

A new approach to the treatment of large and giant hiatal hernia

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Abstract

Objective. To retrospectively analyse the results of a new technique of laparoscopic surgery for large and giant hiatal hernias of the esophageal orifice of the diaphragm, which consists in the use of diaphragmatic incisions and mesh implants to reduce the incidence of recurrence and complications.

Materials and methods. During the period from 2010 to 2023, laparoscopic interventions were performed in 62 patients, 43 (69.4%) women and 19 (30.6%) men, with large and giant hiatal hernias of the esophageal orifice of the diaphragm. The average age of the patients was 62.8 years. The diagnostic criteria used to select patients were the size of the hiatal opening and clinical symptoms. Fibroesophagogastroduodenoscopy, abdominal computed tomography, and contrast radiography were used to assess the size of the hernia and plan surgical intervention. During the operation, we performed loosening incisions of the diaphragm to reduce the tension during suturing of hiatus defects. ProGrip self-locking meshes were also used to close the diaphragmatic defects, which allowed them to be securely fixed without tension and reduce the risk of recurrence.

Results. Most patients had comorbidities that required a special approach during surgery. The average duration of the operations was 132 minutes, which indicates their technical complexity. The postoperative course in most patients was uncomplicated with a minimal recovery period. The average hospital stay was 5.2 days. Recurrence of hernia was detected in 2 (3.2%) of 62 patients, which indicates the effectiveness of the new technique.

Conclusions. The use of a new concept of laparoscopic surgery for large and giant hernias of the esophageal orifice of the diaphragm, which involves the performance of laxative incisions of the diaphragm and the use of self-locking mesh, significantly reduces the incidence of recurrence and complications, which ensures high treatment efficiency and improves the quality of life of patients. The results of the study confirm the importance of an individual approach to the treatment of hiatal hernias and the possibility of optimising laparoscopic techniques to improve their effectiveness.

Key words: hiatal hernia; laparoscopic hernioplasty; laxative incisions; self-locking mesh.

Laparoscopic methods have become the "gold standard" in the treatment of hiatal hernia in recent decades [1, 2]. Their advantages over open laparotomy and thoracotomy have been proven [3]. In most patients after laparoscopic surgery, short-term and long-term results are good [4].

At the same time, laparoscopic interventions for large and giant GORD are accompanied by significant technical difficulties and, unfortunately, a recurrence rate of 25–30% [1, 5].

To reduce the recurrence rate, many surgeons use mesh implants [6, 7]. The use of non-absorbable mesh implants, such as polypropylene, polyester, polytetrafluoroethylene (PTFE), synthetic collagen-coated mesh, and others, can lead to serious complications [8].

The most severe complications occur when the oesophagus is placed in the hole in the centre of the mesh implant and its edges are fixed to the tissues around the oesophagus. In this case, very often the mesh grows into the lumen of the esophagus, which leads to stenosis, mucosal ulcers, esophageal-bronchial fistulas, and other extremely serious complications that can lead to the patient's death [8]. The literature describes such complications that required oesophageal resection [9]. The increasing frequency of such complications has forced many surgeons to completely

abandon the use of non-absorbable mesh implants [10].

American surgeons, following the recommendations of the Society of American Gastrointestinal Endoscopic Surgeons (SAGES), currently use only biobased absorbable mesh. At the same time, randomised trials have shown that the use of absorbable mesh in the long term increases the recurrence rate dramatically [11].

We have accumulated quite a lot of experience in laparoscopic operations for OSA (more than 3800), unfortunately, it was not possible to avoid serious complications after the use of non-absorbable mesh [12].

Having analysed our own and other surgeons' experience, we have changed the concept of laparoscopic surgery in patients with large and giant GSD. These changes are to completely eliminate contact with the mesh implant during laparoscopic fundoplication. Initially, this was done by isolating the oesophagus from the mesh, placing a part of the hernia sac and fatty tissue between it and the sutured mesh. However, we were convinced that this technique does not always give good results. Although the mesh did not grow into the oesophagus with this technique, it happened that severe fibrosis in the hiatal region worsened the functional results of the operation. Since 2010, we have been using the technique of splitting the right pedicle and dissecting the

diaphragm dome on the left, which makes it possible to suture the diaphragm pedicles without tension and prevents the development of hernia recurrence.

The aim of the study was to retrospectively analyse the results of a new laparoscopic surgery technique for large and giant GSD.

