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Correlation of Portal and Splenic Vein Diameter with Presence and Size of Esophageal and Gastric Varices in Liver Cirrhosis Patients on MDCT

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ABSTRACT

Introduction: Variceal formation depends upon the pattern of dilatation of the portal and various splanchnic veins in patients with cirrhotic liver and portal hypertension. Multidetector Computed Tomography (MDCT) may be helpful in the evaluation of such gastroesophageal varices and predicting their risk of haemorrhage.

Methods: After obtaining ethical clearance and consent, 50 patients meeting the inclusion criteria were included and MDCT obtained. The diameters of the portal vein (PV), splenic vein (SV) and left gastric vein (LGV) were measured and originating vein of LGV determined. Pattern, location and diameter of varix was evaluated. Association between the diameters of the originating vein and the grade and pattern of the esophagael and gastric fundic varices was determined.

Results: Of the 50 patients, 41 had gastroesophageal (GE) varices equal to or larger than 1mm with 34% having high-risk varices. The SV was predominantly the originating vein of the LGV. Cutoff SV diameter of 7.75mm and LGV diameter of 5.75mm had a sensitivity of 77.8% with a specificity of 73.2% and 75.6% respectively for the presence of varices.

Conclusions: In our study, EV and GEV was more common and mostly supplied by LGV while isolated gastric fundic varices were supplied by non LGV veins only. The diameters of SV and LGV were associated with the presence and grade of esophageal and gastric fundic varices. MDCT is an important non-invasive modality in patients with portal hypertension and should be used for diagnosis, risk stratification and monitoring of varices.

Keywords: *Liver Cirrhosis; Portal Hypertension;Varices*

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INTRODUCTION

Gastroesophageal (GE) varices are one of the most common complications of portal hypertension (PHT) and may be classified according to location as esophageal, isolated gastric and gastro- oesophageal. Approximately one-third of those affected suffer at least one episode of haemorrhage with substantial morbidity and mortality.[1] Esophageal varices (EV) are more common but have a better prognosis while gastric varices (GV) account for 10- 30% of all variceal haemorrhage, are larger and more severe with higher mortality.[2] These hepatofugal varices result due to an elevated portal venous pressure secondary to morphological changes of chronic liver disease and enable portosystemic venous drainage.[3] Endoscopy being diagnostic and therapeutic is widely accepted and primarily used to detect, grade and follow up varices with prophylactic screening recommended for large varices.[4] However, it is an invasive technique with serious complications like perforation. This has prompted noninvasive evaluation techniques for varices that are more suitable for screening, treatment monitoring, and follow-up.[5,6] Multidetector computerized tomography (MDCT) is one such non-invasive and adequately available technique that is also recommended in chronic liver disease patients to rule out hepatocellular carcinoma.[7,8,9] Doppler ultrasound, which can image larger veins like portal vein (PV) or splenic vein (SV) and measure parameters like diameter, flow direction and flow velocity, is limited by evaluation of collaterals and other smaller or deeper veins. Additionally, Doppler ultrasound is limited by its lack of expertise, poor reproducibility and poor accuracy.[10] Magnetic resonance imaging (MRI) is also limited by a poor depiction of rarer collateral pathways, flow artefacts, expense and accessiblility.[11]

In this study, we evaluated the utility of MDCT imaging for the evaluation of esophageal and gastric fundic varices in patients with liver cirrhosis to detect, correlate the size of originating vein to the pattern of the varices and categorize according to the classification on CT scan.

METHODS

It was an observational study of consecutive 50 patients between July 2017 to July 2018 who either had a clinical history of upper gastrointestinal bleed, PHT, chronic liver disease (CLD), or GE varices and were referred to the Department of Radiodiagnosis and Imaging, Tribhuvan University Teaching Hospital for triple-phase MDCT abdomen/ MDCT portography, or those who upon imaging were found to have radiographic evidence of CLD. Patients with any systemic disease that would affect the abdominal veins, patients with hepatic artery-portal vein fistula, portal vein thrombosis, prehepatic cirrhosis and hepatic carcinoma and post surgery like splenectomy were excluded from the study. The study was done after obtaining ethical clearance from the Institutional Review Board, Institute of Medicine, Tribhuvan University. Informed written consent was taken from participants.

