, community medicine, public health, community health, behavioral health, health policy, health service, health education, health economics, medical ethics, health protection, environmental health, and equity in health. As the journal is Open Access, it ensures high visibility and the increase of citations for all research articles published. The Journal of Health and Medical Sciences aims to facilitate scholarly work on recent theoretical and practical aspects of Health and Medical Sciences.
Sonographic Comparison of Mean Velocity of Portal Vein in Liver Cirrhosis and Normal Individuals

Nouman Khan¹, Izhar Hussain², Iftikhar Alam³, Raham Bacha⁴, Abdul Rehman⁵, MD Makbul Mikrani⁶, Mehreen Fatima⁷, S. Muhammad Yousaf Farooq⁸, Sajid Shaheen Malik⁹, Syed Amir Gilani¹⁰

¹University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT) Faculty of Allied Health Sciences (FAHS), The University of Lahore. Contact: noumankhan9018@gmail.com
²Assistant Professor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT), Faculty of Allied Health Sciences (FAHS), The University of Lahore. Contact: dr.rahambacha@gmail.com
³Medical imaging Doctor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT) Faculty of Allied Health Sciences (FAHS), The University of Lahore
⁴Assistant Professor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT) Faculty of Allied Health Sciences (FAHS), The University of Lahore. Contact: dr.rahambacha@gmail.com
⁵Medical imaging Doctor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT) Faculty of Allied Health Sciences (FAHS), The University of Lahore
⁶Medical imaging Doctor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT) Faculty of Allied Health Sciences (FAHS), The University of Lahore
⁷Assistant Professor, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT), Faculty of Allied Health Sciences (FAHS), The University of Lahore. Contact: mohreen.fatima@uipt.uol.edu.pk
⁸Lecturer, Research Coordinator, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT), Faculty of Allied Health Sciences (FAHS), The University of Lahore. Email: Yousafgelani@gmail.com
⁹Head of Department, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT), Faculty of Allied Health Sciences (FAHS), The University of Lahore. Email: Sajid.shaheen@rsmi.uol.edu.pk
¹⁰Dean, University Institute of Radiological Sciences and Medical Imaging Technologies (UIRSMIT), Faculty of Allied Health Sciences (FAHS), The University of Lahore. E-mail: Profgilani@gmail.com

Corresponding Author: Nouman Khan. Contact: 0347 8171899. Email: noumankhan9018@gmail.com

Abstract

Background: Liver cirrhosis is a life threatening condition, its consequences ranging from gross financial loss to death. Grayscale ultrasound has been used since long for the diagnosis of liver cirrhosis. Gray scale sonography along with color Doppler is the first-line modality used for evaluating the mean velocity of portal vein in Liver Cirrhosis. Chronic liver parenchymal diseases (CLPD) and liver cirrhosis cause decrease in the flow velocity of portal vein. Doppler ultrasound (US) can determine portal vein (PV) velocity in liver cirrhosis. The mean velocity of portal vein provides a distinguishable value between cirrhotic and normal individuals. Mean portal vein velocity is a reliable parameter in the diagnosis of liver cirrhosis and (CLPD). Objective: To compare mean velocities of portal vein of cirrhotic patients, and normal individuals by Doppler Ultrasound. Methods: A total of 188 individuals were cross-sectionally included in this study. The study was conducted in Gilani Ultrasound Centre, Ferozpur Road, Lahore, while using Toshiba Xario with 3-6 MHz transducer. Results: Mean portal vein velocity in cirrhotic patient was 10.72 ± 1.91 cm/s and in normal individuals was 23.36 ± 6.06 cm/s. Conclusions: Liver cirrhosis causes prominent changes in the texture of liver as compared to the texture in normal individuals. This study showed that mean velocity of portal vein was decreased in patients with liver cirrhosis as compared to normal individuals.