Materials and methods

The new laparoscopic surgery technique was used in 62 patients operated on from 2010 to 2023, which was about 20% of the total number of patients with large and giant GI tracts operated on during this period.

According to the American literature, GSOD is considered large if the largest distance between the diaphragm legs is 5 cm or more.

For greater objectivity, we have proposed a classification based on the measurement of the area of the hiatus. If the area of the hiatus is 10–20 cm², the hernia is considered large, and more than 20 cm² is considered giant.

Among the patients operated on using the new technique, large hernias (the area of the hiatus was 14–20 cm²) were diagnosed in 9, and giant hernias (the area of the hiatus exceeded 20 cm²) in 53. There were 43 women (69.4%) and 19 men (30.6%). The age of patients ranged from 34 to 74 years and averaged (62.8 ± 7.2) years. The average body mass index was 30.47 kg/m² (16.2 to 45.8 kg/m²).

It should be noted that all patients had quite serious comorbidities. In 7 patients, the course of the disease was complicated by kyphosis. All patients complained of chest pain, nausea, heartburn, and 42 patients had frequent vomiting. Esophageal patency was impaired in 5 patients and they had significant weight loss.

All patients were thoroughly examined before surgery. They were required to undergo fibroesophagogastroduodenoscopy, gastric X-ray, and computed tomography of the abdominal cavity. According to the examination, 16 patients had hernias so large that the entire stomach, a large appendage of the transverse colon, and part of the spleen were placed in the mediastinum. A short oesophagus was diagnosed in 12 patients. 54 patients had paraesophageal hernias, and 8 patients had giant sliding hiatal hernias.

In 53 (85.5%) patients, the operation was performed for the first time, in 9 patients – repeatedly due to relapse after unsuccessful interventions in other medical institutions.

Features of the laparoscopic intervention technique

The operations were performed under intubation anaesthesia with sufficient patient relaxation, usually using 4 trocar: one 10-mm trocar for optics and three 5-mm trocar for instruments. Only in 5 patients, due to severe technical difficulties, a fifth trocar was used.

The operation began with the removal of the intestines and stomach from the mediastinum. Next, the right leg of the diaphragm was mobilised. The hernia sac was excised as far as possible and lipomas in the posterior and anterior mediastinum, if any, were removed. After that, the oesophagus

was mobilised and its abdominal part was moved into the abdominal cavity. The stomach was mobilised broadly along the large curvature, crossing the short vessels running from the stomach to the spleen. After wide mobilisation of the esophagus, it was possible to lengthen it by 5–7 cm. For congenital short esophagus, 3 patients underwent Collis surgery to lengthen the esophagus at the expense of the cardiac part of the stomach. In this case, the bottom of the stomach was excised using laparoscopic suturing devices.

After complete mobilisation of the esophagus and separation of the right and left diaphragmatic legs, the area of the chial foramen was measured using the formula F. A. Granderath [13]. The condition of the diaphragmatic pedicles was assessed. Only 7 (11.3%) of 62 patients managed to bring the diaphragmatic pedicles together with sutures. The degree of tension of the threads during the reduction of the diaphragmatic pedicles was studied.

Studies conducted in our clinic have shown that if the tension force exceeds 4.5–5 N, the muscle fibres of the diaphragmatic pedicles are dissected, which leads to a sharp increase in the frequency of recurrence [14].

Therefore, if it was possible to suture the diaphragmatic pedicles, but the tension of the suture exceeded 5 N, we performed weakening incisions of the diaphragmatic pedicles. Most often, the right pedicle of the diaphragm was dissected longitudinally, 5–7 mm from the inferior vena cava. If this was not enough, a relieving incision of the diaphragm was made on the left. At the same time, the place of attachment of the diaphragm to the VII rib was determined and, retreating 1.5–2 cm, the diaphragm was dissected 5–7 cm long, reaching the posterior spleen pole. At the same time, it was possible to suture the diaphragmatic pedicles both behind the oesophagus and from above without much tension.

Our measurements of the thread tension force during cruroplasty showed that loosening incisions can reduce it by 34–42%.

