Laparoscopic revisional surgery for failed anti-reflux procedures

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AIM: *Failure ratio of an anti-reflux surgery is 2-17% in adults. After unsuccessful fundoplications, if necessary, revisional surgeries can be performed. Revisional surgeries are technically difficult to perform and require professionally advanced experience. On the other hand, it is still controversial which technique should be used in revisional surgery. The aim of this study is to present our experience with revisional surgical procedures for complications or recurrences after anti-reflux surgeries.*
MATERIAL AND METODS: *A total of 18 patients, 16 of whom were referred to our clinic from other centers, and who underwent revisional surgery for failed fundoplication between 2014 and 2019 were retrospectively analyzed*
RESULTS: *Five patients were male and 13 were female. The mean age was 40.3±11.7 years. The most common symptom was the persistence of reflux symptoms (61.2%). Indications for revisional surgery were recurrent hiatal hernia in 10 patients, thightness in 4 patients, mesh migration in 2 patients, mesh migration with recurrent hiatal hernia in 1 patient, and mesh migration with thightness in 1 patient. The mean operative time was 107.2+29.2 minutes. The median hospital stay was 2.9 days (range: 1-6 days). The most common surgical procedure performed was the repair of hiatal crura with mesh, and reconstruction of fundoplication and fixation of neo-fundoplication to the right crus (44.4%). In addition, other surgical procedures performed were takedown of the previous fundoplication (16.6%), takedown of the previous fundoplication and reconstruction of fundoplication (11.1%), cruroplasty and fundoplication with gastric wedge resection (11.1%), removal of the mesh and takedown of the previous fundoplication (5.6%), removal of sutures from the hiatal crura (5.6%), and gastric wedge resection (5.6%). Four patients (27.8%) developed morbidity due to gastric perforation and pleural opening during these procedures. The median follow-up period was 29 months (range: 6-69 months). Two cases (11.1%) who underwent revisional surgery failed, and re-revisional surgery was performed.*
CONCLUSIONS: *Revisionary surgical procedures performed for failed anti-reflux surgery are not limited to re-fundoplication. Different procedures such as takedown of the previous fundoplication, reconstruction of fundoplication, removal of the mesh, removal of the sutures or wedge resection may be necessary. These procedures can successfully be performed laparoscopically by experienced surgeons in well-equipped centers.*

KEY WORDS: Fundoplication, Gastroesophageal reflux, Laparoscopy, Revisional Surgery, Antireflux surgery

Introduction

The fundoplication procedure described by Rudolf Nissen in 1956 is frequently used in the treatment of hiatal hernia and gastroesophageal reflux disease [1]. This fundoplication procedure was performed laparoscopically for the first time by Dallemagne *et al.* in 1991 [2]. Eventually laparoscopic surgeries were started to be performed more widely and the high rate of patient satisfaction after anti-reflux surgery helped these procedures to be used more frequently [3]. Despite the developments above, failures such as complications and recurrences have been reported after anti-reflux surgery due to incorrect surgical technique or patient-induced reasons.
The aim of this study is to present our surgical expe-

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rience and treatment algorythms in patients who had revisional surgery due to complications or recurrences after anti-reflux surgeries.

Material and Methods

A total of 18 patients, 16 of whom were referred to our clinic from other centers, and who underwent revisional surgery after failed fundoplication between 2014 and 2019 were retrospectively analyzed. Eighteen patients who had revisional surgery due to complications or recurrences related to anti-reflux surgery were included in the study. Patients who had surgery except for the reasons of failure due to postoperative reflux or complications were excluded from the study. Demographic characteristics, previous anti-reflux procedures, indications for revisional surgery, postoperative symptoms, operative complications related to the revisional surgery, timing of revisional surgery, postoperative length of stay, type of revisional surgery, follow-up period, ratios of complications and recurrences after the revisional surgery were determined. The complaints and symptoms were classified using postoperative Visick score [4].

Statistical analysis

Statistical analysis was carried out using IBM SPSS Statistics ver. 24.0 (IBM Co., Armonk, NY, USA). Continuous data were presented as mean (standard deviation) or median (range), and categorical data as frequency. Student's *t*-test was used for comparison of continuous variables. Shapiro-Wilk normality test was performed for numerical variables such as age and follow-up time. Based on the results of analyses, the p value < 0.05 was considered to be statistically significant.

