

# The Importance of Minimally Invasive Procedures in the Treatment of Pyloroduodenal Stenosis

**Khakimov Murod Shavkatovich, Ashurov Sherzod Ermatovich, Kushiev Jakhongir Khabibjon Ugli**

Tashkent Medical Academy, Tashkent, Uzbekistan

**Abstract.** To increase the efficiency of diagnosing acute gastric ulcers and predict the risk of rebleeding by studying the endoscopic, anatomical features and pathomorphological characteristics of tissues in the area of a bleeding gastric ulcer. Most often recurrent bleeding is observed in acute gastric ulcers located along the lesser curvature in the area of the angle of the stomach, along the posterior surface of the body and the antrum of the stomach. The reasons for this circumstance are the insufficiency of endoscopic visualization of the source of bleeding from acute ulcers located along the posterior wall of the cardiac section and the body of the stomach and endoscopic methods of haemostasis, especially with continued bleeding and the presence of blood clots in the lumen of the stomach, as well as a deeper spread of acute ulcers of the lesser curvature of the stomach in the underlying layers due to increased trauma. When choosing the volume of surgical intervention and an effective method of haemostasis in case of bleeding from an acute gastric ulcer, it is necessary to assess the risk of bleeding depending on the location, area and depth of the ulcer.

**Keywords:** *bleeding, ulcer, endoscopy, clipping, perforation, pyloroduodenal stenosis, balloon dilatation.*

## 1. Relevance

Bleeding from acute stomach ulcers is a common medical emergency throughout the world. Endoscopic diagnosis and hemostasis are cornerstones in disease management and mortality reduction. The number of urgent open surgical interventions for bleeding acute ulcers continues to decline; in the UK, the rate of surgery has fallen from 8% to 2% between 1993 and 2006 [1]. During the same period in the United States, the use of endoscopic treatment for acute ulcers increased by 58.9%, and the incidence of emergency ulcer surgery decreased by 21.9% [2].

Despite these advances, death from this disease remains at about 10% [3]. The disease occurs more often in elderly patients with frequent comorbidities who take antiplatelet agents, non-steroidal anti-inflammatory drugs and anticoagulants [4]. The management of such patients, especially those at high risk of cardiothrombotics who are taking anticoagulants, is a challenge for clinicians.

At present, in the diagnosis of acute gastric ulcers, the impact of the anatomical and pathomorphological characteristics of the mucous membrane around the ulcer on the prognosis of the risk of rebleeding and the outcome of the disease is not taken into consideration.

**The aim** of this study was to increase the efficiency of diagnosing acute gastric ulcers and predict the risk of rebleeding by studying the endoscopic, anatomical features and pathomorphological characteristics of tissues in the area of a bleeding gastric ulcer.

## 2. Material and Methods

The material of this study was 298 patients with bleeding from acute gastric ulcers (stress, drug), who were treated in the emergency surgery department of the multidisciplinary clinic of the Tashkent Medical Academy from 2012 to 2022. There were 192 men (64.4%), women - 106 (35.6%). The age of the patients ranged from 18 to 76, averaging  $49.6 \pm 10.3$  years.

The majority of patients (227 - 76.17%) were taken to the emergency department by an ambulance team at various times from the onset of the disease: in the first 6 hours - 35 (11.7%) patients, from 7 to 24 hours - 105 (35.2%) patients. In other patients, the period from the onset of the disease to admission to the hospital was more than a day. Directly in the hospital, bleeding occurred in 71 (23.8%) patients (in intensive care units, cardiology, nephrology, elective surgery, neurology, traumatology and orthopedics, neurosurgery, gynecology, rheumatology).

Most often, acute bleeding gastric ulcers occurred when taking ulcerogenic drugs (NSAIDs, hormone therapy) or alcohol - 123 (41.2%). Also, acute ulcers were quite common

in patients with diseases of the cardiovascular system - 92 (30.9%) and acute ulcers complicated by bleeding after thoracic / abdominal surgical interventions (stress ulcers) - 48 (18.8%) (Table 1).

