

Measuring of Gastric Emptying in Egyptian Pediatric Patients with Portal Hypertension by Using Real-time Ultrasound

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ABSTRACT

Background/Aim: Among the various methods for evaluating gastric emptying, the real-time ultrasound is safe, does not require intubation, or rely on either radiologic or radionuclide technique. The aim of our work was to measure the gastric emptying in pediatric patients with portal hypertension by using the real-time ultrasound. **Patients and Methods:** Forty patients with portal hypertension with mean age 7 ± 2.8 years and 20 healthy children as a control group underwent gastric emptying study by using real-time ultrasound. The cross-sectional area of the gastric antrum was measured in the fasting state and then each subject was allowed to drink tap water then calculated by using formula $\text{area} (\pi \text{ longitudinal} \times \text{anteroposterior diameter} / 4)$. The intragastric volume was assumed to be directly proportional to the cross-sectional area of the antrum. **Results:** The mean gastric emptying half-time volume was significantly delayed in portal hypertension patients (40 ± 6.8 min) compared with the control subjects (27.1 ± 3.6 min) ($P < 0.05$). Patients with extrahepatic portal vein obstruction had significant delayed gastric emptying in comparison to patients with portal hypertension due to other etiologies (36.14 ± 4.9 vs 44.41 ± 6.04 min; $P < 0.01$). **Conclusion:** Ultrasound is a noninvasive and a reliable method for measuring gastric emptying in pediatric patients. Gastric emptying was significantly delayed in patients with portal hypertension. Etiology of portal hypertension may influence gastric emptying time in patients with chronic liver disease.

Key Words: Gastric emptying, liquid, pediatric, ultrasound

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Ultrasonography has been widely used to assess gastric emptying rates and is best suited for emptying of liquid meals.^[1] It is safe, noninvasive, and simple to perform with appropriate equipment. Measuring the gastric antrum volume or area by using ultrasonography is an indicator of gastric emptying and can be considered as an alternative to the conventional radioisotopic method in the study of gastric emptying.^[2] Ultrasound measurement of the antral volume can be undertaken in any subject, irrespective of gas contents in the fundus, and can also be used after any type of meal.^[3]

In patients with liver cirrhosis, abnormal gastric emptying has been reported in up to 78% cases. The delayed gastric

empty was correlated to the severity of liver disease, as indicated by the Child–Pugh status, bilirubin level, prothrombin time, and presence of esophageal varices.^[4] Portal hypertensive gastropathy occurs as a complication of cirrhotic and noncirrhotic portal hypertension. There is a general agreement that the prevalence of portal hypertensive gastropathy increases with esophageal varices obliteration.^[5]

Gastrointestinal symptoms such as dyspepsia, anorexia, and abdominal distension in patients with portal hypertension may be due to delayed gastric emptying.^[6] The aim of the current study was to measure gastric emptying in pediatric patients with portal hypertension by using real-time ultrasound. To the best of our knowledge this is the first Egyptian study of gastric emptying in pediatric patients with portal hypertension by using real-time ultrasound.

PATIENTS AND METHODS

Forty patients with portal hypertension presented to the

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Pediatric Endoscopy Unit, Cairo University Children's Hospital, Egypt, were enrolled in the study.

Twenty age- and sex-matched healthy children without any abdominal symptoms or history of gastrointestinal diseases served as the control group. The healthy subjects were not on any regular medications.

A detailed history was obtained with a special emphasis on the frequency of the epigastric pain (its relationship to meal ingestion), hematemesis, drug intake that may affect gastrointestinal empty (prokinetics, fundic relaxing drugs, H2 receptor antagonist, and proton pump inhibitors) and a history of upper gastrointestinal endoscopy (sclerotherapy and/or band ligation for varices). Patients with severe hepatic dysfunction, acute gastrointestinal bleeding, severe ascites, previous gastric surgery, or any gastrointestinal diseases that may affect gastric emptying, were excluded from the study.

An upper gastrointestinal endoscopy was performed for all patients using gastrointestinal endoscope (Olympus XQ-30). Esophageal varices when present were graded according to the scheme described by Dagradi *et al.*,^[7] whereas the severity of endoscopic gastropathy was graded according to McCormik *et al.*^[8]

Abdominal ultrasound examination and gastric emptying study were performed for patients and controls using Hitachi-EUB 200 device (Kashiwa-Shi, Chiba, Japan) with 3.5 MHz convex transducer. All ultrasound study was performed by the same operator. For gastric emptying study all the patients and controls were examined after an overnight fast. They were instructed to stop any medication that could potentially affect gastric emptying 48 h prior to the study.

They were all examined in the supine position. Measurement of the cross-section area of the gastric antrum was done in the fasting state. We followed the method described by Bolondi *et al.*^[3] Measurements of the gastric antrum were taken from the outer profile of the wall because the lumen of the inner side of the wall is difficult to outline.

The cross-section of the gastric antrum corresponds to the sagittal plane passing through the superior mesenteric vein, and because it is in an elliptical shape, its area was calculated in all the subjects by measuring the longitudinal (A) and anteroposterior (B) diameter using the formula area = $\pi AB/4$; where $\pi = 3.14$. The intragastric volume was assumed to be directly proportional to the cross-sectional area of the antrum.^[3,9]

The cross-sectional area of the gastric antrum was measured in the fasting state. Then each subject was allowed to drink tap water adjusted to provide a volume of 20 ml/kg then

re-measuring the antral volume every 15 min for 1 h.^[9] Sonography was always performed by the same investigator.

The gastric emptying time was calculated by regression equation curve.

The parents or the guardians of the patients and the healthy controls were informed about the study goals, safety, and the benefits from sharing in this study. Written consents were obtained from the parents or the guardians of the patients and control subjects.

