

Original paper

Correlation of endoscopic findings with Doppler ultrasound in portal hypertension in children

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Abstract

Aim of the study: To determine the correlation of the endoscopic findings with portal Doppler and ultrasound (USG) in children with suspected portal hypertension (PHT).

Material and methods: Eighty children with extrahepatic portal vein obstruction (EHPVO) and chronic liver disease (CLD) were included in this retrospective study conducted over a period of 1 year. All patients underwent upper gastrointestinal (GI) endoscopy and Doppler.

Results: The etiology was EHPVO in 30 (37.5%) patients, biliary atresia in 12 (15%), Budd-Chiari syndrome in 11 (13.7%), Wilson's disease in 10 (12.5%), idiopathic CLD in 8 (10%), autoimmune hepatitis in 4 (5%), glycogen storage disease (GSD) in 3 (3.8%), non-alcoholic liver disease (NAFLD) in 1 (1.3%) and systemic lupus erythematosus (SLE) in 1 (1.3%) patient. Fifty-three (66.25%) patients had esophageal varices on endoscopy, of whom 3 (3.8%) had associated gastric varices. Portal hypertensive gastropathy (PHG) was present in 30 (37.5%) patients, of whom 10 (12.5%) had severe PHG. Forty-one (51.3%) patients had PHT on Doppler (κ correlation 0.43). Kappa correlation was 0.43 in patients with biliary atresia, 0.31 in Budd-Chiari syndrome, 0.23 in idiopathic CLD, 0.21 in CLD, and 0.05 in Wilson's disease. All (100%) EHPVO patients and 39 (78%) CLD patients had PHT on USG. Endoscopic findings of PHT were seen in 24 (80%) EHPVO patients and 29 (58%) CLD patients. All patients with EHPVO had cavernous transformation of the portal vein on Doppler. For patients with CLD, the common Doppler findings were collaterals seen in 35 patients and reversal of flow in 12 patients.

Conclusions: Doppler ultrasound followed by endoscopy should be used to diagnose PHT in children. In children with biliary atresia, Doppler ultrasound may miss changes of PHT.

Key words: children, PHT, EHPVO, upper endoscopy, CLD.

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Introduction

A variety of liver disorders, which may lead to portal hypertension, are encountered in children which are distinct from adults. Normal portal venous pressure is 7 mmHg. Hepatic venous portal gradient (HVPG) is defined as portal pressure above 10-12 mm of Hg [1, 2]. HVPG results from a combination of increased portal blood flow and increased portal resistance [1]. In Indian children, variceal bleeding has been found to be the foremost reason for upper gastrointestinal (GI)

bleeding compared to peptic ulcer in the western world [2]. In the Indian scenario, extrahepatic portal vein obstruction (EHPVO) is the cause of portal hypertension (PHT) in 68-76% cases. The other common causes are cirrhosis (24-28%), non-cirrhotic portal fibrosis (4%) and Budd-Chiari syndrome (3%) [2]. PHT results in portosystemic communicating venous channels at numerous sites giving rise to oesophageal, gastric and colonic varices [2]. PHT manifests with complications such as varices or portal hypertensive gastropathy. Very often, the two conditions occur concomitantly.

The endoscopic appearance of portal hypertensive gastric mucosa includes several lesions such as: fine pink speckling, scarlatina-type rash petechia, multiple bleeding spots, papules, superficial reddening, snake-skin pattern, cherry red spots and mosaic-like pattern [3]. As the portal hypertensive gastropathy (PHG) becomes more severe, the mucosa becomes friable and bleeds on contact. Frequently, hemorrhagic spots are seen on the gastric mucosa. Typically, PHG is most evident in the proximal stomach. Clinically, varices present with acute onset of upper GI bleeding which might be torrential and life-threatening because of high pressure in the distended veins [3, 4]. Patients with PHG also present with upper GI bleeding.

Ultrasound (USG) with Doppler is the first-line imaging examination to be performed in patients with suspected liver disease and/or PHT. It is safe, easily repeatable, not very expensive and very sensitive in detecting thrombosis in the portal vein and hepatic veins. These features enable the formation of correct differential diagnoses in new cases of PHT [5-7]. Only two signs are 100% specific signs of PHT: porto-systemic collaterals (e.g. paraumbilical vein, spleno-renal collaterals, etc.) and reversal of flow within the portal vein system. Splenomegaly is often related to PHT; this sign is more sensitive than other signs but less specific. However, increasing spleen size is an independent predictor of gastroesophageal varices in compensated cirrhosis cases [6]. Other signs include dilatation of the portal venous system vessels, lack of or reduced respiratory variations of splenic and superior mesenteric vein diameter, reduced portal vein velocity, increased congestion index of the portal vein and an altered Doppler pattern in the liver veins [7, 8]. Less commonly explored signs include changes in the arterial flow pattern of the hepatic, splenic, mesenteric and renal arteries. As most of these signs show some degree of correlation with the HVPG, none of them can be used as a reliable surrogate for hemodynamic measurement either at first examination or after starting non-selective β -blocker therapy [9, 10]. Hence, we conducted this study to determine the correlation of the endoscopic findings with portal Doppler and USG in children with suspected PHT.