Localization of the ulcer	Number of patients (%)	Volume of blood loss (ml)
Antrum, posterior wall	78 (26,2%)	836±283
Body of stomach, posterior wall	65 (21,8%)	513±167
Lesser curvature	50 (16,8%)	1373±389
Pyloric part posterior wall	28 (9,4%)	617±212
Antrum anterior wall	20 (6,7%)	517±154
Greater curvature	16 (5,3%)	427±126
Body of stomach, anterior wall	14 (4,7%)	483±127
Fundus of the stomach	11 (3,7%)	126±73
Pyloric part anterior wall	8 (2,7%)	589±187
Cardia of the stomach	8 (2,7%)	204±65

**Table 1.** The main pathology (condition) that provokes the occurrence of an acute gastric ulcer complicated by bleeding

Pathology	The number of patients	
	Abs.	%
Use of ulcerogenic drugs or alcohol	123	41,2
Cardiovascular diseases	92	30,9
Surgery on the chest/abdomen	56	18,8
Diabetes	29	9,7
Respiratory system diseases	27	9
Injury	23	7,7
Purulent-inflammatory diseases	19	6,4

Ulcer bleeding was assessed according to the currently most commonly used classification developed by J. Forrest (1974).

During primary endoscopy, ongoing jet arrosive bleeding (Forrest IA) was diagnosed in 24 (8.1%) patients, ongoing capillary bleeding in the form of diffuse leakage (Forrest IB) was found in 56 (18.8%) patients. Hemorrhage in the form of a thrombosed vessel at the bottom of the ulcer (Forrest IIA) was found in 120 (40.3%) cases, an ulcer covered by a blood clot (Forrest IIB) was found in 89 (29.8%) cases.

In most cases, acute bleeding ulcers were located in the region of the posterior wall of the antrum of the stomach - 78 (26.2%) cases, the posterior wall of the body of the stomach - 65 (21.8%) patients, and along the lesser curvature - 50 (16.8%) cases . It should be noted that although ulcers located along the lesser curvature of the stomach are in third place in terms of frequency of occurrence, the volume of blood loss from these ulcers is the largest, averaging 1373±389 ml (Table 2). This is due to the fact that the vessels

of the lesser curvature are located superficially, in the submucosal layer, while the vessels of other parts of the stomach are located more deeply.

**Table 2.** Distribution of patients depending on the localization of acute gastric ulcer and the amount of blood loss

The size of acute gastric ulcers complicated by bleeding ranged from 2 to 25 mm. The largest number were acute ulcers with sizes from 5 to 10 mm - 80 (26.8%) and less than 5 mm - 104 (34.9%) cases. The proportion of patients with acute ulcers from 11 to 15 mm was 45 (14.6%), from 16 to 20 mm - 44 (14.8%). The size of the remaining acute ulcers ranged from 21 to 25 mm - 25 (8.4%) patients.

Endoscopic examination (EGD) of the upper parts of the digestive tract was performed using endoscopes with end-mounted optics "Olimpus" with a standard instrumental channel of 2.8 mm. Dynamic EGD was performed after 24 and 72 hours, as well as on an emergency basis in case of any suspicion of recurrent bleeding.

Criteria for the diagnosis of acute gastric ulcer were:

1. Anamnestic data indicating a connection with the main (background) diseases or stressful effects, previous surgery, the use of ulcerogenic drugs or alcohol abuse.

2. Endoscopic picture of an acute ulcer. Usually, when performing endoscopy, edematous, in places hyperemic, easily vulnerable, covered with viscous mucus and fibrin, the gastric mucosa was detected. On such folds of the mucous membrane, erosions were visualized, which were often multiple, sometimes merged, forming fields without clear boundaries. Acute ulcers were located on the folds of the mucous membrane and were a round or oval ulcer surrounded by a bright red rim without an inflammatory periumular shaft. In the protocols of endoscopic examination, one often encountered similar descriptions characterizing an acute ulcer as: "flat", "simple", "superficial".

It was relatively rare to find a bleeding or thrombosed vessel in an acute ulcer. Much more often, bleeding was visualized in the form of "dew drops", which formed again after removal of the bloody discharge, or in the form of a loose thrombus (microthrombi) covering the ulceration. Quite often, acute ulcers were accompanied by erosions. Acute ulcers did not have undermined edges and an inflammatory shaft along the periphery, which is characteristic of a chronic ulcer.

In the progress of endoscopic examination, the source of bleeding was diagnosed, its size and localization, the number of ulcers, the nature of the edges and bottom of the ulcer, the intensity of bleeding, and signs of hemostasis stability were determined.

The endoscopic signs of unstable hemostasis traditionally included the detection of reduced blood in the lumen of the stomach, a blood clot in the bottom of the ulcer, blood clots and small thrombosed vessels in the ulcer, and hemorrhagic

plaque on its surface. A sign of hemostasis stability was the deposition of fibrin on the ulcerative surface.