Results

Five patients were male and 13 were female. The mean age was 40.3±11.7 years. The mean body mass index (BMI) was 25.95±5.5 (range: 17.3 - 36.9).

Preoperative Evaluation

A detailed anamnesis was obtained from the patients. All the problems and symptoms were recorded. In two patients, previous anti-reflux operations were performed in our clinic, whereas 16 patients were operated at other centers. From their history of previous surgeries, we learnt that 11 patients had mesh cruroplasty and fundoplication , and 7 patients had cruroplasty without mesh and fundoplication. Four patients were consulted to our clinic for the symptoms of thightness, and we learnt from their medical histories that they had unsuccessful endoscopical balloon dilatation.

Table I - *Indications for revisional surgery*

Reasons for Operation	N %
Thightness	4 (22.1%)
Recurrent hiatal hernia	10 (55.6%)
Mesh migration	2 (11.1%)
Mesh migration + Thightness	1 (5.6%)
Recurrent hiatal hernia + Mesh migration	1 (5.6%)

All patients underwent preoperative chest X-ray examination, esophagography and upper gastrointestineal system endoscopy as well as chest computed tomography (CT) scanning and pulmonary function tests, if necessary. They were evaluated endoscopically for esophagitis, cardioesophagitis, loosening of the sphincter, current status of fundoplication, tightness, presence of mesh migration or shrinkage, and presence of hiatal hernia. Barrett's esophagus was detected in one patient, Los Angeles grade C esophagitis in 3 patients, and mesh migration to the stomach in 4 patients. Thoraco-abdominal CT was performed in 3 patients who presented with dysphagia, dyspnea or chest pain. If required, an esophageal motility test was added.

The most common symptom was ongoing reflux (61.2%). The second most common symptom was dysphagia (27.7%).

The most common reason for revisional surgery was recurrence of hiatal hernia (55.6 %) (Table I).

Surgical Methods

All surgical procedures were performed by a single surgeon who specialized in upper gastrointestineal system surgery. All procedures were completed laparoscopically. All patients were explored by laparoscopy under general anesthesia (Fig. 1). As a standard laparoscopical surgery, 5 ports were used. A 10 mm optical trocar was inserted through the umbilicus. Abdomen was ensufled and

Table II - *Revisional procedures*

Procedures	N. 18 - %
Repair of the crus with mesh and fixation of the fundoplication to the crus	8 (44.4%)
Takedown of the previous fundoplication	3 (16.6%)
Cruroplasty and fundoplication with gastric wedge resection	2 (11.1%)
Takedown of the previous fundoplication and the reconstruction of fundoplication	2 (11.1%)
Gastric wedge resection	1 (5.6%)
Removal of sutures from the crus	1 (5.6%)
Removal of mesh and takedown of the previous fundoplication	1 (5.6%)

Fig. 1: A) First exploration view in revisional surgery; B) Very tightly repaired hiatus and short esophagus; C) Enlargement of the hiatus and lengthening of the abdominal esophagus.