After suturing the diaphragmatic pedicles with sutures or using special Pledgets (Americot), the defects on the right and left that formed after diaphragmatic dissection were closed. For this purpose, a special PTFE mesh was initially used in 8 patients, which was sutured to the edge of the defect with separate threads. However, later, a self-locking mesh Progrip (Covidien) was used. For this purpose, a rectangular segment of 4 × 3 cm mesh was cut and fixed to the tissues for 60 seconds. To close the defect of the diaphragm on the left side, a 6 × 3 cm segment of the mesh was cut and fixed with tackers at 2 to 3 points. After that, the mesh was independently fixed to the diaphragm and did not move.

After the diaphragm was dissected, a pneumothorax occurred on the left side with a part of the lung collapsing. Only 3 patients had to have a drainage system installed in the pleural cavity, while the rest of the patients' lungs were able to straighten by the end of the operation.

All the operated patients were called to the clinic and examined within 1 to 10 years. They underwent fibroesophagogastroduodenoscopy, computed tomography of the chest

and abdominal cavities, and a fluoroscopic examination of the stomach. In addition, a special questionnaire was used to determine the patients' quality of life.

Results

Between 2010 and 2023, 62 patients with large and giant GSDs underwent laparoscopic interventions with laxative incisions of the diaphragm structures on the right and left.

The right pedicle of the diaphragm was dissected in 52 patients, the left in 7, and both the left and right in 3.

Since the majority of patients used the Progrid self-locking mesh to close the diaphragmatic defect, all operations were performed quickly enough. The average duration of the operation was (132 ± 22) minutes. The fact that the surgery was short had a great positive impact on the operated patients, as most of them were elderly.

Complications during the operation and in the early postoperative period were minimal. Bleeding from the short vessels of the stomach floor occurred in 1 patient, who underwent repeated relaxation surgery 4 hours after the operation, the source of bleeding was found and the vessels were reliably coagulated. The patient recovered without complications. Thromboembolism of small pulmonary vessels was observed in 2 patients, and they recovered after intensive care for 5–6 days. 1 patient developed myocardial infarction on the 3rd day after surgery and died. Left-sided pleurisy in 2 patients was treated with repeated pleural punctures. Cardiac rhythm disturbances and atrial fibrillation were noted in 2 patients, who were treated in the intensive care unit for 4–5 days. The average hospital stay after surgery was (5.2 ± 1.5) days. There were no complications associated with the closure of diaphragmatic defects with non-absorbable mesh.

Recurrence of GERD was detected by radiological examination in 2 (3.2%) of 62 patients after 2 and 5 years. Subjectively, the patients felt satisfactory and got rid of heartburn by taking proton pump blockers. During the radiological examination of patients in the long term, none of them showed any disorders of diaphragmatic mobility or paralysis of its dome. A significant improvement in the quality of life of patients after surgery was noted. The quality of life of patients after esophageal lengthening surgery using the Collis technique was lower than that of other patients.

Thus, our retrospective study confirmed the feasibility of performing laparoscopic surgery using a new concept in elderly patients with large and giant GSD, in which the diaphragmatic pedicles are usually atrophied.

Discussion

A group of American surgeons led by a well-known reflux disease specialist, Professor S. R. DeMeester, published a series of papers on the use of diaphragmatic incisions in large GERD [8, 15].

We started using this technique in 2010. At first, we performed this operation with caution, fearing various complications. Later, having gained some experience, we began to perform it quite often. Currently, the share of

such operations is 25–30%. After a simple suturing of the diaphragm pedicles in the plastic surgery of the defect of its oesophageal opening, the recurrence rates are very high – 25–30% [1]. Often, patients with large GORD have kyphosis, which complicates the operation and leads to a high recurrence rate [16]. In addition, as shown in studies conducted by us [17] and foreign authors [18], patients have defects in collagen synthesis.

All of the above makes laparoscopic surgery very difficult, and the results are not good enough. When closing a hernia defect in patients with large HIPS, the principle of "tension free" is violated, which leads to a high risk of hernia recurrence.

We, as well as other researchers, have shown that when the thread tension force when suturing the diaphragmatic pedicles is above 5 N, the incidence of hernia recurrence increases dramatically.

The use of mesh implants significantly reduces the incidence of hernia recurrence [1], but the incidence of serious complications increases, requiring repeated traumatic interventions, after which patients often die [19].

Experience shows that in the case of direct contact of the esophageal tissue with the mesh implant, the mesh often grows into the lumen of the esophagus with serious complications.

The use of a new concept of laparoscopic surgery for large and giant GERD, when the legs of the diaphragm are sutured around the esophagus and there is no contact with the mesh, avoids threatening complications. For this purpose, laxative incisions of the diaphragm can be used. In 1997, the American surgeon T. R. Huntington [20] proposed to perform a laxative incision of the right diaphragmatic pedicle.

