Hiatal hernia (HH) is characterized by the protrusion of any abdominal cavity structure, except the esophagus, into the chest cavity through an enlarged esophageal hiatus (EH) of the diaphragm [13].

Acquired HH are divided into 4 types based on their anatomical characteristics [21, 1]. In type I HH (axial or sliding), the gastroesophageal junction (GEJ) and, accordingly, the cardiac portion of the stomach move above the diaphragm by at least 2 cm [4], while the other portions of the stomach remain below it. Type I HHs are referred to as sliding hernias because one of the walls of the hernia...
sac is the posterior wall of the upper part of the cardiac portion of the stomach, which is not covered by the peritoneum. Hernias of types II—IV belong to paraesophageal hernias. In type II hernias, there is a protrusion into the mediastinum of the stomach’s fundus while the GEJ remains normally positioned. Type III (mixed) combines the anatomical characteristics of types I and II, meaning that above the diaphragm, not only the GEJ but also the fundus/body or the entire stomach migrates. Type IV is associated with the presence of other abdominal organs or structures within the hernia sac [10, 7, 13]. It is considered that over 95 % of diagnosed HH are classified as axial hernias, with only 5 % being paraesophageal hernias. Among paraesophageal hernias, more than 90 % are of type III [7]. However, according to data from a single population study among HH, type III hernias account for 29 %, while type I hernias make up 71 % [2].

The preoperative diagnosis of HH is quite complex, with diverse clinical manifestations. Paraclinical diagnostic methods are characterized by low sensitivity and specificity. Recently, in a meta-analysis involving 5,337 patients, it was demonstrated that the sensitivity and specificity of HH diagnosis using barium sulphate radiological examination were 0.63 and 0.85; endoscopic examination — 0.72 and 0.80; high-resolution manometry — 0.77 and 0.92, respectively [11]. Experts from a multinational European Delphi survey, consisting of 72 surgeons from 17 European countries with an average of 23 years of experience, consider fibroesophagogastroscopy to be the most informative diagnostic method for HH. They categorized it as «recommended». However, methods such as CT, contrast radiography, esophageal manometry, impedance pH testing, MRI, and esophageal planimetry were categorized as «acceptable» [5].

The diagnosis of mixed type III HH poses particular challenges as its symptoms are nonspecific. It shares common features with type I and type II hernias, but clinical and endoscopic manifestations differ [11]. Therefore, identifying the specific clinical and endoscopic characteristics unique to type III hernias can contribute to timely diagnosis and a personalized approach to treatment. Some argue that the varied symptoms of type III HH may be linked to its origin, either from type I or type II hernias [18]. However, there is still no definitive understanding of the connection between the clinical and endoscopic characteristics of type III HH and its origin.

Objective — of this study is to substantiate the diversity of clinical and endoscopic manifestations in type III HHs based on their origin, either from type I or type II hernias.

Materials and methods

Our experience in diagnosing HH encompasses 126 patients who underwent elective laparoscopic hernioplastic at the Bogomolets National Medical University Clinic. This includes 87 patients with type III HH from 2014 to 2021 and 39 patients with type I HH from 2019 to 2021. The hernia type was finally determined during the surgery.

The study was carried out in a structured manner, involving multiple phases. Initially, we conducted an assessment of endoscopic examination results in patients diagnosed with type III HH to ascertain the diversity of collected data and the rationale behind categorizing patients into subgroups using a two-stage cluster analysis. Subsequently, in the second phase, we juxtaposed the subgroups generated through cluster analysis, both amongst themselves and in relation to patients afflicted with type I HH, with the aim of discerning commonalities and disparities in endoscopic findings and clinical symptomatology.

The endoscopic examination was conducted using a Fujinon EG 760-R (Japan) fibrogastroduodenoscope, administered under intravenous sedation (propofol), with the patient in the left lateral position. The diameter of the endoscope was 0.92 cm.