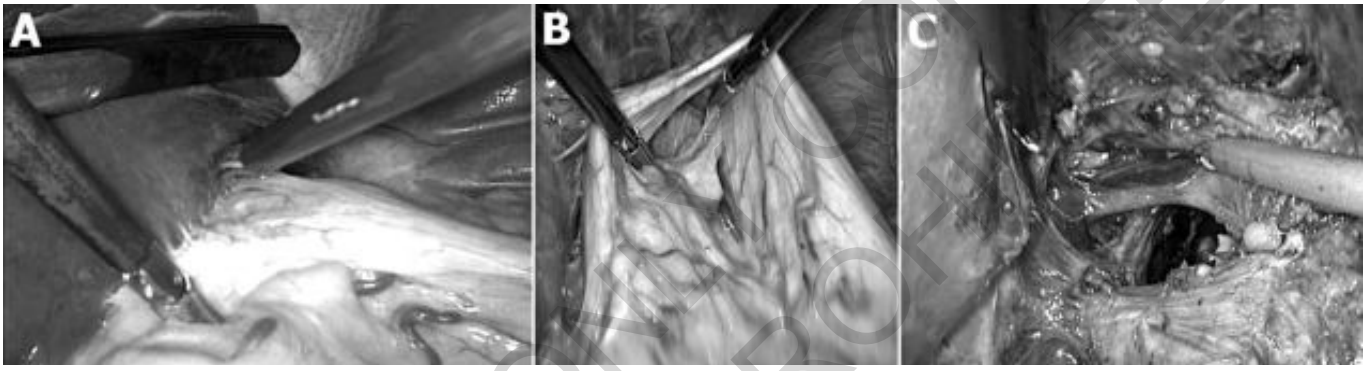

Fig. 2: A) Separation of fibrotic adhesions between the left lobe of the liver and fundoplication; B) Thoroughly loosened fundoplication (fundus sutured to the corpus of stomach; C) Loosening of the diaphragmatic crurae after repair without mesh.

exploration was performed. Adhesions in the abdomen were dissected with scissors using a 10 mm port from the left upper quadrant. Nathanson retractor was placed under the xiphoid in order to eliminate the liver. Two 5 mm ports were placed, one to the left of falciform ligament and other to the right of axillary line. Adhesions between the liver and stomach were carefully separated in reverse Trendelenburg position (Fig. 2). In all cases, the right crus was identified as a first step, and then the left crus was exposed. For all patients, depending on the reasons of failure, a different surgical procedure was performed (Table II).

The causes of failure during the surgery were classified according to Hatch classification [5]. Cases with thightness and mesh migration were added to the unclassified group. The most common pattern of failure was Type I failure (66.6%) (Table III).

TABLE III - *Types of primary fundoplication failure according to Hacht classification*

Type	Cause of Failure	N. 18 - %
Type IA	Cephalad displacement of the gastroesophageal junction through the esophageal hiatus with wrap	2 (11.1%)
Type IB	Cephalad displacement of the gastroesophageal junction through the esophageal hiatus without wrap	10 (55.5%)
Type II	Failure due to paraesophageal hernia	0 (0%)
Type III	Consequence of malposition of the wrap at the time of the initial surgery	3 (16.7%)
Unclassified	Failure of fundoplication, failure of primary wrap, too tight or too loose wraps, undetermined failures related to esophageal or gastric motility abnormalities	3 (16.7%)

Operative Parameters

The mean operative time for revisional surgery was 107.2±29.2 minutes (range: 60 - 180 minutes), and the mean postoperative hospital stay was 2.9±1.6 days (range: 1 - 6 days). Postoperative complication rate for revisional surgery was 27.8%. One patient developed gastric perforation, and 4 patients pleural opening. Chest tube was inserted in 2 patients, one with intaoperative pleural repair (Fig. 3).

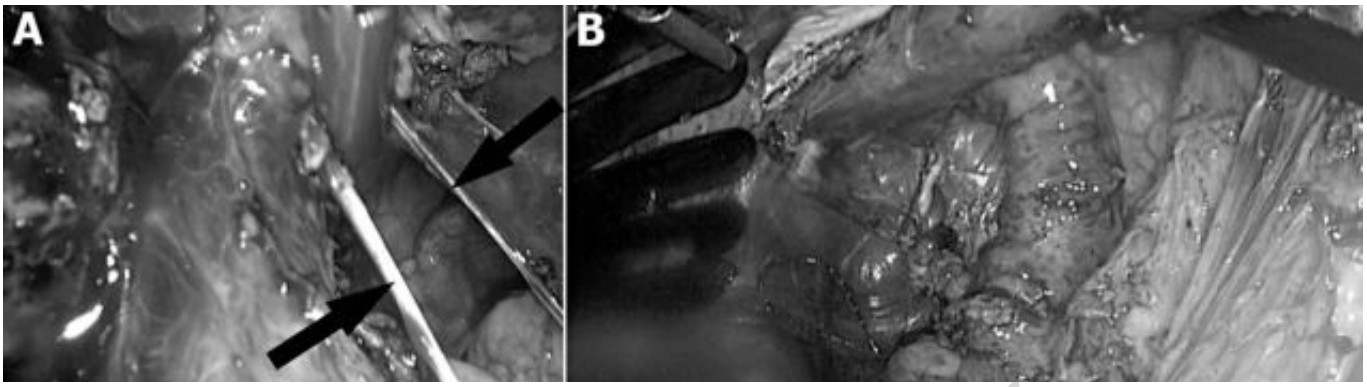

Fig. 3: A) Opening of the left pleura (black arrows) and image of the collapsed lower lobe of lung; B) Repaired image of the pleura with unidirectional barbed suture (V-Loc™).