Keywords: Liver cirrhosis, Portal Vein, Chronic Liver Parenchymal Diseases, Doppler Ultrasound, Mean Portal Vein Velocity

Introduction
Chronic liver diseases (CLD) and liver cirrhosis is a serious health problem due to its high mortality rate worldwide. The mortality rate of liver cirrhosis is approximately 2% of all deaths (Hanafiah et al., 2013). The exact prevalence of cirrhosis worldwide is unknown, but reasonably to be estimated around 1% (Shah et al., 2015). The prevalence of liver cirrhosis in the United States was 0.27% (Scaglione et al., 2015), CLD causes an estimated 36,000 deaths in the United States each year (Wong et al., 2000). Cirrhosis is the leading cause of mortality in Pakistani population, due to widespread diseases of viral hepatitis (Ahmad et al., 2010). According to WHO, Pakistan has 2nd highest estimated prevalence of hepatitis C after Egypt (Organization, 2008). Individuals infected with HBV and HCV are 370 and 130 million respectively and it is anticipated that 15%–40% of chronic hepatitis B virus infected patients will develop cirrhosis (Sami et al., 2009, Shepard et al., 2005).

Cirrhosis is a complication of liver disease that involves gradual damage of normal architecture of liver cell and irreversible scarring of the liver (Friedman, 2003). Scar tissues replaces healthy tissues and partially blocks the flow of blood through the liver (Zhou et al., 2014). It results from multiple pathologic processes including inflammation, fibrosis and regeneration of nodules (Wynn and Ramalingam, 2012). Ultrasound has very high overall reliability in the assessment of liver pathologies (Herna et al., 2011). It is an effective modality to see the texture of the liver and measure the velocity of the portal vein (Gerstenmaier and Gibson, 2014). The sensitivity of U/S for severe fibrosis and cirrhosis was 91.1%, the specificity of 93.5% and the accuracy of 92.3%. Positive predictive value of 91.8% and negative predictive value of 91.5% (Simonovský, 1999).

The gold standard for assessing cirrhosis is liver biopsy, however this procedure is invasive, expensive and carries high risk of complications including bleeding, pneumothorax and perforation of colon or gallbladder (Bedossa and Carrat, 2009, Herrine and Friedman, 2005). Grayscale sonography along with color Doppler is modality of choice for assessing cirrhosis and has advantage over other modalities. According to Ashis Saha et al, ultrasonography is inexpensive, readily available, and free of bio-effects, non-invasive procedure that is performed in patients with liver cirrhosis (Mukhopadyay and Saha, 2015, Jeong et al., 2014). This research is an effort to diagnose liver cirrhosis (Chronic liver parenchymal diseases), with the help of (US). With the application of US in the patients of liver cirrhosis make it possible to diagnose it timely, managed properly and treat accordingly (Pavlov et al., 2016). Doppler US velocimetry is also used to quantify the blood flow velocity in the PV. Hence PV mean velocity could be predictor of liver cirrhosis (Martinez-Noguera et al., 2002).

Methods

This cross-sectional comparative study was conducted at Gilani Ultrasound Center, Ferozpur Road, Lahore, while recruiting 188 individuals. This research was commenced after approval of Institution Review Board (IRB). The study duration was 8 months (March - October, 2018). Ninety four patients of liver cirrhosis and similar number of normal individuals from the same population with same ages were included. The procedure and aim of research was briefly explained to the patients and consent form was signed. All the patients were examined according to American Institute of ultrasound in Medicine (AIUM) guidelines. Patients were scanned by Toshiba Xario using transabdominal transducer of 3-6 MHz. Portal vein velocity was measured while locating it in long axis view. Angle was kept below 60 degree and parallel to the vessel wall. (Figure 1 and 2). Maximum, median and minimum velocity were measured and mean velocity was calculated by the machine automatically (Medicine, 2003). Data was tabulated and analyzed by SPSS version 24.0.

