Application of color doppler ultrasound for diagnosis of liver cirrhosis gastroesophageal varices

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SUMMARY

Purpose: The most accurate and widespread method for diagnosis of gastroesophageal (GE) varices nowadays is upper gastrointestinal endoscopy. The value of color Doppler ultrasonography (CDUS) in correlation with endoscopy has never been extensively studied for liver cirrhosis (LC) patients. Aim of the study was to determine value of CDUS detecting GE varices in different grades of those on upper gastrointestinal endoscopy.

Material and methods: During two years period 144 LC patients were examined with CDUS for presence of portal hypertension and portal-systemic collaterals (PC). Statements 'positive' when signs of GE varices were present or 'negative' when GE varices were not present were made by an experienced sonologist. PC feeding GE varices were subdivided into two groups. Group I — left gastric vein and esophageal varices, and group II — short gastric veins and gastric (fundal) varices. In all 144 patients the upper gastrointestinal endoscopy was performed and GE varices were graded into three classes: class F0 (absent) — 11 patients; class F1 (small) — 49 patients, class F2 (medium) 52 patients and class F3 (large) — 32 patients.

Results: In endoscopic class F0 there were no statements 'positive' and 11 statements 'negative'. In class F1 there were 32 'positive' and 17 'negative' statements — sensitivity 65%. In class F2 there were 45 'positive' and 7 'negative' statements — sensitivity 87%. In class F3 there were 30 'positive' and 2 'negative' statements — sensitivity 94%. Overall sensitivity was 80%.

Conclusions: CDUS showed excellent sensitivity for advanced size GE varices and good overall sensitivity of 80%. CDUS provided information about different tributaries of GE varices as left gastric vein and short gastric veins. However the sensitivity of CDUS in class F1 was low (65%) and upper gastrointestinal endoscopy was much more efficient.

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INTRODUCTION

Bleeding from gastroesophageal varices (GE) is the worst ad most lifethreatening complication of liver cirrhosis (LC). Mortality after a first bleeding episode is around 50% and rebleeding brings additional 30% mortality per episode of bleeding [1,2]. That makes diagnosis of GE varices very important for LC patients. Upper gastrointestinal endoscopy is the most accurate and useful diagnostic modality for the diagnosis and management of GE varices, but it has some contraindications to be performed due to its relative invasiveness [3]. Color Doppler ultrasonography (CDUS) is an noninvasive diagnostic imaging modality providing anatomic and functional information about flow patterns in portal vein and tributaries. It can be employed to examine patients with LC for the presence and location of portal-systemic collaterals (PC) [4]. However, to our knowledge there are very few data about what

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is the accuracy of CDUS in diagnosis of GE varices. We undertook a study to compare accuracy of CDUS to diagnose GE varices in LC patients in comparison with upper gastrointestinal endoscopy.

MATERIAL AND METHODS

During continuous 29 months period (from May 1996 to September 1998), 144 patients admitted to our hospital aged from 5 to 82 years old with liver diseases were examined for portal hypertension and portal-systemic collaterals by CDUS. Patients were included in the study if they had LC verified by liver biopsy before admission or liver biopsy was done within one month from the CDUS examination. Liver biopsy was selected as inclusion criteria because it is the most reliable method for differential diagnosis of chronic liver disease and LC [5]. Patients were excluded from the study if they had: a) prehepatic or posthepatic portal hypertension due to other etiology than LC; b) had previous surgical portal systemic bypass procedures; c) upper gastrointestinal endoscopy was not performed. Patients after surgical shunting procedures were excluded because these procedures can alter natural anatomy of PC.

In all 144 patients the upper gastrointestinal endoscopy was performed to examine the presence of esophageal varices by several endoscopists. Gastroesophageal varices size was graded according simplified Japanese classification into four categories: class F 0 — varices are absent class F 1 — small varices; class F 2 — medium varices and class F 3 — large varices [6]. Differentiation between esophageal and gastric (fundal) varices was not made because of lack of reliable uniform diagnostic criteria used by different examiners who performed an upper gastrointestinal endoscopy. Endoscopic findings valuable for prediction of variceal bleeding as cherry-red spots were omitted because of inability to assess these by US imaging.

CDUS was performed with digital ultrasound scanner Logiq 500 (GE Yokagawa Medical Systems, Yokagawa, Japan). For the deep abdominal US scanning a curved linear array 3.5 MHz transducer was used for all investigations. For the evaluation of technically difficult to image patients a phased array 2.2 MHz sector transducer was used occasionally. All investigations were performed and interpreted by one sonologist. Patients were examined in basal fasting condition, in relaxed supine position. Ultrasound examinations were done in the morning between 8 AM and 12 AM, prior an intake of any medications, except of the emergency needs.

