

The Redo Antireflux Surgery after Failed Fundoplication

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Abstract

The redo antireflux surgery is an advanced surgical procedure which enclosed the following conventional steps: the takedown of the previous fundoplication, the repair of the hiatal defect, followed by the actual antireflux procedure. In reoperations, a great percentage of surgeons favour the short floppy Nissen, although partial fundoplications or gastrojejunostomies are also practiced. A shortened esophagus is usually one of several causes for the reflux reoccurrence, and requires either an extended periesophageal dissection, or a Collis gastroplasty. The surface of the hiatal defect, rather than its diameter, is the most important key for its reconstruction. A large number of repair variants have been introduced and tested, showing that the antireflux surgery is still awaiting an ideal prosthetic material, whereas details regarding tailoring, placement and suturing of current meshes are subjects of debate. The most frequent complication in the redo antireflux surgery is the gastric perforation, but it is also possible that pulmonary or cardiac failure, infections, or acute pancreatitis, may appear. Mortality is around 1% for this procedure with a success rate of 80% and the surgery has a mean duration of 3-4 hours even for experienced teams. Thus, due to its complexity and challenges, the redo antireflux surgery should be performed by an experienced team in a tertiary center to increase the favourable outcome.

Keywords: esophagus, fundoplication, gastroplasty, redo, reoperation

Introduction

The antireflux surgery for medical treatment of refractory gastroesophageal reflux disease (GERD) has a satisfactory outcome in up to 90% of patients. At least 10% will however experience recurrent reflux symptoms or dysphagia (Ferguson, 1997; Furnée *et al.*, 2009; Patti *et al.*, 2015). When medical treatment fails to relieve these symptoms, reoperation is recommended with reported rates varying between 6.9-15% (Zhou *et al.*, 2015; Richter, 2013).

An analysis of 3,175 reoperations (Furnée *et al.*, 2009) mentioned the following causes for redo-surgery after a failed fundoplication: recurrent reflux (41.7%), dysphagia (16.6%), recurrent reflux and dysphagia (4.0%), anatomical abnormalities (2.5%) and gas bloat syndrome (0.7%). The most frequent anatomical abnormalities representing the underlying causes of failure are: intrathoracic wrap migration (27.9%), wrap disruption (22.7%), telescoping (14.1%), para-esophageal hiatal herniation (6.1%), hiatal disruption (5.3%), a tight wrap (5.3%) and strictures (1.9%) (Furnée *et al.*, 2009).

The preoperative workup techniques are similar to those used in the patients undergoing evaluation for primary antireflux surgery.

Examining the patient at Ba-swallow together with an experienced radiologist's interpretation offers important information useful in selecting the appropriate surgical management. Different positions on the radiology table and selective pressure exerted on the abdomen are mandatory for a correct examination (Frantzides *et al.*, 2006).

According to data offered by upper gastrointestinal (GI) series, failed fundoplication may be classified into six types: tight Nissen, incompetent repair, disruption of the wrap, stomach slippage above the diaphragm, slipped Nissen, and transdiaphragmatic wrap herniation (Carbo *et al.*, 2014). Endoscopic application of radiopaque metal clips to mark the Z-line allows a precise visualization of the gastroesophageal junction area at the video contrast investigation (Barkhatov *et al.*, 2015).

Esophagogastroduodenoscopy should usually follow Ba-swallow, while manometry is mandatory in patients with dysphagia and abnormal findings at the upper GI

series. In addition, 24-hours pH monitoring is useful in diagnosing alkaline reflux (Barkhatov *et al.*, 2015).

The aim of the hereby extensive review of current relevant literature was to discuss the indications, techniques, complications and limitations of this surgery. After over twenty years of experience in the laparoscopic approach of GERD, reoperations for failed funduplications still represent a challenge. Based on the authors' expertise in open and laparoscopic redo operations, the most valuable ideas regarding surgical technique and procedure tactic were selected.

The procedure steps of redo antireflux surgery

The essential steps of redo antireflux surgery are: (1) removal of the previous fundoplication, (2) repair of the hiatal defect as needed, and (3) antireflux procedure (Mittal *et al.*, 2013).

Most redo operations for failed antireflux procedures are performed by laparoscopy in tertiary specialized centers.

Considering the fact that postoperative adhesions may be present even in areas remote to the trocar entry points of the previous operation, blind penetration of the abdominal wall with the Veress needle or the first trocar may injure an adherent viscus. The insertion position of the next trocars must be chosen carefully, considering the conditions of the initial fundoplication. A forceful retraction of the liver may tear adhesions on the inferior surface. The spleen is rarely at risk during adhesiolysis (Furnée *et al.*, 2009) but traction on the larger curvature should be made only after transecting adhesions on the spleen.

The hiatal dissection is usually started on the right crus and progression has to follow the correct plane keeping the perimysium on the muscle fibers. Whereas difficulties in delineating the esogastric junction been encountered, a lighted bougie may facilitate the identification of the esophagus. The introduction of this bougie should be done by endoscopy in order to avoid tearing the inferior oesophagus (Frantzides *et al.*, 2006).

Once the fundoplication is identified, anatomy can be restored by removing the stitches securing the wrap. The ultrasonic scissors are the most appropriate tool for this procedure as the thermal damage produced is minimal. If present, the short gastric vessels should be divided to allow the creation of a tension free plication. Together with the identification of the angle of Hiss, this procedure is essential for a correct fundus-to-fundus wrap (Frantzides *et al.*, 2006).

The type 1 esophageal dissection is limited to the last 4 cm of the organ if the necessary 2.5 centimetres of abdominal esophagus are obtained. In case of a short esophagus (SE) a type 3 transhiatal dissection may reach even the carina. If this action it's not enough as a lengthening procedure, a Collis gastroplasty will be instead performed (Puri *et al.*, 2013).

The hiatal defect is sutured and a mesh may be used in order to avoid hiatal disruption. The self-locking sutures might be helpful avoiding relaxation of the knots if tension is present. The figure-of-eight sutures are recommended by

some authors (Juhasz *et al.*, 2012) however, they may cause ischemia of the muscle fibers.

The calibration of the mesh must be loose enough to allow a 10 mm forceps to pass between the esophagus and the crura. Another variant consists in using an intraluminal 60-Fr bougie instead (Mittal *et al.*, 2013).

A prospective double-blind randomized control trial concluded that the anterior suturing of the hiatus is comparable in the short-term to that of the posterior type (Watson *et al.*, 2001). However, an interruption of the muscle fiber loop by the placement of anterior sutures seems to render the hiatal musculature less functional.

The fundoplication is performed using two or three stitches and most authors incorporate the esophagus with one of them. Some authors consider that this procedure might increase the risk for subsequent dysphagia (Frantzides *et al.*, 2006).

The gastropexy consisting in suturing the wrap to the right crus in order to avoid slippage should also be avoided as it is considered that these partner organs have independent motility (Frantzides *et al.*, 2006).

The challenges of the antireflux mechanism

The 360°-type short floppy Nissen fundoplication seems to be favoured in over 50% of reoperations. Partial fundoplication (Toupet, Dor – 21.8%) (Furnée *et al.*, 2009) is used when the patient is also diagnosed with an impaired esophageal motility (Livingston *et al.*, 2001). Several studies have demonstrated that total fundoplication is associated with a slightly better reflux control than partial wraps but is associated with a higher percentage of dysphagia (Shukri *et al.*, 2008).

The resection surgery is quite rare (7.1%) and has limited indications. Some examples include cases of severe esophagitis, Barrett's esophagus, peptic stricture of the esophagus, severely disturbed esophageal motility or a short esophagus. In a study of 202 reoperations, gastric resection was recommended to patients with alkaline reflux, dense adhesions on previously attempted refunduplications or those with severe gastric paresis (Furnée *et al.*, 2009).

In the case of delayed gastric emptying, a history of gagging or retching, a short esophagus especially with decreased motility, morbid obesity, a failed Collis gastroplasty, or a history of three or more failed previous antireflux surgeries, a Roux-en-Y loop (RNY) is indicated instead of fundoplication (Mittal *et al.*, 2013). The preferred method is a gastrojejunostomy (GJ) with a longitudinal pouch of 60-75 cm³. A redo-fundoplication (RF) on the proximal gastric stump may be performed; however, this is not necessary since the RNY is sufficient as an antireflux procedure. When the hyper acidity represents a concern, a near-esophagojejunostomy (EJ) with an extremely small gastric pouch of 5-10 ml capacity may serve as a better alternative (Makris *et al.*, 2009). The RNY esophagojejunostomy is also an alternative procedure in cases of esophageal strictures or irreparable damage to the cardia as a distal esophagectomy and a proximal gastrectomy are also necessary to be performed in these cases (Mittal *et al.*, 2013).

The standard RNY lengths are 20 cm for the biliary limb and 60 cm for the alimentary limb. A longer alimentary limb is usually recommended in obese patients. In open surgery, retrocolic placement is the standard method whereas antecolic placement is easier to perform in laparoscopic surgery (Mittal *et al.*, 2013). Closure of mesenteric defects is mandatory in order to avoid internal herniation.

A temporary gastrostomy is useful in maintaining the nutritional status of the patient along with providing a convenient route for the drug administration. An advantage of sparing the stomach is that a gastric tube remains available for use in esophagoplasty for those patients where a future esophagectomy might be necessary. On the other hand, an isolated distal stomach proves impossible to explore by endoscopic means (Shukri *et al.*, 2008; Mittal *et al.*, 2013).

The tertiary centers with expertise in redo-surgeries after failed funduplications have demonstrated that RNY offers similar results to RF (Mittal *et al.*, 2013; Grover and Kothari, 2015).

The challenges of the shortened oesophagus

The role of the shortened esophagus (SE) in the reoccurrence of GERD by mechanism of herniation, the plication slippage or the hiatal disruption, has been heavily debated over the past 50 years.

Esophageal shortening is triggered by inflammation secondary to acid reflux. Initially limited to the mucosa, it can gradually affect all layers of the esophagus. The variable degree of fibrosis may lead to retraction in a circular or longitudinal manner, thus causing either stenosis or shortening (Horvath *et al.*, 2000).

The frequency of esophageal shortening remains unclear as a very wide range of values from 0% to 60% are reported. Several authors described and introduced lengthening procedures in 57% of the cases (Nason *et al.*, 2011) whereas others deny the existence of the nonreducible esophagus (Madan *et al.*, 2004; Frantzides *et al.*, 2006).

Most of the studies originating in tertiary specialized centres describe a more balanced attitude, with only 10% of patients requiring transhiatal dissection and 5% requiring gastroplasty (Johnson *et al.*, 2000; Awad *et al.*, 2001). A tendency may result from the fact that these units concentrate more difficult cases which are referred from the surrounding, less specialized hospitals. On the other hand the availability of new generation laparoscopic suturing devices may favour the use of gastroplasty techniques, thus raising the percentage of lengthening procedures currently performed.

The preoperative examinations of patients with a suspicion of a short esophagus are similar to those for GERD (Kunio *et al.*, 2015). Preoperative indicators of a short esophagus are: a history of previously failed antireflux surgery, a gastroesophageal junction more than 5 cm above the diaphragmatic hiatus, a large type I or type III hiatal hernia, severe esophagitis, a distal esophagus with hypoperistalsis or aperistalsis, peptic stricture or metaplastic changes (Horvath *et al.*, 2000).

Even in the presence of all these factors, a preoperative diagnosis of a true short esophagus cannot be assured, and an objective diagnosis of a SE is made intraoperatively following adequate mediastinal mobilization; therefore, the surgical team must be prepared for the necessity of a lengthening procedure.

A short esophagus is defined on Ba-swallow by a gastro esophageal junction (GEJ) located superior to the diaphragmatic hiatus. It can be classified into three types: an apparent short esophagus, a true but reducible short esophagus and a true, nonreducible short esophagus (Horvath *et al.*, 2000). For the first type, a standard esophageal dissection of the distal 4 cm is enough in achieving the minimum 2.5 cm length needed for the intraabdominal esophagus. For the second type a periesophageal dissection, ascending to the level of the carina is necessary in order to obtain the minimum length. In case of a true, nonreducible short esophagus, even a high reaching, intramediastinal dissection proves unable to achieve the desired minimum length, thus a gastroplasty becomes mandatory (Kohn *et al.*, 2013).

