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Endoscopic signs of gastroesophageal reflux disease with different hiatal hernias types

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

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A hiatal hernia occurs in 83–94 % of patients with gastroesophageal reflux disease (GERD). Difficulties in diagnosing endoscopic signs of gastroesophageal reflux with combination of the most common hiatal hernia types remain relevant. Untimely and inaccurate endoscopic interpretation of these pathological changes significantly reduces the effectiveness of treatment.

The aim of the research was to study the endoscopic signs of gastroesophageal reflux disease with the most common hiatal hernia type I and type III.

Materials and methods. The examination results of 153 patients with GERD and the most common hiatal hernia type I and type III at the stage of preparation for antireflux surgical treatment were analyzed. The age was 54.5 ± 11.3, there were 48 (31.4 %) men, 105 (68.6 %) women. In Group I – 85 patients with GERD and type I hiatal hernia, in Group II – 68 patients with GERD and type III hiatal hernia. A complete preoperative examination necessarily included endoscopy with chromoendoscopy (mainly NBI or FICE), biopsy from suspicious foci of the gastric mucosa and the lower third of the esophagus followed by histological analysis. Statistical processing and mathematical analysis of the obtained results were performed using the Statistica for Windows 13 (StatSoft Inc., No. JPZ804I382130ARCN10-J). For comparative analysis the arithmetic mean and standard deviation were calculated and presented as M ± s. Differences between groups were assessed using the sub-module "Difference tests" in the module "Basic statistics and tables". Differences at $P < 0.05$ were considered statistically significant.

Results. In both groups, non-erosive forms of gastroesophageal reflux disease prevailed: 57 (67.1 %) and 39 (57.4 %) patients respectively. Both in Groups I and II, among the erosive forms there were mainly LA A stages of esophagitis – 20 (23.5 %) and 17 (25.0 %). CLE signs of the esophageal mucosa prevailed in Group I – 16 (18.8 %) patients, in Group II – 5 (7.4 %) patients. The proximal edges of the gastric folds, which are visualized in all patients, were considered the reference point for the true esophageal-gastric junction. Complicated course of GERD was noted in both groups of patients.

Conclusions. Endoscopic signs of GERD with hiatal hernia type I or type III have characteristic features, the severity of which manifestation does not depend on the type. A reliable indicator of the true esophageal-gastric junction location is the proximal edge of the gastric folds. Complicated course of GERD occurs in both groups: Barrett's esophagus and Schatzki's ring predominate in the Group I, strictures and ulcers of the esophagus – in the Group II.

Ключові слова: гастроезофагеальна рефлюксна хвороба, грижа стравохідного отвору діафрагми, ендоскопічні дослідження травної системи.

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Ендоскопічні ознаки гастроезофагеальної рефлюксної хвороби при різних типах грижі стравохідного отвору діафрагми

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Грижі стравохідного отвору діафрагми виявляють у 83–94 % пацієнтів із гастроезофагеальною рефлюксною хворобою (ГЕРХ). Проблеми діагностики ендоскопічних ознак шлунково-стравохідного рефлюксу при поєднанні з найпоширенішими I та III типами гриж стравохідного отвору діафрагми залишаються актуальними. Несвоєчасна та неточна ендоскопічна інтерпретація цих патологічних змін істотно знижує ефективність лікування.

Мета роботи – вивчити ендоскопічні ознаки гастроезофагеальної рефлюксної хвороби при найпоширеніших I та III типах грижі стравохідного отвору діафрагми на етапі підготовки до хірургічного лікування.

Матеріали та методи. Обстежили 153 пацієнтів із ГЕРХ і найпоширенішими I та III типами гриж стравохідного отвору діафрагми під час підготовки до лапароскопічної антирефлюксної операції. Середній вік – 54,5 ± 11,3 року, 48 (31,4 %) чоловіків, 105 (68,6 %) жінок. У I групі – 85 пацієнтів із ГЕРХ і грижею стравохідного отвору діафрагми I типу; у II групі – 68 хворих на ГЕРХ і з грижею стравохідного отвору діафрагми III типу. Повне передопераційне обстеження обов'язково передбачало ендоскопію з хромоендоскопією (передусім NBI або FICE), біопсією з підозрілих вогнищ слизової оболонки шлунка та нижньої третини стравоходу, гістологічний аналіз. Статистичне опрацювання та математичний аналіз результатів виконали, використавши пакет прикладних програм Statistica for Windows 13 (StatSoft Inc., № JPZ804I382130ARCN10-J). Для порівняльного аналізу розрахували середнє арифметичне та середнє квадратичне відхилення – M ± s. Розбіжності між групами оцінювали за допомогою підмодуля «Диференціальні тести» в модулі «Основні статистики та таблиці». Статистично значущими вважали відмінності при $p < 0,05$.