Postoperative Care

All patients were started on a liquid diet on the first postoperative day except for 3 patients who underwent gastric wedge resection and 1 patient with fundus perforation. In these four patients, we performed esophagography on the third postoperative day, and then started a liquid diet. All patients were advised to have a liquid or soft food diet for 3 weeks. Foods that contain caffeine and acid were advised to be limited. Endoscopy was routinely performed on all patients at 6 months. All patients were evaluated for existence of symptoms by Visick score on the sixth month. Sixteen of 18 patients were scored as Visick I or II, and 2 patients (11.1%) were scored as Visick III or IV (Table IV). Detailed examination was performed in these two patients with high Visick scores, and esophagography was repeated but not upper gastrointestineal system endoscopy.

Recurrence

The median follow-up period was 29 months (range: 6 - 69 months). At 6 months postoperatively, 2 patients who had Visick III or IV scores had a re-revisional surgery due to ongoing complaints after revisional surgery.

Table IV - *Visick classification of upper gastrointestinal symptoms*

Grade	Characteristics	N. 18 - %
Grade I	No symptoms	10 (55.5%)
Grade II	Minimal symptoms, no change in life style and no need to seek medical attention	6 (33.4%)
Grade III	Important symptoms despite using PPI, several changes in life style, medical attention is required	1 (5.6%)
Grade IV	Severe symptoms or worse despite using PPI	1 (5.6%)

One of these patients had revisional surgery due to recurrent reflux. During the first postoperative 6 months, serious swallowing problem was developed and sutures on the hiatus were removed. After this procedure, the symptoms were relieved. The second patient had takedown of the previous fundoplication and removal of the mesh due to mesh migration and thightness. This patient underwent a meshless Nissen fundoplication due to recurrence of reflux symptoms one year after revisional surgery. Visick scoring was performed 3 months after re-revisional surgery in these two patients and we found that both of them were regressed to Visick score II.

Discussion

There are many factors affecting the success of anti-reflux surgery. These can be listed as correct indication, appropriate patient selection, surgical experience, and appropriate operative selection. Success rate of anti-reflux procedures is more than 90% in the first 5 years [6]. However, short- and long-term reflux recurrences following surgical treatment still remain a serious problem. Actually, there is a failure rate of 2% and 17% in laparoscopic Nissen fundoplication [7,8].

In the evaluation of failure after anti-reflux surgery, taking detailed anamnesis and performing an upper gastrointestinal endoscopy should be compulsory. In necessary situations, upper gastrointestinal series, pH monitoring, esophageal manometry, gastric emptying tests, scintigraphic or CT evaluation are recommended [9]. We evaluated all patients with upper gastrointestinal endoscopy and esophagography in our clinic. Patients who had dysphagia underwent additional esophageal manometry and CT evaluation.

Furnée *et al.* evaluated 3,175 failed fundoplications [10]. They stated that symptoms for revisional surgery were persistent reflux (41.7%), dysphagia (16.6%), recurrence of reflux and dysphagia (4%), anatomical anomaly (2.5%) and gas-related symptoms by flatulence (0.7%).

In our series, recurrent reflux was the most common symptom (61.2%) in accordance with the literature.

The reasons for failure of anti-reflux surgery include loose fundoplication, inadequate cruroplasty, opening of fundoplication, displaced fundoplication or transdiaphragmatic herniation of fundoplication [11-13]. Grover *et al*. reported that the most common cause of recurrence was the opening of crus and short esophagus [14]. However, Safranek *et al*. found that the majority of the 28 cases with recurrent reflux had a wrap herniation (54%), with or without wrap disruption (36%) or attenuation of the wrap (18%) [15].

