Assessment of esophageal varices by non-invasive portal Doppler and computed tomography

Ahmed okasha\textsuperscript{a}, Hasan M.Sedeek\textsuperscript{b}, Ghada Mohamed\textsuperscript{c} and Ayman Saad\textsuperscript{d}

\textsuperscript{a,c,d} Department of Radiodiagnosis, Qena Faculty of Medicine, South Valley University
\textsuperscript{b} Department of tropical medicine, Qena Faculty of Medicine, South Valley University

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Liver cirrhosis
Esophageal varices (EV).
Portal Doppler
Portal hypertension

INTRODUCTION

Esophageal varices (EV) development is one of the major complications of liver cirrhosis (Elshazly, 2016). It’s the most recognized portosystemic collaterals because their rupture results in dangerous variceal bleeding, which is considered as the commonest lethal complication of portal hypertension. (Tarek, 2016).

Esophageal varices can be found in 60%-80% of cirrhotic patients, with variceal hemorrhage presenting as the most devastating complication of cirrhosis. Because of this dramatic course of events (Hatem, 2016).

Esophageal varices hemorrhage an emergency event associated with a risk of mortality that still ranges from 10% to 20% at 6 weeks despite recent progress (De Franchis, 2015).

It is very important to identify patients with cirrhosis with a high risk of esophageal varices hemorrhage, because they require effective therapy to reduce the incidence of the first Esophageal varices hemorrhage in particular, esophageal variceal ligation and non-selective beta-blockers (Paul, 2017).

Early diagnosis of gastro esophageal varices before the onset of first bleed is highly recommended as many studies showed that the risk of variceal bleeding can be reduced from 50% to 15% for large esophageal varices (De Franchis R, 2005).

(EGD) remains the gold standard for diagnosis and grading of EV and for the evaluation of the risk of bleeding (Adriana, 2015).

Background: Esophageal varices are the most dangerous complication of the portal hypertension which occurs as a result of increased hydrostatic pressure within the portal vein. Actual direct measurement of portal pressures is an invasive technique while Doppler ultrasound and MDCT are non-invasive, relatively cheap and easily accessible imaging modality that helps easily detection of esophageal varices. It also provides useful information as to it’s cause and presence of complications. The present study was carried out to study the usefulness of portal vein Doppler and MDCT in Portal hypertension due to liver cirrhosis. 50 cases of clinically proven or suspected cases of esophageal varices were assessed with Doppler ultrasound and MDCT. Retrospective review of the findings was done to assess the status of Portal vein and hepatic artery for calibre, presence or absence of blood flow, direction of flow, velocity. Presence of esophageal varices.

Result: there is significant association between the decrease in the peak portal venous velocity, portal venous flow, portal vein congestion index and increase hepatic artery resistivity index and the increase in the esophageal varices grading in MDCT and in endoscopy. There is significant association between the grading of the esophageal varices in CT and its grading at endoscopy.
To limit the number of patients who should undergo endoscopic screening, a non invasive, less expensive and well tolerated test for diagnosis of varices with high sensitivity and specificity has been studied, such as platelet count and prothrombin time; as well as radiological criteria such as spleen size, but found to be not highly accurate predictors of high-risk varices (Schepis, 2001).

Ultrasound imaging also was non invasive, non expensive and well tolerated but it has limited specificity and cannot substitute endoscopy as a screening tool for large esophageal varices (Kim, 2007).

Portal vein Doppler is a non-invasive, highly reproducible and cost effective method for the evaluation of portal hemodynamics (Nanjaraj Chakenahalli, 2016).

Computed tomography (CT) imaging is non invasive, does not necessitate sedation, and allows accurate assessment of variceal site and size, and it is also better tolerated by most of the patients than endoscopy. With rapid evolution of CT technology especially the introduction of multi-detector computed tomography (MDCT) imaging with its multiplanar capabilities, esophageal, paraeosophageal and gastric varices as well as other portosystemic shunts was progressively recognized in patients with liver cirrhosis (Kodama, 2010).

Patients and methods

Inclusion criteria:

A prospective analytic study of 50 patients with liver cirrhosis were included in this study from diagnostic radiology department and endoscopy unit.

Exclusion criteria:

Patients with active gastrointestinal hemorrhage, those with a history of endoscopic variceal ligation, those with a history of adverse reactions to iodinated contrast agent, patients with known congenital anomalies of the portal vein, and those who refused to do endoscopy after CT angiography will excluded from the study.