Endoscopic examination was supplemented by taking material from the area of the ulcer for histological examination, including the study of the cellular composition.

### 3. Results

Upon admission of patients with acute gastric ulcers, endoscopic hemostasis was performed. The choice of hemostasis method depended on the intensity of bleeding.

In case of recurrence of bleeding after endoscopic hemostasis, an attempt was made to repeat endoscopic hemostasis. If it was impossible to achieve endoscopic hemostasis or repeated recurrence, the patients underwent surgical treatment - gastrotomy with stitching of a bleeding acute stomach ulcer. Mostly, endoscopic hemostasis is endoscopic clipping of the bleeding ulcer.

In total, as a result of the treatment we used, 24 (8%) cases of repeated bleeding from the ulcer were observed. An analysis of cases of recurrent bleeding showed that the most common rebleeding was observed when the ulcer was localized along the lesser curvature of the stomach - 7 (2.3%) patients, as well as along the posterior wall of the antrum - 6 (2%) cases (Table 3). At the same time, we would also like to note that the volume of blood loss during recurrent bleeding from ulcers of the above localization was the highest, amounting to  $972 \pm 389$  ml for ulcers of lesser curvature, and  $733 \pm 213$  ml for ulcers of the posterior wall of the antrum.

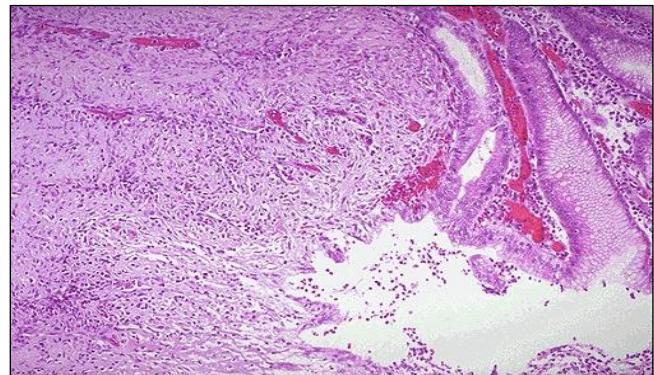
**Table 3.** Distribution of patients with recurrent ulcerative bleeding depending on the localization of acute gastric ulcers and the amount of blood loss

Localization of the ulcer	Number of patients (%)	Volume of blood loss (ml)
Cardiac section	1 (0,3%)	$154 \pm 45$
Fundus of the stomach	0	
Body of stomach, posterior wall	3 (1%)	$403 \pm 127$
Body of stomach, anterior wall	0	
Antrum, posterior wall	6 (2%)	$733 \pm 213$
Antrum anterior wall	1(0,3%)	$497 \pm 144$
Pyloric part posterior wall	3(1%)	$517 \pm 202$
Pyloric part anterior wall	2(0,6%)	$469 \pm 147$
Lesser curvature	7 (2,3%)	$972 \pm 389$
Greater curvature	1(0,3%)	$327 \pm 96$

We conducted a morphological study of biopsy material from gastric ulcers in 24 patients with recurrent ulcer bleeding and in 20 patients who did not experience recurrence of bleeding from the ulcer.

In the morphological study of the biopsy site from the localization of the ulcer along the anterior wall of the body of

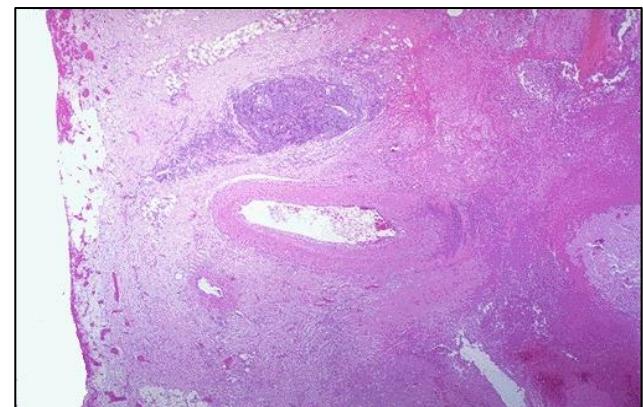
the stomach, the ulcerative defect spread no further than the lamina propria of the gastric wall mucosa (Fig. 1).