The data was transferred to an image processing workstation and standard window settings of window width 350 and window level 50 were used for initial reconstruction. Display parameters (width, level, brightness and opacity) were chosen subjectively to optimize visualization of the portosystemic collaterals. The SV, PV and left gastric vein (LGV) diameters were measured on axial CT images using the liver window setting (window width, 250 Hounsfield Unit; window level, 70 Hounsfield Unit) in the portal venous phase. The diameter of the portal vein was measured at its midpoint as determined on multiplanar reconstruction images, and the diameter of the SV was measured at a point one cm from the confluence of the spleno-mesenteric confluence. The LGV diameter was measured at its origin. The presence of varix was identified and the location was determined whether in the oesophagus, gastric fundus or involving both esophageal and gastric varices. Following the criteria suggested by Kim et al. varices equal to or

larger than >3mm were identified as a high-risk group or score 4, varices between 2-3mm categorized as score 3.[12,13] Those between 1-2 mm were low risk or score 2 and those without varices or <1mm assigned score 1 and considered varices not present. The number of varices with a diameter larger than 3mm were identified as well. The inflowing vein of the varix was categorized as LGV or non-LGV, without further specifying posterior gastric vein (PGV) or short gastric vein (SGV).

The relevant information and data were recorded in predesigned proforma. The data obtained were analyzed using the Statistical Package for Social Sciences 24.0 (SPSS inc., Chicago IL, USA). A p-value of less than 0.05 was considered to be statistically significant. The sensitivity, specificity, positive likelihood ratio (LR+) and negative likelihood ratio (LR-) were obtained with a Pearson correlation. The significance of diameter of the originating vein and presence and grade of GE varices were assessed with Receiver Operating Characteristic (ROC) curve.

RESULTS

We had 50 patients included in the study, of which 36 were male and 14 female. A maximum number of patients were in the age group of 50-59years, the mean age being 54.8 years.

Using the largest varix size ≥3mm as high risk for variceal bleeding, 34% (17) patients had high-risk varices, while rest were low risk as shown in figure 1.

Out of the 41 subjects who had varices 1 mm or larger, 39.02% (16) had esophageal varices, 26.83% (11) had gastric fundic varices while 14 (34.15%) had both esophageal and gastric fundic varices (Figure 2).

LGV was detected as the main inflowing vein in 63.41% of the cases with varices. In the 3 patterns, LGV was the main inflowing vein for only esophagael or combined gastric fundic and esophageal varices, observed in 93.75% (15/16) and 78.57% (11/14) patients, respectively. Notably, LGV was not seen as the primary inflowing vein in any of the patients with only isolated gastric fundic varices (Figure 3).