Results

Total 188 individuals were included in this study, half (94) were cirrhotic and half (94) were normal. The mean age of patients was 46.15 ± 15.88 years (9-83years). The mean velocity of portal vein in cirrhotic patients was 10.72 ± 1.91 cm/s and in 23.36 ± 6.06 cm/s in normal individuals. The standard deviation in normal individuals was 6.06 cm/s, which show a large variation, while the standard deviation in cirrhotic patients was 1.91 cm/s, focus on a narrow range of variation (Figure-3). Relation of the portal vein velocity in liver cirrhosis with 95% confidence interval was significant (p-value was 0.000). (Table-1). Cross tabulation of the liver sonographic texture in normal and cirrhotic patients shows that, coarse liver texture was present in 33 (18%) in cirrhotic
while 0 (0%) in normal individuals. Heterogeneous texture was present in 61 (32%) cirrhotic while 26 (14%) in normal individuals. However homogeneous texture was present in 68 (36%) in normal individuals and 0 (0%) in cirrhotic patients. Gender cross tabulation of the liver texture shows that, that the total number of females in this study were 77 (41%), in which 33 (18%) were cirrhotic and 44 (23%) were normal. Detail is given in (Table-2, Figure-4).

Fig 1: Homogeneous echotexture of liver in normal individual, mean PV velocity is 20.1 cm/s.

Fig 2: heterogeneous echotexture of liver in cirrhotic patient, mean velocity of PV is 9.9 cm/s.

Discussion
Portal vein velocity decreases with liver congestion and resultant portal hypertension. Previously some data is published regarding chronic liver diseases and portal vein velocities. According to study in 2005, conducted by Irandati Mukhopadhyay and Ashis Saha; in West Bengal, the study shows that Duplex ultrasound is excellent investigation of choice in assessing pathophysiological hemodynamics, judging the severity of disease in patients with liver diseases. The mean velocity of portal vein in normal individual in was 15.5 ± 4.0 cm/sec in 100 individuals. The mean velocity of portal vein in Liver Cirrhosis was 9.8 ± 2.8 cm/sec in 80 patients(Mukhopadyay and Saha, 2015). Another study conducted in 2005, on cirrhotic patients with portal hemodynamics, by Arvind Chouhan et al, they studied 100 patients. Portal vein mean velocity is estimated by using correction factor to a true average mean velocity. Portal vein velocity was in the range of 12.9 cm/s in cirrhotic and 15-18cm/s in control group(Chouhan et al., 2015). A study was conducted in 2008, on portal vein hemodynamics in patients with non-alcoholic fatty liver diseases (NAFLD), in Turkey by Besir Erdogmus et al. The Mean flow velocity was 14.6 cm/s in grade 1 patients, 12.6 cm/s in grade 2 patients and 10.3 cm/s in grade 3 patients. The mean flow velocity in control group was 16.5 cm/s and 12.3 cm/s in NAFLD patients(Erdogmus et al., 2008). A study was conducted in 2016, on Doppler assessment of children with liver cirrhosis and portal hypertension in comparison with a healthy control group, in Iran, by Maryam Riahinezhad et al. Portal vein mean velocity were 15.03 ± 7.3 cm/s in a group of 33 children with cirrhosis, 16.47 ± 6.4 cm/s in 19 controls (P = 0.51), 11.6 ± 4.7 cm/s in cirrhotic patients with varices. Alteration in Doppler parameter of portal vein velocity may be helpful indicators in liver cirrhosis(Riahinezhad et al., 2018). The results of this study were correlated with the previous studies, that shows decrease in portal vein velocity provide useful information in the diagnosis of liver cirrhosis.

**Conclusion**

Liver cirrhosis causes prominent changes in the texture of liver as compared to the texture in normal individuals. This study showed that mean velocity of portal vein was decreased in patients with liver cirrhosis as compared to normal individuals.

![Figure 3: Frequency of portal vein mean velocity in cirrhotic and normal individuals](image-url)
Table 1: Relation of the portal vein velocity in liver cirrhosis with 95% confidence interval was significant (p-value was 0.000).

