Optimal Surgical Treatment of Hiatal Hernias of Types II-IV

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ABSTRACT

Hiatal hernias of types II-IV have anatomical features that cause a displacement of the abdominal organs into the mediastinum through the hiatal opening of the diaphragm parallel to the esophagus without or together with it (paraesophageal component), which is an absolute indication for surgical treatment, since it is the cause of life-threatening conditions (acute intestinal or gastric, esophageal obstruction, strangulation and further necrosis of the organs located in the hernial sac). The recurrence rate of hiatal hernias of types II-IV reaches 20-40% and even 60%, underscoring the need for analysis and search for new solutions to this problem. The article analyzes the long-term results of treatment of 150 patients with hiatal hernias of types II-IV hernias, operated in the thoracic surgery department of the P. A. Bayandin Murmansk Regional Clinical Hospital in the period from 2013 to 2017, which made up a retrospective group (standard surgical treatments). Based on the assessment of the treatment results, changes were made to the surgical intervention tactics used.

Keywords: esophageal hernia, hiatal hernia, gastroesophageal reflux disease, diaphragmatic plastic surgery, cruroraphy, fundoplication.

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ABSTRACT

Hiatal hernias of types II-IV have anatomical features that cause a displacement of the abdominal organs into the mediastinum through the hiatal opening of the diaphragm parallel to the esophagus without or together with it (paraesophageal component), which is an absolute indication for surgical treatment, since it is the cause of life-threatening conditions (acute intestinal or gastric, esophageal obstruction, strangulation and further necrosis of the organs located in the hernial sac). The recurrence rate of hiatal hernias of types II-IV reaches 20-40% and even 60%, underscoring the need for analysis and search for new solutions to this problem. The article analyzes the long-term results of treatment of 150 patients with hiatal hernias of types II-IV hernias, operated in the thoracic surgery department of the P. A. Bayandin Murmansk Regional Clinical Hospital in the period from 2013 to 2017, which made up a retrospective group (standard surgical treatments). Based on the assessment of the treatment results, changes were made to the surgical intervention tactics used. From 2018 to 2024, 180 patients with hiatal hernias of types II-IV underwent surgery in the same unit, forming a prospective study group (optimal surgical treatments). A comparison of these groups was carried out. The research evaluates the perception of certain factors, primarily shortening of the esophagus, as objective conditions with the transformation of surgical tactics allowing for achieving significantly better results. Good or satisfactory treatment outcomes were achieved in 73.7% of cases in patients of the retrospective group, and poor outcomes were achieved in 26.7%. In patients of the prospective group, these results were 88.6% and 11.4%, respectively. The research confirms that with shortening of the esophagus in type III hernias, its high mobilization does not allow to reliably prevent repeated displacement of the stomach into the chest; the use of prostheses to correct the esophageal hiatus in case of shortening of the esophagus is an ineffective method of preventing relapse of the disease; the formation of a fundoplication cuff in the mediastinum in case of shortening of the esophagus should be considered an effective method of preventing relapse; in case of hernias of types II-IV and normal length of the esophagus, the use of prosthetic materials to correct the size of the hiatal opening is justified and allows to reduce the frequency of unsatisfactory treatment results.

Keywords: esophageal hernia, hiatal hernia, gastroesophageal reflux disease, diaphragmatic plastic surgery, cruroraphy, fundoplication.

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I. INTRODUCTION

Surgical treatment of hiatal hernias of types II-IV is a separate surgical problem that has been discussed for many years. Given the high long-term disease recurrence rate, unsatisfactory

surgical outcomes are reported according to various sources in 20-40% of cases. [1, 3, 4, 7, 9].

The reasons for unsuccessful treatment outcomes are the large size of the hernial gate (esophageal hiatus) and the destruction of the ligamentous apparatus that holds the organs of the abdominal cavity (primarily the stomach) in the abdominal position. Another factor influencing the tendency of this type of hernia to relapse is the primary or secondary (due to various pathogenetic influences) shortening of the esophagus. [2, 5, 11].

