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ORIGINAL RESEARCH

CT portography using MDCT versus color doppler in detection of varices in cirrhotic patients

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ABSTRACT

Background: All chronic liver diseases end with cirrhosis. Upper gastrointestinal tract hemorrhage brought on by the formation of esophageal varices is the most frequent cause of death in cirrhotic individuals. It will be possible to prevent potential difficulties during interventional procedures and surgery if portosystemic collaterals are diagnosed using non-invasive approaches.

Materials and Methods: A cross-sectional study involving 90 patients who were diagnosed with liver cirrhosis based on symptoms and test results and presented to the medical gastroenterology department. To best display portal venous architecture, disease, and venous collaterals, Color Doppler US was first done using the Philips Epiq 7G machine. The transducer and gain settings were changed in each instance. The work station was used to obtain portography pictures while the 256 Slice Phillips (Brilliance) was used to do CT. All of the patients underwent endoscopy, and the results were compared using the Pearson's Coefficient test to those obtained from USG and CT.

Results: Of the 90 patients, 26, 14, 38, and 12 had esophageal varices of Grades I–III and none at all. Grade I and II varices were not found in USG, however 8/12 Grade III varices were. All 38 cases of grade II varices and 12 cases of grade III varices were found using CT. For the diagnosis of paraesophageal, splenorenal, anterior abdominal wall, peri-umbilical, and peri-cholecystic collaterals, USG and CT showed excellent agreement (Kappa values >0.7). There was no agreement between USG and CT for the detection of esophageal, gastric mucosal, perigastric, and retroperitoneal collaterals.

Conclusion: Grade III varices are found by USG, while Grade II and III varices are found by CT. Compared to USG, CT is more effective at delineating all portosystemic collaterals. When defining intricate collateral routes, USG is less accurate than MDCT portal venous phase. In order to identify unanticipated varices that could cause considerable bleeding during liver transplant procedures, multislice CT can be used to detect potentially problematic varices by tracing the path of tortuous veins.

Keywords: Liver cirrhosis,Varices,MDCT portography, Color Doppler

INTRODUCTION

Every chronic liver illness eventually progresses to cirrhosis, which causes fibrosis, architectural disarray, and nodule formation that causes portal hypertension and is linked to ascites, hepatic encephalopathy, and esophagogastricvarices [1]. Esophageal varices have been reported to occur in 90% of cirrhotic patients [2]. After the initial varicealhemorrhage, those who survive may develop a series of consequences, such as hepatic encephalopathy, spontaneous bacterial peritonitis, and hepatorenal syndrome. Identification of those who are at risk and subsequent preventative treatment are therefore crucial. In patients with cirrhosis, hemorrhage occurs in 25 to 40% of cases and is linked to a 30% death rate. The risk of bleeding increases with varices size [3].

Due to the considerable mortality linked with variceal bleeding, patients with liver cirrhosis receive endoscopic esophageal screening [4]. High risk of bleeding was associated with moderate to large varices (5mm diameter), which were discovered on endoscopy in 30% of cirrhotic patients. Large varices call for endoscopic variceal ligation [5].

Extra-vascular anatomy is best described by CT imaging [6]. Due to its ability to acquire images and continuously during a single breath hold, the development of multidetector-row computed tomography (MDCT) has improved spatial resolution and eliminated motion artifacts [7]. As a result, MDCT is regarded as the best imaging technique in this situation [8]. The ability to post-process imaging data with a variety of three-dimensional (3D) reformatting techniques can improve the identification of the origin of the veins and the distribution of porto-systemic collateral vessels in patients with cirrhotic liver. By illustrating the path of these tortuous veins, MDCT angiography with three-dimensional vascular reconstructions can improve the surgeon's awareness of potentially troublesome varices. This knowledge is essential for liver transplants as well as other routine surgeries where unexpected varix can result in serious bleeding [9].

Following an initial diagnosis by follow-up, screening is indicated since it can reduce the incidence of variceal hemorrhage by 50%. MDCT is a less invasive, well-tolerated, less expensive screening method with improved sensitivity and specificity [10] compared to endoscopy, which has low compliance. Due to the high prevalence of liver cirrhosis in our country with life-threatening varices, we intended to conduct this study to evaluate the diagnostic effectiveness of MDCT scan over color Doppler in detecting esophageal varices in cirrhotic patients.

MATERIAL AND METHODS

We did this study with 90 patients at the Max Superspeciality Hospital (Saket), Gastroenterology department from May 2021 to May 2022. The median age of the patients and the split between males and women were noted. The study procedure was explained to all eligible subjects. The study included patients with decompensated liver cirrhosis of any origin. Patients with severe hematemesis, a history of contrast agent allergies, patients with renal failure or hepato-renal syndrome and patients who refused to participate in the trial were excluded.