Statistical analysis

Statistical analysis was performed using the SPSS program version 11 (SPSS Inc, Chicago, IL, USA). Student's test was used for the analysis of continuous variables and Spearman rank test for correlation. $P < 0.05$ was considered statistically significant. Results were expressed as mean \pm standard deviation. Linear regression was used to calculate the half gastric volume.

RESULTS

Forty patients with portal hypertension (28 males, 12 females; mean age 7.08 ± 2.77 years) and 20 healthy children (11 males, 9 females; mean age 8.25 ± 2.24 years) as control group; were entered in the study. The age and sex were not statistically significantly different between the patients and the control ($P > 0.05$).

Clinical characteristics of the patients are shown in Table 1.

The mean gastric emptying half volume time measured by ultrasound was significantly delayed in portal hypertension patients [40 ± 6.8 min (range 21.7–54.7)] compared with that in normal controls [27.1 ± 3.6 min (range 21.4–36 min)] ($P < 0.05$).

According to the etiology of portal hypertension, patients with extrahepatic portal vein obstruction had significant delayed gastric emptying compared with patients with

Table 1: Clinical characteristics of the patients

	Patients N (40)
Etiology of portal hypertension	
Extrahepatic portal vein obstruction [n (%)]	21 (52.5)
Liver cirrhosis (hepatitis B or C) [n (%)]	9 (22.5)
Congenital hepatic fibrosis [n (%)]	6 (15)
Cryptogenic cirrhosis [n (%)]	2 (5)
Veno-occlusive disease [n (%)]	2 (5)
Gastrointestinal symptoms	
Recurrent abdominal pain [n (%)]	15 (37.5)
Early satiety and/or bloating [n (%)]	16 (40)
Nausea and/or vomiting [n (%)]	18 (45)
Hematemesis [n (%)]	40 (100)

portal hypertension due to other etiologies (36.14 ± 4.9 vs 44.41 ± 6.04 min; $P < 0.01$). Gastric emptying half volume time was not significantly different between patients with congenital hepatic fibrosis (47.75 ± 3.74 min) and patients with chronic viral hepatitis (43.61 ± 5.2 min).

Changes in the antral volume with time among the controls group and portal hypertension patients is shown in Figure 1.

Endoscopic findings among patients with portal hypertension revealed erythema of the esophageal mucosa in 11 (27.5%) and incompetent cardia in 5 (12.5%) patients. Severe portal hypertensive gastropathy was found in 14 (35%) patients, mild form in 24 (60%) and normal gastric mucosa in 2 (5%). Normal duodenal mucosa was evident in 30 (75%) patients and mild erythema of the duodenal mucosa in 10 (25%) patients. All patients had esophageal varices and received sclerotherapy. Seven (17.5%) patients had gastric varices and 2 (5%) had duodenal varices.

DISCUSSION

In the present study the gastric emptying time measured by real-time ultrasonography, was significantly delayed in patients suffering from portal hypertension compared with the controls. Delayed gastric emptying in patients with chronic liver disease has been reported by several authors.^[4,10-13] On the contrary, Madsen *et al.*^[14] reported accelerated gastric emptying in patients with portal hypertension and Galati *et al.*^[15] reported that the presence of cirrhosis had not affected gastric emptying in patients with liver cirrhosis.

Balan *et al.*^[11] observed that the gastric emptying was disturbed in patients with portal hypertension and received sclerotherapy, which may contribute to portal hypertensive gastropathy. Gastroparesis in patients with liver cirrhosis may be due to autonomic dysfunction, which correlated positively with delayed gastric emptying.^[16]

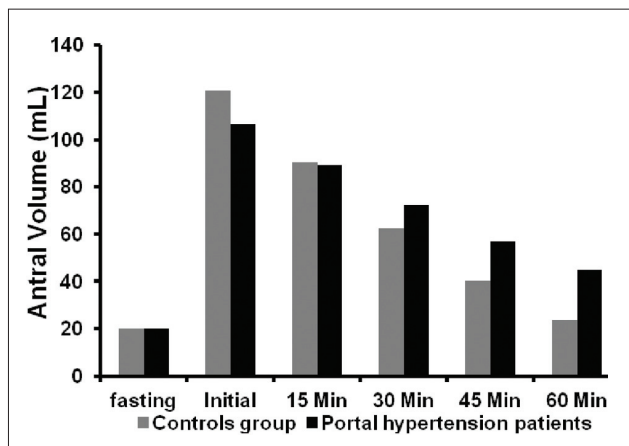


Figure 1: Antral volume variation with time among patients and controls

The overall prevalence of portal hypertensive gastropathy ranges from 20% to 98% among patients with known cirrhosis.^[5,17-24] Although it is not clear what factors play the most important role in the development of portal hypertensive gastropathy, there is a general agreement that, the incidence and severity of portal hypertensive gastropathy increases with esophageal varices obliteration.^[5,25,26] A delay in gastric emptying in patients with portal hypertension can aggravate or lead to the development of portal hypertensive gastropathy due to the deleterious effects of endogenous substances, such as acid and pepsin.^[11]

In the current study, patients with extrahepatic portal vein obstruction had significantly delayed gastric emptying compared with patients with portal hypertension due to other etiologies. This observation may reflect the effect of etiology of portal hypertension on gastric emptying. In contrast to our results, Sadik *et al.*^[27] found that gastric emptying was not delayed in patients with idiopathic portal vein thrombosis compared with healthy controls. To conclude, real-time ultrasound is a noninvasive technique, safe, does not require intubation and it is a reliable method for the evaluation of gastric emptying, especially in pediatric patients. We have shown delayed gastric emptying in patients with portal hypertension, which seems to be linked more with the etiology of portal hypertension.

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