

**COMPREHENSIVE SURGICAL TREATMENT OF HERNIAS OF THE  
HESOPHAGEAL HOLE OF THE DIAPHRAGM**

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**Abstract.** The use of the developed choice of tactics for surgical treatment of esophageal hernias of the diaphragm has made it possible to reduce the number of postoperative complications and mortality

**Keywords:** hernia, esophageal opening of the diaphragm, surgical treatment

**Relevance.** Despite the broad scope of the topic of hiatal hernias, key issues of significant importance for practical surgery remain unresolved (2,3). There is no unified approach to the selection of surgical techniques for different types of hiatal hernias; clear stratification criteria allowing for personalized treatment tactics based on clinical and morphological characteristics have not been developed; there are contradictions in the justification of indications for the use of reinforcing meshes; the relationship between the size of the hernia defect, esophageal motility, and the choice of antireflux correction method has been insufficiently studied; and the number of studies evaluating surgical outcomes depending on a stratified approach based on objective parameters is limited (1,2).

Hiatal hernia (HH) complicated by reflux esophagitis (RE) is one of the most common gastrointestinal diseases. It has now been proven that its incidence has surpassed that of gastric and duodenal ulcers and ranks first among all benign pathologies of the cardiofundal region (7,8,9,10). Hiatal hernia is diagnosed in 5-15% of patients with various gastrointestinal diseases during radiographic examinations (1,11).

HH is most often detected in people of active working age 40-60 years. But it poses an equally serious problem in elderly patients, when surgical treatment options are limited by concomitant cardiovascular and respiratory pathology (1,12,13). According to D. Kröll (2019), GERD occurs in 33-50% of people over 60 years of age.

Typical complications of the pathology include esophagitis of varying severity, esophageal bleeding, peptic stricture and shortening of the esophagus, Barrett's esophagus, ulcers, and esophageal cancer (1,2,4,5).

At the current stage of medical development, therapeutic treatment is recognized as the primary treatment for patients with hiatal hernia complicated by ER (1,14). However, it is obvious that hiatal hernia, as the cause of ER, cannot be treated conservatively, forcing patients to undergo lifelong courses of therapy. Many patients develop intolerance or tolerance to medications, while others develop complications caused by reflux of gastric contents into the esophagus. Surgical treatment is indicated for such patients (1).

Currently, the R. Nissen fundoplication procedure and its modifications are considered the "gold standard" for surgical treatment of patients with hiatal hernia and ER (2). However, many researchers note a high rate of disease recurrence after surgery or the development of new

symptoms that had not previously bothered the patient. As the follow-up period after R. Nissen fundoplication increases, an increase in the percentage of unsatisfactory surgical outcomes is noted (3).

The disadvantages of fundoplication techniques are associated, firstly, with the high traumatic nature of the interventions due to the need to mobilize the distal esophagus and fundus of the stomach. Secondly, the fundoplication cuff alters the anatomical relationship of organs in the gastroesophageal junction and, ultimately, leads to disruption of the physiological functioning of the esophagogastric junction (1). According to R. Nissen, the main cause of fundoplication failure is considered to be fundoplication cuff failure due to inadequate technical execution of the surgery (14). However, in the literature, little attention is paid to the preoperative examination of patients with hiatal hernia and the planning of surgical treatment tactics (1).

Thus, no "ideal" surgical procedure has yet been developed for GERD, and the choice of surgical technique remains controversial and continues to be debated (1). Therefore, clarifying the optimal surgical technique for patients with GERD complicated by ER, from the perspective of assessing long-term treatment outcomes, should be recognized as a pressing issue requiring resolution.

**The objective of the study** was to develop an algorithm for selecting a surgical treatment strategy for hiatal hernias.

**Materials and Methods.** The analysis was conducted at the Bukhara Regional Multidisciplinary Clinic and covered the period 2015-2025. The total sample consisted of 128 patients with hiatal hernias who underwent laparoscopic surgery. The study was designed in a retrospective-prospective manner.

**Results and discussion.** The following factors had the greatest impact on the likelihood of an unsatisfactory outcome: esophageal dyskinesia, severe weakening of the valve mechanism (Hill III-IV), a high degree of gastric migration (3-4), and the presence of a type III-IV hernia. These features were subsequently included in the multivariate logistic analysis model to develop a prognostic algorithm.