Independent Samples Test

|                  | Levene's Test for Equality of Variances | t-test for Equality of Means |
|------------------|----------------------------------------|------------------------------|
|                  | F    | Sig.    | t    | df   | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
| Equal variances assumed | 61.282 | 0.000 | -    | 186  | 0.000          | -12.64255       | 0.65615                   | -13.93701 to -11.34809 |
| Equal variances not assumed | -    | 0.000 | -    | 111.36 | 0.000          | -12.64255       | 0.65615                   | -13.94272 to -11.34239 |

Table 2: Cross tabulation of gender wise texture of liver in cirrhotic and normal individuals.

| Gender | Group   | Total |
|--------|---------|-------|
|        | Cirrhotic | Normal |       |
| Female | Coarse  | 12 (6.3%) | 0 (0%) | 12 (6.3%) |
|        | heterogeneous | 21 (11.1%) | 8 (4.2%) | 29 (15%) |
|        | homogenous | 0 (0%) | 36 (19%) | 36 (19%) |
|        | Total    | 33 (18%) | 44 (23%) | 77 (41%) |
| Male   | Coarse  | 21 (11%) | 0 (0%) | 21 (11%) |
|        | heterogeneous | 40 (21%) | 18 (10%) | 58 (30%) |
|        | homogenous | 0 (0%) | 32 (17%) | 32 (17%) |
|        | Total    | 61 (32%) | 50 (27%) | 111 (59%) |
| Female | Coarse  | 33 (18%) | 0 (0%) | 33 (18%) |
|        | heterogeneous | 61 (32%) | 26 (14%) | 87 (46%) |
|        | homogenous | 0 (0%) | 68 (36%) | 68 (36%) |
| Total  |         | 94 (50%) | 94 (50%) | 188 (100%) |
Figure 4: Texture of liver in cirrhotic and normal individual’s gender wise.

References:

AHMAD, W., IJAZ, B., JAVED, F. T., JAHAN, S., SHAHID, I., KHAN, F. M. & HASSAN, S. 2010. HCV genotype distribution and possible transmission risks in Lahore, Pakistan. World journal of gastroenterology: WJG, 16, 4321.

BEDOSSA, P. & CARRAT, F. 2009. Liver biopsy: the best, not the gold standard. Journal of hepatology, 50, 1-3.

CHOUHAN, A., TRIKHA, S., DHAWLE, S., NAGWANSHI, J. & CHANDRA, S. 2015. A study of correlation of esophageal varices in cirrhotic patients with portal haemodynamics with special reference to portal vein diameter, portal vein velocity, congestion index, liver vascular index. Journal of Evolution of Medical and Dental Sciences, 4, 59-67.

ERDOGMUS, B., TAMER, A., BUYUKKAYA, R., YAZICI, B., BUYUKKAYA, A., KORKUT, E., ALCELIK, A. & KORKMAZ, U. 2008. Portal vein hemodynamics in patients with non-alcoholic fatty liver disease. The Tohoku journal of experimental medicine, 215, 89-93.

FRIEDMAN, S. L. 2003. Liver fibrosis—from bench to bedside. Journal of hepatology. 38, 38-53.

GERSTENMAIER, J. & GIBSON, R. 2014. Ultrasound in chronic liver disease. Insights into imaging, 5, 441-455.

HANAFIAH, K. M., GROEGER, J., FLAXMAN, A. D. & WIERSMA, S. T. 2013. Global epidemiology of hepatitis C virus infection: new estimates of age-specific antibody to HCV seroprevalence. Hepatology, 57, 1333-1342.
HERNAEZ, R., LAZO, M., BONEKAMP, S., KAMEL, I., BRANCATI, F. L., GUALLAR, E. & CLARK, J. M. 2011. Diagnostic accuracy and reliability of ultrasonography for the detection of fatty liver: a meta-analysis. *Hepatology*, 54, 1082-1090.