Результати. В обох групах переважали неерозивні форми ГЕРХ: 57 (67,1 %) та 39 (57,4 %) хворих відповідно у групах. З-поміж ерозивних форм виявляли переважно LA A стадії езофагіту – 20 (23,5 %) та 17 (25,0 %) у I та II групі відповідно. CLE ознаки слизової оболонки стравоходу переважали в I групі – у 16 (18,8 %), у II – у 5 (7,4 %) хворих. Орієнтиром

справжнього стравохідно-шлункового з'єднання вважали проксимальні краї шлункових складок, візуалізовані в усіх хворих. Ускладнений перебіг ГЕРХ визначили в обох групах хворих.

Висновки. Ендоскопічні ознаки ГЕРХ при I та III типах гриж стравохідного отвору діафрагми мають характерні особливості, ступінь прояву яких не залежить від типу грижі. Надійна ознака розташування справжнього стравохідно-шлункового з'єднання – проксимальний край шлункових складок. Ускладнений перебіг ГЕРХ виявили в обох групах: стравохід Баррета та кільце Шацького переважають у I, стриктури та виразки стравоходу – у II групі.

Gastroesophageal reflux disease (GERD) is one of the most common gastroenterological diseases. In the general population, the incidence of this disease reaches 20 % and continues to increase [1–3]. Along with multichannel pH-impedance-monitoring, video-esophagogastroduodenoscopy plays an essential and sometimes decisive role in the successful diagnosis of both complicated and uncomplicated GERD [4–7]. The widespread and rapid increasing of GERD is becoming threatening, primarily due to the development of such dangerous complications as erosive and ulcerative esophagitis, peptic strictures of the esophagus, Barrett's esophagus and esophageal adenocarcinoma [8–11]. Untimely and inaccurate endoscopic diagnosis of these complications significantly reduces the effectiveness of treatment [5,12–15]. Considering that hiatal hernia (HH) occurs in 83–94% of patients with GERD and the most common types of them are type I and type III difficulties in determining pathological changes in the esophageal mucosa as well as some key endoscopic landmarks of the true esophagogastric junction, Z-line, borders of segments of cell metaplasia with GERD in combination with these hernias types remain relevant [2,3,5,12,16–19]. All of the above requires continued work in the direction of studying the endoscopic signs features of GERD associated with the most common hiatal hernia types, which will improve the diagnosis and treatment efficiency of this disease.

Aim

The aim of the research was to study the endoscopic signs of gastroesophageal reflux disease with the most common hiatal hernia I and III types at the preparation stage for surgical treatment.

Materials and methods

The work carried out a detailed analysis of the endoscopic examination results of 153 patients with GERD associated with type I or type III hiatal hernia. Criteria for inclusion in the study were confirmed GERD, the presence of type I or type III hiatal hernia, consent to surgical treatment and the absence of general contraindications for surgery. Exclusion criteria – absence of GERD, other rare types (II or IV) of hiatal hernia, other chronic gastroenterological diseases in the acute stage, acute surgical pathology, refusal of surgical treatment. The age was 54.5 ± 11.3, there were 48 men (31.4 %), 105 women (68.6 %).

Patients were divided into two groups depending on the hiatal hernia types [3,5,17,18]. Group I consisted of 85 patients with GERD and hiatal hernia type I (the most common sliding hiatal hernia with gastroesophageal junction displacement proximally up through the esophageal opening and the stomach positioning alongside the longitudinal axis with the esophagus while the fundus of the stomach remains below the diaphragm). Group II consisted of 68 patients with GERD caused by hiatal hernia type III (the most common paraesophageal hiatal hernia when the gastroesophageal junction and a part of the stomach (fundus, body) herniate through the hiatus into the mediastinum but gastroesophageal junction displaces alongside the longitudinal axis as in type I and the most proximal stomach part herniate into the mediastinum and location above the gastroesophageal junction). The groups of patients were comparable in terms of age, sex and comorbidities.

