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RESEARCH ARTICLE

LARGE SILENT GASTRIC FUNDAL VARICES IN CIRRHOTIC PATIENTS: ROLE OF ABDOMINAL MULTIDETECTOR TRIPHASIC COMPUTED TOMOGRAPHY.

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Abstract

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Background:- Gastric varices have been recognized as a major cause of gastrointestinal bleeding, reaching 33% in patients with portal hypertension mostly secondary to liver cirrhosis. Compared with esophageal variceal bleeding, haemorrhage caused by fundal varices, although less frequent, is more severe and haemostatic control is more difficult. The diagnosis and treatment of gastrointestinal bleeding are based mainly on endoscopic examinations however; radiological studies such as computed tomography (CT) studies have proved useful in clinical practice. Spiral imaging has dramatically improved CT in the evaluation of focal hepatic lesion. The aim of this study is to investigate the role of abdominal Multidetector triphasic CT scan done for early detection of hepatocellular carcinoma (HCC) as a predictor and diagnostic tool for silent large gastric fundal varices in patients with liver cirrhosis.

Methods:- A total of 145 patients were enrolled in this study. All patients were referred for early detection of HCC with suspected focal hepatic lesion or elevated α fetoprotein above 50 and below 400 IU/dl. All patients underwent full clinical and laboratory investigations. Abdominal US was performed for all patients. Abdominal Multidetector triphasic CT scan was done by a single experienced radiologist for evaluation for the presence of hypervascular focal hepatic lesions, splenomegaly, epigastric and hilar collaterals, portal vein thrombosis and the presence of esophageal or gastric fundal varices. All patients underwent standard upper GIT endoscopy and according to the endoscopic findings the studied patients were further classified to three groups: group I (GI) 79 patients (54.48%) with no or small esophageal and/or gastric varices, group II (GII) 42 patients (28.97%) with large esophageal varices, and group III (GIII) 24 patients (16.55%) with large gastric fundal varices

Results:- There was a statistically significant increase in portal vein diameter, splenic size (long axis span), splenic vein diameter, presence of gastro-renal collaterals, portal vein thrombosis and HCC in patients with large gastric fundal varices in relation to other groups. platelet/splenic ratio as calculated by dividing platelet count over long axis of the spleen was determined for each patient which had significant lower values in relation to presence of large gastric varices

Step-wise regression analysis was done for all the above mentioned variables revealing that only three predictors namely the presence of large fundal varices by abdominal CT, presence of splenic hilar or splenorenal collaterals and platelet/splenic ratio were found to have highly significant independent

predictive value for the presence of those varices being 1312.64, 19.11 and 16.99 respectively (P < 0.001).

Out of 24 patients with gastric fundal varices diagnosed by Upper GIT endoscopy, 22 cases were diagnosed by Multidetector triphasic CT with 91.67% sensitivity and 100% specificity and area under the ROC curve 0.96 (P \leq 0.001). On the other hand, out of 42 patients diagnosed by Upper GIT endoscopy with large esophageal varices, only 29 cases were diagnosed by Multidetector triphasic CT with 69.05% sensitivity and 100% specificity (P \leq 0.001). Decrease in platelet/splenic ratio had sensitivity of 75% and specificity of 67.77% (P \leq 0.001).

Moreover, detection of HCC by Multidetector triphasic CT was confirmed in 31 cases and portal vein thrombosis in 20 patients

Conclusions:- Triphasic CT is a reliable noninvasive, highly tolerable examination in evaluation of gastric varices with ability to detect other portosystemic collaterals; in addition, the detection of other associated pathologies.

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Introduction:-

Hepatic cirrhosis is the clinical and pathologic result of a multifactorial chronic liver injury characterized by excessive fibrosis and nodular regeneration replacing the normal hepatic parenchymal architecture. It is known that cirrhosis is associated with a markedly increased risk of hepatocellular carcinoma (HCC), the sixth most common malignancy worldwide and one of the most common cause of cancer related death [1, 2].