The state of the antireflux valve mechanism according to the Hill classification also proved to be a significant predictor: with grades III-IV impairment, an unsatisfactory outcome was observed in 48% of patients, versus 8.6% in the group with grades I-II (OR = 5.75;  $p = 0.006$ ). This symptom reflects the functional failure of the diaphragmatic zone, which requires at least stabilization measures (for example, gastropexy), and in some cases also strengthening of the diaphragmatic ring.

The Barrett/HPE hernia type also proved significant: in patients with types III-IV, the failure rate was 50%, compared to 12.5% for types I-II ( $p=0.024$ ). These data demonstrate the importance of considering the morphological type of hiatal hernia when planning intervention. In other words, with large, sliding, and mixed hernias, basic crurography is insufficient.

The degree of gastric migration deserves special attention: with grades 3-4 (subtotal and total displacement of the cardia into the thoracic cavity), the risk of recurrence and functional impairment increased more than fourfold compared to less severe forms of displacement ( $p=0.018$ ). This result directly substantiates the need to include elements of gastric fixation and additional stabilization of the diaphragm. Finally, the daily acidity indicator also showed a statistically significant association with an unfavorable outcome: with a  $pH < 4$  more than 4% of the time, an unsatisfactory result was observed in 47.6% of cases, versus 12.8% with normal values (OR=5.60;  $p=0.007$ ). This parameter can serve as an objective criterion for the presence

of clinically significant GERD and, accordingly, an indication for expanding the scope of the intervention.

According to the data obtained, the most significant independent prognostic factor was a sign of esophageal motility disorder, in particular the presence of dyskinesia (OR=7.85; 95% CI: 2.10-29.35;  $p=0.002$ ), which emphasizes the inconsistency of esophageal peristaltic activity, significantly reducing the effectiveness of standard interventions and requiring modification of surgical tactics. The Hill valve mechanism score was the second most influential factor: grades III-IV esophageal-gastric junction impairment was associated with a nearly fivefold increased risk of unsatisfactory outcome compared to grades I-II (OR=4.95;  $p=0.008$ ). This indicator reflects the degree of functional failure of the gastric valve mechanism and can be considered an indication for the addition of gastropexy or mesh reinforcement.

A high degree of gastric migration (grades 3-4) demonstrated an OR=3.80 (95% CI: 1.20-12.00;  $p=0.025$ ), indicating the need to stabilize the cardia with fixation or additional reinforcement in cases of significant gastric displacement into the thoracic cavity.

Finally, the Barrett/HPE hernia type (III-IV) retained independent prognostic significance even after adjustment for other variables (OR=2.95;  $p=0.041$ ), allowing the inclusion of the morphological type of hiatal hernia in the risk score, particularly when assessing hernia sac volume and GERD deformation.

Based on the results of multivariate logistic analysis, an integrated prognostic score was developed to stratify patients according to the risk of developing an unsatisfactory outcome after surgical treatment of hiatal hernia. The score included only those features that retained independent prognostic significance in multivariate regression: Barrett/HPE hernia type, degree of gastric migration, Hill valve status, and the presence of esophageal motility disorders. Each feature was assigned a corresponding weight (point) proportional to its impact on the risk of outcome, estimated using the odds ratio (OR). The most significant factor was esophageal motility disorder, which was assigned a score of 2. Other features (hernia type III-IV, Hill III-IV, degree of gastric migration  $\geq 3$ ) were assigned a score of 1 each, reflecting their clinical significance but a lesser impact on prognosis than dyskinesia.

Overall, the developed risk stratification scale and algorithm for choosing surgical treatment tactics for hiatal hernias represent a logically formalized system based on a quantitative assessment of clinical and instrumental parameters, which forms the basis for their digital implementation in the form of specialized software.

Given the clear structure of input data (hernia type, degree of gastric migration, valve mechanism parameters, manometry data) and their diagnostic reproducibility, this algorithm can be integrated into a digital platform with artificial intelligence elements, providing automated interpretation of significant parameters and predicting the likelihood of an unsatisfactory outcome. The use of artificial intelligence will allow for real-time recommendations for the optimal surgical intervention for a specific patient, improve the accuracy of clinical decisions, eliminate the variability of human interpretation, and thereby standardize a personalized approach to GERD surgery.