All research participants underwent endoscopy, and the varices were ranked using a modified Paquet classification [11].

GRADING OF VARICES

Grade I: Varices in Grade I that rise barely above the mucosal level.

Grade II: Varices that protrude by one-third of the luminal diameter and cannot be crushed by air insufflations are classified as Grade II.

Grade III: Grade III varices that are in touch with one another and protrude up to 50% of the luminal diameter.

TECHNIQUE

Color Doppler Ultra Sound was performed usingPhilips Epiq 7G machine using a curvilineartransducer probe. Scans were obtained along sagittal and transverse axis and in supine and rightlateral decubitus positions. Selection of transducer and gain settings varied in each case for optimumdemonstration of portal venous anatomy andpathology.

CT was performed with a 256 Slice Phillips (Brilliance) whereas MRI was done using 3T Phillips (Inginia).

PATIENT PREPARATION

(1) Patients in fasting 6 hours before scan.
(2) No oral contrast was used.
(3) GFR had to be at least 90 ml/min.
(4) The patients were adequately hydratedwith water up to 2 litres.
(5) An intravenous cannula was introducedthrough accessible vein in upper limb.

PATIENT POSITION

(1) In supine position, using the scout imagescanning was done from base of lungs topubic symphysis in all phases.
(2) Pre-contrast images was taken at 5 mmthickness, at a slice pitch of 1.5, a gantryrotation period of 0.9s, and a table speedof 15 mm/ rotation. The X-ray tubevoltage was 120 kV, and current was 150mA.
(3) Images using a MDCT scanner weretaken in the arterial, portovenous, anddelayed phases for all patients. Allpatients received 100 ml of low osmolarnonionic iodinated material (Omnipaque350) introduced at an infusion rate of 3-5ml/s intravenous using a single powerinjector.
(4) Arterial phase images were acquired at 18s, portal phase images were acquired at 60s and delayed-phase images were alsotaken of the entire liver at 200s.
(5) All the data acquired were reconstructed and postprocessed on the workstation equipped withsoftware for generation of 3D images. ThePortography and portal venous phase images wereanalyzed for the presence of collaterals and theirsites were recorded.
(6) Dilated veins within and outside the wall of distalesophagus are called as EsophagealandParaesophagealVarices respectively. Esophagealvarices are evidenced by nodularity and protrusioninto the esophageal lumen. Dilated veins presentin the submucosal layer of the stomach are Gastric Mucosal Varices. Dilated veinssurrounding the stomach are PerigastricCollaterals. Enhancing tortuous vessels around the gall bladder.Veins along thespleen and left kidney were termed as SplenorenalCollaterals. Recanalizedparaumbilicalvein is seed dilated at ligamentumteres andfalciform ligament level. Dilated veins along theanterior abdominal wall and around the umbilicuswere called as Anterior Abdominal andPeriumbilical Collaterals respectively.

Data was collected and subjected to statistical analysis using SPSS version 24.

STATISTICAL ANALYSIS

Statistical tests were used and data were gathered, noted, coded and processed using SPSS software. The outcomes were gathered, collated, and statistically examined. In order to distinguish between USG and CT portography for the detection of varices in cirrhotic patients, the McNemar test is performed. The level of agreement between USG and CT portography is calculated using Cohens Kappa. Calculations were made between USG and CT for each type of collateral to determine the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy. The relationship

between USG and various endoscopic grading and CT and various endoscopic grading was examined using a non-parametric chi-square test.

RESULTS

In endoscopy, 66 patients out of 90 patients developed esophageal varices of various severity. In a sample population of 90 individuals, endoscopy identified 7grade I varices, 19 grade II varices and 6 grade III varices. Grade I and II varices were not found in USG, however 4 out of 6 Grade III varices were. All 38 cases of grade II varices and 12 cases of grade III varices were found using CT (Table 1).

The number of collaterals found using Color Doppler USG and CT portography, as well as the degree of agreement between the two imaging modalities is shown in Table 2 below. Only 8 cases of varices were found by USG, while 56 cases were found by CT. With a Kappa value of 0.112, there was no agreement between USG and CT portography. Compared to CT portography, USG has much lower sensitivity (14.29%) for detecting esophageal varices. Only 8 cases out of 56 cases discovered by CT portography were diagnosed by Color Doppler ultrasonography.

Para-esophageal collaterals were present in 36 out of 90 individuals. CT identified 36/36 (100%) instances, while USG identified 26/36 cases (72.22%). With a Kappa value of 0.757, there was good agreement between USG and CT identification for para esophageal varices. The sensitivity and specificity of the comparison between USG and CT portography were 72.2% and 100% respectively. Gastric mucosal varices were present in 20 out of 90 individuals. USG identified 6/20 patients (30%), while CT identified 36/36 cases (100%). With a Kappa value of 0.4, there was only moderate agreement between USG and CT identification of stomach mucosal varices. Table 3 compares USG and CT for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy.