Portosystemic collateral circulation is a consequence of portal hypertension, which occurs in chronic liver disease and is responsible for numerous complications, including hemorrhage resulting from the rupture of esophageal and fundal gastric varices and hepatic encephalopathy [3-5].

Portosystemic shunts commonly involve the gastrorenal and the splenorenal systems. The retrogastric varices are seen in the posteromedia aspect of the gastric fundus near to the cardia. They are fed by the left gastric or the gastroepiploic vein and drain into the left renal vein through the gastrorenal shunt, whereas perisplenic varices drain directly into the left renal vein via the splenorenal shunt [2].

Gastric varices have been recognized as a major cause of gastrointestinal bleeding, reaching 33% in patients with portal hypertension mostly secondary to liver cirrhosis [6]. Compared with esophageal variceal bleeding, haemorrhage caused by fundal varices, although less frequent, is more severe and haemostatic control is more difficult with reported mortality of approximately 45% [6, 7]. Even after standard endoscopic management, GV bleeding is still associated with high rebleeding rates, ranging from 22% to 37% [8, 9]. Although the prognosis of esophageal variceal hemorrhage has improved over the past few decades [10, 11], the clinical outcome of gastric variceal bleeding is still far from satisfactory [12].

Variceal hemorrhage is not only a complication of portal hypertension but also propably the first presenting symptom of undiagnosed hepatocellular carcinoma (HCC) [13]. The reported incidence of HCC presenting with variceal bleeding ranges from 1 to 15 % [14].

Risk factors for gastric variceal hemorrhage include the size of fundal varices (large nodular type is more than medium sized one which in turn more than small varix, defined as larger than 10 mm, between 5 to 10 mm and less than 5 mm, respectively), Child-Pugh class, presence of hepatocellular carcinoma and endoscopic presence of variceal red spots (defined as localized reddish mucosal area or spots on the mucosal surface of a varix)[15].

The diagnosis and treatment of gastrointestinal bleeding are based on endoscopic examinations however; radiological studies such as computed tomography (CT) angiography are becoming more and more common in clinical practice [16].

Varices appear as well-defined tubular or serpentine homogeneous structures. The administration of intravenous contrast is vital to delineate dilated venous structures [2].

Spiral imaging has dramatically improved CT in the evaluation of focal hepatic lesions less than 3 cm. The use of multidetector computed tomography (MDCT) with dynamic contrast-enhanced triple-phase technique and reformatted images is essential to detect small HCC lesions [17]. The conspicuity of a liver lesion depends on the attenuation difference between the lesion and the normal liver. Triphasic CT (arterial-dominant, portal-dominant and delayed phases) increase the diagnostic capabilities [18, 19]. The diagnosis of HCC can be made safe if a mass larger than 1.0 cm shows typical features of HCC (arterial hypervascularity with contrast uptake with portal and delayed phase washout) obviating the need for biopsy if these features are present [17].

The aim of this study is to investigate the role of abdominal Multidetector triphasic CT scan done for early detection of HCC as a predictor and diagnostic tool for silent large gastric fundal varices in patients with liver cirrhosis.

Subjects and Methods:-

A total of 145 patients were enrolled in this prospective study during the period from June, 2013 to October 2015. All patients were referred to tropical medicine department, Mansoura university hospital for early detection of HCC with suspected focal hepatic lesion or elevated α fetoprotein above 50 and below 400 IU/dl. All patients underwent full clinical examination with careful assessment of jaundice, ascites and edema lower limb. Laboratory investigations were done for: CBC, serum bilirubin, albumin, ALT, AST, serological makers for viral hepatitis, α -fetoprotein and serum creatinine.

Exclusion criteria included history of GIT bleeding, renal insufficiency and adverse reactions to iodinated contrast agents or refusal of the study protocol. Also, patients with history of major abdominal surgery or history of splenectomy were excluded from this study.

The severity of liver cirrhosis was classified using the Child–Pugh classification standard [20] identifying 19 patients as Class A, 75 cases as Class B and 51 patients as Class C.