The main landmarks during the endoscopic examination

- GEJ: the point where the upper part of the stomach’s fold connects with the tubular esophagus (the location where the palisade esophageal vessels terminate).
- Squamous-columnar junction: the boundary where the squamous epithelium of the esophagus transitions into the columnar epithelium of the stomach (Z-line). It is clearly visible due to the color difference between the squamous (pale pink) and columnar (pink or red) epithelium.
- Crural impression (CI): a round or oval opening that surrounds the proximal part of the stomach. It expands and contracts in response to respiratory movements and corresponds to the location of the crus of the esophageal hiatus.

An essential characteristic of HH was the presence of gastric mucosa above the CI by more than 2 cm.

We assessed the following characteristics:
- distance from teeth to the crural impression;
- length of the esophagus, measured as the distance from teeth to the GEJ;
- axial length of the hernia, calculated as the difference between the distance from teeth to the crural impression and the length of the esophagus (i.e., the distance between GEJ and CI);
• configuration of the hernia sac (HS), characterized as either a symmetrically expanded tubular or an asymmetrically deformed cavity;
• presence of Schatzki rings;
• esophagitis;
• degree of erosive esophagitis according to the Los Angeles classification [15, 16];
• presence of Cameron ulcers as linear ulcers on the stomach or erosions on the folds of the mucous membrane in the CI area [22];
• location of the GEJ in relation to the upper border of the hernia (below, above, or at the same level) (assessed during inversion);
• presence of erosions or ulcers in the stomach and duodenum;
• anatomy of the EH — horizontal and vertical dimensions, as well as the area of the EH (assessed during inversion). The area of the EH was calculated as the area of an ellipse: (vertical dimension of EH/2) · (horizontal dimension of EH/2) · 3.14. The area of the EH was assessed during diaphragm relaxation (exhalation) since it decreases during inhalation (Fig. 1).

Statistical analysis was performed using the IBM SPSS Statistics, v. 22. Descriptive statistics were calculated, and the mean values are presented as mean and standard deviation (M ± SD). A comparison of the means of quantitative variables was conducted using the Mann-Whitney U test. The comparison of relative values was carried out by the Pearson’s chi-squared test. To assess the variance of variable values between groups, Levene’s Test for Equality of Variances was applied, which is based on means. To identify groups of similar objects, a two-stage cluster analysis was performed. The null hypothesis of variable equality was rejected at p < 0.05.

Results
The comparison of endoscopic characteristics between patients with type I and type III HH revealed statistically significant differences in several indicators, as presented in Table 1.

In particular, with type III hernias, a shorter length of the esophagus (distance from the incisors to the GEJ) was observed, measuring 33.3 ± 2.8 cm compared to 34.6 ± 1.4 cm; a greater axial length of the hernia was observed, measuring 6.6 ± 2.6 cm compared to 5.2 ± 1.0 cm; and a larger hiatal area, measuring 7.9 ± 1.6 cm² as opposed to 7.3 ± 1.1 cm².

The analysis of the mean values of the mentioned indicators showed significantly higher data dispersion around the mean for type III hernias, which is characterized by the standard deviation. Levene’s Test for Equality of Variances, based on the mean, revealed statistically significant differences in the variances of such indicators as the length of the esophagus and the axial length of the hernia between type I and type III hernias, all p < 0.01.

The majority of categorical parameters exhibited a nearly equal distribution in cases of type III hernias. For instance, esophagitis and reflux esophagitis were identified in approximately 59.8 % and 50.6 % of patients, respectively, whereas they were not present in approximately 40.2 % and 49.4 % of cases, respectively. In contrast, in cases of type I hernias, these conditions were diagnosed in 100 % and 82.1 % of patients, respectively.

The hernia cavity shape was also observed in two variations: as an expanded asymmetric tube in 36.8 % of cases and as a deformed sac-like cavity in 58.6 % of cases.
Moderate degrees of severity of reflux esophagitis (stages A and B) together constituted 52.3%, while more severe cases (stages C and D) accounted for 41.4%. This is in contrast to type I hernias, where this proportion was 18.8% / 81.2%.