HERRINE, S. K. & FRIEDMAN, L. S. 2005. Divining the role of liver biopsy in hepatitis C. *Journal of hepatology*, 43, 374-376.

JEONG, W. K., LIM, H. K., LEE, H.-K., JO, J. M. & KIM, Y. 2014. Principles and clinical application of ultrasound elastography for diffuse liver disease. *Ultrasonography*, 33, 149.

MARTINEZ-NOGUERA, A., MONTSERRAT, E., TORRUBIA, S. & VILLALBA, J. Doppler in hepatic cirrhosis and chronic hepatitis. Seminars in Ultrasound, CT and MRI, 2002. Elsevier, 19-36.

MEDICINE, A. I. O. U. I. 2003. AIUM Practice Guideline for the performance of an antepartum obstetric ultrasound examination. *Journal of ultrasound in medicine: official journal of the American Institute of Ultrasound in Medicine*, 22, 1116.

MUKHOPADYAY, I. & SAHA, A. 2015. Quantitative assessment of portal vein by colour Doppler imaging in patients with various liver diseases in West Bengal and reflection of pathophysiological haemodynamics and evaluation of prognosis. *Int. J. Recent Scient. Res*, 6, 5234-5236.

ORGANIZATION, W. H. 2008. Hepatitis C. Fact Sheet No. 164. Revised October 2000. *WHO web site*.

PAVLOV, C. S., CASAZZA, G., SEMENISTAIA, M., NIKOLOVA, D., TSOCHATZIS, E., LIUSINA, E., IVASHKIN, V. T. & GLUUD, C. 2016. Ultrasonography for diagnosis of alcoholic cirrhosis in people with alcoholic liver disease. *The Cochrane Library*.

RIAHINEZHAD, M., REZAEI, M., SANEIAN, H., FAMOURI, F. & FARGHADANI, M. 2018. Doppler assessment of children with liver cirrhosis and portal hypertension in comparison with a healthy control group: An analytical cross-sectional study. *Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences*, 23.

SAMI, S., KOREJO, R. & BHUTTA, S. Z. 2009. Prevalence of hepatitis B and C: a Jinnah Postgraduate Medical Centre experience. *Journal of Obstetrics and Gynaecology Research*, 35, 533-538.

SCAGLIONE, S., KLIETHERMES, S., CAO, G., SHOHAM, D., DURAZO, R., LUKE, A. & VOLK, M. L. 2015. The epidemiology of cirrhosis in the United States. *Journal of clinical gastroenterology*, 49, 690-696.

SHAH, S. M. A., MASHIA, S. A., YOUNUS, M. F., GHAURI, A., EJAZ, R., ALSHALABI, H., KAKAR, I. K. & UMAR, M. 2015. Hepatic cirrhosis-disease burden. *J. Rawalpindi Med. Coll. Stud. Suppl.*, 19, 17-20.

SHEPARD, C. W., FINELLI, L. & ALTER, M. J. 2005. Global epidemiology of hepatitis C virus infection. *The Lancet infectious diseases*, 5, 558-567.

SIMONOVS&KÝ, V. 1999. The diagnosis of cirrhosis by high resolution ultrasound of the liver surface. *The British journal of radiology*, 72, 29-34.

WONG, J. B., MCQUILLAN, G. M., MCHUTCHISON, J. G. & POYNARD, T. 2000. Estimating future hepatitis C morbidity, mortality, and costs in the United States. *American Journal of Public Health*, 90, 1562.

WYNN, T. A. & RAMALINGAM, T. R. 2012. Mechanisms of fibrosis: therapeutic translation for fibrotic disease. *Nature medicine*, 18, 1028.

ZHOU, W.-C., ZHANG, Q.-B. & QIAO, L. 2014. Pathogenesis of liver cirrhosis. *World journal of gastroenterology: WJG*, 20, 7312.