Abdominal US was performed for all patients. Abdominal Multidetector triphasic CT scan was done by a single experienced radiologist for evaluation for the presence of hypervascular focal hepatic lesions, splenomegaly, epigastric and hilar collaterals, portal and splenic veins diameter, portal vein thrombosis and the presence of esophageal or gastric fundal varices.

Plain CT examination including the lower chest and the upper abdomen was done first to demonstrate anatomical location and compare pattern of enhancement, followed by triphasic examination after injection of 100-150 ml of a non-ionic iodinated contrast media (Ultravist 300; Iopamidol Schering, Berline, Germany) using automatic injector (Meorad Stellant injector, Pittsburg, Germany), at a rate of 3-4 ml/s through a 18-gauge IV catheter inserted into an antecubital vein. Three sets of images were acquired in a craniocaudal directional at 25, 65, and 180 s after injection of the contrast medium.

The first acquisition was used for hepatic arterial phase imaging; the second acquisition for portal venous phase imaging, and the third acquisition to image the hepatic venous phase. Images were obtained during single breath holding. All scans were performed utilizing a 16-slice CT scanner (Brilliance 16; Phillips Medical Systems, Cleveland, Ohio) and utilizing the high quality scan mode, at 16X1.5 mm; section thickness, 2 mm; section increment, 0.45 mm; 120 kV; 200 mA; pitch, 1.5; and rotation time, 0.75 seconds for portal venous phase imaging.

Images were transferred to a workstation (Extended Brilliance Workspace; Phillips Medical Systems, Best, the Netherlands) and multiplanar reformation (MPR) images were obtained in coronal and sagittal sections at 1- or 1.5- mm thickness, and a 5-mm interval in the region where varices were detected. Maximum intensity projection (MIP), shaded-surface display (SSD) and volume rendering were the preferred algorisms for creating vascular maps. All CT images were interpreted by a single experienced radiologist.

The protocol used in this study is routinely performed for patients with hepatic diseases to assess the vascularity of suspected focal hepatic lesions.

On CT scans, varices appear as well-defined round, tubular, or serpentine structures that are smooth, have homogeneous attenuation, and enhance with contrast material to the same degree as adjacent vessels [21]. Portal vein thrombosis was confirmed by the presence of noncontrast uptake areas in the portal vein on the portal venous

phase of triphasic contrast computed tomography of the abdomen [13]. When the portal vein is occupied by malignant tumor thrombus, intraluminal enhancement may be seen [2].

All patients underwent standard upper GIT endoscopy using Olympus XQ 240 type videoscope (Olympus, Tokyo, Japan) within 1 week following CT study; esophageal varices were evaluated for location and form, and presence or absence of red color sign. Classification system of the Japanese Society for Portal Hypertension and esophageal varices [22, 23] was used such as Score 1 (small straight), Score 2 (enlarged tortuous) and Score 3 (large coiled shaped). The gastric varices (GV) form was graded using the system described by Hashizume et al. [24]. GV classification was based on the criteria proposed by Sarin et al. [6] into esophago-gastric varices; esophageal varices extending either from the gastroesophageal junction to the small curvature of the stomach (GOV1), or to the fundus (GOV2); and isolated gastric varices (IGV), located in the fundus (IGV1) or elsewhere in the stomach (IGV2)

According to the endoscopic findings the studied patients were further classified to three groups: group I (GI) 79 patients (54.48%) with no or small esophageal and/or gastric varices, group II (GII) 42 patients (28.97%) with large esophageal varices, and group III (GIII) 24 patients (16.55%) with large gastric fundal varices; gastroesophageal varices type 2(GOV2) and/or isolated gastric varices type 1 (IGV1)

Acceptance and tolerability of the patients for either triphasic CT or upper GIT endoscopy were assessed by patient questionnaire after doing both techniques.

The study was conducted following the guidelines of the 1975 Declaration of Helsinki, and all patients gave their written informed consent to participate in it.