Portal vein Doppler was done with (GE, Logiq P6): The following variables were calculated:

- portal vein diameter, sectional area and mean velocity.
- portal vein flow, resistivity index of the hepatic artery, congestion index of the portal vein:
  a) Portal vein
  1. Portal vein diameter (PVD; mm).
  2. Cross-sectional area of the portal vein (cm2).
  3. Mean portal vein velocity (cm/sec) (PVV).
  4. Portal venous flow (PVF).
  5. Hepatic artery resistive index (HARI).
  6. Congestion index of the portal vein (CI).

Fig 1: Increase HARI and decrease PVV in grade I EV.

CT examination for the abdomen

Plain CT examination including the lower chest and the upper abdomen was done first to demonstrate calcification and compare pattern of enhancement, followed by triphasic examination after injection of contrast media; 1-2 ml/kg of omenpaque 350 will injected using automatic injector at a rate of 4.0 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 seconds after injection of the contrast medium. The first acquisition will use for hepatic arterial phase imaging; the second acquisition for portal venous phase imaging, and the 3rd acquisition to image the hepatic venous phase. Images obtained during single breath holding. All scans were performed utilizing a 64-slice CT (Toshiba) scanner and utilizing the high-quality scan mode, at 1.25-mm slice thickness, and reconstruction Intervals of 0.625 mm for portal venous phase imaging. Images were transferred to a workstation and multiplanar reformation (MPR) images were obtained in coronal and sagittal sections at 0.5- or 1-mm thickness, and a 5-mm interval in the region where varices detected. The second set of triphasic enhanced CT images were used for evaluation of the entire esophageal varices in detail. All CT images were interpreted. Utilizing the information obtained from MDCT, images were analyze for the following:
I. Size of the varices.
II. Visualized porto-systemic collaterals.
III. Acceptance and tolerability of the patients for either MDCT or upper GIT endoscopy.

Upper GIT endoscopy was performed within 2 weeks following CT study; esophageal varices were evaluated for location and form, and presence or absence of RC sign.

Classification system of the Japanese Society for Portal Hypertension and esophageal varices was used such as Score 1 (small straight), Score 2 (enlarged tortuous) and Score 3 (large coiled shaped).

Red color sign (RC), defined as endoscope-detected dark red spots on the mucosa of the lower esophagus, was used to evaluate the risk of hemorrhage and provide a rough estimate of intravascular pressure within the esophageal varices (EV). RC was classified into four grades: RC 0: no mucosal coloring; RC 1: a few localized red spots; RC 2: between RC 1 and RC 3; and RC 3: several mucosal red spots throughout the circumference of the lower esophagus. Upper GI endoscopy was done, results were recorded, tabulated and statistically analyzed.

Fig 2 : CT abdomen grade II EV

Statistical analysis

- Revision of data and coding of variables in the questionnaire was done and was entered in the computer
- Analysis of data was performed by Statistical Package for Social Sciences (SPSS) as follows:
  1- Description of quantitative data as mean and Range.
  2- Description of qualitative data as number and percentage (%).
  3- Chi-Square test is used to compare qualitative parameters.
  4- R-test (correlation co-efficient) is used to rank different parameters against each other either direct or indirect. P value > 0.05 is considered non significant (NS) and P value <0.05 is considered significant (S) while P value <0.01 is considered highly significant (HS).

Result

50 cirrhotic patients were invited and enrolled in this study. Regarding the cirrhotic patients enrolled in this study, their age ranged from 44 - 80 years with a mean value of 59.44 ± 9.351.

Among 50 cirrhotic patients enrolled in the study, endoscopy grading show: 21 patients had no varices. 5 patients were found to have grade I EV, 8 patients were found to have grade II EV and 16 were found to have grade III EV.

Among 50 cirrhotic patients enrolled in the study, CT grading show: 18 patients had no varices. 7 patients were found to have grade I EV, 9 patients were found to have grade II EV and 16 were found to have grade III EV.

Table 1: portal vein parameters:

<table>
<thead>
<tr>
<th>(n=50)</th>
<th>Range</th>
<th>Mean ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44-80</td>
<td>59.44±9.35</td>
</tr>
<tr>
<td>HA RI</td>
<td>0.5-0.8</td>
<td>0.66±0.1</td>
</tr>
<tr>
<td>PV DIAM</td>
<td>9.8-17</td>
<td>13.23±2.19</td>
</tr>
<tr>
<td>PV flow</td>
<td>752.1-1305</td>
<td>1039.1±196.78</td>
</tr>
<tr>
<td>PVV</td>
<td>1.4-22.1</td>
<td>13.95±4.68</td>
</tr>
<tr>
<td>Cong index</td>
<td>0-0.2</td>
<td>0.13±0.06</td>
</tr>
</tbody>
</table>