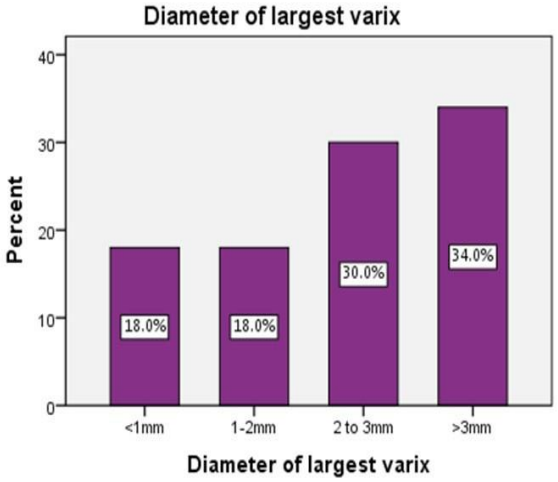

Figure 1: *Bar chart of distribution of varices in each grade*

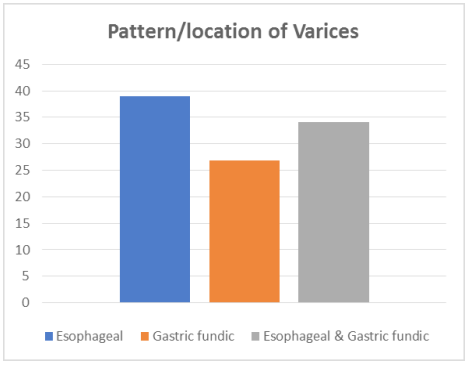

Figure 2: *Bar chart with percentages among a pattern of varices.*

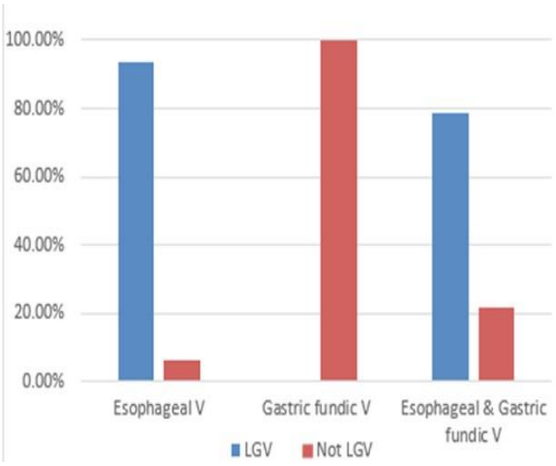

Figure 3: *Bar chart showing LGV as an inflowing vein in each pattern of varices in percentage*

The SV was most often the originating vein

of varices larger than or equal to 1 mm with its diameter ranging from 3.5 to 21.1 mm and a median of 8.1 mm as shown in Table 1 and 2. The draining vein of LGV was the splenic vein in 58% and portal vein in 42% of the cases.

Table 1: Percentage distribution of originating vein of varices

Originating vein	Frequency	Percent
Portal vein	5	12.1
Splenic vein	24	58.5
Both PV and SV	12	29.3
Total	41	100

Table 2: Diameter of originating veins PV, SV and LGV

	Diameter of PV	Diameter of SV	Diameter of LGV
Mean	14.52	8.88	6.38
Median	14.45	8.1	6.4
Std. Deviation	2.32	3.32	1.33
Minimum	8.0	3.5	4.0
Maximum	21.0	21.1	9.0

Pearson correlation between diameters of the largest varix and SV, PV and LGV were observed to be r = 0.525 (p = 0.000091), r = 0.155 (p value = 0.282) and r = 0.729 (p = 0.0000000019), respectively. Though larger diameter of varices was noted with increasing diameter of PV, however, no statistical significance was present.

The cut-off SV diameter of 7.75mm achieved a sensitivity of 77.8% and a specificity of 73.2% with an area under the curve (AUC) of 0.808 for predicting GE varices. A cut-off value of 8.3mm achieved a sensitivity of 88.9% with a specificity of 56.1% (Figure 6). The positive likelihood ratio (LR+) are 2.9 and 2.03 and the negative likelihood ratio (LR-) of 0.30 and 0.198, respectively.

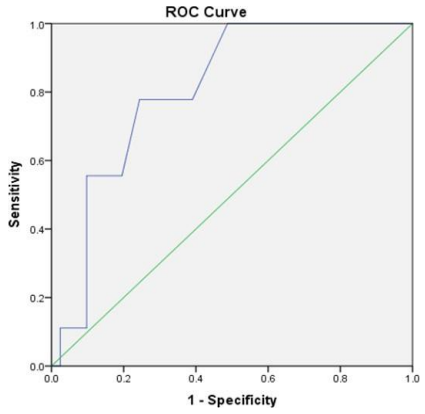

Figure 4: *ROC curve of splenic vein for predicting GE varix*

PV diameter cut-off value of 13.95mm achieved a sensitivity of 66.7% and a specificity of 63.4% with an AUC of 0.587, while a cut-off value of 15.25mm achieved a sensitivity of 77.8% with a specificity of 41.5%. LR+ of 1.8 and 1.32 and LR- of 0.52 and 0.53 was achieved respectively (Figure 5).

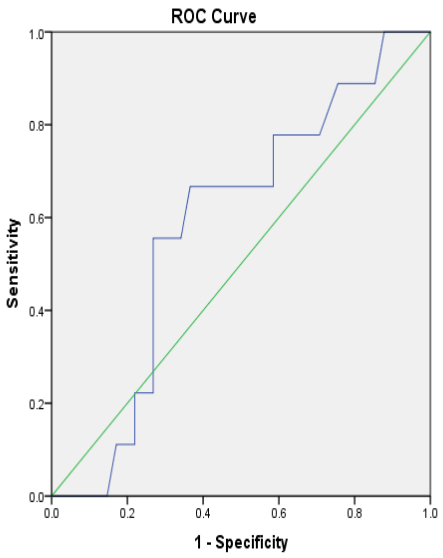

Figure 5: *ROC curve of the portal vein for predicting GE varices*

The cut-off LGV diameter of 5.75mm had a sensitivity of 77.8% with a specificity of 75.6% with an AUC of 0.82. A cut-off value of 6.85mm achieved a sensitivity of 100% with a specificity of 41.5% (Figure 6). The LR+ were 3.2 and 1.7 and LR- were 0.29 and 0, respectively for the former and latter diameters.