To completely exclude the contact of the Progrid mesh with the intestine, we usually mobilise the left lobe of the liver, which reliably covers the mesh.

When using laxative diaphragmatic incisions, the right pedicle of the diaphragm was more often dissected, as was the case with American colleagues [8]. This is because with this technique, the operation is simpler, there is no pneumothorax and there is no need to drain the left pleural cavity. In case of very large hernias, the diaphragm has to be cut both on the right and on the left. No serious complications have been observed with this technique.

The defect formed after dissection of the right pedicle of the diaphragm or the left diaphragm was initially closed, as in the case of American colleagues, with PTFE mesh, fixing it with separate sutures to the muscles. It should be noted that this technique is not without a certain risk of damage to the inferior vena cava in closed defects of the right diaphragmatic stem. Subsequently, a self-locking mesh Progrid was used to close defects in the diaphragm. For this purpose, in a number of patients, the mesh was fixed with absorbable tackers or sutures at 2 to 3 points, after which it was reliably fixed to the tissues and did not move.

The use of the Progrid mesh significantly simplified the laparoscopic surgery and reduced its duration, which is very important given the elderly age of most patients. No

complications associated with the use of Progrid mesh were observed. American surgeons reported that due to poor fixation of PTFE mesh, a hernia defect was formed in the right leg of the diaphragm with subsequent impingement of the small intestine loop. In the case of Progrid mesh, no such complications were noted, as we used mesh fragments that were much larger in area and reliably closed the defect in the muscle.

A study of long-term results in patients operated on using the new technique revealed hernia recurrence in 2 (3.2%) patients. The same rates of hernia recurrence are reported by American researchers.

Conclusions

Thus, laparoscopic surgery using the new concept for large and giant GSDs can reduce the incidence of recurrence and, most importantly, avoid serious complications associated with the use of mesh resorbable implants.