Material and methods

Eighty children who underwent endoscopy were included in the study. This retrospective study was conducted over a period of 1 year from June 2018 to 2019 after approval from the hospital ethics committee. Patients with chronic liver disease (CLD) or EHPVO were included in the study [11]. PHT on Doppler was

diagnosed if there was reversal of flow, presence of gastric or splenic collaterals or presence of portal cavernoma [6].

Doppler ultrasound was done before endoscopy. Most of the patients had USG examination earlier also and were known to have PHT.

All endoscopies were performed using an Olympus GIF-H170 Optera video gastrointestinal scope. Endoscopic features of portal hypertension such as presence of esophageal varices, number of varices, grade of varices [12] and presence of fundic varices were noted. Mild PHG was diagnosed if there was presence of snake skin pattern in the stomach and severe PHG was associated with erosions [13].

Laboratory and demographic data at the time of endoscopy such as age, gender, etiology of CLD, liver function tests, hemogram, and Child-Pugh score were noted. Thrombocytopenia was determined if the platelet count was $< 150,000$ cells/mm³.

Aspartate aminotransferase (AST) to platelet ratio index (APRI) score was calculated using the following formula:

$$\text{APRI score} = \left[\frac{\text{AST/upper normal limit of AST}}{\text{platelet count}} \times 100 \right]$$

AST was measured in IU/l, the upper normal limit was taken as 40 IU/l. The platelet count was measured in $10^9/l$.

Statistical analysis

Prevalence of PHT on endoscopy and Doppler ultrasound was determined. Kappa correlation was used to determine the agreement between PHT detected on endoscopy and that with Doppler in various etiologies of PHT. Kappa < 0 was considered as less than chance agreement, 0.01-0.20 slight agreement, 0.21-0.40 fair agreement, 0.41-0.60 moderate agreement, 0.61-0.80 substantial agreement and 0.81-0.99 almost perfect agreement.

Results

The mean age at the time of endoscopy was 7.38 ± 4.17 years with a range of 1-18 years. Male : female ratio was 51 : 29. The etiology was EHPVO in 30 (37.5%) patients, biliary atresia in 12 (15%), Budd-Chiari syndrome in 11 (13.7%), Wilson's disease in 10 (12.5%), idiopathic CLD in 8 (10%), autoimmune hepatitis in 4 (5%), glycogen storage disease (GSD) in 3 (3.8%), non-alcoholic liver disease (NAFLD) in 1 (1.3%) and systemic lupus erythematosus (SLE) in 1 (1.3%) patient. Previous hematemesis was noted in 19 (23.7%) patients and 13 (16.3%) had melena.

Forty-one (51.2%) patients had thrombocytopenia. The mean hemoglobin was 10.32 ± 1.32 gm/dl, white cell count was 7.58 ± 4.54 cells/mm³ and platelets of 1.82 ± 1.09 cells/mm³. Mean serum glutamic-oxaloacetic transaminase (SGOT) was 89.62 ± 193.79 IU/l and serum glutamic pyruvic transaminase (SGPT) was 70.10 ± 147.57 IU/l. Splenomegaly was present in 62 (77.5%) patients. The mean splenic size on USG was 70.10 ± 147.57 mm. On Doppler, 41 (51.3%) had changes of PHT. All (100%) EHPVO patients and 39 (78%) CLD patients had PHT on USG. Endoscopic findings of PHT were seen in 24 (80%) EHPVO patients and 29 (58%) CLD patients. All patients with EHPVO had cavernous transformation of the portal vein on Doppler. For patients with CLD, the common Doppler findings were collaterals seen in 35 patients and reversal of flow in 12 patients. Fifty-three (66.25%) patients had esophageal varices on endoscopy (κ correlation 0.43), of whom 3 (3.8%) had associated gastric varices. PHG was present in 30 (37.5%) patients, of whom 19 (23.7%) had mild PHG, and 1 (1.3%) and 10 (12.5%) had severe PHG. Correlation of endoscopic findings and Doppler ultrasound is depicted in Table 1. Table 2 compares factors associated with endoscopic PHT and no endoscopic PHT. The platelet count ($p = 0.06$) and APRI index ($p = 0.031$) were significant-

ly lower in patients with endoscopic PHT. Factors associated with CLD and EHPVO are analyzed in Table 3.

Discussion

Whenever there is associated liver disease, the course of portal hypertension per se becomes more complicated due to signs of liver failure such as jaundice, ascites, encephalopathy, etc. along with the usual GI bleeding. At times, patients may present without evidence of portal hypertension. Hence, such patients should undergo diagnostic endoscopies to look for varices [14]. The Doppler ultrasound did not detect PHT in patients with biliary atresia, which was subsequently detected on endoscopy. The risk of portal hypertension in biliary atresia patients is high in the early years of life [15]. Hence, diagnostic endoscopy should be performed in these patients. Due to the rarity of spontaneous regression of varices, primary prophylaxis for bleeding is indicated in patients with gastric varices along the cardia, esophageal varices and red markings [15]. Portal hypertension was seldom seen in patients with Wilson's disease in our study and hence Doppler and upper GI endoscopy were equivalent.