Table 1: Comparison of different grades of esophageal varices classified on endoscopy, detected in CD USG and CT portography.

CT & USG VS Endoscopy		Negative, n (%)	Positive, n (%)	Total, n (%)
No Varices	Count (CT) Count (USG)	24(26.7) 26(28.9)	2(2.2) 0	26(28.9) 26(28.9)
Grade I	Count (CT) Count (USG)	10(11.1) 14(15.6)	4(4.4) 0	14(15.6) 14(15.6)
Grade II	Count (CT) Count (USG)	0 38(42.2)	38(42.2) 0	38(42.2) 38(42.2)
Grade III	Count (CT) Count (USG)	0 4(4.4)	12(13.3) 8(8.9)	12(13.3) 12(13.3)
Total	Count (CT) Count (USG)	34(37.8) 82(91.1)	56(62.2) 8(8.9)	90(100) 90(100)

Table 2: Degree of agreement between Color Doppler USG (CD) vs CT portography (CT) for different portosystemic collaterals

Varices	CD Positive, n (%)	CT Positive, n (%)	Positive in both, n (%)	CD only, n (%)	CT only, n (%)	Kappa Value	Degree of Agreement
Esophageal varices	8(8.9)	56(62.2)	56(62.2)	0	48(53.3)	0.112	Poor
Paraesophageal Collaterals	26(28.9)	36(40)	36(40)	0	10(11.1)	0.757	Substantial
Gastric Mucosal Varices	6(6.7)	20(22.2)	20(22.2)	0	14(15.6)	0.54	Moderate
Perigastric Collaterals	18(20)	48(53.3)	48(53.3)	0	30(33.3)	0.359	Fair

Table 3: Sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG vs CT for different portosystemic collaterals

Varices	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
Esophageal varices	14.29	100	100	41.46	46.67
Paraesophageal Collaterals	72.22	100	100	84.38	88.89
Gastric Mucosal Varices	30	100	100	83.33	84.44
Perigastric Collaterals	37.5	100	100	58.33	66.67

DISCUSSION

The majority (53.3%) of the patients included in our study were between the ages of 40 and 60. In the majority of instances, either persistent drunkenness or chronic hepatitis infection caused cirrhosis. Other causes include extra hepatic portal venous blockage, Wilson's disease, and non-alcoholic fatty liver disease. 4 out of 90 patients were classified as having cryptogenic cirrhosis, because there was no known reason for their condition.

The presence of varices in USG and CT was assessed at the sites listed below. Anterior abdominal wall, periumbilical, retroperitoneal, and pericholecystic regions, as well as the distal esophagus, paraesophageal, perigastric, gastric mucosal, splenorenal and sections of the stomach were investigated.

According to FengHua Li et al. [12], duplex Doppler is useless for identifying cirrhosis patients who are at risk for variceal hemorrhage. Only PV and LGV hemodynamics were assessed in the study's experimental and control groups. He came to the conclusion that the optimum modality is endoscopy, followed by PV hemodynamics. Contrary to this, in our study, Color Doppler Ultrasound was able to identify higher grade esophageal varices, making it a useful tool for the initial evaluation of cirrhosis patients.

Trans abdominal USG can be used as a common non-invasive approach for prediction of esophageal varices, according to Zhang et al [14] study on 286 patients. He only assigned a USG grade to the varices and compared the spleen diameter and PV hemodynamics with endoscopic findings.

In conjunction with our work, Young Jun Kim et al. [11] demonstrated that MDCT has sensitivity, specificity and accuracy for differentiating big from minor or no esophageal varices were 92 percent, 84 percent and 85 percent, respectively. They studied 67 patients with liver cirrhosis. Due to the difficulty in detecting minor varices, the overall sensitivity for the detection of varices was less than 70%.

CONCLUSION

A typical clinical condition in modern practice is liver cirrhosis exacerbated by portal hypertension. The first line USG test for evaluating liver cirrhosis is affordable, radiation-free and readily available. To delineate intricate collateral routes, USG falls short of MDCT portal venous phase. To prevent any unintentional vascular harm during intervention, it is crucial to mention these esophageal varices and other collaterals.

Esophageal varices detected by endoscopy can be detected more reliably by MDCT portography. Compared to USG, CT has greater sensitivity for detecting all higher grade II and III esophageal varices as well as other portosystemic collaterals. In addition to its application in identifying early HCC and monitoring nodule malignancy, CT portography can be utilized to assess collaterals in cirrhotic patients. In liver transplant procedures, MDCT portography is crucial for identifying troublesome varices that could cause copious bleeding by illuminating the intricate veins. The endoscope can be replaced by CT portography pictures in the detection of troublesome varices.

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