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RELATIONSHIP BETWEEN SIZE OF ESOPHAGEAL VARICES AND PORTAL VEIN DIAMETER IN PATIENTS WITH CHRONIC LIVER DISEASE.

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Chronic liver disease; Esophageal varices; Portal vein diameter; Portal hypertension; Ultrasonography; Upper gastrointestinal endoscopy.

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Abstract

Objective: *To determine the relationship between the size of esophageal varices and portal vein diameter in patients with chronic liver disease.*

Study design: Cross-sectional study.

Setting: *Department of Medicine, Dow University of Health Sciences/Civil Hospital, Karachi.*

Period: *Six months.*

Methods: *This was a cross-sectional study of 200 consecutive patients aged 30-65 years with an ultrasonographical confirmed chronic liver disease who underwent upper gastrointestinal endoscopy for evaluation of esophageal varices. The diameter of portal vein was measured on abdominal ultrasonography, and esophageal varices were classified endoscopically as small (less than 2 mm), medium (2 to 4 mm) or large (more than 4 mm). A structured proforma was used*

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to collect demographic and clinical characteristics. The analysis of the data was done with SPSS version 26.0. Statistically significant p-values were defined as p values of ≤0.05.

Results: *The mean age of the participants was 50.2 ± 9.8 years, with 128 (64.0%) males. Small, medium and large esophageal varices were seen in 52 (26.0%), 87 (43.5%) and 61 (30.5%) patients, respectively, by endoscopy and the mean portal vein diameter was 14.6 ± 2.1 mm. The mean portal vein diameter was found to be significantly larger with larger varices (12.2 ± 1.1 mm, 14.3±1.2 mm and 17.0 ± 1.5 mm for small, medium and large varices, respectively, p<0.001). Portal vein diameter was well correlated with variceal size by Spearman's analysis (ρ=0.782, p<0.001), regardless of the stratification.*

Conclusion: *Portal vein diameter was highly correlated with esophageal varices size in CLD patients.*

INTRODUCTION

Chronic liver disease (CLD) is a major health problem worldwide and often results in portal hypertension, and ultimately, gastroesophageal varices (GEV). Esophageal varices are one of the most serious complications of cirrhosis, as they are associated with a significant mortality and morbidity if they rupture. Thus, early detection of patients with large varices is important to allow for proper surveillance, prophylactic therapy and prompt intervention to prevent variceal bleeding. [1].

Although upper gastrointestinal endoscopy is still considered the gold standard to detect and grade esophageal varices, it is invasive, expensive, resource intensive, and not widely available in all health care settings. Thus, much effort has been focused on the search for valid non-invasive indicators that will allow prediction of variceal presence and the extent of the varices. [2].

Various non-invasive methods, such as liver and spleen stiffness measurement, have shown good diagnostic performance in assessing clinically important PH and its associated complications of OVs. However, their use is hindered by multiple factors including their cost, availability, and need to carefully interpret the results with expensive and specialized equipment and expertise.[3] Likewise, composite clinical and laboratory indices have demonstrated useful correlation with endoscopy results, but these indices vary in their predictive value depending on different patient populations.[4-6]

International practice guidelines have recently recommended use of validated non-invasive tools that can risk stratify patients to reduce unnecessary endoscopy and also to ensure that patients at high risk of varices are identified.[7] Among the non-invasive tools readily available, portal vein

diameter has emerged as a good practical predictor of portal hypertension and has been shown to be significantly associated with the presence of gastroesophageal varices.[8] Advanced imaging models that incorporate portal vein diameter have also been shown to have encouraging results in predicting variceal bleeding, further reinforcing the relevance of portal venous morphology in those with cirrhosis.[9-10]

While prior studies showed that the portal vein diameter is useful in predicting esophageal varices, there was limited and conflicting data on the relationship of PVD with the size (grade) of esophageal varices in chronic liver disease, especially in the local population. Therefore, this study was conducted to establish the correlation between portal vein diameter and the size of esophageal varices to see if a simple ultrasonographic measurement could help identify these at risk at an early stage and help in the optimization of the number of patients to be referred for an endoscopy.

METHODS

A cross sectional study was carried out in the Department of Medicine, Dow University of Health Sciences/Civil Hospital, Karachi for six

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months. All participants gave written informed consent before participating in the study.

A sample size of 61 participants was determined using PASS (version 15) software, using a null correlation coefficient of 0, an expected correlation coefficient of 0.502, a power of 95%, and a two-sided level of significance of 1%. To enhance the accuracy and generalizability, a non-probability consecutive sampling technique was used to enroll 200 consecutive patients with chronic liver disease.

All patients with chronic liver disease diagnosed on ultrasonography (USG) aged 30–65 years irrespective of gender who underwent upper gastrointestinal endoscopy (UGIE) for evaluation of esophageal varices were included. Diagnosis of chronic liver disease was made by the presence of increased echogenicity of hepatic parenchyma, poor/absent visualization of diaphragm, intrahepatic vessels and posterior aspect of right hepatic lobe on ultrasonography. Malignancy, chronic kidney disease and coagulopathy were exclusion criteria.