Over the long history of surgical treatment of hiatal hernias of types II-IV, many ways have been proposed to improve the results of surgical interventions, which are ideologically divided into several options. The first category includes techniques aimed at improving the reliability of plastic surgery of the hiatal opening: the use of a circular ligament of the liver, and patches made of biological or polymer prosthetic materials, to correct its size. The second group of techniques is aimed at strengthening the abdominal position of the stomach, and is called "gastropexy" in the literature. The essence of all surgical options is to fix the stomach to the anterior or lateral abdominal wall, preaortic fascia, etc. The third category of operations is aimed at correcting the shortening of the esophagus: its high mobilization in the mediastinum, intersection of the vagus nerves, esophagogastroplasty (lengthening of the esophagus due to the small curvature of the stomach) [3, 6, 7, 8, 9]. Unfortunately, the vast majority of these techniques have significant negative consequences and have not been widely used in clinical practice. Thus, to date, the issue of increasing the effectiveness of surgical treatment of hiatal hernias of types II-IV remains open.

II. MATERIALS AND METHODS

The long-term treatment outcomes of 150 patients with hernias of the esophageal orifice of the diaphragm operated in the Department of thoracic surgery of the P.A. Bayandin Murmansk Regional Clinical Hospital (Russia) in the period from 2013 to 2017 were analyzed. These patients formed a retrospective group (standard surgical treatments). The results obtained led to changes in the tactics used for surgical interventions. From 2018 to 2024, 180 patients with hiatal hernias of types II-IV, who made up the prospective study group (optimal surgical treatments), were operated on in the same unit.

The groups were comparable in age and gender composition (Figure 1).

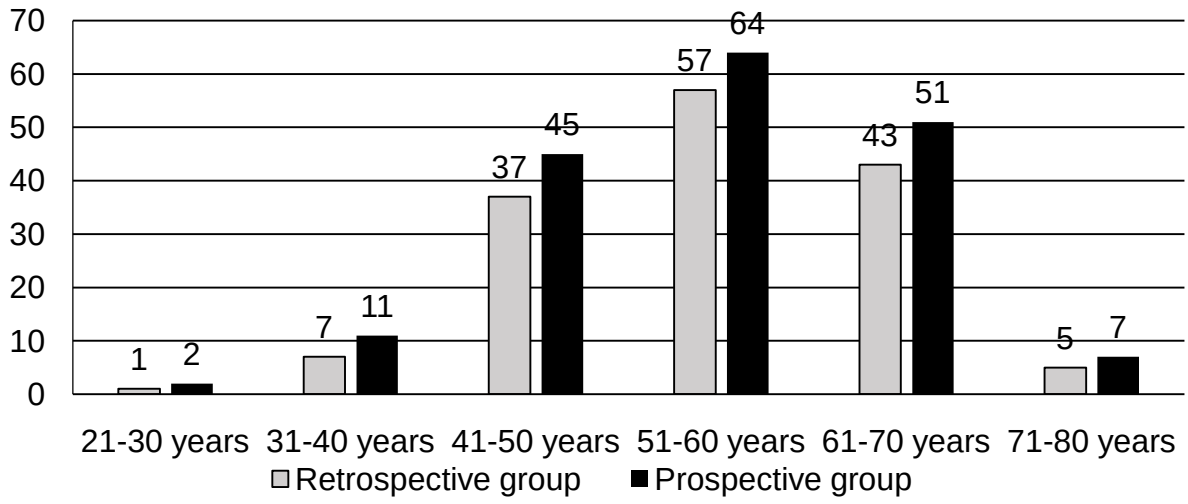

Figure 1: Distribution of Patients in the Retrospective and Prospective Groups by Gender and Age

The clinical signs of the disease in patients of both groups were similar and consisted of manifestations of gastro-esophageal reflux (heartburn, belching, regurgitation, chronic cough, hoarseness of voice, cardiac arrhythmias, etc.) in type III hernias.

Another category of symptoms (pain behind the sternum or in the abdomen, often worse after eating, vomiting, shortness of breath) was caused by a disruption in the passage of contents through the organs of the abdominal cavity displaced into the mediastinum. The reason for such changes in

function in hernias of types II-III was the formation of a “gastric valve" – the rotation of the part of the stomach located in the chest in different planes. In type IV hernias, the symptoms were caused by rotation or compression in the hiatal opening of the colon.

The method of instrumental diagnosis of the type of hiatal hernias in patients of both groups was the upper digestive tract radiography with contrast agent ($BaSO_4$) (Table 1.).

Table 1: Types of Diaphragmatic Hernias in Patients of the Retrospective and Prospective Groups

Type of Hiatal Hernia	Number of Patients, Absolutely . (%)	
	Retrospective Group (Standard Surgical Treatments)	Prospective Group (Optimal Surgical Treatments)
Paraesophageal Hernias (Type Ii)	17 (11,3%)	25 (13,9%)
Mixed Hernias (Type Iii)	131 (87,3%)	152 (84,4%)
Hiatal Hernias (Type Iv)	2 (1,3%)	3 (1,7%)
Total	150 (100%)	180 (100%)

In type II hiatal hernias, X-rays showed that the fundus, and sometimes a part of the stomach body, displaced into the mediastinum. In these cases, the gastroesophageal junction was located in the abdominal cavity. In mixed hernias, the findings were similar, except for the displacement of the gastro-esophageal junction into the chest. In type IV hernias, the imaging revealed a displacement of not only the stomach but also other organs into the mediastinum, creating additional radiographic shadows.

To clarify the nature of anatomical disorders, diagnose the “gastric valve” in hernias of types II-III, or determine the organ displaced to the chest in hernias of type IV, computed tomography with a water-soluble contrast agent was performed. A “gastric valve" in patients of the retrospective group was detected in 13 (76.4% with this type of anatomical changes) with paraesophageal and 93 (71.0%) with mixed hernias. In the prospective group, 16 (64.0%) and 106 (69.7%) patients were affected, respectively. In type IV hernias, the colon was visualized in two people in the retrospective and three in the prospective group.

During endoscopic examination of the upper digestive tract, changes in the mucous membrane of the esophagus and stomach were noted in some patients of both groups (Table 2).

Table 2: Endoscopic Changes of the Upper Digestive Tract in Patients of the Prospective Group

Patient Groups	Number of Patients, Absolutely . (%)		
	Erosive Esophagitis	The Cylindrical Cell Metaplasia	Erosive Gastritis
Retrospective Group (Standard Surgical Treatments)	86 (57,3%)	19 (12,7%)	110 (73,3%)
Prospective Group (Optimal Surgical Treatments)	110 (61,1%)	16 (8,8%)	101 (67,3%)

Pronounced erosive esophagitis and cylindrical cell metaplasia of the esophageal epithelium in patients of both groups were observed mainly in type III hernias characterized by gastroesophageal reflux. Erosive gastritis was detected in the part of the stomach displaced to the chest in patients of both groups with paraesophageal and mixed hernias.

The indications for surgical treatment in patients of both the retrospective and prospective groups were *identical:* the presence of clinical manifestations of the disease and the risk of developing life-threatening conditions (ischemia and necrosis of abdominal organs located in the chest or their acute obstruction).

III. RESULTS

All patients of both the retrospective and prospective groups underwent laparoscopic removal of esophageal hernias of types II-IV. Neither group required conversion of surgical access.

The basic principles for mobilizing the necessary anatomical formations in both groups were identical. The abdominal organs located in the chest were moved to the abdominal position, while the frontal was straightened along the axis and a probe with a diameter of 45 Fr was inserted into its lumen for anatomical orientation. The hernial sac mobilized in the chest, bluntly and acutely, and separated from the hiatal pedicels. After that, the sac was acutely separated from the abdominal part of the esophagus and the proximal part of the stomach, and excised.

After the mobilization was completed, the main anatomical conditions influencing the choice of reconstruction option and predicting the long-term results were evaluated: the length of the abdominal esophagus and the size of the hiatal opening (Table 3).

The performance of the reconstructive stage in patients of the retrospective and prospective groups was fundamentally different in cases of esophageal shortening (with type III hernias). It is this issue that has led to the evolution of views on tactical approaches to the treatment of hernias of the esophageal orifice of the diaphragm following the initial analysis of long-term results.

In the retrospective group, when the esophagus was shortened (the length of the abdominal region was less than 2.0 cm), its high mobilization in the mediastinum (up to the level of the middle thoracic part) was performed. It was assumed that this technique would reduce the likelihood of recurrence of a hiatal hernia (Table 4).

Table 3: Length of the Esophagus and Size of the Hiatal Opening in Patients of The Retrospective and Prospective Groups

Type of Hiatal Hernia	Number of Patients, Absolutely . (%) P					
	The Normal Length of the Esophagus			Shortening of the Esophagus		
	Size of Hiatal Opening			Size of Hiatal Opening		
	before 5 cm	more 5 cm	more 8 cm	before 5 cm	more 5 cm	more 8 cm
Retrospective group Hernias (type II)	4 (23,5%)	11 (64,7%)	2 (11,8%)	-	-	-
Prospective group Hernias (type II)	13 (52,0%)	7 (28,0%)	5 (20,0%)	-	-	-
Retrospective group Hernias (type III)	5 (3,8%)	13 (9,9%)	6 (4,5%)	2 (91,5%)	79 (60,3%)	26 (19,8%)
Prospective group Hernias (type III)	12 (7,9%)	17 (11,2%)	2 (1,3%)	7 (4,6%)	95 (62,5%)	19 (12,5%)
Retrospective group Hernias (type IV)	-	-	2 (100%)	-	-	-
Prospective group Hernias (type IV)	-	-	3 (100%)	-	-	-

Table 4: Types of Surgical Interventions in Patients of the Retrospective and Prospective Groups

Type of Hiatal Hernia	Number of Patients, Absolutely . (%)					
	Plastic Surgery of the Hiatal Opening with Own Tissues		Plastic Surgery of the Hiatal Opening with the Installation of a Prosthesis Behind the Esophagus		Plastic Surgery of the Hiatal Opening with the Installation of a Prosthesis behind and an Front of the Esophagus	
	Circular Fundoplication of the R. Nissen Type	Posterior Fundoplication of Type A. Toupet	Circular Fundoplication of The R. Nissen Type	Posterior Fundoplication of Type A. Toupet	Circular Fundoplication of The R. Nissen Type	Posterior Fundoplication of Type A. Toupet
Retrospective group Hernias (type II)	4 (23,5%)	-	11 (64,7%)	-	1 (5,9%)	1 (5,9%)
Prospective group Hernias (type II)	13 (52,0%)	-	-	7 (28,0%)	-	5 (20,0%)
Retrospective group Hernias (type III)	7 (5,4%)	-	85 (64,9%)	7 (5,3%)	29 (22,1%)	3 (2,3%)
Prospective group Hernias (type III)	133 (87,5%)	-	-	17 (11,2%)	-	2 (1,3%)
Retrospective group Hernias (type IV)	-	-	-	-	-	2 (100%)
Prospective group Hernias (type IV)	-	-	-	-	-	3 (100%)

In the prospective group, when the esophagus was shortened, a fundoplication cuff in the mediastinum was initially assumed to form. In such situations, circular reconstruction of the R. Nissen type (360) was always performed with suture fixation of the cuff to the gastroesophageal junction area. This type of fundoplication is most resistant to destruction when displaced into the chest. Prosthetic materials were not used to correct the size of the hiatal opening during the formation of the cuff in the mediastinum.

In patients with a normal length of the esophagus, the reconstructive stage in the retrospective and prospective groups was identical. With small sizes of the esophageal orifice of the diaphragm (up to 5 cm) and full-fledged muscular legs, the hiatal orifice was plasticized with its own tissues. With its large size or hypotrophy of the diaphragm legs, posterior crural surgery was performed to strengthen the suture line with a mesh prosthesis. In cases of severe tissue tension (the size of the esophageal orifice of the diaphragm is more than 8 cm), posterior and anterior surgery was performed with reinforcement with a prosthesis. “Heavy” polypropylene implants were used ("Prolen", “Esfil", “Uniflex"), U-shaped or of linear shape, which were located no closer than 2-3 mm from the inner edge of the radial hole and fixed with a stapler or nodal seams. To prevent damage to the esophagus by the edge of the prosthesis, a fundoplication cuff was placed between them.

There were no statistically significant differences in the incidence of intraoperative complications between the two groups. In patients of the retrospective group, undesirable effects occurred in 13 (8.6%) cases: gastric perforation - in 2 (1.3%), bleeding – in 3 (2.0%), pneumothorax – in 8 (5.3%). In patients of the prospective group, complications were noted in 16 (8.9%) cases: gastric perforation – in 2 (1.1%), esophageal perforation – in 1 (0.6%), bleeding – in 2 (1.1%),

pneumothorax – in 11 (6.1%). All complications were classified into categories I-II on the Clavien-Dindo scale and were eliminated during surgery. The duration of operations in both groups was comparable: in the retrospective group, 107-189 minutes (on average, 132 minutes), in the prospective group, 105-176 minutes (on average, 127 minutes). Complications in the early postoperative period were observed with equal frequency in both groups: 5 (3.3%) and 8 (4.4%), respectively. There were no deaths in the retrospective and prospective groups.