All patients underwent a complete preoperative examination and were preparing for laparoscopic antireflux surgery. To diagnose GERD all patients were interviewed by valid diagnostic questionnaires and scales, and polypositional video esophagogastroduodenoroentgenography with passage of a water-soluble contrast agent with daily intraesophageal pH or pH-impedance monitoring were performed. The hiatal hernia type was determined by polypositional X-ray examination with water-soluble contrast agent (barium) swallow in the Trendelenburg position with a routine Valsalva maneuver obligatory performed by "Opera T 90cex", "General Medical Merate S.p.A.", Italy.

Esophagogastroduodenoscopy was performed by modern endoscopical equipment "Evis Exera III, scope HQ 190" ("Olympus", Japan) in the first half of the day, on an empty stomach, under local anesthesia with lidocaine. Endoscopic evaluation began with examination of the tongue, pharynx, epiglottis, larynx, glottis with vocal cords. Next, we examined the orifice of the esophagus, the esophago-pharyngeal junction with thinned pharyngeal pockets – the piriform sinuses, then the bronchial and diaphragmatic constriction, the esophageal-gastric junction, the lumen of the stomach, the pylorus, the bulb of the duodenum, the upper duodenal flexure, the descending duodenum (to exclude other pathologies – peptic ulcers of the stomach, gastritis, stomach cancer). Changes in the shape and diameter of the esophagus, the state of the esophageal mucosa, esophagogastric junction, stomach, and duodenum were assessed. Pay attention to the remains of food in the esophagus or stomach. The lumen of the esophagus was examined for the presence of strictures, fungal infections, erosions, ulcers, rings, diverticula. During inversion examination the state of the mucous membrane of the lesser curvature of the stomach body, cardia and fundus was assessed. Mucosal examination was always performed using chromoendoscopy (mainly using NBI or FICE spectral analysis techniques) for a more sensitive differentiation of pathological changes. Assessed for signs of Barrett's esophagus or adenocarcinoma. A mandatory stage of endoscopic examination was a biopsy from suspiciously altered foci of the gastric mucosa, Z-line, esophagus for

Table 1. Characteristics of the esophageal mucosal layer in both groups

Color	Group I (n = 85)	Group II (n = 68)	P
Pink/pale pink	61 (71.8 %)	57 (83.8 %)	0.0791
Hyperemic	17 (20.0 %)	7 (10.3 %)	0.1012
Whitish	7 (8.2 %)	4 (5.9 %)	0.5839
Total	85 (100.0 %)	68 (100.0 %)	–

P: value of statistical significance.

Table 2. Distribution of patients in Groups I and II according to the severity of esophagitis according to the Los Angeles classification

Degree of esophagitis	Group I (n = 85)	Group II (n = 68)	P
NERD	57 (67.1 %)	39 (57.4 %)	0.3332
LA A	20 (23.5 %)	17 (25.0 %)	0.9154
LA B	8 (9.4 %)	8 (11.8 %)	0.8761
LA C	–	4 (5.8 %)	–
LA D	–	–	–

P: value of statistical significance.

Table 3. Erosion length characteristic in both groups with erosive esophagitis

Degree of esophagitis	Group I (n = 85)		Group II (n = 68)		
	n	length, mm	n	length, mm	P
LA A	20 (23.5 %)	3.73 ± 0.7	17 (25.0 %)	3.7 ± 0.9	0.9099
LA B	8 (9.4 %)	6.7 ± 1.9	8 (11,8 %)	8.7 ± 3.4	0.1684
LA C	–	–	4 (5.9 %)	7.8 ± 3.1	
LA D					

P: value of statistical difference.

Table 4. Number of patients with CLE signs of the esophageal mucosa depending on the severity of esophagitis in both groups

Degree of esophagitis	Group I (n = 85)	Group II (n = 68)	P
NERD	11 (12.9 %)	3 (4.4 %)	0.6776
LA A	2 (2.4 %)	2 (2.9 %)	0.9752
LA B	3 (3.5 %)	–	–
LA C	–	–	–
LA D	–	–	–
Total	16 (18.8 %)	5 (7.4 %)	0.5448

P: value of statistical significance.

subsequent histological analysis. During the study photo and video recording were performed for a more detailed review and analysis after the diagnosis. The most significant details of the study were recorded in the protocol and kept in the archive [4,7,18,20,21].