To detect gastroesophageal collaterals following regions and structures were scanned: a) around the confluence of portal vein for the left gastric vein collaterals; b) a region posterior to the left lobe of the liver and around the GE junction for presence of GE varices; c) a region around the upper medial pole of the spleen for the short gastric veins collaterals. Statements 'positive' when signs of GE varices were present or 'negative' when GE varices were not present were made. The statement that PC are present was based on following gray scale and CDUS imaging criteria:

1. Hypoechoic tortuous tubular or oval cystic structures (varices) in above described anatomic areas.
2. Varices demonstrated by CDUS in described anatomic areas.
3. Presence of hepatofugal flow in dilated left gastric and short gastric veins documented by CDUS.

GE collaterals were subdivided in two major groups based on CDUS findings. Group I collaterals included left gastric vein and esophageal varices (Figure 1). Group II collaterals included short gastric veins and gastric (fundal) varices (Figure 2).

RESULTS

Among 144 LC patients on endoscopy, 11 patients did not have GE varices (class F0); 49 patients had class F1 varices; 52 patients had class F2 varices and 32 patients had class F3 varices (Table 1).

Figure 1. Group I left gastric vein collateral.

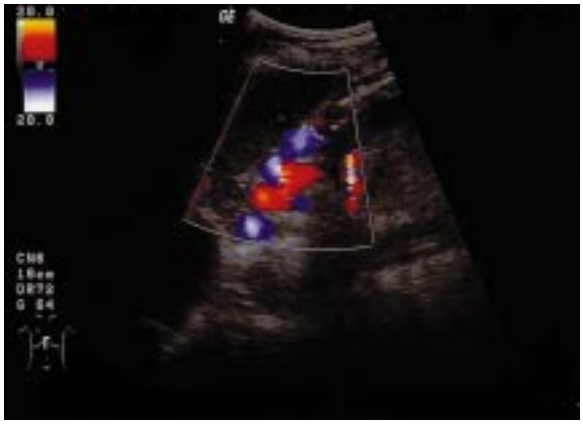
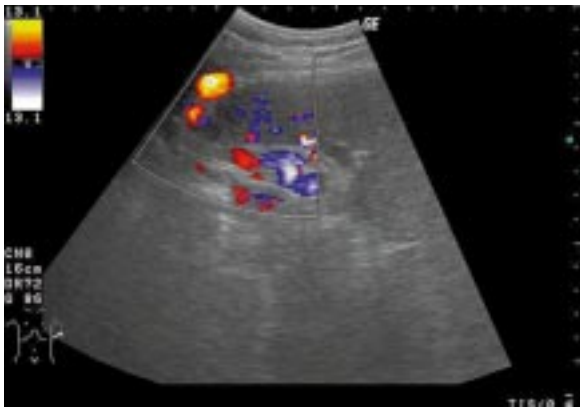


Figure 2. Group II short gastric veins collaterals.



In endoscopic class F 0 there were no statements 'positive' and 11 statements were 'negative'. In class F1 there were 32 'positive' and 17 'negative' statements — sensitivity 65% and specificity 100%. Among positive patients on CDUS 26 patients had group I collaterals, 15 had group II collaterals and 9 patients had both. In class F II there were 45 'positive' and 7 'negative' statements — sensitivity 87%. Among positive patients on CDUS 29 patients had group I collaterals, 25 had group II collaterals and 9 patients had both. In class III there were 30 'positive' and only two 'negative' statements — sensitivity 94%. Among positive patients on CDUS 21 patients had group I collaterals, 24 had group II collaterals and 15 patients had both. Overall sensitivity was 82% (Table 2).

Among 133 patients who had GE varices on endoscopy, 76 (57%) patients had group I; 64 (48%) patients had group II and 33 (25%) patients had both group I and group II PC on CDUS.

DISCUSSION

Presence of PC contributes to two major problems: development of portal-systemic encephalopathy due to shunting of intestinal blood directly into the systemic circulation, and formation of varices and variceal bleeding. The varices are usually formed in the locations where significant amount of shunting to the systemic circulation is present. Clinically most important site of PC varices is gastroesophageal junction because bleeding from those appears to be the primary direct cause of mortality among LC patients [1,2]. Bleeding from other than GE varices as mesenteric and hemorrhoid plexus appears to be a rare and minor problem (less than 7%) [7]. Collaterals as paraumbilical and splenorenal collaterals appears to be beneficial reducing

Table 1. Presence of PC on endoscopy and CDUS in LC patients.