Statistical analysis:-

Data are expressed as mean value \pm standard deviation (SD). All the data were edited and processed using the MedCalc® Version 13 for windows (MedCalc Software bvba, Ostend, Belgium). Statistical analyses were evaluated using the Student t-test, One way analysis of variance (ANOVA) F-ratio and the chi-square method ($\chi 2$ test), P value of ≤ 0.05 was considered statistically significant. Step-wise multivariate regression analysis was performed to identify variables independently associated with the presence of large gastric fundal varices. The receiver-operating characteristics (ROC) curves were computed, and areas under the curves as well as 95% confidence intervals were calculated for variables found to be independent predictive for the presence of large gastric fundal varices.

Results:-

The studied 145 cases included 89 males (61.38%) and 56 females(38.62%) with age ranging between 43-73 years with mean 57.81±6.66. There were no significant differences in age and sex distribution regarding detection and grading of esophageal or gastric fundal varices (p > 0.05).

Group		Number	Age	F-ratio	Р
Group I	Male	53 (36.55%)	58.29±6.86		
	Female	26 (17.93%)		0.52	>0.05
Group II	Male	23 (15.86%)	57.00±6.61		
	Female	19 (13.1%)			
Group III	Male	13 (8.97%)	57.62±6.15		
	Female	11 (7.59%)			

Table 1:- summarizes age and sex distribution in the studied groups of patients.

All the studied patients had hepatitis C related liver cirrhosis. The diagnosis of cirrhosis for the involved patients was based on the combination of typical clinical features (symptoms and signs of cirrhosis and its complications), laboratory results (viral marker, hyperbilirubinemia, hypoalbuminemia, coagulopathy, and cytopenia testing), and imaging findings (liver configuration, border irregularity, splenomegaly, ascites, and collateral vessels).

The severity of liver cirrhosis was classified using the Child–Pugh classification standard [20] identifying 19 patients (13.1%) as Class A, 75 cases (51.73%) as Class B and 51 patients (35.17%) as Class C. There were no

significant differences regarding detection and grading of esophageal or gastric fundal varices between different Child-Pugh Classes (p > 0.05).

Group	Child-Pugh Class	Child-Pugh Class	Child-Pugh Class	χ2 test	Р
	А	В	С		
Group I (79)	11 (7.59%)	36 (24.82%)	32 (22.07%)		
Group II (42)	6 (4.14%)	23 (15.86%)	13 (8.97%)	3.75	>0.05
Group III (24)	2 (1.38%)	16 (11.03%)	6 (4.14%)		

According to biochemical and laboratory data of the studied groups (Table 3), there was a statistically significant difference in palatlet count being more reduced in patients with large gastric fundal varices and in patients with large esophageal varices in relation to group I with no or small varices. Also, serum AFP level was elevated in patients with large varices.

Table 3:- summarizes the Lab. Investigation in the studied groups of patients.

Group	Group I	Group II	Group III	F-ratio	Р
Variable	(79)	(42)	(24)		
Platlet	92.15±17.08	81.10±22.11	77.33±15.09	8.52	*** <u><</u> 0.001
Alt	63.52±15.90	67.17±16.59	65.46±11.88	0.78	>0.05
Ast	69.80±18.69	67.76±19.45	69.08±16.85	0.16	>0.05
S. Bilirubin	1.88±0.73	1.95±0.81	2.03±0.90	0.37	>0.05
S. Albumen	3.35±0.59	3.29±0.53	3.30±0.44	0.18	>0.05
AFP	30.24±27.13	54.50±72.31	60.50±87.35	4.08	*≤0.05

* P significant if ≤ 0.05 *** P significant if ≤ 0.001

Abdominal Multidetector triphasic CT scan was done to evaluate the presence of hypervascular focal hepatic lesions, splenic diameter, portal and splenic vein diameter, presence of portal vein thrombosis and the presence of esophageal or gastric fundal varices in addition to other porto-systemic collaterals.

On CT scans, esophageal varices appeared as intraluminal protrosions with scalloped borders and associated wall thickening that enhance with contrast material to the same degree as adjacent vessels at portal phase (Fig. 1)

Gastric varices are seen as well defined clusters of rounded and tubular areas of increased attenuation in the posterior or posteromedial aspect of the gastric fundus near the cardia. The posterior gastric lumen may be scalloped or lobubated by the subjacent dilated veins (Fig. 2).

Maximum intensity projection (MIP), shaded-surface display (SSD) and volume rendering were preformed for creating vascular maps (Fig. 3)

Hepatocellular carcinoma was diagnosed in 31 cases from the involved patients with liver cirrhosis by its early enhancement in arterial phase with rapid wash out in portal and delayed venous phases.

Endoscopic examination of the studied cases revealed 79 cases (54.48%) with no or small esophageal and/or gastric varices (group I), 42 cases (28.97%) with large esophageal varices (Group II) (Fig. 4) and 24 cases (16.55%) with large gastric fundal varices (Group III) (Fig. 5). Eighty one cases showed GI, GII portal hypertensive gastropathy (PHG), 49 cases showed GIII hemorrhagic PHG, 4 cases with Gastric antral vascular ectasia (GAVE) while 11 cases normal stomach mucosa.



Axial contrast enhanced CT images show esophageal varices (arrow) Figure 2:-



Axial contrast enhanced CT images show large gastric fundal varices (arrow) Figure 3:-



- A. Coronal contrast-enhanced portal phase maximum intensity projection (MIP) reformatted CT image shows gastric fundal varix with extensive gastro-renal shunt.
- B. Coronal contrast-enhanced volume-rendered CT image of the same patient.

There was a statistically significant increase in portal vein diameter, splenic size (long axis span), splenic vein diameter, presence of gastro-renal collaterals, portal vein thrombosis and HCC in patients with large gastric fundal varices in relation to other groups (Table 4).

Platelet/splenic ratio as calculated by dividing platelet count over long axis of the spleen was calculated for each patient which had significant lower values in relation to presence of large gastric varices (Table 4).
Table 4:- Radiologic characteristics of the studied patient groups

a				The state of the s	D
Group	Group I (79)	Group II (42)	Group III (24)	Test	P
Variable					
Portal vein	13.90±1.71	14.26±1.06	14.67±1.01	F-ratio	>0.05
diameter				2.82	
Splenic span	16.15±1.57	17.54±2.21	19.59±2.38	F-ratio	***≤0.001
				30.97	
Splenic vein	9.01±1.62	9.74±1.61	10.83±1.90	F-ratio	*** <u><</u> 0.001
-				11.47	
Presence of	22 (27.85%)	28 (66.67%)	21 (87.50%)	χ^2 test	*** <u><</u> 0.001
spleno-renal				33.63	
collaterals					
Presence Of	4 (5.06%)	8 (19.05%)	8 (33.33%)	χ2 test	*** <u>≤</u> 0.001
portal vein				13.75	
thrombosis					
Focal hepatic	10 (12.66%)	13 (30.95%)	8 (33.33%)	χ2 test	*≤0.05
lesion				7.91	
Presence of OV	0	29 (69.05%)	0	χ2 test	***≤0.001
				88.90	
Presence of FV	0	0	22 (91.67%)	χ2 test	***≤0.001
				130.76	
Plat/spl ratio	5.80±1.42	4.74±1.61	4.06±1.09	F-ratio	*** <u>≤</u> 0.001
-				16.79	

* P significant if ≤0.05







(a)

A. Upper GIT endoscopy shows risky F2 intraluminal esophageal varices B. Upper GI endoscopy shows 4 cords of intraluminal F3 eophageal varices

Figure 5:-



Two upper GIT endoscopy show 2 large nodular grape like isolated gastric fundal varices IGV1

All variables that were found to be different between patients with and without large gastric fundal varices on univariate analysis were included in a step-wise regression analysis to identify independent predictors for presence of such varices. In this analysis only three predictor namely the presence of large fundal varices by abdominal CT, presence of splenic hilar collaterals and platelet/splenic ratio were found to have highly significant independent predictive value for the presence of those varices being 1312.64, 19.11 and 16.99 respectively (P< 0.001).