Statistical processing and mathematical analysis of the obtained results were performed using the Statistica for Windows 13 (StatSoft Inc., No. JPZ804I382130ARCN10-J). For comparative analysis the arithmetic mean and standard deviation were calculated and presented as M ± s. Differences between groups were assessed using the sub-module "Difference tests" in the module "Basic statistics and tables". Differences at $P < 0.05$ were considered statistically significant.

Results

Visual analysis of the esophagus mucosa of GERD patients showed that in both groups the mucosa was mostly pink or pale pink, which is typical for healthy mucosa.

Hyperemic and whitish coloration was found in lesser quantities (*Table 1*).

However according to the data of endoscopic color signs the groups regardless of the hiatal hernia type did not significantly differ from each other.

In both groups of patients regardless of the hiatal hernia type non-erosive forms of GERD prevailed – 57 (67.1 %) and 39 (57.4 %), respectively.

The erosive form of GERD was detected in 28 (32.9 %) patients in Group I, while in Group II – in 29 (42.6 %) patients.

The severity of reflux esophagitis was assessed according to the Los Angeles classification, according to which only A and B degrees of esophagitis severity were diagnosed in Group I, while A, B and C degrees were presented in Group II [5].

As can be seen from *Table 2*, the groups of patients also did not differ from each other in degree A and B of the esophagitis severity, however, the presence of reflux esophagitis with degree C in Group II may indicate more severe course of GERD in patients with type III hiatal hernia.

The length of erosions also did not differ statistically in both groups with A and B degrees of the esophagitis (*Table 3*).

In Group I, the length of erosions in grade A esophagitis was 3.73 ± 0.7 mm, grade B – 6.7 ± 1.9 mm. In Group II, with degree A – 3.7 ± 0.9 mm, degree B – 8.7 ± 3.4 mm, degree C – 7.8 ± 3.1 mm.

Routine use of chromoendoscopy (mainly NBI, FICE spectral analysis) in all patients made it possible to diagnose columnar epithelium (Columnar Lined Esophagus (CLE)) in 21 (13.7 %) patients in both groups totally (*Fig. 1*).

In Group I CLE signs of the mucosa prevailed and occurred in 16 (18.8 %) patients, while in Group II – only in 5 (7.4 %) patients, but without significant difference (*Table 4*).

At the same time both in Group I and in Group II CLE-esophagus is more common in NERD.

Length analysis of the circular (C) and maximum (M) segments of the CLE-esophagus in groups is presented in *Table 5*.

The length of the circular segments in both groups did not differ, while the maximum segment was significantly longer in the Group II of patients with type III hiatal hernia.

An important step in the endoscopic diagnosis of GERD was the determination of the true area of gastroesophageal junction, the key point of which is the diagnosis of the Z-line. The Z-line was not diagnosed in all patients: in Group I in 79 (92.9 %), in Group II – in 53 (77.9 %) patients. In Group I of patients with type I hiatal hernia the Z-line was diagnosed significantly more often than in the Group II with the type III hiatal hernia ($P = 0.0123$).

Palisade vessels were also visualized not in all patients in both groups: in 50 (58.8 %) patients of Group I and in 30 (44.1 %) patients of Group II, however without a statistically significant difference ($P = 0.2020$) (*Fig. 2*).

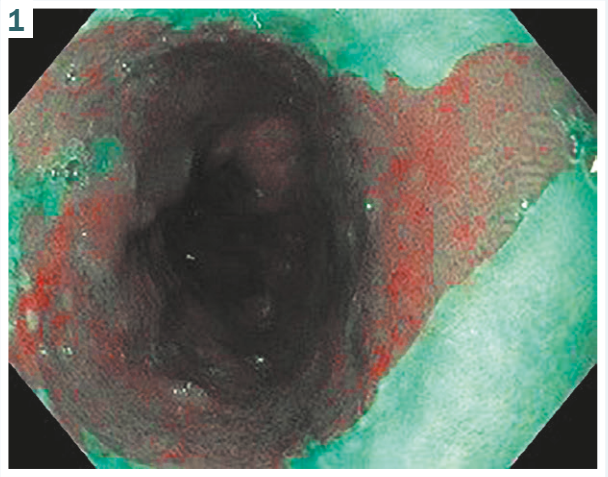
The main landmarks of the true gastroesophageal junction were considered to be the proximal edges of the gastric folds.

