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Research Article

MSCT in Determining the Signs of Possible Bleeding from Gastric Varices

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Abstract

Gastric varices are considered as one of the main causes of gastrointestinal bleeding in patients with portal hypertension caused by liver cirrhosis. Such bleeding is often more severe than bleeding from esophageal varices, and control of hemostasis is problematic. With esophagogastroduodenoscopy differentiation between varicose veins and gastric folds can be difficult. Currently, most patients with liver cirrhosis undergo multispiral computed tomography (MSCT) to assess the severity of liver cirrhosis, identify hepatomas, detect esophageal varices, determine the presence and severity of ascites, splenomegaly. Little attention has been paid to the differentiation of gastric varices.

Aim: To establish the parameters of gastric varices which determine a high risk of gastric bleeding according to the results of multispiral computed tomography.

Material and Methods: The results of studies of 61 patients with liver cirrhosis and gastric varices were retrospectively studied. 9 of them had signs of bleeding on endoscopic examination or the corresponding data in the medical history. In 5 patients gastric bleeding occurred 28-52 days after MSCT. MSCT was performed mainly according to the standard multiphase scanning technique, but with the addition of hydro-CT.

Results: According to the results of MSCT with multiplanar reconstructions gastric bleeding was detected in patients with protrusion of submucosal varicose veins into the gastric lumen by 5 mm or more with a vein diameter > 7 mm.

Conclusion: Based on the results of standard MSCT it is possible to predict the development of gastric bleeding and to select patients for preventive minimally invasive interventions on the gastric veins.

Keywords: CT; Portal Hypertension; Gastric Varices

Introduction

Portal hypertension is a typical clinical syndrome caused by an abnormal increase in pressure in the portal vein. Varicose veins develop when the hepatic venous pressure gradient is >10 mmHg, and when the gradient is >12 mmHg veins begin to bleed. This severe complication often results in massive bleeding from the upper gastrointestinal tract. 50-80% of patients with cirrhosis eventually develop esophageal or gastric varices [1]. Screening esophagogastroduodenoscopy for severe varicose veins of the esophagus and stomach is associated with a risk of a lethal complication, but this procedure is regularly prescribed for patients with a high risk of bleeding [2]. In addition, differentiation between varicose veins and gastric folds can be difficult, especially in patients with portal hypertensive gastropathy. Bleeding from gastric varices is often more severe than esophageal bleeding, and hemostasis control is difficult. Measurement of the hepatic venous

pressure gradient is currently not recommended for screening for varicose veins, although it is a predictor of hepatic decompensation [3].

Currently, most patients with liver cirrhosis undergo multislice computed tomography (MSCT) to assess the severity of liver cirrhosis, identify hepatomas and varicose veins of the esophagus, determine the presence and severity of ascites, splenomegaly. However, not enough attention is paid to the differentiation of gastric varicose veins. The development of MSCT increasingly allows the detection of spontaneous portosystemic shunts. Computed tomography is non-invasive, does not require sedation, and at the same time allows you to identify and accurately measure varicose veins. It is reasonable to assume that most patients tolerate CT better than endoscopy. Moreover, if the accuracy of MSCT in determining varicose veins of the esophagus and stomach is significant, it can be assumed that the strategy of using MSCT at the first stage of patient examination can be cost-effective in the dynamic monitoring of varicose disease [1].

Materials and Methods

The present study included the results of CT examinations of 61 patients (42 men and 19 women) aged 55 to 72 years. The selection criteria were: 1) a confirmed diagnosis of liver cirrhosis, 2) the presence of portal hypertension, 3) the presence of MSCT data with multiphase contrast enhancement, 4) standard CT was supplemented with hydro-CT for adequate visualization of the walls of the stomach 5) the presence of anamnesis materials six months before and six months after CT.

In addition to general information about the patients, data from laboratory and instrumental research methods, special attention in a case history was given to determining the signs of gastrointestinal bleeding, especially gastric bleeding, confirmed by endoscopic examination of the upper gastrointestinal tract. We divided patients into 2 groups in accordance with anamnesis: 1) 14 patients with gastric bleeding: 9 had history of bleeding but did not undergo endoscopic treatment and 5 patients had gastric bleeding within six months (in practice, 28-52 days) after MSCT, 2) 47 patients with no history of endoscopic treatment and gastroesophageal bleeding, with no signs of bleeding within six months after CT scan.

MSCT was performed mainly according to the standard multiphase scanning technique, but with the addition of hydro-CT. Before the study, each patient was asked to drink slowly, in small sips, up to 1 liter of pure water for 40-60 minutes to adequately visualize the loops of the small intestine. Immediately before the study, patients were asked to quickly drink 500-600 ml of water to stretch the walls of the stomach (hydro-CT technique). This patient preparation technique is considered standard for abdominal CT in the basic clinics of the Radiology Department of Pirogov Russian National Research Medical University. Computed tomography of the abdomen was usually performed with a 3- or 4-phase scanning after a bolus intravenous injection of a contrast agent in a volume of 100-120 ml, at a rate of 3-5 ml/sec. The condition of the gastric veins was assessed in the late arterial and/or parenchymal phases of contrast enhancement. Preference is given to late arterial phase (if available). Air insufflation is also possible to stretch the stomach.