Table 2: Red color sign

<table>
<thead>
<tr>
<th>Red color sign</th>
<th>Number of cases seen by endoscopy (n=50)</th>
<th>Correlation with No. of cases of similar CT grades of EV (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC0</td>
<td>21(42%)</td>
<td>18(36%)</td>
</tr>
<tr>
<td>RC1</td>
<td>5(10%)</td>
<td>7(14%)</td>
</tr>
<tr>
<td>RCII</td>
<td>8(16%)</td>
<td>9(18%)</td>
</tr>
<tr>
<td>RCIII</td>
<td>16(32%)</td>
<td>16(32%)</td>
</tr>
</tbody>
</table>

Table 3: ROC curve analysis according to Endoscopic Grade

<table>
<thead>
<tr>
<th></th>
<th>AUC</th>
<th>Cut off</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accur</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARI</td>
<td>0.952</td>
<td>50.6</td>
<td>96.55</td>
<td>95.24</td>
<td>96.6</td>
<td>95.2</td>
<td>95.90</td>
</tr>
</tbody>
</table>
Discussion

50 cirrhotic patients were invited and enrolled in this study. Regarding the cirrhotic patients enrolled in this study, their age ranged from 44 - 80 years with a mean value of 59.44 ± 9.351.

Among 50 cirrhotic patients enrolled in the study, endoscopy grading show: 21 patients had no varices. 5 patients were found to have grade I EV, 8 patients were found to have grade II EV and 16 were found to have grade III EV.

Among 50 cirrhotic patients enrolled in the study, CT grading show: 18 patients had no varices. 7 patients were found to have grade I EV, 9 patients were found to have grade II EV and 16 were found to have grade III EV.

As regards portal vein velocity, there was a significant inverse relation between portal vein velocity and grades of EV. Patients with no varices had portal vein velocity with a mean value of 18.77±1.89 cm/sec. The mean portal vein velocity in patients with grade I, II, and III varices was 12.32±1.89 Cm/sec., 10.64±1.35 cm/sec. & 9.78±2.66 cm/sec respectively. There was a statistically significant relation to the presence of EV (p.value <0.001) with 100 %sensitivity, 100 % specificity and 100% accuracy.

As regard the Hepatic artery resistive index (HARI) was performed in our study, we found statistical significance between this parameter and presence of EV. Patients with no varices had portal vein velocity with a mean value of 0.57±0.07 cm/sec. The mean portal vein velocity in patients with grade I, II, and III varices was 0.68±0.08 Cm/sec., 0.73±0.05 cm/sec. & 0.75±0.05 cm/sec respectively with 96.55 %sensitivity, 95.24 %specificity and 95.9 accuracy.

As regard portal vein diameter (PVD) was performed in our study; we found statistical significance between this parameter and presence of EV. Patients with no varices had portal vein diameter with a mean value of 11.11±0.86 cm/sec. The mean portal vein velocity in patients with grade I, II, and III varices was 14.44±2.02 cm/sec., 14.5±1.59 cm/sec. & 14.99±1.25 cm/sec respectively 86% sensitivity, 100% specificity and 93.1 accuracy.

As regard the portal vein flow velocity (PVFV) was performed in our study, we found statistical significance between this parameter and presence of EV. Patients with no varices had portal vein flow velocity with a mean value of 1228.76±105.25 cm/sec. The mean portal vein flow velocity in patients with grade I, II, and III varices was 1110.2±74.1., 838.94±64.56 cm/sec. & 868.04±60.74 cm/sec respectively (p.value <0.001) with 96.55% sensitivity, 95.24% specificity and 95.9 accuracy.

As regard congestion index (CI) was performed in our study; we found statistical significance between this parameter and presence of EV. Patients with no varices had portal vein diameter with a mean value of 0.1±0 cm/sec. The mean portal vein velocity in patients with grade I, II, and III varices was 0.14±0.05., 0.09±0.06 & 0.19±0.03 respectively with (P < 0.001) with 62.07 % sensitivity, 100% specificity and 81.04 accuracy.

There was a significant correlation between esophageal varices grade and portal vein parameter. This correlation is shown in table . There was also significant correlation between grade of EV in endoscopy and CT.

In our study MDCT used for detection of esophageal varices and revealed high sensitivity, specificity, accuracy, positive and negative predictive values of CT in detection of EV were 95 %, 97 %, 96 %, 93 % and 97 % respectively.

References:


