

Surgical Management of Esophageal Hiatus Hernia

Suren Stepanyan^{1,2*}, Vahe Hakobyan^{1,2}, Areg Petrosyan^{1,2}, Rafael Mesropyan^{1,2}, Hayk Yeghiazaryan^{1,2}, Andranik Aleksanyan^{1,2}, Hayk Safaryan^{1,2}, Hakob Shmavonyan^{1,2}, Karen Papazyan^{1,2} and Ani Babayan^{1,2}

¹*Yerevan State Medical University, Department of Surgery 1 (Yerevan, Armenia)*

²*Mickaelyan Institute of Surgery, Clinic of Surgery (Yerevan, Armenia)*

***Corresponding Author:** Suren Stepanyan, Yerevan State Medical University, Department of Surgery 1 (Yerevan, Armenia).

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Abstract

Background: There is no unique operative technique accepted for esophageal hiatal hernia until now, and many different procedures with numerous modifications are reported. Repair of large hiatal hernia is a technically challenging procedure with significant perioperative morbidity and high risk of recurrence.

Methods: Laparoscopic and open procedures with suture-only method and mesh reinforcement were performed. In all groups crural closure was performed with two or three interrupted nonabsorbable sutures between the right and left diaphragmatic pillars. Nissen or Nissen-Rossetti funduplications performed as the antireflux procedures in all cases.

Results: There were 26 type I, 39 type II, 25 type III, and 12 type IV hiatal hernias. In 100 cases operations were performed from a planned elective list after regular admission, in 2 cases performed urgent open procedures for strangulated hiatal hernia. The conversion to open surgery was performed in 3 cases due to adhesions in upper abdomen after previous operation – open cholecystectomy. There were no cases of persistent dysphagia, that requires endoscopic balloon dilation or reoperation. No intraoperative complications were detected in both groups. There was no in-hospital mortality. There were no mesh related complication in mesh reinforcement group.

Two patients in the group without mesh reinforcement had hernia recurrence, they underwent reoperation with satisfactory results.

Conclusion: Hiatal hernia repair with mesh reinforcement is the safe and reliable method of procedure for HH. The less traumatic and effective is laparoscopic hernioplasty with mesh. Combination of hiatoplasty and antireflux procedure is mandatory operations for HH.

Keywords: *Hiatal Hernia; Hiatal Hernia Repair; Laparoscopic Fundoplication; Mesh Reinforcement; Polypropylene Mesh*

Introduction

Hernia of esophageal hiatus of diaphragm or hiatal hernia (HH) is protrusion of abdominal organs through the esophageal hiatus of the diaphragm into the mediastinum. The incidence of HH is 43%, about 20% of patients with hiatus hernia are symptomatic [1,2].

Hiatal hernias are typically classified according to the position of the gastroesophageal junction (GEJ): type I hiatal hernia, sliding hernia - GEJ is displaced superiorly to the hiatus; type II hernia, true paraesophageal hernia (PEH) - the GEJ lies below the hiatus, but part

or all of the stomach migrates above the hiatus alongside the esophagus; type III hernia, mixed hernia with sliding and paraesophageal component - the GEJ and a portion of the stomach lie above the hiatus; type IV hernia, when the GEJ, the stomach, and other organs such as the omentum, colon, or other viscera migrate to the mediastinum. Type II, III and IV are also called “paraesophageal hernias” [3,4].

The pathophysiology of diaphragmatic hernias still is widely debated. The main factors that lead to migration of the gastroesophageal junction into the mediastinum and sliding HH formation are: increased intraabdominal pressure; esophageal shortening due to fibrosis or excessive vagal nerve stimulation; a widening of the diaphragmatic hiatus due to age-related or congenital changes in muscle or connective tissue [4].

In studies are common terms as “giant hiatal hernia” and “large hiatus hernia”. Giant hiatal hernia is characterized by more than 1/3 of stomach migration into mediastinum with or without other organs [5].

The most useful description of the term “large hiatus hernia” suggested by Mohi et al. They consider “large hiatus hernia” if more than 50% of the stomach herniated into the chest. Giant hiatal hernias represent 5 - 10% of all hiatal hernias [6].