Finally, 62.1% of cases were identified with the GEJ located distal to the upper border of the hernia sac, whereas 37.9% of cases showed the GEJ proximal to the hernia sac or at the same level (Fig. 2).

The identified diversity in the endoscopic findings of type III HH suggests the possibility of various subtypes of such hernias.

To test this hypothesis, we conducted a two-stage cluster analysis using data from 7 variables obtained from endoscopy:

1) length of the esophagus;
2) axial length of the hernia;
3) presence of reflux esophagitis;
4) severity of reflux esophagitis;
5) variation of the hernia sac in direct view;
6) relation between the GEJ and the upper border of the hernia sac during inversion;
7) presence of Schatzki rings.

The analysis identified two clusters with a high degree of association and differentiation. This means that the endoscopy data can be divided into two groups that have significant similarity within one group and are substantially different from another. The primary grouping factor turned out to be the nature of the relationship between the GEJ and the upper border of the HS in inversion. Therefore, based on this indicator, HH can be divided

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Type I (n = 39)</th>
<th>Type III (n = 87)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from incisors to EH, cm</td>
<td>39.8 ± 1.4</td>
<td>39.9 ± 1.3</td>
<td>0.811</td>
</tr>
<tr>
<td>Distance from incisors to GEJ, cm</td>
<td>34.6 ± 1.4</td>
<td>33.3 ± 2.8</td>
<td><strong>0.005</strong></td>
</tr>
<tr>
<td>Axial length of the hernia, cm</td>
<td>5.2 ± 1.0</td>
<td>6.6 ± 2.6</td>
<td><strong>0.001</strong></td>
</tr>
<tr>
<td>Shape of the HS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expanded symmetric tubular</td>
<td>33 (84.6%)</td>
<td>4 (4.6%)</td>
<td><strong>0.001</strong></td>
</tr>
<tr>
<td>Expanded asymmetric tubular</td>
<td>6 (15.4%)</td>
<td>32 (36.8%)</td>
<td></td>
</tr>
<tr>
<td>Deformed sac-like</td>
<td>0</td>
<td>51 (58.6%)</td>
<td></td>
</tr>
<tr>
<td>The horizontal dimension of the EH, cm</td>
<td>2.9 ± 0.3</td>
<td>3.1 ± 0.4</td>
<td>0.160</td>
</tr>
<tr>
<td>The vertical dimension of the EH, cm</td>
<td>4.9 ± 0.6</td>
<td>5.2 ± 0.7</td>
<td>0.102</td>
</tr>
<tr>
<td>The area of the EH, cm²</td>
<td>7.3 ± 1.1</td>
<td>7.9 ± 1.6</td>
<td><strong>0.025</strong></td>
</tr>
<tr>
<td>Esophagitis</td>
<td>39 (100%)</td>
<td>52 (59.8%)</td>
<td><strong>0.0001</strong></td>
</tr>
<tr>
<td>Erosion esophagitis, stage according to the Los Angeles classification</td>
<td>32 (82.1%)</td>
<td>44 (50.6%)</td>
<td><strong>0.001</strong></td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>5 (11.4%)</td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>B</td>
<td>6 (18.8%)</td>
<td>18 (40.9%)</td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>C</td>
<td>20 (62.5%)</td>
<td>16 (36.4%)</td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>D</td>
<td>6 (18.8%)</td>
<td>5 (11.4%)</td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>Schatzki ring</td>
<td>5 (12.8%)</td>
<td>4 (4.6%)</td>
<td>0.098</td>
</tr>
<tr>
<td>Location of the GEJ in relation to the upper border of the HS</td>
<td></td>
<td></td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>Below</td>
<td>0</td>
<td>54 (62.1%)</td>
<td><strong>0.0001</strong></td>
</tr>
<tr>
<td>Above or at the same level</td>
<td>39 (100%)</td>
<td>33 (37.9%)</td>
<td><img src="https://via.placeholder.com/150" alt="" /></td>
</tr>
<tr>
<td>Cameron ulcer</td>
<td>0</td>
<td>5 (5.7%)</td>
<td>0.127</td>
</tr>
<tr>
<td>Erosive gastritis</td>
<td>9 (23.1%)</td>
<td>14 (16.1%)</td>
<td>0.348</td>
</tr>
<tr>
<td>Duodenal ulcer</td>
<td>4 (10.3%)</td>
<td>3 (3.4%)</td>
<td>0.123</td>
</tr>
</tbody>
</table>
into two subgroups: type IIIA where the GEJ is located proximally or at the level of the upper border of the HS, and type IIIB, where the GEJ is located distally to the upper border of the HS. The comparison of endoscopic features in the formed subgroups based on the relationship between the GEJ and the upper border of the HS showed that they significantly differ in several other indicators, as indicated in Table 2.

Specifically, patients in group IIIA had, on average, a shorter esophageal length compared to patients in subgroup IIIB: 31.6 ± 3.1 cm versus 34.2 ± 2.1 cm, and a longer axial length of the hernia: 8.4 ± 2.8 cm versus 5.6 ± 1.6 cm, all \( p = 0.001 \). Furthermore, in patients with type IIIA HH, esophagitis was more frequently observed at 87.9% compared to 42.6%, and reflux esophagitis at 87.9% compared to 27.8%, all \( p = 0.001 \). In the structure of erosive esophagitis, severe stages C and D (LA) predominated at 58.6%, while for type IIIB, they constituted 26.7%, \( p = 0.044 \). In type IIIB HH, Shatzki rings were not observed, whereas in type IIIA hernias, they were present in 12.1% of patients, \( p = 0.009 \).

The comparison of endoscopic phenomena in subgroups IIIA and IIIB with type I HH revealed that in subgroup IIIA, there was a significantly
shorter esophageal length of 31.6 ± 3.1 cm compared to 34.6 ± 1.4 cm (p = 0.001), and a larger axial length of the hernia of 8.4 ± 2.8 cm compared to 5.2 ± 1.0 cm (p = 0.001). However, there were no differences in these indicators between patients with type I HH and subtype IIIB.

Both subgroups significantly differed from type I HH in terms of the shape of the HS during direct examination, as they didn’t show cases of a HS shaped as an enlarged symmetric tube. In terms of the frequency of erosive esophagitis, the severity of its forms, and the frequency of detecting Shatzki rings, patients with type I HH and subtype IIIA were statistically similar. However, in subgroup IIIB, erosive esophagitis and its severe forms were significantly less common, and Shatzki rings were not detected.

So, patients with subtype IIIA HH (unlike subtype IIIB) exhibited endoscopic features characteristic of type I HH, along with a longer axial length of the hernia and a shorter esophageal length. It’s worth noting that the area of the EH did not differ between type I HH and subtype IIIA. However, in subtype IIIB, it was significantly larger. In addition to a certain similarity in endoscopic features, patients with type IIIA HH were almost indistinguishable from patients with type I HH in terms of clinical indicators, as shown in Table 3.

In the case of HH subtype IIIA, only two indicators were found to differ from those in type I HH: a shorter duration of the disease at 49.3 ± 9.6 years compared to 56.1 ± 10.3 years (p = 0.007), and a lower frequency of dyspnea at 15.4 % compared to 39.4 % (p = 0.021).

Table 2. Comparative assessment of endoscopic characteristics in patients with HH type I and subtypes IIIA and IIIB

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Type I</th>
<th>Type IIIA (n = 33)</th>
<th>Type IIIB (n = 54)</th>
<th>P</th>
<th>1/IIIА</th>
<th>1/IIIB</th>
<th>IIIА/IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from incisors to EH, cm</td>
<td>39.8 ± 1.4</td>
<td>40.1 ± 1.3</td>
<td>39.8 ± 1.3</td>
<td>0.503</td>
<td>0.913</td>
<td>0.398</td>
<td></td>
</tr>
<tr>
<td>Distance from incisors to GEJ, cm</td>
<td>34.6 ± 1.4</td>
<td>31.6 ± 3.1</td>
<td>34.2 ± 2.1</td>
<td>0.001</td>
<td>0.331</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Axial length of the hernia, cm</td>
<td>5.2 ± 1.0</td>
<td>8.4 ± 2.8</td>
<td>5.6 ± 1.6</td>
<td>0.001</td>
<td>0.254</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Shape of the HS

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Type I</th>
<th>Type IIIA (n = 33)</th>
<th>Type IIIB (n = 54)</th>
<th>P</th>
<th>1/IIIА</th>
<th>1/IIIB</th>
<th>IIIА/IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded symmetric tubular</td>
<td>33 (84.6 %)</td>
<td>4 (12.1 %)</td>
<td>0</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Expanded asymmetric tubular</td>
<td>6 (15.4 %)</td>
<td>26 (78.8 %)</td>
<td>6 (1.1 %)</td>
<td>0.001</td>
<td>0.254</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Deformed sac-like</td>
<td>0</td>
<td>3 (9.1 %)</td>
<td>48 (88.9 %)</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>The horizontal dimension of the EH, cm</td>
<td>2.9 ± 0.3</td>
<td>3.0 ± 0.4</td>
<td>3.1 ± 0.4</td>
<td>0.679</td>
<td>0.076</td>
<td>0.202</td>
<td></td>
</tr>
<tr>
<td>The vertical dimension of the EH, cm</td>
<td>4.9 ± 0.6</td>
<td>5.1 ± 0.7</td>
<td>5.2 ± 0.8</td>
<td>0.208</td>
<td>0.103</td>
<td>0.867</td>
<td></td>
</tr>
<tr>
<td>The area of the EH, cm²</td>
<td>7.3 ± 1.1</td>
<td>7.7 ± 1.1</td>
<td>8.1 ± 1.4</td>
<td>0.157</td>
<td>0.015</td>
<td>0.330</td>
<td></td>
</tr>
<tr>
<td>Esophagitis</td>
<td>29 (87.9 %)</td>
<td>39 (100 %)</td>
<td>23 (42.6 %)</td>
<td>0.025</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Erosion esophagitis, stage according to the Los Angeles classification</td>
<td>23 (72.7 %)</td>
<td>32 (82.1 %)</td>
<td>15 (27.8 %)</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>1 (3.4 %)</td>
<td>4 (26.7 %)</td>
<td>0.019</td>
<td>0.001</td>
<td>0.072</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>6 (18.8 %)</td>
<td>11 (37.9 %)</td>
<td>7 (46.7 %)</td>
<td>0.001</td>
<td>0.254</td>
<td>0.168</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>20 (62.5 %)</td>
<td>13 (44.8 %)</td>
<td>3 (20.0 %)</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>6 (18.8 %)</td>
<td>4 (13.8 %)</td>
<td>1 (6.7 %)</td>
<td>0.119</td>
<td>0.135</td>
<td>0.922</td>
<td></td>
</tr>
<tr>
<td>Schatzki ring</td>
<td>5 (12.8 %)</td>
<td>4 (12.1 %)</td>
<td>0</td>
<td>0.929</td>
<td>0.007</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Cameron ulcer</td>
<td>0</td>
<td>2 (6.1 %)</td>
<td>3 (5.6 %)</td>
<td>0.119</td>
<td>0.135</td>
<td>0.922</td>
<td></td>
</tr>
<tr>
<td>Erosive gastritis</td>
<td>9 (23.1 %)</td>
<td>6 (18.2 %)</td>
<td>8 (14.8 %)</td>
<td>0.610</td>
<td>0.309</td>
<td>0.678</td>
<td></td>
</tr>
<tr>
<td>Duodenal ulcer</td>
<td>4 (10.3 %)</td>
<td>0</td>
<td>3 (5.6 %)</td>
<td>0.058</td>
<td>0.396</td>
<td>0.168</td>
<td></td>
</tr>
</tbody>
</table>
At the same time, patients with HH subtype IIIB significantly differed from patients with HH type I in nearly all clinical indicators: they less frequently experienced heartburn — 25.9% compared to 82.1% (p = 0.001), chest pain — 24.1% compared to 64.1% (p = 0.001), hoarseness of voice — 33.3% compared to 66.7% (p = 0.001). These symptoms are characteristic of gastroesophageal reflux and gastroesophageal reflux disease (GERD). Instead, symptoms more characteristic of impaired food evacuation were more frequently reported. Specifically, patients more often complained of postprandial fullness — 57.4% compared to 15.4% (p = 0.001), vomiting — 24.1% compared to 7.7% (p = 0.039), and hiccups — 29.6% compared to 7.7% (p = 0.010). They more frequently reported shortness of breath — 42.3% compared to 15.4% (p = 0.005) and heart rhythm disturbances — 48.1% compared to 12.8% (p = 0.001).