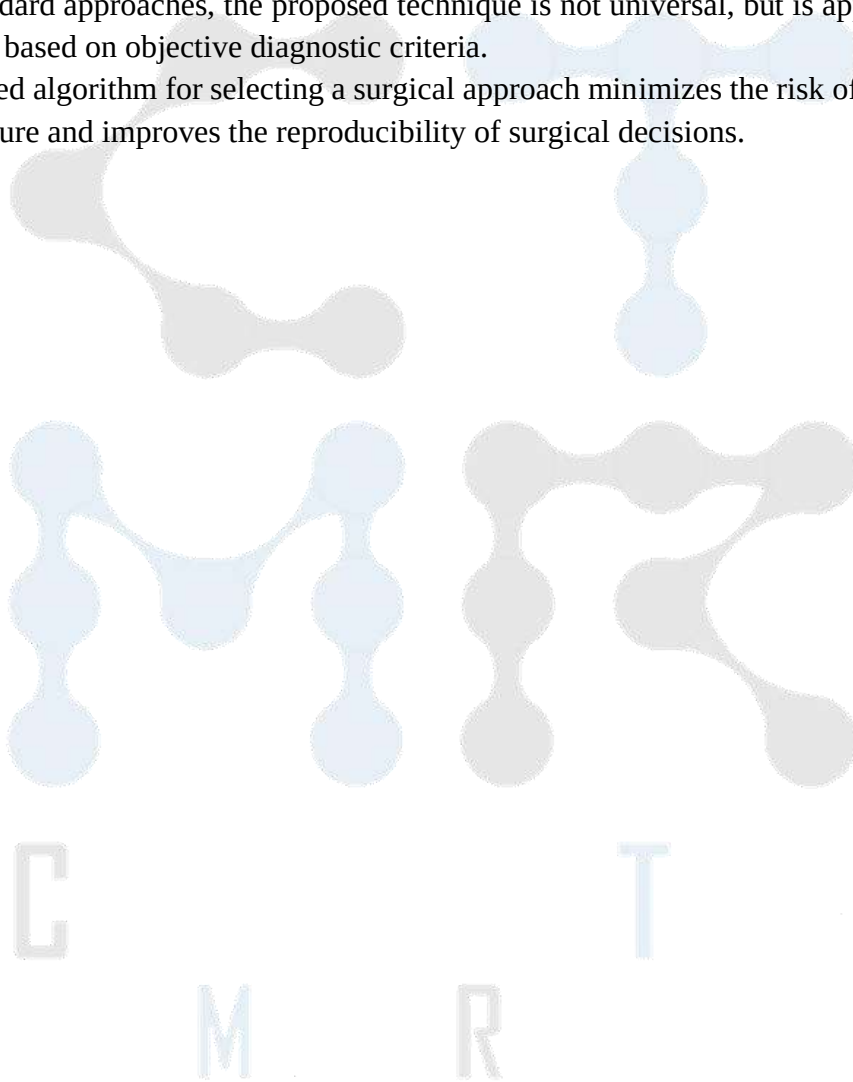
Based on the overall assessment, the following stratification is proposed: 0-1 points: patients with minimal anatomical and functional impairments. They are recommended to undergo modified cruroraphy, typically without additional stages. 2-3 points: intermediate risk zone, in which modified cruroraphy can be supplemented with functional gastropexy to stabilize the cardia and prevent axial displacement.  $\geq 4$  points: high risk of unsatisfactory results with the traditional

approach. Patients in this category are recommended to undergo a full modified technique, including cruroraphy with subalarcotot sutures, gastropexy, and placement of a semi-encompassing "saddle" mesh implant.

The algorithm ensures clinical validity, reproducibility, and individualization of surgical approaches for hiatal hernia. The model's application in real-life practice has been validated in clinical cases and reduces the risk of recurrence, functional impairment, and unnecessary extension of surgical intervention. The data obtained form the methodological basis for further systematic evaluation of the results of the proposed approach.

#### **CONCLUSIONS:**

1. Unlike standard approaches, the proposed technique is not universal, but is applied on a case-by-case basis, based on objective diagnostic criteria.
2. The proposed algorithm for selecting a surgical approach minimizes the risk of recurrence and functional failure and improves the reproducibility of surgical decisions.



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