Receiver-Operating Characteristics curve (ROC curve) was done for all variables with statistically significant on univariate analysis (Fig 6, 7)



Out of 24 patients with gastric fundal varices diagnosed by Upper GIT endoscopy, 22 cases were diagnosed by Multidetector triphasic CT with 91.67% sensitivity and 100% specificity and area under the ROC curve 0.96, $P \le 0.001$.Presence of spleno-renal and splenic hilar collaterals had area under the ROC curve 0.73, $P \le 0.001$ with sensitivity 87.50% and specificity 58.68%.

Increase in splenic size as detected radiologically by measuring long axis of the spleen had area under the ROC curve 0.85, P \leq 0.001 at cut of value 18,4 Cm and sensitivity 75% and specificity 83.47%. Increase in splenic vein diameter as measured by MIP reformatted CT image had area under the ROC curve 0.71, P \leq 0.001 at cut of value 10 mm with sensitivity 45.83% and specificity 85.12



Increase in portal vein diameter as detected radiologically had area under the ROC curve 0.65, P \leq 0.05 at cut of value 13 mm with sensitivity of 95.83% and low specificity of only 26.45%. Reduction in platelet count had area under the ROC curve 0.68, P \leq 0.001with sensitivity 87.50% and specificity 42.98% with cut off value of platelet count \leq 93.000/ml

Decrease in platelet/splenic ratio had area under the ROC curve 0.77, P≤0.001 at cut of value of 4.71 with sensitivity of 75% and specificity of 67.77%

On the other hand, regarding the diagnosis of large esophageal varices out of 42 patients diagnosed by Upper GIT endoscopy, only 29 cases were diagnosed by Multidetector triphasic CT with 69.05% sensitivity and 100% specificity and area under the ROC curve 0.85, $P \le 0.001$.

Seventy four patients (51.04%) out of 145 found that MDCT is more preferable and accepted than endoscopy, only 22 (15.17%) patients found endoscopy more tolerable (due to good sedation with no IV iodinated dye administration) and 49 patients (33.79%) show no preference between both techniques. The preference of CT as imaging modality from the patient point of view was statistically significant p < 0.001

Discussion:-

Esophageal and gastric fundal varices, which can contribute to massive hemorrhage of the upper alimentary tract, are the most common collateral vessels in cirrhotic patients with portal hypertension. An increasing number of treatments, such as endoscopy and intravascular interventional techniques, require radiographic examination of the varices. Thus, visualization of the originating veins of the inflowing vessels is crucial to guide further treatments [25].

We tried in this study to detect the value of Multidetector triphasic CT in diagnosis of large silent gastric fundal varices as a non-invasive procedure and its acceptance to the patients. This study includes 145 patients with liver cirrhosis (89 males, 56 females, age 43–73 years; mean 57.81 \pm 6.66.

Compared with other modalities used to evaluate varices, MDCT portography has proven to be the optimal imaging technique, due to its high spatial resolution, rapid image acquisition, and powerful post processing of the imaging data [26]. In this study, utilizing CT, the scanning series take very short time and most of the patients can withstand single breath hold which makes the procedures and diagnostic quality much better. This was mentioned by Rydberg et al. [27].who clarified that the rapid scanning capability of CT allows increased craniocaudal scanning range and thinner slice acquisition in a single breath hold. This results in high spatial resolution and better depictions of fine vasculature.

We found also the availability of precise MIP in sagittal and coronal planes raise the diagnostic performance in visualization of gastric varices, esophageal varices as well as visualization of other portosystemic collaterals and this was also reported by Nakayama et al. [28].and Ishikawa et al. [29].