Hacht *et al*. evaluated and classified the types of fundoplication failures after anti-reflux surgery [5]. Type I failures occur with cephalad displacement of the gastroesophageal junction through the esophageal hiatus with (type IA) or without (type IB) the wrap. The proposed mechanisms by which type I failures occur include inadequate esophageal length, inadequate hiatal closure, and inadequate fixation of the wrap to the abdomen. Type II failures are defined as failure secondary to paraesophageal hernia. The mechanism thought to give rise to type II failures include inadequate hiatal closure and/or a redundant wrap. Type III fundoplication failures occur as a consequence of malposition of the wrap at the initial operation. This results in a distortion of the cardia of the stomach, which gives rise to continued reflux and dysphagia. This type of failure, along with failures that result from a lack of appreciation of coexistent esophageal or gastric dysmotility, stems from the lack of thoroughly evaluating the patient before surgery and/or a misinterpretation of anatomy at the time of the initial fundoplication. Similarly, failure to adequately size the fundoplication may lead to a wrap that is too loose or tight. We evaluated the reasons of postoperative failures in our cases with preoperative symptoms according to the Hacht classification. The most common pattern of failure was type I (66.6%), type III (16.7%), and unclassified type (16.7%).

Great care should be taken to decide on which type of revisional surgery for failed fundoplication should be made. In order to decide which surgery is the best option, all the factors that bring the patient to the operation must be carefully considered [16]. The decision to choose the surgery is a challenging clinical problem that needs to be individualized according to the clinical features of patients, the severity of symptoms, the type of esophagitis, the presence of ulcers, the presence of strictures, the type of Barrett's esophagus, delayed gastric emptying, acid/bile reflux, the number of previous operations, and the presence of obesity. In our clinical practice, individualized procedures are involved and funduplications are disrupted in line with their consent, taking into account the expectations of some patients.

Experiencing dysphagia in the early stages of anti-reflux surgery is a common problem and is usually tempo-

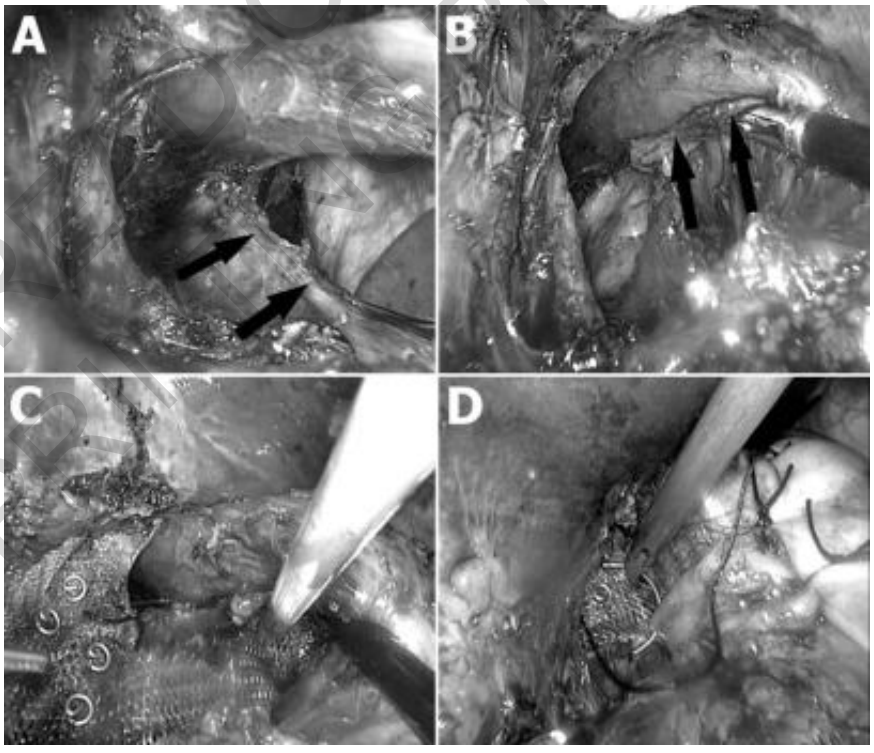

Fig. 4: A) Finding the posterior vagus (black arrows) and lengthening the abdominal esophagus; B) Approaching the posterior vagus upward to the esophagus (black arrows; C) Fixing the light mesh with the tucker without touching the esophagus wall (at least 5 mm away from the esophagus; D) Fixation of the fundoplication to the crus to prevent migration into the thorax.

Fig. 5: A) Removal of the prolene mesh material which migrated into the wrap (black arrows; B) Wedge resection of the perforated area in wrap; C) Prolene mesh piece which migrated and wedge resection material.

rary [17]. Kiladze *et al.* performed relaparoscopy due to progressive dysphagia in 2 patients out of 120 patients [18]. Adhesiolysis was performed in one patient, and sutures on the hiatal crus were removed in another patient. In our study, 5 patients had thightness. Four of these patients had failed endoscopical balloon dilatation in their previous medical history. For revisional surgery, we performed an opening of fundoplication in 3 patients, loosening the crura in 1 patient, and both opening of fundoplication and removal of mesh in 1 patient.

In order to prevent failure in the first anti-reflux surgery, a polypropylene mesh and tension-free cruroplasty are usually performed. During this process it is very important that mesh should not touch the esophagus wall directly (Fig. 4). Celasin *et al.* stated that mesh should be at least 1 cm away from the esophagus [19]. Otherwise, depending on the fibrotic tissue and the direct effect of mesh, difficulty in swallowing and/or mesh migration towards esophagus or stomach wall may occur [20]. In our 11 cases (61.1%), mesh cruroplasty and fundoplication were performed during the first anti-reflux surgery. In 4 cases, mesh migration was observed. In 3 patients, a wedge resection of the gastric tissue where the mesh was migrated with a rim of normal gastric tissue was performed with a laparoscopic stapling device (Fig. 5). In the fourth case, the fundoplication was disrupted and the mesh was removed, but gastric perforation developed, which was primarily repaired.

Some authors advocate that re-fundoplication should be the first approach in revisionary surgery, which is more complex, difficult to perform and has a longer operation time than the first operation [16]. However, we performed re-fundoplication only in 4 patients (22.2%).

In a systematic review of redo-fundoplications, Darren *et al.* found recurrent hiatal hernia in half of the failed anti-reflux surgery cases [21]. The most common cause of failure in our clinical practice was the migration of gastroesophageal junction into the thorax with or without wrap. Therefore, we mostly performed releasing the esophagus, pulling it into the abdomen, and then mesh cruroplasty (44.4%). In this procedure, in order to prevent the wrap moving upwards, we fixed the fundoplication to the right diaphragmatic crus with silk sutures. Most authors considers the failure of anti-reflux surgery as recurrent reflux only. For this reason, studies have generally focused on redo-fundoplication. However, as seen in our series, cases with complications such as postoperative thightness or mesh migration were the causes of failure after anti-reflux surgery. Tackling these problems will require procedures such as loosening the hiatus, disruption of fundoplication and/or gastric wedge resection as in our series, but not simple refundoplication. In a systematic review of the literature, Furnée *et al.* reported intraoperative and postoperative complication rates of 21.4% and 15.6%, respectively, in redo surgery [10]. The most common intraoperative complication was gastric or esophageal injury and the second most common intraoperative complication was pneumothorax. One of our patients had perforation of the stomach and 4 patients had pleural injury. Chest tube was inserted in 2 patients with pleural injury and the patient with gastric injury underwent intraoperative primary repair. Laparoscopic revisional surgery may require to conversion to open surgery due to intra-abdominal dense adhesions, bleeding or poor visualization. However, Al Hashmi *et al.* reported that 98% of these procedures can be completed laparoscopically [22]. All cases in our series were completed laparoscopically.

Some authors says that approximately 10% of patients will go to new revisional surgery after redo reflux procedures [23,24]. In our series, we performed laparoscopic re-revisional surgery in 2 of the 18 patients (11.1 %). In one of these patients, meshless Nissen fundoplication was performed, however, sutures on the hiatus were removed in other patient.

Conclusion

Due to recurrence of reflux, mesh migration, dysphagia and thightness, revisional surgery may be necessary in patients who had previously undergone anti-reflux sur-

gery. Revisional surgeries are not limited to only re-fundoplications. Procedures to be performed vary according to the symptoms, complaints and even to the expectations of patients. As seen in our series, procedures such as, takedown of the previous fundoplication, loosening the hiatus, repairing the hiatus with or without mesh, wedge resection, and refundoplication can be used in the revisional surgery. All these procedures can be performed successfully by experienced surgeons laparoscopically at well-equipped medical centers.

Riassunto

Il fallimento di una procedura chirurgica per reflusso gastro esofageo negl adulti varia dal 2 al 17%, ed è possibile, se necessario procedere con interventi di revisione, che sono tecnicamente difficili e richiedono una buona esperienza professionale. Per altro verso non c'è accordo circa la tecnica chirurgica da adottare in questi casi. Si vuole qui presentare la nostra esperienza con procedure chirurgiche di revisione per complicanze o recidive intervenute dopo interventi chirurgici anti-reflusso.

La casistica analizzata retrospettivamente riguarda 18 pazienti sottoposti ad intervento di revisione di una fundoplicatio fallita, tra il 2014 e il 2019 di cui 16 operati in altra sede.

Si tratta di 5 uomini e 13 donne, dell'età media di 40,3 ± 11,7 anni, con il sintomo più comune rappresentato nel 61,2% dalla persistenza dei sintomi da reflusso. Le indicazioni per procedere ad una chirurgia di revisione sono state l'ernia iatale ricorrente in 10 pazienti, la dispnea in 4 pazienti, la migrazione di una mesh in 2 pazienti, la migrazione della mesh con ernia iatale ricorrente in 1 paziente e la migrazione della mesh con syenosi in 1 paziente. La durata media dell'intervento è stata di 107,2 + 29,2 minuti, e la degenza in ospedale è stata di 2,9 giorni in media (tra 1-6 giorni). La procedura chirurgica più comune adottata è stata la riparazione della breccia dello hiato con mesh, la ricostruzione della fundoplicatio e la fissazione della neo-fundoplicatio sul pilastro destro nel 44,4% dei casi. Inoltre, sono state eseguite altre procedure chirurgiche di rimozione della precedente fundoplication (16,6%), rimozione della precedente fundoplication e ricostruzione della fundoplication (11,1%), cruroplastica e fundoplication con resezione del cuneo gastrico (11,1%), rimozione della mesh e rimozione della precedente fundoplication (5,6%), rimozione delle suture dalla breccia iatale (5,6%) e resezione del cuneo gastrico (5,6%). Quattro pazienti (27,8%) hanno affrontato la morbilità di una perforazione gastrica e dell'apertura pleurica durante queste procedure. Il periodo di follow-up mediano è stato di 29 mesi (intervallo: 6-69 mesi). Due casi (11,1%) sottoposti a intervento di revisione non sono riusciti ed è stato eseguito un intervento di ri-revisione.

Nella nostra esperienza le procedure chirurgiche di revisione di interventi chirurgici anti-reflusso non riusciti non si limitano alla reintegrazione sottodiaframmatica del fondo gastrico, ma potrebbero essere necessarie diverse procedure come la rimozione della precedente fundoplication, la ricostruzione della fundoplication, la rimozione della rete, la rimozione delle suture o la resezione del cuneo gastrico erniato. Queste procedure possono essere eseguite con successo laparoscopicamente da chirurghi esperti in centri ben attrezzati.

References

1. Stylopoulos N, Rattner DW: *The history of hiatal hernia surgery: from Bowditch to laparoscopy*. Ann Surg, 2005; 241: 185-93.

2. Dallemagne B, Weerts JM, Jehaes C, Markiewicz S, Lombard R: *Laparoscopic Nissen fundoplication: Preliminary report*. Surg Laparosc Endosc, 1991; 1: 138-43.

3. Tolboom RC, Draaisma WA, Broeders IA: *Evaluation of conventional laparoscopic versus robot-assisted laparoscopic redo hiatal hernia and antireflux surgery: A cohort study*. J Robot Surg, 2016; 10: 33-9.

4. Visick AH: *A study of the failures after gastrectomy*. Ann R Coll Surg Engl, 1948; 3: 266-84.

5. Hatch KF, Daily MF, Christensen BJ, Glasgow RE: *Failed fundoplications*. Am J Surg, 2004; 188:786-91.

6. Dallemagne B, Arenas Sanchez M, Francart D, Perretta S, Weerts J, Markiewicz S, et al.: *Long-term results after laparoscopic reoperation for failed antireflux procedures*. Br J Surg, 2011; 98: 1581-87.