According to the classification set out in [4], gastroesophageal varices were classified as follows:

- **Gastroesophageal varix type 1 (GOV1):** Spreading of esophageal varices along lesser curvature;
- **Gastroesophageal varix type 2 (GOV2):** Spreading of esophageal varices along great curvature;
- **Isolated gastric varix type 1 (IGV1):** Gastric fundal varices;
- **Isolated gastric varix type 2 (IGV2):** Varices of gastric body, pilorus and antrum or duodenum.

Dilated gastric veins can be divided into perigastric, adventitial (on the outer surface of the stomach wall) and submucosal (in the submucosal layer of the stomach) [5] (Figure 1).

Figure 1: Fragment of a computed tomogram with visualization of gastric veins. Late arterial phase of contrast enhancement. Perigastric (arrow) and submucosal (double arrow) veins are clearly seen.

In addition to localization, the transverse size of gastric varicose veins by their small diameter and the degree of protrusion into the gastric lumen were assessed. Multiplanar reconstructions were formed so that the studied gastric wall was perpendicular to the image plane to minimize the averaging effect (Figure 2).

The distribution of gastroesophageal varices in the studied groups by types is provided in table 1. The distribution by location relative to the gastric wall and the size of varicose veins is set out in table 2.

	GOV 1	GOV 2	IGOV 1	IGOV 2
1 group	17	8	9	3
2 group	36	9	1	9
Total	53 (57.6%)	17 (18.5%)	10 (10.9%)	12 (13.0%)

Table 1: Distribution of gastroesophageal varices in the studied groups by types*.

*The number of varicose veins does not correspond to the number of patients, since one patient may have varicose veins of different localization.

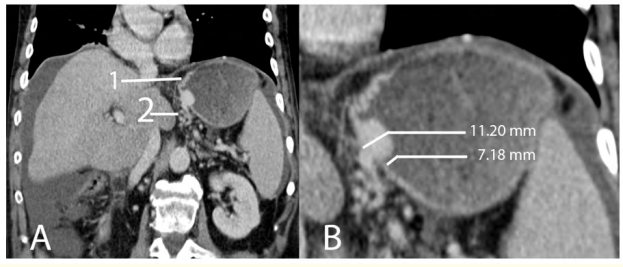

Figure 2: Fragments of computed tomograms with visualization of gastric varices. A - an oblique frontal reconstruction with adequate projection of the gastric wall, 1 - submucosal vein, 2 - perigastric veins. B - a fragment of the previous image, enlarged 3 times. Measurements of the vein diameter (11.20 mm) and degree of protrusion (7.18 mm) of varicose veins into the gastric lumen.

	Adventitial vein			Submucosal vein				
	Diameter (mm)			Diameter (mm)			Protrussion depth (mm)	
	n	Median	min/max	n	Median	min/max	Median	min/max
1 group	17	6.7	3.4/28.2	20	7.2	3.2/23.8	5.2	3.1/18.4
2 group	48	6.0	2.7/22.2	7	3.3	0/4.9	0.4	0/2.9

Table 2: Distribution by location relative to the gastric wall and size of varicose veins.

As per the table 1, esophageal varices with spread along the lesser curvature were most often determined. Isolated gastric varices (IGOV1+IGOV2) occur 3.2 times less frequently as opposed to gastroesophageal varices (GOV1+GOV2).

Table 2 reveals that both types of veins, submucosal and adventitial, occur in the two groups. Dilated adventitial veins were determined in all patients, and the median diameters of these veins were comparable and did not fundamentally differ in both groups. Submucosal veins were determined in all 14 patients of the first group and just in 15% of patients without anamnestic data of gastrointestinal bleeding. Obviously, in the group of patients with previous bleeding, the diameters of the veins were more than 2 times greater the size of the veins in patients in the control group.

A significant difference was found in assessing the degree of protrusion of varicose veins into the lumen of the stomach. In the group of patients without a history of bleeding, the protrusion did not exceed 3 mm (range 0 to 2.9 mm, median 0.4 mm). At the same time, in the group with bleeding, the protrusions were more pronounced (from 3.1 to 18.4 mm, median 5.2 mm). It should be noted that gastric bleeding with a protrusion of a vein of 3.1 mm occurred only in 1 patient with endoscopic signs of portal hypertensive gastropathy. The median values of the diameter and protrusion of the veins can be considered as reference values for predicting bleeding.

Discussion

In portal hypertension, anastomoses are formed between the portal vein and systemic veins, through which portal blood enters the systemic circulation. The portal vein is decompressed, and up to 90% of the portal blood flow enters the portosystemic collaterals, which leads to vascular dilatation [6]. Gastric varices

are less common than esophageal varices and have been reported to occur in 20% of patients with portal hypertension [7]. Varicose veins of the stomach are formed in 5-33% of patients with liver cirrhosis [4]. Bleeding from gastric varices occurs less frequently than from esophageal varices - 25% versus 64% of cases within 2 years. However, bleeding from gastric varices is clinically more severe [8] and can be fatal (>45% mortality) [9].