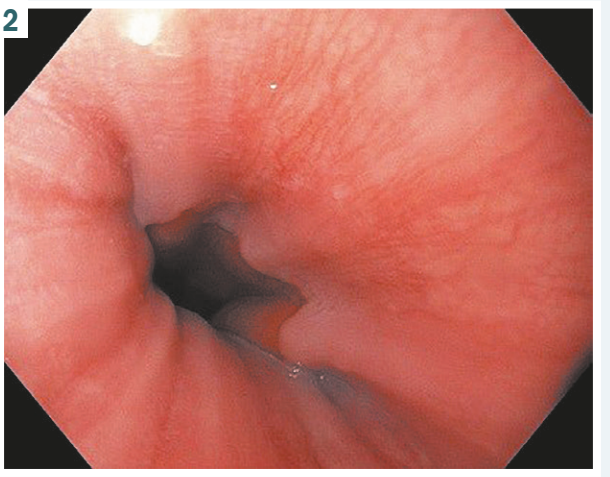
In Group I the proximal edge of the gastric folds was determined at a distance of 39.9 ± 1.3 cm from the incisor teeth, in Group II – at a distance of 39.5 ± 2.6 cm,

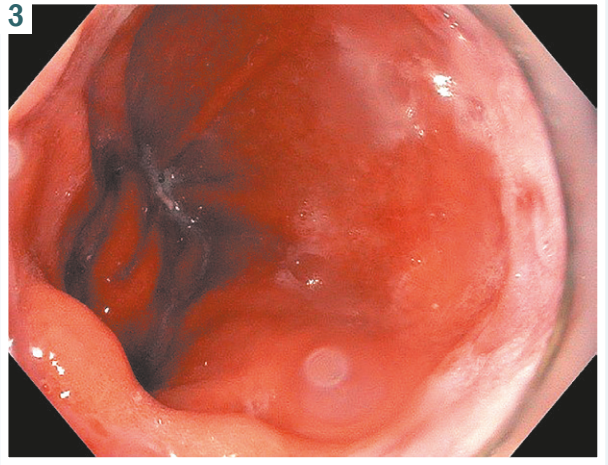
Table 5. Length characteristics of C and M segments in both groups depending on the severity of esophagitis

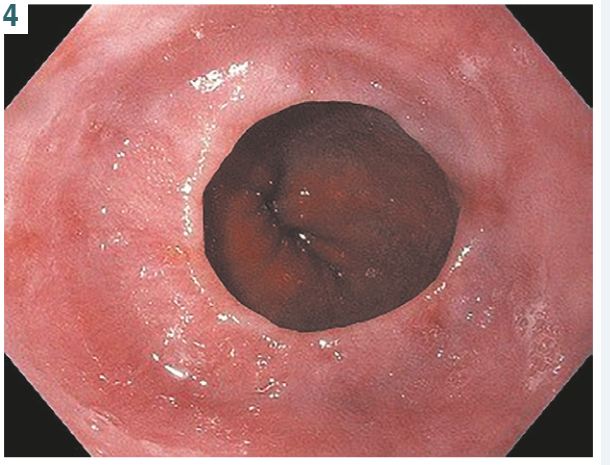
Degree of esophagitis	Group I (n = 85)	Group II (n = 68)	Value of difference	Group I (n = 85)	Group II (n = 68)	Value of significance
	C, mm	C, mm	P	M, mm	M, mm	P
NERD	1.7 ± 1.4	1.6 ± 1.2	0.9125	2.8 ± 1.5	3.5 ± 0.7	0.4572
LA A	2.0 ± 1.4	2.7 ± 1.2	0.6451	2.5 ± 2.1	5.0 ± 1.4	0.2963
LA B	4.0 ± 1.7	–	–	5.3 ± 2.1	–	–
LA C	–	–	–	–	–	–
LA D	–	–	–	–	–	–

P: value of statistical significance.









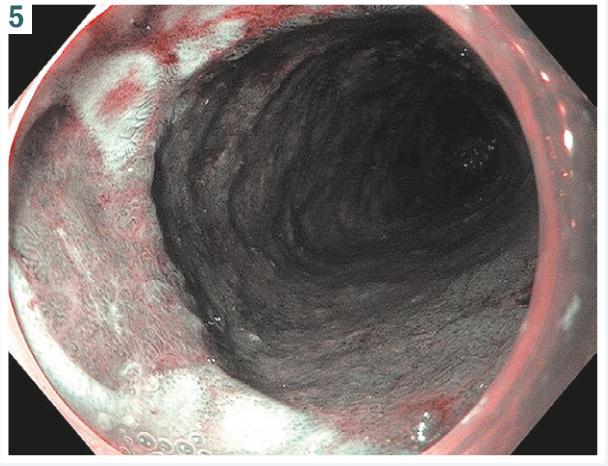


Fig. 1. CLE-esophagus (narrow binding imagine).

Fig. 2. Endoscopic view of palisade vessels.

Fig. 3. Endoscopic view of the gastric folds proximal edge location and the Z-line.

Fig. 4. Endoscopic diagnosis of GERD complication (Schatzki's ring).

Fig. 5. Barrett's esophagus (NBI).

Table 6. Distance of the proximal edge of the gastric folds and Z-line from the incisor teeth

Distance name	Group I (n = 85)	Group II (n = 68)	P
Distance of the proximal edge of the gastric folds from the incisors, cm	39.9 ± 1.3	39.5 ± 2.6	0.2174
Z-line distance from incisors, cm	36.6 ± 2.2	34.8 ± 2.6	0.0001
P	0.0001	0.0001	–

P: value of statistical significance.

Table 7. Characteristics of complicated forms of GERD

Complication	Group I (n = 85)	Group II (n = 68)
Schatzki's ring	4 (4.7 %)	–
Esophageal ulcer	–	4 (5.9 %)
Esophageal stricture	–	4 (5.9 %)

Table 8. Characteristics of patients with biopsy and Barrett's esophagus in both groups

Biopsy and Barrett's esophagus	Group I (n = 85)	Group II (n = 68)	P
Biopsy	49 (57.6 %)	37 (54.4 %)	0.6918
Barrett 0146s esophagus	16 (18.8 %)	3 (4.4 %)	0.0072

P: value of statistical significance.

which corresponded to the norm. Whereas the Z-line was displaced proximally in both groups and was determined at a distance of 36.6 ± 2.2 cm from the incisor teeth in the Group I and at a distance of 34.8 ± 2.6 cm in the Group II (*Table 6*).

As can be seen from the presented *Table 6*, the distance of the proximal edge of the gastric folds from the incisors practically does not differ between groups and corresponds to the endoscopic norm, while it differs statistically from the location of the Z-line. At the same time, the distance of the Z-line also differs between groups and is located more proximally in the Group II of patients with type III hiatal hernia. The distance between the proximal edge of the upper gastric folds and the Z-line was 3.7 ± 1.3 cm in Group I, while in Group II it was 5.0 ± 1.6 cm and statistically significantly differed between the groups (P = 0.0001) (*Fig. 3*).

The complicated course of GERD presented by esophageal strictures, ulcers and Schatzki's rings. The Schatzki's ring is shown in *Fig. 4*.

In Group II there is a predominance of complicated forms of GERD presented by strictures – 4 (5.9 %) and ulcers – 4 (5.9 %) of the esophagus. Schatzki's ring is observed in 4 patients (4.7 %) only in Group I (*Table 7*).

All analyzed patients underwent chromoendoscopy (mainly NBI and FICE) for more accurate identification of pathological changes in the mucosal layer and targeted biopsy. As a result in Group I targeted biopsy of the lower third mucosal layer of the esophagus was performed in 57.6 % patients, in the Group II – in 54.4 % patients (*Table 8*).

As a result, in the Group I Barrett's esophagus was confirmed in 16 (18.8 %) patients and significantly differs from the results obtained in the Group II in which Barrett's esophagus was diagnosed only in 3 (4.4 %) patients with GERD (*Fig. 5*).

Discussion

Thus, during visual endoscopic examination in both groups, pink and pale pink mucosa of the esophagus is predominantly found, which corresponds to the physiological norm. The groups do not differ from each other and according to other color characteristics of the mucosa (*Table 1*). Therefore, this sign, as well as visual endoscopic examination in general, in a large number of cases does not allow to make a convincing conclusion about the presence or absence of GERD, the intensity of reflux, the depth of the mucosal lesion or the type of hiatal herniation [2,5,16].

This is supported by the data obtained on the predominance of non-erosive forms of gastroesophageal reflux disease in both groups (*Table 2*). As for erosive forms, the appearance of patients with stage C in Group II may indicate a more severe course of the disease with type III hiatal hernia. Although the groups do not differ in degree A or B and in the length of erosions (*Tables 2, 3*). Statistically, the groups also do not differ in the frequency of determining signs of CLE-esophagus (*Table 5*). But clinically there are more patients with CLE-esophagus in Group I, despite the fact that this group is represented by patients with type I hiatal hernia (18.8 % to 7.4 %, respectively). At the same time, this trend is expressed in patients with non-erosive form of reflux disease, when, it would seem, there are no obvious endoscopic signs of GERD.