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References

- Campos V, Palacio DS, Glina F, Tustumi F, Bernardo WM, Sousa AV. Laparoscopic treatment of giant hiatal hernia with or without mesh reinforcement: A systematic review and meta-analysis. *Int J Surg.* 2020 May;77:97–104. doi: 10.1016/j.ijssu.2020.02.036. Epub 2020 Mar 3. PMID: 32142902.
- Davis SS Jr. Current controversies in paraesophageal hernia repair. *Surg Clin North Am.* 2008 Oct;88(5):959–78, vi. doi: 10.1016/j.suc.2008.05.005. PMID: 18790148.
- Memon MA, Memon B, Yunus RM, Khan S. Suture Cruroplasty Versus Prosthetic Hiatal Herniorrhaphy for Large Hiatal Hernia: A Meta-analysis and Systematic Review of Randomized Controlled Trials. *Ann Surg.* 2016 Feb;263(2):258–66. doi: 10.1097/SLA.0000000000001267. PMID: 26445468.
- Wijnhoven BP, Watson DI. Laparoscopic repair of a giant hiatus hernia—how I do it. *J Gastrointest Surg.* 2008 Aug;12(8):1459–64. doi: 10.1007/s11605-008-0473-3. Epub 2008 Jan 23. PMID: 18213501.
- Rathore MA, Andrabi SI, Bhatti MI, Najfi SM, McMurray A. Metaanalysis of recurrence after laparoscopic repair of paraesophageal hernia. *JSLs.* 2007 Oct–Dec;11(4):456–60. PMID: 18237510; PMCID: PMC3015848.
- Watson DI. Evolution and development of surgery for large paraesophageal hiatus hernia. *World J Surg.* 2011 Jul;35(7):1436–41. doi: 10.1007/s00268-011-1029-3. PMID: 21380582.
- Granderath FA, Carlson MA, Champion JK, Szold A, Basso N, Pointner R, et al. Prosthetic closure of the esophageal hiatus in large hiatal hernia repair and laparoscopic antireflux surgery. *Surg Endosc.* 2006 Mar;20(3):367–79. doi: 10.1007/s00464-005-0467-0. Epub 2006 Jan 19. PMID: 16424984.
- McKay SC, DeMeester SR, Sharata A, DeSouza ML, Bradley DD, Reavis KM, et al. Diaphragmatic relaxing incisions for complex hiatal reconstruction: longer-term follow-up confirms safety, efficacy and rare complications. *Surg Endosc.* 2023 Nov;37(11):8636–43. doi: 10.1007/s00464-023-10293-6. Epub 2023 Jul 26. PMID: 37495846.
- Yatabe K, Ozawa S, Ito E, Oguma J, Kazuno A, Nitta M, et al. Late esophageal wall injury after mesh repair for large esophageal hiatal hernia: a case report. *Surg Case Rep.* 2017 Dec 15;3(1):125. doi: 10.1186/s40792-017-0401-4. PMID: 29247269; PMCID: PMC5732121.
- Oelschlager BK, Pellegrini CA, Hunter JG, Brunt ML, Soper NJ, Shepard BC, et al. Biologic prosthesis to prevent recurrence after laparoscopic paraesophageal hernia repair: long-term follow-up from a multicenter, prospective, randomized trial. *J Am Coll Surg.* 2011 Oct;213(4):461–8. doi: 10.1016/j.jamcollsurg.2011.05.017. Epub 2011 Jun 29. Erratum in: *J Am Coll Surg.* 2011 Dec;213(6):815. PMID: 21715189.
- Frantzides CT, Carlson MA, Loizides S, Papafili A, Luu M, Roberts J, et al. Hiatal hernia repair with mesh: a survey of SAGES members. *Surg Endosc.* 2010 May;24(5):1017–24. doi: 10.1007/s00464-009-0718-6. Epub 2009 Dec 8. PMID: 19997755.
- Grubnik VV, Berezytskyi YaS, Ilyashenko VV, Grubnyk VV, Korchovyi DV, Kiosov OM. Complications, caused by application of the net implants in the hiatal hernias plasty. *Klin Khir.* 2022 March/April;89(3–4):35–9. Ukrainian. doi: 10.26779/2522-1396.2022.3-4.35.
- Granderath FA, Schweiger UM, Pointner R. Laparoscopic antireflux surgery: tailoring the hiatal closure to the size of hiatal surface area. *Surg Endosc.* 2007 Apr;21(4):542–8. doi: 10.1007/s00464-006-9041-7. Epub 2006 Nov 14. PMID: 17103275.
- Grubnik VV, Tkachenko AI, Grubnik VV. Dependence of the recurrence development on the sutures tension force while performance of laparoscopic crurography. *Klin Khir.* 2020 January/February;87(1–2):30–4. Ukrainian. doi: 10.26779/2522-1396.2020.1-2.30.
- Greene CL, DeMeester SR, Zehetner J, Worrell SG, Oh DS, Hagen JA. Diaphragmatic relaxing incisions during laparoscopic paraesophageal hernia repair. *Surg Endosc.* 2013 Dec;27(12):4532–8. doi: 10.1007/s00464-013-3107-0. Epub 2013 Aug 16. PMID: 23949479.
- Polomsky M, Siddall KA, Salvador R, Dubecz A, Donahue LA, Raymond D, et al. Association of kyphosis and spinal skeletal abnormalities with intrathoracic stomach: a link toward understanding its pathogenesis. *J Am Coll Surg.* 2009 Apr;208(4):562–9. doi: 10.1016/j.jamcollsurg.2009.01.004. PMID: 19476791.
- Grubnyk VV, Savenko TA. Collagen type I and III study in the gastroesophageal junction in the patients with hiatal hernia. *Surgery of Ukraine.* 2019;(1):34–8. Ukrainian. doi: 10.3978/SU2019-1-34.
- Von Diemen V, Trindade EN, Trindade MR. Hiatal hernia and gastroesophageal reflux: Study of collagen in the phrenoesophageal ligament. *Surg Endosc.* 2016 Nov;30(11):5091–8. doi: 10.1007/s00464-016-4858-1. Epub 2016 Mar 22. PMID: 27005292.
- Stadlhuber RJ, Sherif AE, Mittal SK, Fitzgibbons RJ Jr, Michael Brunt L, Hunter JG, et al. Mesh complications after prosthetic reinforcement of hiatal closure: a 28-case series. *Surg Endosc.* 2009 Jun;23(6):1219–26. doi: 10.1007/s00464-008-0205-5. Epub 2008 Dec 6. PMID: 19067074.
- Huntington TR. Laparoscopic mesh repair of the esophageal hiatus. *J Am Coll Surg.* 1997 Apr;184(4):399–400. PMID: 9100687.

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