**Figure 1.** The wall of the stomach. Biopsy from an ulcer along the anterior wall of the body of the stomach. Hematoxylin-eosin staining. Magnification: eyepiece 10, objective 20

There were large areas of the gastric mucosa with a small focus of a superficial defect with destruction of the adjacent sections of the glands, moderate polymorphic inflammatory infiltration and edema of the underlying stroma. In neighboring areas, the surface and glandular epithelium had increased secretory activity. The nuclei of epithelial cells were mainly located basally, moderately enlarged, with clearly visible nucleoli. Stroma with moderate edema, increased number of lymphocytes.

In the morphological study of the biopsy site from the localization of the ulcer along the posterior wall of the antrum of the stomach, the ulcerative defect spread more deeply up to the submucosa (Fig. 2).

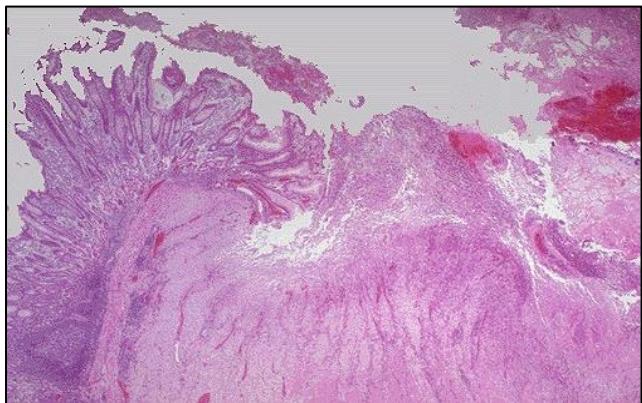


**Figure 2.** The wall of the stomach. Biopsy from an ulcer along the posterior wall of the antrum of the stomach. Hematoxylin-eosin staining. Magnification: eyepiece 10, objective 20

The surface of the ulcer during microscopic examination is covered with loose filaments of fibrin, under which there is an ulcerative surface with necrosis, a polymorphic inflammatory infiltrate. Glands with swollen epithelium in a state of partial or complete desquamation.

In the morphological study of the biopsy site from the localization of the ulcer along the lesser curvature of the stomach, the ulcer not only spread to the submucosa, but also passed into the muscular membrane (Fig. 3).

Microscopically, the ulcer was clearly defined, the normal gastric mucosa passes into a deep ulcer, at the base of which there is purulent-necrotic detritus. The arterial branch at the base of the ulcer is eroded and bleeds. The surface of the gastric mucosa with foci of ulcerative necrotic changes with polymorphic, predominantly leukocyte infiltration. In the preserved areas, the gastric mucosa with large folds covered with proliferating, prismatic epithelium. In the thickness of the tissue there are unevenly enlarged glands with enlarged, richly colored nuclei. Stroma with increased lymphoid infiltration.



**Figure 3.** The wall of the stomach. Biopsy from an ulcer along the lesser curvature of the stomach. Hematoxylin-eosin staining. Magnification: eyepiece 10, objective 20

Thus, as a result of a morphological study of a biopsy from gastric ulcers, it was noted that the spread of the ulcerative-necrotic defect is deeper, up to the muscle layer, especially when ulcers are localized along the lesser curvature of the stomach, which is reflected in a higher frequency of recurrence of bleeding.



**Figure 4.** Acute ulcers associated H.pylori of the body of the stomach (the ulcer of the posterior wall is covered with a fresh thrombus)

#### 4. The Discussion of the Results

Bleeding from an acute gastric ulcer is one of the most common upper gastrointestinal emergencies. The prevalence of acute gastric ulcers is 1.4% in the Western population and can be as high as 4.1% in Asia [5]. According to the UK National Audit in 2017, bleeding acute gastric ulcers accounted for 19% of all causes of acute bleeding from the

upper gastrointestinal tract [6]. A systematic review by American authors reported the incidence of bleeding from acute ulcers, which ranged from 4 to 37 per 100,000 population per year [7]. In China, the prevalence of bleeding from acute gastric ulcers is not well understood, although this pathology is common. In hospital endoscopy studies conducted in Wuhan and Beijing, the prevalence of acute gastric ulcers was 5.7%, and the bleeding rate was estimated to be between 3.9% and 5.5% [8]. In an aging population (the number of people over the age of 60 will double in the next two decades) and with increasing urbanization, the prevalence of coronary and cerebrovascular diseases will increase and, consequently, the incidence of acute upper gastrointestinal bleeding associated with the use of aspirin and anticoagulants. When examining patients with acute upper gastrointestinal bleeding associated with aspirin and non-steroidal anti-inflammatory drugs, researchers reported a low level of adherence to gastroprotective drugs.