An analysis of the circular (C) and maximum (M) segments length in both groups also did not show statistically significant differences. Although clinically the length of the maximum segment in the Group II of patients was twice a long with grade A of esophagitis than in the Group I (2.5 ± 2.1 mm to 5.0 ± 1.4 mm, respectively).

An important step in the endoscopic diagnosis of GERD was the determination of the true esophageal-gastric junction zone, the key points of which are the determination of the Z-line, the boundaries of the palisade vessels disappearance and the location of the gastric folds proximal edge. Analysis of the Z-line visualization in both groups showed a statistically significant predominance of successful determination of the Z-line in the Group I with type I hiatal hernia, which was determined in almost all patients of this group – 92.9 % patients. In the Group II the number of patients was slightly less – 77.9 % respectively.

The border of the palisade vessels disappearance is also a landmark of the esophagogastric junction. However, unfortunately, palisade vessels were not detected in all patients in both groups and did not show a statistically significant difference between the groups (58.8 % to 44.1 %, respectively, P = 0.2020). At the same time, the proximal border of the gastric folds was visualized in all patients of both groups. In this regard, its location was considered the most significant border of the true esophageal-gastric junction and the most reliable sign of the border between the stomach and esophagus. The analysis of this sign provided interesting data. Thus, the distance of the proximal border of the gastric folds from the incisor teeth did not differ from the norm between groups and was 39.9 ± 1.3 cm in Group I, 39.5 ± 2.6 cm in Group II. A similar, almost physiological, location of the proximal edge of the gastric folds in both groups is explained as follows.

The hiatal hernia type was determined by polypositional X-ray examination, when the patient was necessarily examined in the Trendelenburg position with a routine Valsalva maneuver, and the type of fixation of the hernia, and, consequently, the type of migration of the stomach into the mediastinum were variable. Whereas endoscopic examination was performed only in a horizontal position without performing a Valsalva maneuver and the associated possible displacement of the stomach fundus, which was the reason for obtaining the above results. Concerning the Z-line location and the gastric folds proximal edge border the analysis of the obtained data showed a statistically significant shift of the Z-line proximal to the upper edge of the gastric folds in both groups, with a predominance of the shift in the Group II with the type III of the hiatal hernia. This confirms the presence of pathological reflux in all patients and the associated displacement of the Z-line in the proximal direction above the true border of the esophageal-gastric junction caused by the migration of the columnar gastric epithelium due to the gastric contents reflux into the esophagus [2,5,18]. And the significant predominance of the Z-line shift in the Group II to the gastric fold proximal edge and incisor teeth may be a sign of a more severe and prolonged course of GERD in the Group II of patients with type III hiatal hernia. A fact confirming this position is the predominance of complicated forms of GERD in the form of ulcers and esophageal strictures of the esophagus in the Group II of patients (*Table 7*). Although, in contrast to this situation, the proportion of confirmed Barrett's esophagus cases was higher in Group I in patients with type I hiatal hernia with proven statistical significance (P = 0.0072).

Thus, the analysis of the above endoscopic signs of GERD in patients with the most common varying types (I and III) of hernia showed a variety of their manifestations and the absence of a convincing dependence of the severity of one or another sign on the type of the hernia. This confirms the need for an individual approach to the implementation of videoesophagogastroduodenoscopy in GERD associated with a hiatal hernia and a differentiated interpretation of the obtained results taking into account other diagnostic data.

Conclusions

1. Endoscopic signs of gastroesophageal reflux disease with types I or III hiatal hernias have characteristic features the severity of which does not directly depend on the hernia type.

2. The most reliable sign of the true esophageal-gastric junction location in gastroesophageal reflux disease associated with type I or III of hiatal hernias is the proximal edge of the gastric folds.

3. The location of the Z-line in gastroesophageal reflux disease is not a reliable criterion for the esophageal-gastric junction border and can be displaced in the proximal direction at different distances in patients with type I or type III of hiatal hernia.

4. Complicated course of gastroesophageal reflux disease presented by esophageal strictures and ulcers prevails in patients with type III hiatal hernia, while Barrett's esophagus is more common in patients with type I hiatal hernia.

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