	Patients No.	Positive No. (%)	Negative No. (%)
F0	11	0 (0%)	11 (100%)
F1	49	32 (65%)	17 (35%)
F2	52	45 (87%)	7 (13%)
F3	32	30 (94%)	2 (6%)

Table 2. Distribution of different groups of PC in LC patients.

	Positive No.	Group I No. (%)	Group II No. (%)	Both Group I and Group II No. (%)
F0	0	0	0 (0%)	0 (0%)
F1	32	26 (81%)	15 (47%)	9 (28%)
F2	45	29 (64%)	25 (56%)	9 (20%)
F3	30	21 (70%)	24 (80%)	15 (50%)

incidence of variceal bleeding as they diverts blood flow from the GE varices and decompress portal vein system [8].

Left gastric vein (LGV) (former called coronary gastric vein) is a direct tributary of the portal vein. It drains the abdominal part of the esophagus, where it usually anastomoses through the submucosal esophageal plexus with tributaries of the azygos venous system that drain the thoracic esophagus into the superior vena cava. Portal hypertension causes a hepatopetal flow in LGV and considerable distention of submucosal veins, producing esophageal varices [9,10]. The other possibility for GE varices to be fed is from the splenic vein through the short gastric veins toward the left gastric vein and the GE junction [10]. The short gastric veins usually supply fundal varices when esophageal varices are mostly supplied by LGV. In endoscopic classifications of the varices fundal and esophageal varices are frequently described together, however angioarchitecture of these varices is different and it should be separated in two types: cardiac and fundal [11]. Overall incidence and anatomic distribution of PSC in LC is different from study to study and depends on the imaging method. The most reliable results seem to be in Okuda study where the transhepatic portography in 460 PHS patients was employed [12]. In this study left gastric vein collaterals and esophageal varices are found in up to 80-90% of the cirrhotic patients whether short gastric veins are not so frequent and are found in up to 34%.

Upper gastrointestinal endoscopy is very accurate diagnostic method examining LC patients for both

esophageal and gastric varices and its value in management of GE varices cannot be underestimated. However this method has some contraindications to be performed and is unpleasant to the patient [3].

CDUS is novel noninvasive imaging modality. Bolondi first described ultrasound diagnosis of portal hypertension in 1982 [13] and in 1987 Burns reported application of US Doppler flowmetry to diagnose PHS [14]. CDUS provides combination of cross section anatomy and functional imaging. This method identifies blood vessels not seen on conventional B-mode scanning and fills their lumen with color coded information about the direction and speed of blood flow. CDUS in portal hypertension provides information about: a) location and size of PC b) flow direction in PV, branches and tributaries [4,15]. To our knowledge there are very few data about its value to diagnose GE varices in LC patients if compare with other imaging modalities.

In our clinical setting CDUS showed good correlation with endoscopy findings in LC patients with medium — F2 and large — F3 varices: 87% and 94% respectively. It was not so sensitive when patients had small varices F 1 — 64% but overall sensitivity of CDUS was good — 80%. Unfortunately, exact negative predictive value and specificity cannot be established from this study because we had small 11 patients sample who were free of GE varices and an the sonologist in some cases could be biased by previously known endoscopy findings. Surprisingly we found high incidence of PC of short gastric veins on CDUS images — 64 (48%) of patients among 133 positive on endoscopy had those PC. These collaterals generally are easier to image by ultrasonography than left gastric vein and esophageal varices because of their proximity to the abdominal wall. Also spleen serves as good acoustic window for CDUS.

In this study population we had very high incidence of GE varices on endoscopy — 92%. It could be explained that majority of patients with LC were referred to CDUS examination by an attending physician when they had GE varices on endoscopy. Because of lack of agreement between different investigators who performed upper gastrointestinal endoscopy we were not able to compare CDUS findings with endoscopy for different types of GE varices as esophageal and gastric (fundal).

We did not find reports in the literature concerning distribution of different PC that could feed GE varices based on CDUS imaging and correlating those findings with other imaging modalities.

CONCLUSIONS

CDUS appears to be valuable imaging modality to evaluate presence of GE varices in patients with LC. It provides excellent sensitivity for patients with advanced GE varices and overall sensitivity of 80% when different sizes of varices are present. CDUS provides information about different possible tributaries of GE varices as left gastric vein and/or short gastric veins. However the sensitivity of CDUS in endoscopic class F 1 liver cirrhosis patients is low (65%) and upper gastrointestinal endoscopy is much more effective for detection of small GE varices.

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