It should be noted that in terms of clinical symptoms, patients with HH subtype IIIB also differed from those with subtype IIIA, almost as much as they did from patients with type I HH.

**Discussion**

It is generally accepted that HH type III (mixed type) combines the anatomical characteristics of type I and type II hernias, meaning that above the diaphragm, it can involve not only the GEJ (as in the first type) but also the fundus/body or the entire stomach (as in the second type). A type III hernia should therefore acquire other shared features of type I and type II hernias.

On the other hand, it is known that axial sliding hiatal hernias in most cases manifest with symptoms of gastroesophageal reflux and GERD [9], while type II paraesophageal hernias typically...
have an asymptomatic course [8, 20, 6]. Endoscopically, type I HHs are characterized by esophageal shortening, an increased distance between the GEJ and the EH, esophagitis, GERD, cardia herniation, and other signs, while in type II HH, the length of the esophagus remains unchanged, there are usually no endoscopic reflux symptoms, and only the herniated protrusion of the gastric fundus is visualized in retroflexion. So, how do these different clinical and endoscopic manifestations of type I and type II hernias combine to form type III hernias?

Of course, a type III hernia does not develop suddenly and instantaneously but forms gradually over time. It is important to understand which specific type of hernia (type I or type II) precedes the development of a type III hernia.

P. J. Kahrilas, et al. [9] write that with the progressive enlargement of the hernia through the diaphragmatic hiatus, the diaphragmatic-esophageal ligament stretches, displacing the GEJ above the diaphragm and adding a sliding component to the type II hernia. They mean that a type III hernia is a transformation of a type II hernia. R. V. Petrov, et al. [19] also believe that type III paraesophageal hernia arises from a type II hernia due to the continuous stretching of the diaphragmatic-esophageal ligament, the gradual enlargement of the EH, and the formation of a HS from the peritoneum. The GEJ, in addition to a part or the whole fundus and body, migrates upward, either partially or entirely, after the stomach, within the hernia sac.

A. O. Nykonenko, et al. [17] outline a characteristic feature of type III hernia, in their view, in which the GEJ is displaced along the longitudinal axis, as in type I hernia, while the most proximal part of the stomach, which protrudes into the mediastinum, is located above the GEJ. This formulation also implies that a type II hernia preceded the development of a type III hernia.

Unlike the viewpoint mentioned before, S. Paul and R. Bueno emphasize that a type III HH can originate from either a type I HH or a type II HH. In the presence of a type I HH, over time, the diaphragmatic-esophageal ligament may weaken, leading to the development of a type II defect.

Conversely, the presence of a type II defect can, over time, weaken the diaphragmatic-esophageal ligament, leading to the development of a type I defect. In this case, the symptoms of type III HH manifest as a combination of symptoms from both type I and type II hernias. Typically, the symptoms of the larger defect predominate. The incidence of the progression from a type I or type II HH to a type III hernia is unknown [18].

If we assume that hernias of type I and type II, which differ in clinical and endoscopic manifestations, are precursors of type III hernia, then in such patients, significant variability in these manifestations can be expected.

The study comprised 126 patients with HH, including 87 with type III hernia and 39 with type I hernia, who underwent elective laparoscopic hernia surgery.