In addition, acute erosions and ulcers of the upper gastrointestinal tract can occur as a result of stress in severe concomitant trauma, respiratory failure, extensive burns, sepsis, and other critical conditions. A distinctive feature of stress lesions of the mucosa is the relationship with physiological stress, the diffuse nature of the lesion and the variety of clinical manifestations. Within a few hours after stress, multiple flat punctate subepithelial bleeding mucosal defects with a diameter of 1-2 mm with a slight perifocal inflammatory reaction appear in the body and fundus of the stomach. Erosions can merge, forming significant defects of the mucous membrane with a diameter of 1-3 cm or more, without clear boundaries [9]. The lesions of the mucosa become deeper, the formation of acute ulcers is possible, in which the wall defect reaches the muscle layer.

Acute gastric ulcer is a localized deep necrotic lesion affecting the entire thickness of the mucosa and the muscular layer of the mucosa. It is generally believed that these ulcers develop due to an imbalance between mucosal defense mechanisms and damaging factors on the intraluminal surface of the stomach.

Ulcerogenesis begins with the destruction of the protective mucous layer formed by epithelial cells. The damage to the mucosal layer can lead to detachment of the surface epithelium and exposure of capillary endothelial cells in the underlying connective tissue. When the capillaries are damaged, there is a lack of oxygen and nutrients. As a consequence, hypoxic necrosis will occur in deep glandular cells, namely stem or progenitor cells, cervical mucosal cells, zymogen cells, enteroendocrine cells, and parietal cells. In addition, damaged macrophages, mast cells, and endothelial cells secrete vasoactive substances and pro-inflammatory mediators, which impairs mucosal microcirculation [10]. Necrosis of the epithelium and connective tissue eventually leads to the formation of ulcers, followed by the development of such a formidable complication as bleeding from the ulcer. According to various authors, mortality in bleeding from acute stress ulcers can reach 19-64% [11-13].

Despite advances in anti-ulcer therapy and modern surgical techniques, the incidence of rebleeding remains high. According to the American Society of Gastroenterology, the frequency of rebleeding in acute gastric ulcers can be 3.7–38.4% [8, 11–13].

In general, the issues of tactics for the treatment of patients with acute ulcerative-erosive gastroduodenal bleeding are currently insufficiently developed, without taking into account the morphological and anatomical features of bleeding from acute gastric ulcers of various localization, and therefore high mortality rates remain both in our country and throughout the world.

In the present study, to determine the ulcerogenesis of acute ulcers and the risk of bleeding, we studied the frequency of localization of acute gastric ulcers complicated by bleeding and the morphological structure of acute ulcers. Morphological studies have shown that acute ulcers located along the lesser curvature are deeper than ulcers located in other parts of the stomach. In addition, the vessels of acute ulcers of lesser curvature are located superficially, in the submucosal layer, while the vessels of acute ulcers of other parts of the stomach are located deeper, which determines not only a higher volume of blood loss, but also an increase in the frequency of recurrence of bleeding from ulcers of this localization. Besides, it is necessary to note the high incidence of recurrence of bleeding from acute ulcers located along the posterior wall of the cardiac section and the body of the stomach, which, in our opinion, is associated with insufficient visualization of the source of bleeding and endoscopic methods of hemostasis, in the presence of active bleeding and the presence of blood clots in the stomach.

## 5. Conclusions

1. Most often, acute stomach ulcers are located along the lesser curvature of the stomach, which is the main “food path” and are more susceptible to trauma.

2. Most often, recurrent bleeding occurs from acute gastric ulcers, which are located along the lesser curvature in the area of the angle of the stomach, along the posterior surface of the body and the antrum of the stomach. The reasons for this circumstance are: the insufficiency of endoscopic visualization of the source of bleeding from acute ulcers located on the back wall of the cardiac section and the body of the stomach and the implementation of endoscopic methods of hemostasis, especially with ongoing bleeding and the presence of blood clots in the lumen of the stomach; a deeper spread of acute ulcers of the lesser curvature of the stomach into the underlying layers due to increased trauma.

3. A qualitative assessment of the risk of bleeding depending on the location, area and depth of the spread of the ulcer is decisive in choosing the most adequate volume of

surgical intervention and an effective method of hemostasis in bleeding from an acute gastric ulcer.

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