Demographic and clinical parameters such as age, gender, place of residence, duration of chronic liver disease, diabetes mellitus, hypertension, smoking status and Child–Pugh classification were documented on a structured proforma after enrollment. Diabetes mellitus was defined as having a known diagnosis that has been treated with antidiabetic drugs for at least 6 months and hypertension was defined as known diagnosis that has been treated with antihypertensive drugs for at least 6 months. Smoking was considered to be a lifetime history of ≥100 cigarettes and smoking in the last month. Body mass index (BMI) was determined by dividing the weight (kg) by height (m) squared. Weight was measured on a calibrated digital weighing scale where the participants were wearing very light clothes and the height was measured with the wall mounted stadiometer without shoes.

Abdominal ultrasonography was performed for all the enrolled patients and the diameter of the portal vein was measured in millimeters. Later, UGI was done to evaluate the size of the esophageal varices. The varices were grouped as small (<2 mm), medium (2-4 mm) and large (>4 mm). To achieve uniformity of assessment, all ultrasonographic and endoscopic examination was performed by physicians with more than 5 years' experience after fellowship. On a predesigned proforma, study variables such as age, sex, place of residence, height, weight, body mass index, duration of chronic liver disease, diabetes mellitus, hypertension, smoking status, Child–Pugh classification, portal vein diameter and size of esophageal varices were recorded.

Microsoft Excel 2016 was used to enter data and SPSS version 26.0 was used to analyze the data. Normally distributed continuous variables (e.g. age, body mass index, length of chronic liver disease and portal vein diameter) were presented as mean ± standard deviation or median with interquartile range as appropriate. Categorical variables were presented as frequencies and percentages. Spearman's rank correlation coefficient was used to evaluate the correlation between portal vein diameter and esophageal varices diameter. Stratified analysis was performed for potential effect modifiers (age, gender, place of residence, body mass index, duration of chronic liver disease, diabetes mellitus, hypertension, smoking status and Child–Pugh class), and post-stratification Spearman's rank correlation was used. Statistically significant values were set at a two tailed p value of ≤0.05.

RESULTS

A total of 200 patients with chronic liver disease were included in the study. The mean age was 50.2±9.8 years (range: 30–65 years), with males constituting 128 (64.0%) of the study population. The mean body mass index was 25.8±3.9 kg/m², while the median duration of chronic liver disease was 6 (IQR: 4–9) years. The overall mean portal vein diameter was 14.6±2.1 mm. The baseline demographic and anthropometric characteristics are presented in **Table I.**

Most participants belonged to Child–Pugh class B (46.5%), followed by class C (34.0%) and class A (19.5%). Diabetes mellitus was present in 79 (39.5%) patients, hypertension in 61 (30.5%), and 69 (34.5%) were smokers. Clinical characteristics of the study population are summarized in **Table II**.

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Upper gastrointestinal endoscopy revealed small esophageal varices in 52 (26.0%), medium varices in 87 (43.5%), and large varices in 61 (30.5%) patients. A progressive increase in mean portal vein diameter was observed with increasing variceal size. Patients with small varices had a mean portal vein diameter of 12.2±1.1 mm, compared with 14.3±1.2 mm in those with medium varices and 17.0±1.5 mm among patients with large varices ($p<0.001$). These findings are shown in **Table III**.

Spearman's rank correlation demonstrated a strong positive correlation between portal vein diameter and the size of esophageal varices ($\rho=0.782$, $p<0.001$). After stratification by age, gender, diabetes mellitus, hypertension, smoking status, body mass index, duration of chronic liver disease, and Child–Pugh class, the correlation remained statistically significant in all strata ($p<0.05$), indicating that these variables did not materially influence the relationship. Details of the correlation analysis are presented in **Table IV.**

Table I. Baseline demographic and anthropometric characteristics (n=200)

Variable	Mean ± SD / n (%)
Age (years)	50.2 ± 9.8
Male	128 (64.0)
Female	72 (36.0)
Height (m)	1.67 ± 0.08
Weight (kg)	72.1 ± 11.9
Body Mass Index (kg/m²)	25.8 ± 3.9
Duration of chronic liver disease (years), Median (IQR)	6 (4–9)
Portal vein diameter (mm)	14.6 ± 2.1

Table II. Clinical profile of patients with chronic liver disease (n=200)

Variable	n (%)
Urban residence	137 (68.5)
Rural residence	63 (31.5)
Diabetes mellitus	79 (39.5)
Hypertension	61 (30.5)
Smoking	69 (34.5)
Child–Pugh Class A	39 (19.5)
Child–Pugh Class B	93 (46.5)
Child–Pugh Class C	68 (34.0)

Table III. Association of portal vein diameter with size of esophageal varices (n=200)

Size of Esophageal Varices	n (%)	Portal Vein Diameter (mm) Mean ± SD
Small (<2 mm)	52 (26.0)	12.2 ± 1.1
Medium (2–4 mm)	87 (43.5)	14.3 ± 1.2
Large (>4 mm)	61 (30.5)	17.0 ± 1.5
Kruskal–Wallis test		p <0.001

Table IV. Stratified Spearman's correlation between portal vein diameter and size of esophageal varices

Variable	n	Spearman's ρ	p-value
Overall	200	0.782	<0.001

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Age ≤50 years	103	0.741	<0.001
Age >50 years	97	0.806	<0.001
Male	128	0.775	<0.001
Female	72	0.793	<0.001
Diabetes mellitus	79	0.748	<0.001
No diabetes	121	0.798	<0.001
Hypertension	61	0.727	<0.001
No hypertension	139	0.791	<0.001
Smokers	69	0.760	<0.001
Non-smokers	131	0.786	<0.001
BMI <25 kg/m²	92	0.751	<0.001
BMI ≥25 kg/m²	108	0.804	<0.001
Child–Pugh Class A	39	0.612	<0.001
Child–Pugh Class B	93	0.744	<0.001
Child–Pugh Class C	68	0.829	<0.001

DISCUSSION

This study showed a high correlation between diameter of portal vein and grade of esophageal varices in chronic liver disease patients. The diameter of the PV was an important determinant of the severity of the varices, with medium and large varices significantly associated with larger PV diameters, indicating that PV diameter may be a simple, readily available, and non-invasive marker of the severity of varices. These findings add to the increasing interest in ultrasonographic parameters for recognition of patients with a higher risk of clinically significant portal hypertension and its complications.

Our findings are in line with previous studies which have shown that non-invasive ultrasonographic parameters, especially when complemented by hematological indices, were helpful to predict the presence of esophageal varices and reduce unnecessary endoscopy[11] and portal venous measurements were significantly associated with gastroesophageal varices in patients with chronic liver disease, highlighting their clinical importance in routine practice[12]. As well as similar observations were made in low-income healthcare setting where non-invasive diagnostic methods were found to be acceptable for identifying esophageal varices, particularly where endoscopic resources are scarce[13].

In recent years the assessment of portal haemodynamics has become more and more important. Also, Khan et al. demonstrated good diagnostic accuracy of portal vein Doppler parameters for esophageal varices in patients with cirrhosis, supporting the use of validated non-invasive methods as a means to reduce unnecessary screening endoscopies without compromising patient safety in patients with compensated advanced chronic liver disease.[14] The Baveno VII consensus had recommended the use of such validated non-invasive methods in this patient population to reduce unnecessary screening endoscopies while maintaining patient safety.

The present findings agree with the studies that validated Doppler ultrasonography and other imaging modalities. Nouh et al. showed that portal color Doppler US could be used to reliably predict esophageal varices, which highlights the importance of ultrasonography as a cheap, reproducible diagnostic tool in the prediction of esophageal varices. [16] Cho et al. also showed that combining splenic stiffness with spleen size and platelet based risk score, the prediction of high-risk varices could be improved, suggesting that these multiple non-invasive markers of ultrasonography may be complementary in clinical assessment. [17] Elkerdawy et al. expanded on this by demonstrating that gall bladder wall thickness could also reflect portal hypertension and predict esophageal varices. [18]

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Recent evidence published has continued to support the use of imaging-based predictors. Similarly, Kamath et al. reported that an assessment of the ability to predict the presence of large Esophageal Varices (EV) by PV diameter and laboratory indices was accurate and may obviate the need for routine screening endoscopy, especially in resource-limited healthcare settings. [19] Also, Kwape et al. reported that non-invasive assessment tools showed satisfactory diagnostic performance and may reduce the need for routine screening endoscopy, especially in resource-limited healthcare systems. [20]

The results of the present study confirm the literature recently published and reinforce the data on portal vein diameter as an easily obtained, cost-effective and reproducible index for the estimation of the severity of esophageal varices in patients with chronic liver disease.

Strengths and Limitations

The main strength of this study was the relatively large number of patients and the fact that the ultrasonographic and endoscopic measurements were conducted by experienced physicians using standardized measurements, thereby improving the uniformity of the measurements. Furthermore, portal vein diameter was directly compared to variceal size using stratified analysis, which controlled for key clinical confounders. However, a cross-sectional design did not allow for causal inference to be made, and the study was performed in a single tertiary care center, which may limit the applicability of the results. Moreover, the use of newer non-invasive techniques for liver fibrosis assessment, like transient elastography and liver stiffness measurement, was not assessed for comparison.

Recommendations

The diameter of the portal vein should be routinely used as an additional parameter in the ultrasonographic evaluation of patients with chronic liver disease to help detect patients at high risk of large esophageal varices. Future multicenter prospective evaluations should be performed to compare the diameter of the PV with other validated non-invasive markers and to create combined models that are more predictive and will increase the accuracy of diagnosis and decrease unnecessary EGD procedures.

CONCLUSION

There was a strong positive correlation between portal vein diameter and esophageal varices size in chronic liver disease cases. It is a simple, inexpensive and widely available ultrasonographic parameter and could be a valuable non-invasive predictor of variceal severity and help clinicians prioritize patients for endoscopic evaluation, especially in resource-limited environments.

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