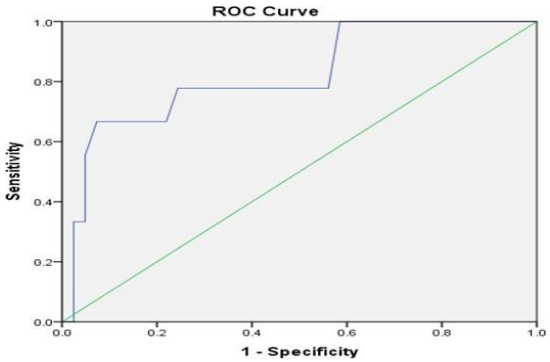

Figure 6: *ROC curve of LGV for predicting GE varices*

We found a significant statistical correlation between the high-risk varices and SV and LGV diameter at 0.01 level (0.000) with r= 0.594 and 0.713 respectively. Additionally, the spontaneous lienorenal shunt was seen in 5 (10%) and absent in 45 (90%) patients.

DISCUSSION

Esophageal or gastro-oesophageal varices are more common in chronic liver disease compared to isolated gastric varices which tend to be larger with more fatal bleed. Endoscopy is currently the gold standard for grading and risk stratification with various classifications and grading schemes.[8] Of the various radiological imaging modalities used to identify, calculate risk and pattern of varices, MDCT has been most promising.[9] In addition to being a non-invasive technique, patients with cirrhosis often undergo MDCT scans as a part of their routine clinical management. Features of PHT like Esophageal varices, splenomegaly, ascites, and enlargement of the PV or the presence of enlarged collateral vessels are often seen on cross-sectional imaging. Comparison between CT and endoscopic findings and has shown that the variceal size agreement between radiologists is better than the agreement between endoscopic interpretations.[1,9]

MDCT with its ability to post-processing imaging data with various reformatting techniques can facilitate the identification of the originating veins and the distribution of portosystemic collateral vessels in patients with liver cirrhosis and maybe a non- invasive imaging technique for monitoring in this setting.[12,13] Moftah et al., found that CT esophagography stratification of high and low-risk varices using a four-point confidence scale of Kim et al., compared very well with endoscopic grading, with nearly 100% sensitivity and accuracy.[14] Studies also suggest that MDCT being cost-effective and favoured by patients, can be used as a single noninvasive surveillance tool for both EV and hepatocellular carcinoma in patients with liver cirrhosis.[15,16,17,18] MDCT is a faster, well-tolerated, noninvasive procedure more accepted compared to endoscopy in 83% of the patients for evaluation and grading of esophageal varices, detection of other portosystemic collateral and hepatobiliary pathologies over endoscopy.[19,20]

The portosystemic collateral veins develop as the portal venous pressure increases, forming conduits for the systemic return of the spleno-mesenteric blood. GEV and EV are the most common pattern of varices with supply from left gastric veins and isolated gastric varices (IGV) relatively less common being largely supplied by short or posterior gastric veins.[20] Another study also found EV or GEV to be the most common pattern with feeding vessel predominantly from LGV while IGV accounted for only 14% of cases with feeding vein from LGV or non- LGV.[21] Compared to these, we had a larger percentage of gastric fundic varices or IGV all of which were supplied by non LGV implying supply by posterior or short gastric veins. Knowledge of the porto-systemic road map would facilitate interventional radiologists to carry out procedures like transjugular intrahepatic portosystemic shunts, balloon- occluded anterograde/ retrograde transvenous obliteration.

Zhou et al. found the median values of PV, SV and LGV to be 12.9mm, 9.3mm and 6.0mm, respectively which was slightly lower than that in our study. Cut-off SV diameter of 8.5mm achieved a sensitivity of 83.3% and specificity of 58.1% for predicting the varices which are consistent with our result.[1]

CONCLUSION

EV and GEV were more common and mostly supplied by LGV while isolated gastric fundic varices supplied by non LGV veins only. The diameters of SV and LGV are associated with the presence and grade of esophageal and gastric fundic varices. The correlation with the LGV and varices could be due to the origin of LGV from the SV. Though a larger diameter of varices was noted with increasing diameter of PV, however, no statistical significance was present. To conclude, MDCT is an important non-invasive modality in patients with portal hypertension and should be used for diagnosis, risk stratification and monitoring of varices

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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