The hospital stay after surgery in the retrospective group ranged from 4 to 11 days (on average – 6 days), whereas in the prospective group – it ranged from 4 to 12 days (on average – 5 days).

The long-term results of surgical treatment of hernias of types II-V over a period of two to five years were studied and compared in 116 (77.3%) of 150 patients in the retrospective group and 132 (73.3%) of 180 patients in the prospective group (Fig. 2).

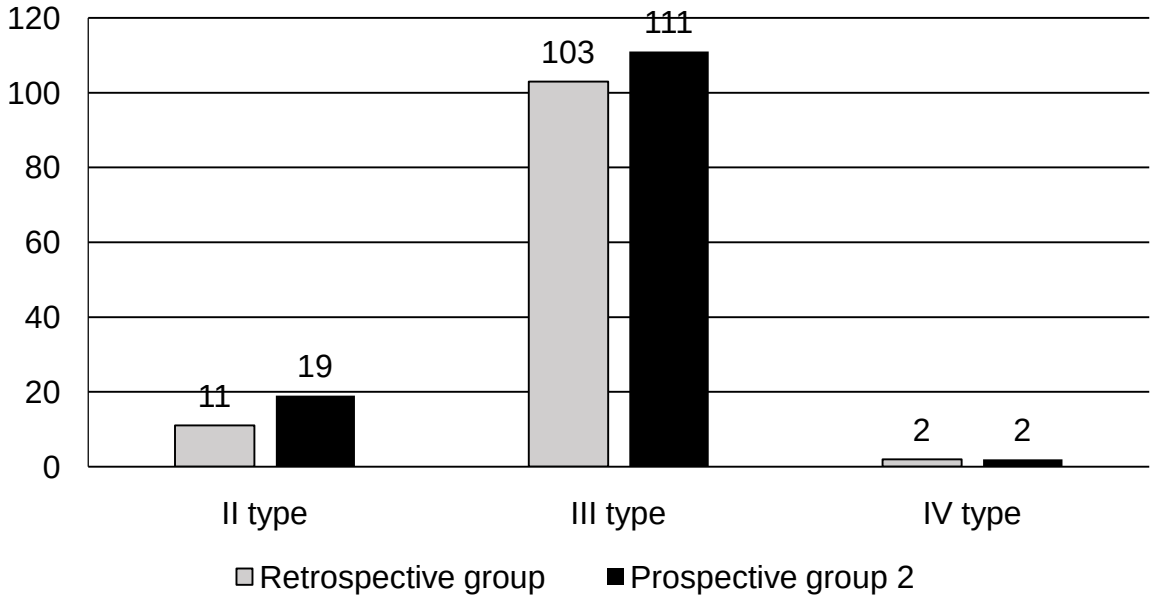

Figure 2: Number of Patients in the Retrospective and Prospective Groups with Studied Long-Term Treatment Outcomes

The analysis of the treatment results included the evaluation of clinical symptoms, as well as upper digestive tract X-ray data studies with $BaSO_4$, and esophago gastroduodenoscopy.

The result was considered good in the absence of clinical symptoms of hiatal hernia, manifestations of gastroesophageal reflux and erosive gastritis, as well as the preservation of anatomical relationships established during surgery between the esophagus, stomach, and diaphragm. A satisfactory outcome was the absence of clinical and endoscopic manifestations of the disease, despite radiological signs of minimal displacement of the stomach into the thoracic cavity. The unsatisfactory results included clinical and anatomical recurrence of diaphragmatic hernia.

A good or satisfactory long-term treatment outcome was found in 85 (73.7%) of 116 patients in the retrospective group and 117 (88.6%) of 132 in the prospective group. Unsatisfactory - in 31 (26.7%) and 15 (11.4%), respectively (Table 5).

Table 5: Results of Treatment of Patients in the Retrospective and Prospective Groups

Type of Hiatal Hernia	Number of Patients, Absolutely . (%)	
	Good or Satisfactory	Unsatisfactory
Retrospective group Hernias (type II)	9 (81,8%)	2 (18,2%)
Prospective group Hernias (type II)	17 (89,5%)	2 (10,5%)
Retrospective group Hernias (type III)	74 (71,8%)	29 (28,2%)
Prospective group Hernias (type III)	98 (88,3%)	13 (11,7%)
Retrospective group Hernias (type IV)	2 (100%)	-
Prospective group Hernias (type IV)	2 (100%)	-

The differences were statistically significant.