The surgical treatment of a SE is oriented towards lengthening procedures consisting of either an extended periesophageal dissection or a Collis procedure. The esophagectomy is seldom applied. Intrathoracic fundoplication as an alternative procedure should be avoided due to a high rate of complications (strangulation, perforation, ulceration, bleeding) as well as a precarious quality of life for the patient (epigastric or chest pain, dysphagia) (Horvath *et al.*, 2000). An interesting lengthening procedure consisting of a complete circular myotomy just below the level of the aortic arch, in combination with a Belsey Mark IV anti-reflux repair has yielded promising results in a small scale study (Allen and Matthews, 1993).

Prior to the advent of videolaparoscopy, high periesophageal dissection was performed by thoracotomy with the esophagus being mobilized to the level of the aortic arch. This procedure was favoured since a safely performed transhiatal dissection could not reach high enough. Currently the dissection is performed via thoracoscopy as a preservation of a tradition linked to the thoracic approach (Juhasz *et al.*, 2010). However, most surgeons nowadays favour the laparoscopic transhiatal access instead. Still, the presence of massive morbid obesity, multiple prior foregut operations, extremely foreshortened esophagus, and massive herniation of multiple abdominal viscera generally indicate a thoracotomy as the initial approach (Puri *et al.*, 2013). The use of a plastic sling passed under the GEJ is quite useful in exposing the area during dissection but bears the risk of excessive traction (Bjelović *et al.*, 2014). This would lead to an apparent gain in length by elongating the esophagus as a result of its elasticity. A simple check consists in releasing any tension on the organ before measuring the intra-abdominal segment. Misidentification of the proximal stomach with the esophagus is caused by the insufficient resection of the hernial sac and fat pad (Whitson *et al.*, 2006) and may favour an incorrect placement of the fundoplication around the upper gastric pole.

The Collis gastroplasty is considered an alternative procedure if a high periesophageal dissection fails to provide the required minimum 2.5 cm of intraabdominal esophagus. Pearson was the first who combined the Belsey plication with a Collis procedure (Pearson *et al.*, 1971) and later reported excellent results with this method.

In 1996, Swanstrom and his team (Swanstrom *et al.*, 1996) were the first who described a combined laparoscopic and thoracoscopic approach for a Collis-Nissen procedure. After the transection of the short gastric vessels, the fundus must be completely mobilized in order to allow transhiatal access of the stapling device on the stomach which is rotated in an anterior direction. The first thoracic trocar must be placed following the usual precautions required when pleural adhesions may be present. A selective intubation is usually not necessary as a low insufflation pressure collapses the right lung. An articulating stapler provides the surgeon more freedom in choosing the thoracic entry point for the 12 mm trocar. Otherwise, in order to obtain an appropriate angle, the trocar must be placed high on the midaxillary line. Two operative telescopes allow a safer penetration through the mediastinal pleura. A calibrating bougie of 48-54 Fr pushed close to the lesser curvature is mandatory. A 30 mm blue cartridge should be used as the gastric wall is thin at this level. The suture line must be checked for haemorrhage on both sides. The distention caused by the bougie may impair the bleeding so the line on the neoesophagus should be checked again after removing the bougie. Overseeing the suture line is not necessary. During the completion of a Nissen fundoplication, the excessive traction on the suture line should be avoided.

Johnson and Hunter (Johnson *et al.*, 1996) have developed a totally laparoscopic approach resembling a vertically banded gastroplasty. After a standard preparation of the fundus, a circular stapler is fired at an appropriate distance to the lesser curvature and the Hiss angle. The breach obtained allows the passage of an Endo-GIA stapling device which will be positioned parallel to the lesser curvature, ascending to the Hiss angle.

A Collis variant in which the neoesophagus is obtained by performing a wedge resection of the fundus uses two or three firings of the articulated Endo-GIA. The first starts from the larger curvature, the second continues towards the lesser curvature and the last reaches the Hiss angle (Whitson *et al.*, 2006; Puri *et al.*, 2013).

The uncut Collis-Nissen gastroplasty has an acceptable morbidity and excellent short and long-term results (Trastek, 1995).

The long-term complications encountered after a Collis gastroplasty include: the distal esophageal aperistalsis with dilatation and dysphagia. The persistence of acid-producing gastric mucosa above the wrap may cause heartburn and asymptomatic recurrence (Jobe *et al.*, 1998; Puri *et al.*, 2013).