Many decades the autoplasty was the main method of repair for HH [4].

The serious problem of the hiatoplasty with the own tissues is the recurrence after HH repair. It has been found to have an incidence of 7 to 43% [7-14].

The use of prosthesis was an important step for prevention of HH recurrence. The first laparoscopic procedure with mesh-reinforced hiatoplasty for HH was published by Edelman in 1995 [15].

The method of mesh reinforcement has been proven effective in controlled randomized trials [7,16]. This method significantly reduce the risk for postoperative disruption of hiatal repair [17-20].

The worrisome issue is the risk of complications related to the use of the prosthesis: migration of the mesh into the esophagus or stomach, the development of fibrotic strictures or adhesions in the hiatal area. The incidence rate of this complications varies from 0.1 to 20% in the literature [10,14,20-22].

Patients and methods

A total of 102 consecutive patients with HH were operated in the clinic of Republican Medical Center “Armenia” (Yerevan, Armenia) and Mickaelyan Institute of Surgery (Yerevan, Armenia) from 2010 to 2020.

The male-to-female ratio was 1:1,5 (38 male, 64 female). The mean age was 48 ± 12 years (range 21 - 81) years.

In 62 (60.8%) cases performed laparoscopic, in 40 (39.2%) – open procedures. In 3 cases operation started laparoscopically, then performed conversion, the cases were included in open group. Perioperative patient risk was assessed using the American Society of

Anesthesiology (ASA) Scoring System. In the laparoscopy group were included only ASA I and ASA II patients. The demographic data for all groups are shown in table 1 and table 2.

	Open procedures (n = 40, 39.2%)	Laparoscopic procedures (n = 62, 60.8%)	p value
Male/female	14/26	24/38	0.705
Age (years)	57.5±11 (21-81)	47.5±12 (26-73)	<0.001
Presence of Barrett's esophagus	9	6	0.074
Presence of GERD	30	56	0.038
ASA I	4	28	<0.001
ASA II	29	33	
ASA III	7	1	

Table 1: Patient Demographics and Clinical Characteristics in Open and Laparoscopy Groups.

ASA, American Society of Anesthesiology.

	Operations with mesh reinforcement (n = 39, 38.2%)	Operations without mesh reinforcement (n = 63, 61.8%)	p value
Male/female	13/26	25/38	0.519
Age (years)	57±11 (31-81)	48±12 (21-77)	0.00053
Presence of Barrett's esophagus	7	8	0.467
Presence of GERD	35	51	0.235
ASA I	15	17	0.298
ASA II	20	42	
ASA III	4	4	

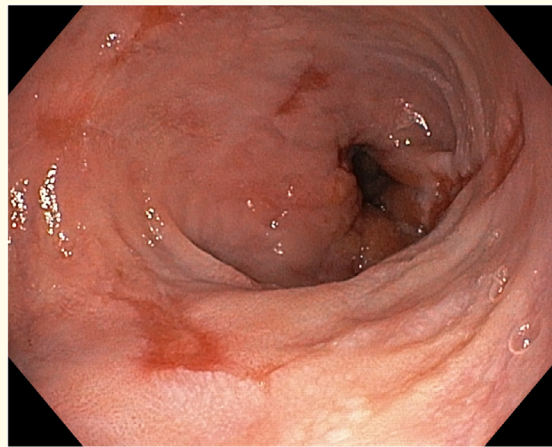
Table 2: Patient Demographics and Clinical Characteristics in Mesh and Without Mesh Groups.

ASA, American Society of Anesthesiology.

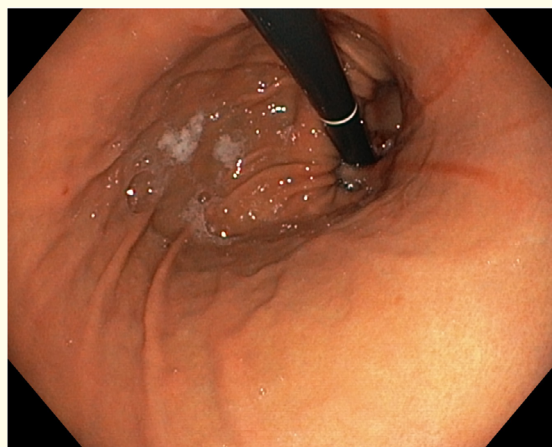
Patient demographics have significant differences between the laparoscopy and open groups (Table 1).

Patient demographics did not differ significantly between the group with mesh reinforcement and the group without mesh reinforcement (Table 2).

Preoperative evaluation included upper endoscopy (Figure 1), x-ray with barium contrast swallow (Figure 2), esophageal 24-h pH measurement. Final confirmation of a paraesophageal involvement by the hernia was accomplished intraoperatively.



A



B

Figure 1: Endoscopic examination in case of type I hiatal hernia. A) The view from the esophagus, B) The view from the stomach, (retroversion of the endoscope).



Figure 2: X-ray examination of the hiatal hernia. The main part of the stomach is located above the diaphragm.

Surgical technique

The procedure was performed with the patient under general anesthesia. Preoperative intravenous administration of an antibiotic was done. The patient was placed in a combined 20°–30° reversed Trendelenburg and French position.

Capnoperitoneum was created with Veress needle inserting above the umbilicus and connecting it to a CO₂ insufflator. An intra-abdominal pressure of 12–14 mm Hg is achieved and maintained. Five trocars are inserted into the peritoneal cavity at the follow sites: 10mm trocar in left mesogastrium for the scope, 10mm trocar above umbilicus for Babcock grasper, 5mm trocar in upper epigastrium for liver retractor; two 5mm trocars in right and left subcostal areas for working instruments.

A careful reposition of the stomach, a complete reduction of the hernia content (Figure 3) and dissection of hernia sac, a circular mobilization of the esophagogastric junction were performed.

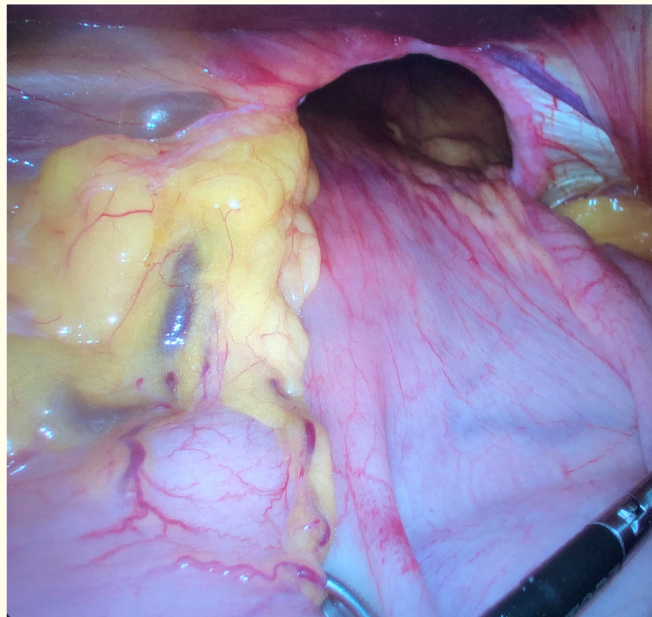


Figure 3: Reduction of the hernia content (stomach) from the sac of hiatal hernia.

The first step was dissection of the phrenogastric and hepatogastric attachments.

The hepatic branch of the vagus was carefully preserved. The vagus nerves were identified and left attached to the esophagus.

After mobilization of hepatogastric ligament the right diaphragmatic crus is exposed.

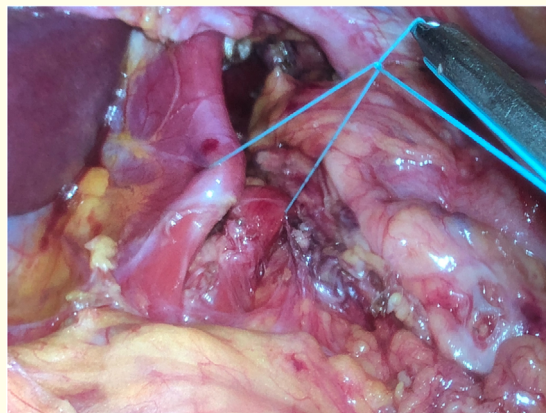
The short gastric vessels and gastrodiaphragmatic ligament are divided to release the gastric fundus. After mobilization of gastric fundus the left crus is exposed. The esophagus is mobilized from the medial margins of the left and right crura and it provides a wide posterior window behind the esophagus.

The hernia orifice was estimated using the opening jaws of a atraumatic grasper (Karl Storz, Tuningen, Germany) as a reference.

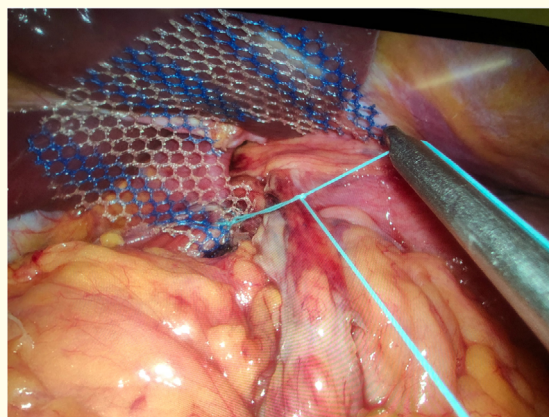
After mobilization of esophagogastric junction at least 4 cm of the esophagus was brought into the abdomen.

In the group of hiatoplasty without mesh reinforcement posterior crurorrhaphy was routinely performed with the application of two to three nonabsorbable sutures (2-0 Ethibond; Ethicon, Spreitenbach, Switzerland) after placement of a 56-Fr esophageal tube. Crurorrhaphy was combined with fundoplication in all the patients. Nissen or Nissen-Rossetti funduplications performed as the antireflux procedures.

In the group of mesh reinforcement prosthesis was fixed around the esophagus in addition to the suture repair of the hiatus. Two or three interrupted stitches approximated the two pillars (Figure 4, A) and then a 10-10cm polypropylene mesh was fixed by nonabsorbable stitches (2-0 Ethibond; Ethicon, Spreitenbach, Switzerland) on the both left and right crura and diaphragm onlay (Figure 4, B). The internal edges of the mesh were stitched to the diaphragm to avoid the contact of free edges of the mesh and esophagus, erosion of the wall of organ. We took special care taken to avoid wrinkles and free flaps (Figure 5, A). The operation was completed with the formation of a 360° Nissen or Nissen-Rossetti antireflux wrap with 3-0 Ethibond (Ethicon, Spreitenbach, Switzerland) or 3 - 0 PremiCron (B.Braun, Barcelona, Spain) (Figure 5, B). The wrap was formed with two stitches and was fixed to the anterior wall of esophagus. A thick gastric probe was inserted into the cardia during wrap formation and fundoplication in all the surgeries.

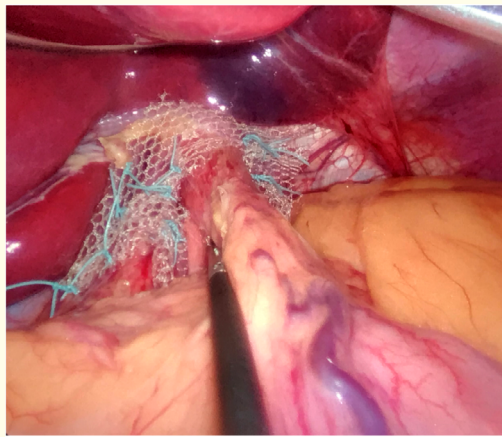


A

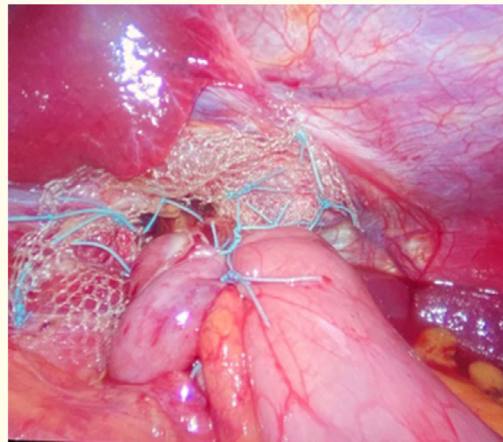


A

Figure 4: The steps of hiatoplasty. A) Diaphragmatic cruras are stitched. B) Polypropylene mesh is fixed on the right crura of diaphragm.



A



B

Figure 5: The steps of hiatoplasty. A) Polypropylene mesh is fixed around the esophagus. B) Antireflux procedure – fundoplication is performed.

Oral feeding was started on day 1 after surgery, beginning with liquid food and a soft diet. They were instructed to take soft food for 2 months.

Patients without complication were discharged on the third or fourth postoperative day and were invited for follow-up examination on 7th day, at the second month and at the 6th month.

The results in early postoperative period were assessed with contrast X-ray examination and 24-hour pH-metry in 5^{-th} to 7^{-th} days after surgery. A barium contrast examination was performed for all patients to rule out an anatomic recurrence (Figure 6). Recurrence was defined as any migration of the cardia to chest level or evidence of a new paraesophageal sac.

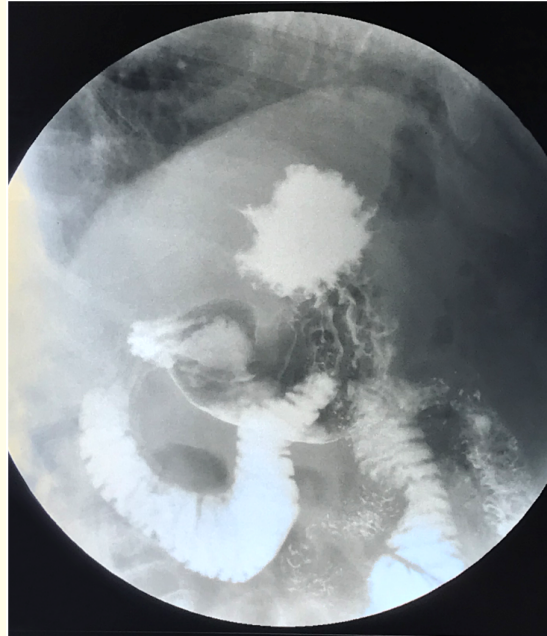


Figure 6: X-ray contrast examination in Trendelenburg position. The antireflux wrap prevents gastroesophageal reflux.

Postoperative complications were considered as a major failure when a second operation or medical therapy longer than 6 months was required. All other complications were considered minor.

Quality-of-life assessment

After a 6-month follow-up, patients were examined or interviewed in the outpatient clinic or over the phone. Patients were specifically asked about their symptoms, and three quality-of-life questionnaires were administered- one generic - Short Form-36 [SF-36].

They were also called via telephone and questioned about their complaints (dysphagia, gas-bloating syndrome, diarrhea, etc.). Functional outcomes were considered “excellent” when a patient was asymptomatic and did not need any medication; “good” when a patient had symptoms not severe enough to require medications; “moderately good” when a patient’s symptoms could be controlled with medication; and “poor” when a patient’s symptoms were not eliminated by the operation.

This study was approved by the Ethics Committee of Yerevan State Medical University.

Statistical analysis

Results were analyzed using both the chi-square test and the Student t-test. A p-value less than 0.05 was considered statistically significant.

Results

Common complains in preoperative period were heartburn and regurgitation. Preoperative symptoms are shown in table 3.

	Preoperative (case)	Postoperative (case)
Heartburn	86	2
Regurgitation	27	0
Respiratory symptoms	17	1
Dyspahgia/post-prandial chest pain	15	3
Abdominal pain	4	0
Chronic bleeding	2	0
Gas bloat syndrom	8	6

Table 3: Preoperative and postoperative symptoms.

The mean period from the onset of the symptoms to operation was 46 (10 -120) months.

No patient had history of previous operation for HH or GERD.

Esophagogram showed large HH in 54 cases, 28 patients had intrathoracic migration of more than 1/3 of stomach. In 14 cases were large HH with > 50% of the stomach in the chest, in 12 cases - displacement of all stomach, part of omentum, large intestine into chest. There was no cases of short esophagus in the study group.

Endoscopic evaluation revealed no esophagitis in 59 patient (57.8%), grade A-B oesophagitis in 26 patients (25.5%) and grade C-D esophagitis in 17 patients (16.7%).

24 hour pH-metry was performed in 68 patients. The examination showed acid exposure in 47 cases. The mean pH < 4 and the median pH < 3.5 were in 32 patients (47%). Non acid refluxes were registered in 12 cases (17,6%). DeMeester Score was >14,7 in 54 cases.

An interesting fact has been observed: non acid pH in stomach were noted in patiens with subtotal or total HH. Postoperative pH-metry was performd in 32 patients who had acid refluxes, non of them had reoccurrence after surgery.

There were 26 type I, 39 type II, 25 type III, and 12 type IV hiatal hernias. In the laparoscopy group were included patients with all types of hernias.

In 100 cases operations were performed from a planned elective list after regular admission, in 2 cases performed urgent open procedures for strangulated hiatal hernia.

The perioperative data is presented in table 4.

	Operations with mesh reinforcement (n = 39)		Operations without mesh reinforcement (n = 63)		p value
	Laparoscopic procedures (n = 17)	Open procedures (n = 22)	Laparoscopic procedures (n = 45)	Open procedures (n = 18)	
Mean operative time (min)	170 (range 110-200)	178 (range 120-210)	120 (range 100-150)	135 (range 110-165)	<0.05
Postoperative overall hospital stay (days)	5.3 (range 3-7)	7.5 (range 6-9)	5.2 (range 3-7)	7.2 (range 5-8)	<0.001

Table 4: Perioperative characteristics.

The mean operative time was significantly shorter in the group without mesh and the postoperative overall hospital stay was significantly shorter in laparoscopy group (Table 4).

The conversion to open surgery was performed in 3 cases due to adhesions in upper abdomen after previous operation – open cholecystectomy.

In the study group all procedures were completed by fundoplication. All procedures were performed by senior surgeons.

In postoperative period 5 patients had transient subcutaneous emphysema in the neck that resolved spontaneously while 24 hours.

The symptoms of the patients with gas-bloating syndrome (in 6 cases) was controlled by medical therapy in postoperative period.

Transient dysphagia noted 3 patients in the laparoscopy group without mesh reinforcement. In all cases dysphagia was resolved within 4 - 6 weeks. Difficulties of swallowing in first 3 - 4 postoperative days had 21 patients after surgery.

There were no cases of persistent dysphagia, that requires endoscopic balloon dilation or reoperation. No intraoperative complications were detected in both groups. There was no in-hospital mortality. There were no mesh related complication in mesh reinforcement group.

Two patients with symptoms of gastroesophageal reflux (heartburn, regurgitation) required medical treatment with proton pump inhibitors and prokinetics for relief of symptoms. Two patients in the group without mesh reinforcement had symptoms of hernia recurrence: heartburn, dysphagia, regurgitation. Recurrent hernia was diagnosed with endoscopy, barium esophagogram and contrast enhanced CT scan. They underwent reoperation with satisfactory results, in one case was open, in another – laparoscopic procedure. Patients after reoperation are symptom free.

Perioperative data were collected retrospectively. The mean follow-up period was 54 ± 28 months (range 10–117 months). Complete follow-up assessment was obtained for 26 (25%) of the patients, follow-up evaluation only by telephone interview – for 54 (53%), there were no contacts with remaining 22 (22%) of the patients, they were considered dropouts. The hiatal hernia recurrence rate was investigated via a barium contrast swallow for 29 patients. The results of follow-up assessment of 80 patients are presented in table 5.

	Operations with mesh reinforcement (n = 32)		Operations without mesh reinforcement (n = 48)		p value
	Laparoscopic procedures (n = 14)	Open procedures (n = 18)	Laparoscopic procedures (n = 33)	Open procedures (n = 15)	
“Excellent” functional outcome,	12	15	26	11	0.912
“Good” functional outcome	2	3	5	2	
“Moderately good” functional outcome	-	-	1	1	
“Poor” functional outcome.	-	-	1	1	

Table 5: Results of follow-up assessment of operated patients.

The quality-of-life evaluation by the questionnaire showed not significant difference between two groups, improvement of results in mesh reinforcement group.

Discussion

Hiatal or paraesophageal hernia (PEH) is defined as the protrusion of intraabdominal organs through a dilated esophageal hiatus [3]. The pathogenesis of diaphragmatic hernias is multifactorial as there is no definitive single cause of hiatal hernia formation [4].

HH is asymptomatic in some cases, but many patients present with a variety of symptoms (dyspepsia, chest pain, anemia, fatigue). Paraesophageal hernia may induce lifethreatening complications, mainly associated with gastric volvulus. Once it is diagnosed, surgical repair is indicated, although it now appears that this gold standard may be revised as well [23].

In our study main symptoms of HH were heartburn, regurgitation, respiratory symptoms, dysphagia and chest pain. More than 80 months 38 patients suffer from this symptoms.

Reinforcement of the hiatus and fundoplication are the method of choice in the operative treatment of HH. Reinforcement with suture-only method and with mesh are widely used.

Large studies have shown that the main failure of hiatal or paraesophageal hernia repair or antireflux procedures is the failure of crural closure or crural reinforcement [3]. Crus closure has been described as the “Achilles’ heel” of hiatoplasty and antireflux surgery [24,25].

In our study the first and mandatory step of hiatoplasty was crural reinforcement with 2 - 3 stitches.

Since the minimally invasive approach to the repair of paraesophageal hiatal hernias (PEH) was introduced by Cuschieri and colleagues in 1992, laparoscopic PEH repair has gained rapid acceptance as a standard method. With implementation of meshes into hiatal hernia surgery, a significant reduction in recurrences could be achieved [26]. The first laparoscopic fundoplication performed by Dallemagne, *et al.* in 1991. This method has gained popularity among surgeons, it provides good to excellent functional and symptomatic outcomes in procedures for HH [27].

Two methods for hiatoplasty: suture-only method, suture plus mesh superimposed method were used in our study on open and laparoscopic procedures. Both methods were supplemented with fundoplication.

Routine mesh repair of the crura has proved to be effective in reducing the rate of postoperative hernia recurrence or intrathoracic wrap migration during long-term follow-up evaluation. The incidence of prosthetic mesh-related complications even during a very long follow-up period is very low and does not represent a contraindication to use of the mesh [27].

In our study there were no case of hernia recurrence in mesh group, and we had no mesh-related complications. The absence of mesh-related complications was due to carefully fixation of edges of the mesh to the diaphragm.

Mueller-Stich B. P., *et al.* (2006) consider that hiatal mesh reinforcement should be performed routinely [16]. There are many variants of the type, size and shape of prosthesis used in procedures for HH. Wassenaar E. B., *et al.* (2012) suggested a four-ply Surgisis_® mesh (Cook, Bloomington, IN) to use, cut in a U-configuration and fixe to the crura using sutures and/or fibrin sealant (TISSEELTM; Baxter, Deerfield, IL). They fix the mesh in a U-configuration around the esophagus, not circumferentially, and avoid too tight fixation around the esophagus [28]. Several different types of PTFE and PTFE composite materials are used including DualMesh (W.L. Gore and Associates, Inc., Flagstaff, AZ, USA) and a simple PTFE patch. Porcine small intestine submucosa (Surgisis; Cook Surgical, Bloomington, IN, USA), which provides a scaffolding for native tissue ingrowth, also is used. For a large PEH, in which crural closure is under increased tension, it has become our practice to close the crura with interrupted, nonabsorbable suture, and then to place an onlay reinforcement of human acellular dermal matrix (Alloderm; Lifecell Corp., Branchburg, NJ, USA). In authors opinion the most commonly used mesh is polypropylene (Prolene; Ethicon, Inc., Somerville, NJ, USA) [29].

In our study was used only polypropylen mesh (Prolene; Ethicon, Inc., Somerville, NJ, USA; Optilen mesh, B.Braun, Germany). It is important to use soft mesh that is easy handling and there is small risk of injury, erosion of surround organs.

Despite a success rate of 85 to 95% reported in large series with a mid- and long-term follow-up evaluation, important complications are related to the hiatoplasty. These complications, including intrathoracic wrap migration and hiatal hernia recurrence, result from inadequate closure of the hiatal crura or disruption of the hiatoplasty [30].

In the group of patients that underwent a suture-only hiatoplasty, postoperative hernia recurrence or intrathoracic wrap migration occurred in 9.6% of the cases, all within the first 5 months, whereas in the group of patients that had mesh-only hiatoplasty, the recurrence rate was 1.8%. When the mesh was superimposed on the pillars suture, recurrence occurred for only one patient (1.1%) with a very large hiatal hernia. Currently, after a very long mean follow-up period, these results show that the use of a mesh in crural repair is very effective in reducing the postoperative incidence of hernia recurrence or intrathoracic wrap migration almost to zero [27].

Mueller-Stich B. P., *et al.* (2006) found a high radiologic recurrence rate of 19% for HH without mesh reinforcement in follow-up period longer than 4 years. They have not seen any PEH recurrences in the follow-up period 20 months after the introduction of hiatal mesh reinforcement [16]. Targarona E.M., *et al.* (2004) reported about anatomic recurrence rate of 20% assessed by barium swallow. They conclude that a more liberal use of mesh in the hiatus would prove beneficial [31].

Concerning the symptomatic outcome, it is remarkable that only half of the patients with radiologic PEH recurrence were symptomatic [11,13,16,31-33].

Juhasz A., *et al.* (2012) define recurrent hiatus hernia as large if more than 5 cm of gastric tissue is present above the hiatus [24].

In our study there were only two cases of symptomatic recurrence of HH and both hernias occurred after hiatoplasty without mesh reinforcement.

In GERD, hiatal hernia is a very frequent finding, found in up to 80 - 90% of the surgical patient population. The rationale for surgery is to create a functional antireflux barrier. The reconstruction of the antireflux barrier consists of three fundamental components: (1) proper length of the intra-abdominal esophagus, (2) crural repair, and (3) fundoplication [34].

Antireflux procedure is recommended by many surgeons as compensation for the destruction of the anchoring system of the inferior esophageal sphincter [31,35].

In the study all procedures completed by Nissen or Nissen-Rossetti fundoplication. The successful performance of antireflux procedure results in good postoperative outcomes, heartburn was noted only in two cases.

Even when an experienced laparoscopic foregut surgeon operates on carefully selected patients, a small subgroup suffers from postoperative dysphagia, which might not be related to the wrap but rather to the hiatal closure [25].

In the study were 3 cases of postoperative dysphagia and chest pain. In our opinion the symptoms were referred to tight wrap, they were resolved within 4 - 6 weeks.

Mueller-Stich B. P., *et al.* (2006) presented the long-term follow-up evaluation of postoperative results after procedures for HH. More than 96% of the patients assessed their operation result as good or very good, and 98% were satisfied with their decision to undergo surgery. In contrast to the excellent patient assessment, only one-third of the patients were completely free of gastrointestinal symptoms or side effects postoperatively. An additional one fourth reported mild gas bloating. All other patients admitted further complaints such as severe gas bloating or gastroesophageal reflux symptoms [16].

In our study 80% of examined in postoperative period patients has "excellent", 15% - "good", 2.5% - "moderately good" and 2.5% - "poor" functional outcome. More than 90% of operated patients were satisfied with the results of surgery.

Conclusion

Hiatal hernia repair with mesh reinforcement is the safe and reliable method of procedure for HH. The less traumatic and effective is laparoscopic hernioplasty with mesh. Combination of hiatoplasty and antireflux procedure is mandatory operations for HH.

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