IV. DISCUSSION

Surgical treatment of hiatal hernias of types II-IV, according to most experts, remains a separate and far from being solved problem of practical medicine. [1, 4, 6, 7, 9].

The main reasons for the high frequency of unsatisfactory surgical results in this type of hernia are two anatomical factors: shortening of the esophagus and the large size of the hiatal opening. Additional physiological effects include propulsive contractions of the digestive tract, of which the esophagus is a part, and respiratory excursions of the diaphragm, leading to a displacement of the organs relative to each other. [1, 2, 3, 4,10].

Unfortunately, the current level of knowledge and technical capabilities does not allow us to overcome these factors conceptually, and the search for ways to reduce the recurrence rate of type II-IV hiatal hernias after surgical treatment, as in many other areas of practical medicine, is still developing along the path of finding reasonable compromises [1, 4, 6, 7, 9].

The conducted research reflects this approach and illustrates its effectiveness. The desire to maximize the restoration of natural visceral anatomy, as realized in patients of the retrospective group, enabled very average treatment results consistent with the literature. On the contrary, the perception of certain factors, primarily the shortening of the esophagus, as objective conditions with the transformation of surgical tactics makes it possible to achieve significantly better results. A good or satisfactory treatment result in patients of the retrospective group was achieved in 73.7% of cases, and a poor result in 26.7%. In patients of the prospective group – in 88.6% and 11.4%, respectively.

Significant differences in treatment outcomes in the retrospective and prospective groups were achieved with mixed (type III) hiatal hernias. It is with this type of disease that a decrease in the length of the esophagus often occurs. Unfortunately, its high mobilization, contrary to the available evidence, as shown by the analysis of surgical interventions in patients of the retrospective group, is not always effective in preventing the recurrence of hiatal hernias. Disease recurrence in the retrospective group was detected in 28.2% of cases.

The formation of a fundoplication cuff in the mediastinum in such situations, as recommended by some researchers, turned out to be a simple and fairly reliable technical procedure that gives a good long-term functional result. The frequency of unsatisfactory outcomes of surgical interventions in patients of the prospective group was 11.7%. An additional confirmation of the leading role of esophageal shortening in the recurrence of type III hiatal hernias is the multiple times more frequent use of prostheses to strengthen the plastic of the hiatal opening in

patients of the retrospective group, compared with the prospective group (124 cases versus 19), with much more modest long-term results [2, 5, 11]. On the contrary, with a normal length of the esophagus (hernias of types II and IV, sometimes type III), the use of polymer implants should be considered an important option to increase the reliability of reconstruction, since in such situations the key cause of disease recurrence is the leading one. This opinion is supported by some experts, and the comparable treatment results obtained in the study in patients of the retrospective and prospective groups allow us to consider it justified (recurrence of 18.2% and 10.5%, respectively) [2, 5, 11].

A sufficiently large number of observations (173 people in the retrospective and prospective groups) and a long time to evaluate long-term results (from two to five years in both groups) in this study allows us to consider the use of prostheses to safely correct the size of the diaphragm's food-water opening. There are no undesirable consequences associated with the use of this technology. The indications in the literature of a high incidence of complications have not been confirmed [1, 2, 3, 4,10].

V. CONCLUSIONS

1. Surgical treatment of hiatal hernias of types II-IV remains far from solving the problem of practical medicine. The disease recurrence rate exceeds 10%.
2. When the esophagus is shortened in type III hernias, its high mobilization does not reliably prevent the stomach from moving back into the chest.
3. The use of prosthetics to correct the hiatal opening during esophageal shortening is an ineffective way to prevent recurrence of the disease.
4. The optimal surgical treatment of hernias includes the following conclusions based on a comparative study: the formation of a fundoplication cuff in the mediastinum with shortening of the esophagus should be considered an effective way to prevent recurrence of hiatal hernia;
5. In cases of hernias of types II-IV and normal esophageal length, the use of prosthetic materials to correct the size of the hiatal opening is reasonable, and reduces the frequency of unsatisfactory treatment results.

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