Extrahepatic portal vein obstruction is defined as the obstruction of the extrahepatic portal vein with

Table 1. Correlation of portal hypertension (PHT) as detected by ultrasound (USG) and endoscopy according to diagnosis

Diagnosis	n	USG PHT n (%)	Endoscopic PHT n (%)	κ correlation
EHPVO	30	30 (100.0)	24 (80.0)	NA
CLD	50	39 (78.0)	29 (58.0)	0.21 (fair)
Biliary atresia	12	9 (75.0)	11 (91.7)	0.43 (moderate)
Budd-Chiari syndrome	11	9 (81.8)	5 (45.5)	0.31 (fair)
Wilson syndrome	10	8 (80.0)	3 (30.0)	0.05 (slight)
Idiopathic CLD	8	7 (87.5)	5 (62.5)	0.23 (fair)

CLD – chronic liver disease

Table 2. Comparison of endoscopic portal hypertension (PHT) with no endoscopic PHT

Variable	Endoscopic PHT (varices and/or portal HT gastropathy) (n = 53)	No PHT on endoscopy (n = 27)	P value
Platelet count	1.75 ± 1.50	2.21 ± 1.30	0.06
Thrombocytopenia	30 (56.6%)	11 (42.3%)	0.24
APRI score	1.11 ± 1.03	2.70 ± 5.99	0.031
Splenomegaly	50 (94.3%)	12 (44.4%)	< 0.00001

Table 3. Factors associated with chronic liver disease and extrahepatic portal vein obstruction (EHPVO)

Factors	Chronic liver disease (n = 50)	EHPVO (n = 30)	P value
Ultrasound findings			
Reversal of flow	12 (24%)	4 (13.3%)	0.387
Gastric or splenic collaterals	35 (70%)	26 (86.7%)	0.110
Thrombocytopenia	25 (50%)	16 (53.3%)	0.820
Previous hematemesis (no. of episodes)	4.32 ± 2.77	5 ± 0	0.092
Previous melena	6 (12%)	13 (43.3%)	0.002
Splenomegaly	38 (76%)	26 (86.7%)	0.171
Platelet count ($\times 10^9$ cells/mm ³)	1.97 ± 1.35	1.79 ± 1.10	0.263

or without the involvement of the intrahepatic portal veins. It is characterized by features of recent thrombosis or portal hypertension with portal cavernoma as a sequela of portal vein obstruction [11]. Usually, Doppler ultrasonography is the first imaging modality used and is accurate in the assessment of the portal venous system [16]. EHPVO in childhood is most often chronic and presents with features of variceal bleeding and splenomegaly [16]. Initial thrombus formation is asymptomatic and the only sign may be the formation of new vessels, which on Doppler ultrasonography is known as portal cavernoma. Thus, most patients with EHPVO will have collaterals on Doppler.

Endoscopy has a significantly higher sensitivity regarding the diagnosis of portal hypertension and permits visualization of collaterals belonging to intrinsic (deep) venous circulation, which if large can significantly increase the risk of variceal bleeding. Also, therapeutic intervention can be done at the time of endoscopy. Children with thrombocytopenia and splenomegaly can be considered for surveillance endoscopy with an intention to treat using sclerotherapy or band ligation [17]. Patients with low platelet counts and low APRI scores are more likely to have findings of PHT on endoscopy. Unfortunately, it is an invasive procedure and remains not widely available [18-20]. On the other hand, Doppler ultrasound is a non-invasive method that provides precise information regarding blood flow in major vessels of the abdomen [21]. However, it remains non-therapeutic. Plestina *et al.* [22] suggested that Doppler ultrasound may be of use in prediction of the risk for oesophageal variceal bleeding. However, these findings are inconsistent with the results of other studies. For example, Berzigotti *et al.* [23] found that color Doppler ultrasound played no role in predicting clinically significant portal hypertension and esophageal varices. Also, Cioni *et al.* [24] found no relationship between the parameters of portal flow and the risk of bleeding, while Li *et al.* reported that Doppler ultrasound parameters of the portal vein exhibited no correlation with the severity of endoscopic abnormalities in patients with cirrhosis [21].

Conclusions

Both endoscopy and Doppler ultrasonography are needed to best diagnose and for appropriate management of portal hypertension. Doppler ultrasonography, being non-invasive, should be used first, after which detailed evaluation can be carried out by endoscopy. It is extremely useful in patients with EHPVO. However, in children with biliary atresia, endoscopy may be performed even if the Doppler does not show changes of PHT.

Limitations

Most patients were known to have PHT as they had undergone US examination earlier. This could have promoted observer bias.

Disclosure

The authors declare no conflict of interest.

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