7. Pham TH, O'Rourke RW, Hunter JG: *Laparoscopic and Open Nissen Fundoplication*. In: Peters JH, McFadden DW (eds): Shackelford's Surgery of the Alimentary Tract. 7th ed. Vol. 1. Philadelphia: Elsevier Saunders, 2013; 226-36.

8. Hunter JG, Smith CD, Branum GD, Waring JP, Trus TL, Cornwell M, et al.: *Laparoscopic fundoplication failures: Patterns of failure and response to fundoplication revision*. Ann Surg, 1999; 230: 595-604.

9. Iqbal A, Awad Z, Simkins J, Shah R, Haider M, Salinas V, et al.: *Repair of 104 failed anti-reflux operations*. Ann Surg, 2006; 244: 42-51.

10. Furnée EJ, Draaisma WA, Broeders IA, Gooszen HG: *Surgical reintervention after failed antireflux surgery: A systematic review of the literature.* J Gastrointest Surg, 2009; 13: 1539-49.

11. Carbo AI, Kim RH, Gates T, D'Agostino HR: *Imaging findings of successful and failed fundoplication*. Radiographics, 2014; 34: 1873-84.

12. Fei L, Rossetti G, Allaria A, Conzo G, Sampaolo S, Moccia F, et al.: *Laparoscopic hiatal hernia repair. Is the mesh hiatoplasty justified?*. Ann Ital Chir, 2014; 85: 38-45.

13. Smith CD, McClusky DA, Rajad MA, Lederman AB, Hunter JG: *When fundoplication fails: redo?* Ann Surg, 2005; 241: 861-69.

14. Grover BT, Kothari SN: *Reoperative antireflux surgery*. Surg Clin North Am, 2015; 95: 629-40.

15. Safranek PM, Gifford CJ, Booth MI, Dehn TC: *Results of laparoscopic reoperation for failed antireflux surgery: does the indication for redo surgery affect the outcome?*. Dis Esophagus, 2007; 20: 341-45.

16. Braghetto I, Csendes A: *Failure After Fundoplication: re-Fundoplication? Is There A Room For Gastrectomy? In Which Clinical Scenaries?* Arq Bras Cir Dig, 2019; 32: 1440.

17. Kamolz T, Granderath FA, Bammer T, Pasiut M, Pointner R: *Dysphagia and quality of life after laparoscopic Nissen fundoplication in patients with and without prosthetic reinforcement of the hiatal crura*. Surg Endosc, 2002; 16: 572-77.

18. A Kiladze M, Giuashvili S, Kiladze M, Elgandashvili D: *A comparative study of laparoscopic and open Nissen fundoplication for GERD in Georgia*. Ann Ital Chir, 2014; 85: 551-55.

19. Celasin H, Genc V, Celik SU, Turkcapar AG: *Laparoscopic revision surgery for gastroesophageal reflux disease*. Medicine (Baltimore), 2017; 96: 5779.

20. Li J, Cheng T: *Mesh erosion after hiatal hernia repair: the tip of the iceberg?* Hernia, 2019; 23: 1243-252.

van Beek DB, Auyang ED, Soper NJ: *A comprehensive review of laparoscopic redo fundoplication*. Surg Endosc, 2011; 25: 706-12.

21. Al Hashmi AW, Pineton de Chambrun G, Souche R, Bertrand M, De Blasi V, Jacques E, et al.: *A retrospective multicenter analysis on redo-laparoscopic anti-reflux surgery: Conservative or conversion fundoplication?* Surg Endosc, 2019; 33: 243-51.

22. Awais O, Luketich JD, Schuchert MJ, Morse CR, Wilson J, Gooding WE: *Reoperative antireflux surgery for failed fundoplication: An analysis of outcomes in 275 patients*. Ann Thorac Surg, 2011; 92: 1083-89.

23. Deschamps C, Trastek VF, Allen MS, Pairolero PC, Johnson JO, Larson DR*: Long-term results after reoperation for failed antireflux procedures*. J Thorac Cardiovasc Surg, 1997; 113: 545-50.