The study had several steps. In the first step, an assessment of the results of endoscopic examination in patients with type III HH was conducted to determine the diversity of the obtained data and the feasibility of dividing patients into subgroups using a two-stage cluster analysis. In the second step, the subgroups obtained through cluster analysis were compared with each other and with patients with type I HH to determine the similarities or differences in endoscopic examination data and clinical symptoms.

To the best of our knowledge, this is the first study in which the diversity of clinical and endoscopic manifestations of type III HH has been assessed and the rationale for its differentiation into subgroups based on its origin, either type I or type II, has been established.

In type III HH, the endoscopic indicators were significantly more diverse than in type I HH, which could indicate the likelihood of different subtypes of type III hernia. A two-stage cluster analysis was conducted using data from 7 variables: the length of the esophagus, the axial length of hernia, the presence and severity of reflux esophagitis, the form of the HS in a direct view, the relationship between the GEJ and the upper border of the HS in an inversion view, and the presence of Schatzki rings. This analysis identified two clusters (groups) with a good degree of association and differentiation.

The primary factor in group formation was the relationship between the GEJ and the upper border of the HS in an inversion view. Therefore, based on this indicator, type III HH can be categorized into two subgroups: type IIIA, where the GEJ is positioned proximally or at the level of the upper border of the HS, and type IIIB, where the GEJ is located distally to the upper border of the HS.

The differentiation of patients with type III HH into two subgroups based on this endoscopic feature can be explained by the various origins of the hernia. If a type III hernia preceded a type I hernia, the GEJ is expected to be positioned higher or at the level of the upper border of the HS (Fig. 3). Conversely, if a type II hernia precedes it, the GEJ is expected to be positioned lower than the upper border of the HS (Fig. 4).
Based on this criterion, we formed two subgroups: subgroup IIIA (where, theoretically, the development of type III hernia was preceded by type I hernia) and subgroup IIIB (where, theoretically, the development of type III hernia was preceded by type II hernia).

Comparing the clinical symptoms of patients with type I hernia to those assigned to a specific subtype of type III hernia showed no significant difference in the frequency of symptoms between type I hernia and subtype IIIA. On the other hand, patients with type III B hernias significantly differed from patients with type I hernias in most clinical characteristics: they less frequently experienced symptoms associated with gastroesophageal reflux and GERD (heartburn, chest pain, hoarseness of voice), which is probably related to the partial preservation of anti-reflux mechanisms, and more frequently reported symptoms characteristic of impaired food evacuation (postprandial fullness, vomiting, hiccups).

They also more frequently reported dyspnea and heart rhythm disturbances. In terms of clinical symptoms, patients with HH subtype IIIB also differed from those with HH subtype IIIA, much like they differed from patients with HH type I.

The formed subgroups also significantly differed in terms of endoscopic indicators.

Patients in subgroup IIIA had, on average, a shorter length of the esophagus, a longer axial length of the hernia, and more frequently presented with esophagitis and reflux esophagitis. They also had more frequent occurrences of Schatzki rings, which were absent in subtype IIIB. In the structure of erosive esophagitis, severe stages C and D (LA) predominated, accounting for 58.6% compared to 26.7% in type IIIB, p = 0.044.

In the case of type IIIB hernias, Schatzki rings were not observed, whereas in type IIIA hernias, they were present in 12.1% of patients, p = 0.009.

Therefore, in patients with type IIIA HH (compared to type IIIB), there is a predominance of endoscopic signs characteristic of type I HH.

Therefore, patients with type III HH exhibit significant diversity in clinical and endoscopic manifestations, which is determined by the different origin of the hernia (from type I or type II).

An endoscopic characteristic indicating the origin of the hernia is the location of the GEJ relative to the highest point of the HS: below it, from type II HH (62.1%), at or above it, from type I HH (37.9%).

Limitations of the study. The data obtained by us can be extrapolated to the entire population of patients with HH types I—III with certain caution.

Firstly, this is due to the relatively small number of patients included in the study.

Secondly, the study does not encompass all variations of HH progression in the population. Specifically, it did not include patients with asymptomatic or mildly symptomatic HH and those with HH type II.