The challenges of the hiatal defect

Even before the first published studies regarding the complications of esophageal erosions due to prosthetic

materials were conducted, the presence of mesh used in hiatoplasties raised worries. Large unicentric studies reported few or even no mesh-related complications (Granderath *et al.*, 2003; Juhasz *et al.*, 2010). However, observations suggest that complications from synthetic mesh placed in this location may be more common than previously thought. Regardless the tailoring of the mesh, complications sometimes simply arise. The heart-shaped, the keyhole or the horseshoe meshes have all been described in cases in which erosions, stenosis or dense fibrosis have occurred.

In cases where crural approximation is difficult, mesh may be used as a bridge or as an interposition (Kohn *et al.*, 2013) however, both methods still produce the above mentioned complications (Stadlhuber *et al.*, 2009).

Non-absorbable sutures used to secure the mesh are safer than staples which are prone to causing complications by penetrating the diaphragmatic vessels. Teflon pledgets may be used in order to avoid sutures cutting through the muscle fibers; esophageal erosions tend to occur as a complication, however without clinical consequences (Juhasz *et al.*, 2010).

Although the distance of the mesh edges from the esophagus is potentially an important aspect to consider, most of the available studies fail to mention or provide precise data regarding this. A possible mechanism in which the edge of the mesh slowly cuts the esophagus if applied too close it has been described. The shrinkage, the migration or strong diaphragmatic contractions may produce the same effect even in correctly applied meshes (Stadlhuber *et al.*, 2009).

All the types of mesh, whether synthetic (polypropylene, polytetrafluoroethylene, dual) or biological may lead to complications (Stadlhuber *et al.*, 2009). The sterilized human dermal collagen allows spontaneous closure of small fistulae, provokes minimal fibrosis thus strictures, dysphagia or adhesions are seldom observed (Ringley *et al.*, 2006; Bell *et al.*, 2013).

The most frequent symptoms associated with mesh complications are dysphagia, heartburn, and chest pain. Fever, epigastric pain and weight loss can also be encountered (Stadlhuber *et al.*, 2009).

Regarding the surgical tactic, if mesh complications require a distal esophagectomy, RNY esophagectomy seems to be the favoured surgical approach. If the upper gastric pole is resected as well, the distal stomach may be left in situ (Juhasz *et al.*, 2010).

Although the routine mesh use is encouraged by some authors (Johnson *et al.*, 2006), a more balanced attitude recommends bioprosthesis usage in the hiatal disruptions, large paraesophageal hernias or tearing at crus closure (Frantzides *et al.*, 2006; Juhasz *et al.*, 2010).

The guidelines for the minimal dimension of the hiatus requiring a mesh repair should consider the hiatal surface more than its maximal diameter (Kohn *et al.*, 2013). An autologous graft with fascia lata may offer the ideal solution. The available data is promising, but results on a larger scale have yet to confirm these initial good results (Bjelović *et al.*, 2014).

Although the details regarding tailoring, placement and suturing of the current available materials remain

largely debated, ideal prosthetic material used in antireflux surgery has yet to be discovered.

The conversion rate from laparoscopic to open surgery is low for experienced teams (1.4-8.7%) and is mostly attributed to dense adhesions, severe intraoperative bleeding or poor visualization of the surgical field (Frantzides *et al.*, 2006; Furnée *et al.*, 2009).

The gastric perforation is the most frequent intraoperative complication and can be treated through laparoscopic surgery, although the use of mesh is contraindicated due to possible bacterial contamination (Frantzides *et al.*, 2006).

The redo-antireflux surgery has a mean duration of 3-4 hours even for experienced teams (Furnée *et al.*, 2009; Juhasz *et al.*, 2010) with postoperative mortality rates approximately around 1% (Furnée *et al.*, 2009).

Infectious, pulmonary, cardiac complications or acute pancreatitis can affect up to 15% of the patients (Hughes *et al.*, 1999). Symptomatic outcome after reoperation is reported as successful in up to 80% of patients (Awad *et al.*, 2001; Furnée *et al.*, 2009; Dallemagne *et al.*, 2011).

Conclusions

The redo-antireflux surgery has a higher morbidity and mortality rate than primary antireflux surgery. A correct preoperative assessment of the patient, along with the presence of adhesions, shortening of the esophagus and an enlarged hiatus are the main issues which must be solved. An increased effort in collecting prospective data could lead to better technical and tactical solutions.

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