Gastric varices drain blood into the systemic veins through the esophageal and paraesophageal veins (gastroesophageal venous system), the inferior phrenic vein (gastro-phrenic venous system), or both [10]. In the first case, anastomoses are formed between the left gastric and azygos veins, in the second case, between the posterior gastric, short gastric, inferior phrenic veins and the left renal and adrenal veins (gastrorenal shunt) or inferior vena cava (gastrocaval shunt) [11]. Evaluation of these blood flow pathways in gastric varicose veins is important for choosing options for conservative treatment and interventional technologies. It was shown in [12] that the use of a system for modeling and combining the phases of a contrast study in MSCT makes it possible to choose the optimal surgical technique for correcting portal hypertension.

However, first of all, it is necessary to assess the degree of probability of bleeding. Factors predisposing to variceal bleeding currently include: 1) varicose vein pressure, 2) varicose vein size, 3) varicose vein wall tension, 4) severity of liver disease [13]. In most cases, portal pressure reflects intravascular pressure [14], and the development of variceal bleeding requires a hepatic venous pressure gradient of more than 12 mm Hg. There is no linear relationship between the severity of portal hypertension and the risk of variceal bleeding [15]. Numerous studies have shown that the risk of variceal bleeding increases with the size of varicose veins. In the experimental work [16] on the in vitro model it was shown that the rupture of varicose veins is associated with the tension of the varicose wall. The tension depends on the radius of the varicose veins. In this model, increased varicose veins and reduced varicose wall thickness lead to rupture of the varicose veins.

The authors of the study [17] argue that bleeding from varicose veins of the stomach is possible with a lower portosystemic pressure gradient than from the veins of the esophagus. The Asian Pacific Association for the Study of the Liver (APASL) established criteria for the diagnosis of high and low risk varicose veins in 2008. High-risk varicose veins were defined as large (>5 mm) nodules in association with one of the "red" endoscopic features. Varicose veins of small size (≤5 mm) without "red" signs were classified as low-risk [18]. Most authors do not provide data on the localization of varicose veins relative to the wall of the organ. This distinction is not appropriate for MSCT.

On computed tomographic imaging, varicose veins can be divided into submucosal and perigastric (adventitial) veins depending on their location relative to the gastric wall [5]. The distinction between submucosal and perigastric varicose veins is of great clinical interest, since bleeding mainly develops from submucosal varices [19]. The authors of the study [20] determined that gastric varices >6 mm wide are potentially dangerous for bleeding, and tried to determine the degree of their protrusion into the lumen of the stomach and esophagus. In relation to the stomach, the data obtained are inconclusive, since the degree of stretching of the gastric wall was not taken into account.

In a study [21], it was noted that adequate stretching of the gastric wall is necessary for confident visualization of varicose veins. In our study, we examined the data of patients in whom CT was supplemented with hydro-CT. The article [22] shows that when water is used as an oral contrast agent during gastric distension, varicose veins have a typical image on contrast-enhanced MSCT. The results of our study showed that the most important sign of the likelihood of gastric bleeding should be considered the degree of protrusion of gastric varicose veins into the gastric lumen, the severity of which should be determined only with adequate distension of the stomach (Figure 3).

Figure 3: Influence of the degree of gastric distension on the quality of visualization of varicose veins protrusion. Fragments of computed tomograms, late arterial phase of enhancement. A - an image without gastric distension, the degree of protrusion cannot be determined (arrow). B - an image with gastric distension by water. The size of varicose veins and the degree of protrusion can be confidently calculated (double arrow).

Portal hypertension can also lead to portal hypertensive gastropathy [23] - a serious pathological condition that can cause acute or even massive blood loss. The frequency of portal hypertensive gastropathy varies from 2% to 12%, which makes this complication a less common cause of bleeding from the upper gastrointestinal tract [24]. In our study, this type of bleeding occurred just once, but with smaller sizes and less protrusion of the submucosal varicose veins of the stomach. However, according to the authors [25], portal hypertensive gastropathy occurs in 80% of patients with liver cirrhosis. Due to changes in the blood flow of the mucous membrane, its integrity is often violated, the processes of epithelial dystrophy predominate, and the surface becomes loose. A higher degree of intraluminal protrusion probably indicates a thinner protective layer of the gastric wall between the blood vessel and the acidic contents of the gastric lumen, although hypochlorhydria is usually observed in patients with portal hypertension. According to the authors [26], for patients with varicose veins spreading to the stomach, the size of the vein, the presence of vasculopathy, gastropathy are not independent prognostic criteria for the risk of bleeding. But in this study, the degree of protrusion of varicose veins into the lumen of the stomach according to MSCT data was not determined, which, in our opinion, should be considered as a very important prognostic factor in predicting gastric bleeding in patients with portal hypertension.

Conclusion

In conclusion, it should be stated that the high probability of gastric varices bleeding can occur with a diameter of submucosal veins of more than 7 mm and protrusion into the stomach lumen of more than 5 mm. In MSCT, the degree of protrusion should be assessed by multiplanar reconstructions of an adequately distended stomach using the hydro-CT technique.

Conflict of Interests

There is no conflict of interests.

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