Thirdly, the study was retrospective, while precise data regarding the transformation of HH types can be obtained through prospective observation of patients with type I and II HH.

DECLARATION OF INTERESTS

The authors declare that they have no conflicts of interest.

ETHICS APPROVAL

The protocol was presented by the ethical commission of Bogomolets National Medical University.

AUTHORS CONTRIBUTIONS

T.A. Tarasov: concept and design of the study, collection, analysis, and interpretation of data, drafting and revision of the manuscript; L.Y. Markulan: collection, analysis, and interpretation of data.
Порівняльна оцінка клінічної та ендоскопічної семіотики гриж стравохідного отвору діафрагми

Т.А. Тарасов, Л.Ю. Маркулан

Навчальний медичний університет імені О.О. Богомільца

Грижа стравохідного отвору діафрагми (ГСОД) III типу поєднує анатомічні характеристики гриж І і ІІ типів. Провівши III тип гриж гетерогенізувати і можуть відзеркалювати її походження — з типу І чи ІІ, але дотепер немає визначеності щодо зв'язку клінічних і ендоскопічних проявів ГСОД типа ІІІ з її походженням.

Мета — на підставі аналізу клінічних і ендоскопічних проявів гриж стравохідного отвору діафрагми типу ІІІ обґрунтувати гетерогенізувати їхніх характеристик різним походженням від типу гриж І і ІІ.

Матеріали та методи. У дослідження увійшло 126 хворих з ГСОД, у тому числі 87 III типу та 39 — І типу, порівняли клінічну та ендоскопічну семіотику гриж стравохідного отвору діафрагми типу ІІІ з клінічними та ендоскопічними проявами грижі стравохідного отвору діафрагми типу І та ІІ для визначення спільності або відмінності даних ендоскопічного дослідження та клінічної симптоматики.

References


Результати. Кластерний аналіз визначив два кластери показників з хорошою мірою їх зв'язаності та поділу. Основним фактором поділу на кластери виявився характер відношення стравохідно-шлункове з'єднання (СШЗ) та верхньої межі грижової порожнини при огляді в інверсії. За цим показником ГСОД типу ІІІ можна поділити на дві субгрупи: тип І — СШЗ розташоване на рівні найвищої точки грижової порожнини, тип ІІ — СШЗ розташоване дистальніше найвищої точки грижової порожнини. Частота більшості ендоскопічних симптомів грижі в субгрупі ІІІ на відміну від субгрупи ІІВ, статистично значущо не відрізнялася від грижі типу І за винятком меншої довжини стравоходу та більшої осьової довжини грижі. Крім того, хворі з субтипом грижі ІІІА майже не відрізнялися від хворих типу І за клінічними показниками за винятком більшого середнього віку та частоти віддиху. При субтипу ІІВ був великий різниці з грижею типу І за середньою значучу різною відмінностей симптомів, пов'язаних з гастроезофагеальним рефлюксом. Хворі з грижі ІІІА мають вищі частоти ендоскопічних симптомів грижі типу ІІ, що інші вони можна відрізнити від грижі типу І за клінічними показниками за винятком більшого середнього віку та частоти віддиху. При субтипу ІІІВ більша частота симптомів, пов'язаних з гастроезофагеальним рефлюксом, вона відома у грижі типу ІІ. Крім того, хворі з грижі ІІІА мають більшу частоту віддиху.

Висновки. Хворі з ГСОД типу ІІІ мають суттєву гетерогенність клінічних і ендоскопічних проявів, що обумовлено різним походженням грижі (з типу І або з типу ІІ). Ендоскопічною ознакою, що вказує на походження грижі, є розташування шлунково-стравохідного з'єднання відносно найвищої точки грижової порожнини: нижче неї — з грижі ІІ типу (62,1 %), на рівні або вище — з грижі ІІІ типу (37,9 %).

Ключові слова: грижа стравохідного отвору діафрагми, діагностика, семіотика, підтипи грижі.

FOR CITATION