In this study, using CT in detection of gastric varices showed high sensitivity, specificity and accuracy. Our recorded sensitivity, specificity of CT in detection of gastric varices by single experienced radiologist were 91.67% and 100% respectively this was in agreement with Kodama et al. [30].and Mifune et al. [31] who clarified the important advantage of multi-detector row CT, which permits routine use of very thin collimation for imaging the portosystemic collateral vessels whereas collateral vessels can now be demonstrated without the risk, discomfort and invasiveness of catheterization.

On the other hand, regarding the diagnosis of large esophageal varices, using Multidetector CT the sensitivity and specificity were 69.05 % and 100% respectively with relatively low sensitivity with many cases only diagnosed by endoscopy this may be explained by their mural location and the absence of adjacent adipose tissue [21]. One the other hand, the sensitivity and specificity were 94.8%, 98.5%, for radiologist A and 99.4%, 99.6% for radiologist B in another study done by ELKammash et al. [32].

This study revealed that, the presence of large fundal varices by abdominal CT, presence of splenorenal collaterals and platelet/splenic ratio were found to have highly significant independent predictive value for the presence of those large gastric varices by endoscopy also, multidetector triphasic CT was able to detect the feeding and draining variceal vessels, yet it could not detect the direction of blood flow within the portosystemic collaterals which is considered as a technically related drawback, This limitation was mentioned also by Chen et al. [26].

Different from esophageal varices, gastric varices are usually associated with spontaneous splenorenal or gastrorenal shunts (GRSs). These shunts, collectively described as GRSs, usually connect through the inferior phrenic or suprarenal vein to the left renal vein. The present data revealed that such collaterals were present in 87.5% in patients with large gastric fundal varices in relation to 66.67% in patients with large esophageal varices and only 27.85% in group (I) with no or small varices which was higher figure than previously reported by Chang et al. who detected that 60-85% of gastric varices were associated with GRS, in comparison with 17-21% of esophageal varices.[33].

Bolongesi et al. [34] and Yen et al.[35]demonstrated that the diameters of portal vein and splenic vein were the key criteria for diagnosis of PHT and that there was a linear correlation between the diameters and severity of PHT. However Li et al. [36] reported that the diameter of PV and SV were not sensitive enough to be used as markers of PHT severity. In this study, the sensitivity of portal vein diameter was 95.83 % with low specificity (only 26.4%) while the sensitivity and specificity of splenic vein diameter was 45.83% and 85.12% respectively.

Because of the significant difference in SV diameter between patients with and without esophageal and gastric fundal varices, the SV diameter measurements can be used as criteria to predict the presence of varices with a cutoff SV diameter of 10 mm for differentiating PHT with and without esophageal and gastric fundal varices based on the present data and using ROC analysis and this in agreement of study done by Zhou et al.[37]. However in this study, SV diameter failed to be independent predictors for presence of such varices. Endoscopy is the gold standard in the diagnosis and management of gastroesophageal varices; however, the use of endoscopy as a method of screening is limited, due to its invasive, expensive, need sedation, and patients poor acceptance of the procedure [38, 39]. The preference of CT as imaging modality over endoscopy from the patient point of view as initial tool was statistically significant p<0.001. This was in agreement with Kodama et al. and Kang et al. who stated that CT is better tolerated by most of patients than endoscopy [30, 40].

Screening for the presence of esophageal or gastric varices in risky patients is mandatory for initiating primary prophylaxis in such patients, with the choice dependent on clinical, radiological and endoscopic findings [41]. Also, performing endoscopic sclerotherapy without prior knowledge of whether the patient possesses gastric shunt, may easily lead to sudden mortality due to ectopic embolisation [42].

Like other CT, it has the advantage of being a readily available, noninvasive and rapid procedure while providing information regarding disease etiology [43], possibility for recently developed HCC [12]. And other associated pathologies.

The ongoing rapid technical evolution in multidetector CT technology with introduction of 64 and 128 row multidetector machines with multiplanar reconstruction will expand more and more the application of CT for evaluating patients with liver cirrhosis.

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