Side Effects of Fundoplications and How to Deal with Them

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Introduction

The results of the surgery of gastro-esophageal reflux are irrefutable. Multiple clinical studies have shown its effectiveness to control pathological gastro-esophageal reflux. Comparisons with a suitable medical treatment regularly demonstrated its superiority and even, in the less favorable studies, its equivalence [1–4]. If surgery is effective in controlling reflux, it nevertheless generates side effects that are reported by a majority of the patients [5–8]. Typically, these side effects are dysphagia, to varying degrees, a difficulty or inability to belch and, in corollary, a tendency to abdominal bloating and flatulence. They have a mechanical origin, related to a hyper-competence of the antireflux barrier. To reduce them, changes to the architecture of the valve have been proposed, from a completely circular valve to varying degrees of partial valves [9]. The importance and impact of the side effects on the quality of life of patients depend on proper selection of patients, technical quality of the surgical procedure, and on the physiological principles of antireflux procedures. They are generally more severe in the immediate postoperative course and decrease in the long course, either because the antireflux mechanism weakens, or because of addiction or adaptation of the body of the patient, or by a phenomenon of psychological habituation [6, 10]. Nevertheless they can be extremely disabling in some patients, and can pose therapeutic problems. In general, the management strategy will be either conservative management, endoscopy, or further. The most appropriate strategy varies according to the individual patient and the particular problem, and for this reason it must be tailored to the specific situation.

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Antireflux Barrier and Fundoplication

The antireflux barrier corresponds to the Gastro-Esophageal Junction (GEJ), which is a complex anatomical zone whose functionality is dependent on the intrinsic lower esophageal sphincter (LES), the muscles of the diaphragm (extrinsic), the integrity of the phreno-esophageal ligament and the persistence of the angle of His (gastric flap valve).

Current understanding of gastroesophageal reflux makes a distinction between LES relaxation and GEJ opening, the latter being essential for reflux to occur [11]. The opening of the GEJ when swallowing, or during TLESR episodes, is the result of relaxation of the LES (internal component) and focal inhibition of the pillars of the diaphragm during inspiration (external component) [12, 13]. This results in a significant reduction of the intraluminal GEJ pressure. In addition to relaxation, there is a proximal migration of the GEJ, more important during TLESR than swallowing [11, 14]. The proximal movement may be a means by which the gastric flap valve is overcome and the GEJ lumen opens in order to allow the air to escape. Studies have shown that most episodes of belching occurred during TLESRs [15].

Reduction of hiatus hernia and re-approximation of the diaphragmatic pillars, restoration of intra-abdominal length of the esophagus, re-creation of the flap valve of the esophagus, mechanical compression of the esophagus can, either isolated or combined, lead to an increased pressure at the level of the GEJ, a decreased incidence of transient lower esophageal sphincter relaxations and incomplete GEJ relaxation on swallowing or during transient sphincter relaxation, which are the hypothetical mechanisms of efficacy of a fundoplication [16–18].

With regard to the effect of fundoplication on LES pressure and relaxation, there are conflicting data about whether it increases basal LES pressure by exerting a mechanical compressive effect on the LES [19, 20]. Jiang et al. did not find any significant change in basal LES pressure after fundoplication in an animal model and concluded that the effects of fundoplication were not related to the compressive effects of surgical

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wrap [21]. Fundoplication reduces cranial displacement and relaxation of the LES in response to axial stretch and vagal nerve stimulation [19]. Diminution of cranial displacement of LES after fundoplication surgery was also reported by Kahrilas et al. [21]. They suggest also that the major contribution in terms of pressure is provided by the re-calibration of the hiatal opening and the restoration of the contact of the diaphragmatic pillars with the GEJ, the fundoplication essentially ensuring the length of the subdiaphragmatic zone of high-pressure [22]. The effect of the cruroplasty adds to the repositioning and the strengthening of the lower esophageal sphincter by the fundoplication. These concepts are important because they explain the variability of the results obtained by different operators, which close more or less the hiatal opening and create valves of variable length [23].

More recently, a new technology based on impedance planimetry allows to study the dynamics of the GEJ, and in particular its distensibility [24]. Years ago, Harris et al. identified that sphincters do not necessarily need to contract tightly to be competent, and their work suggested that resistance to distension by measurement of radial force should be the prime determinant of sphincteric strength [25]. This parameter appears more appropriate than the simple measures of intraluminal pressure, as it is provided by manometry, and takes into account the Cross Sectional Area of opening of the junction in response to intraluminal controlled parameters of distension. This allows measuring the resistance to the opening of the junction and better reflects the physiological reality. Kwiatek et al. have demonstrated, using this technology, that the less distensible zone of the GEJ is the hiatal orifice, in healthy individuals and after fundoplication, that the distensibility of the hiatus was significantly higher during the post-deglutition relaxation, but was reduced after fundoplication, and that, after fundoplication, patients have a more reduced distensible segment than controls [26]. These results confirm the data of post-operative manometry showing a reduction in the capacity of relaxation of the high pressure zone after surgery [16, 27–29].

Dysphagia

Dysphagia is a common side effect of fundoplication, reported between 10 and 90 %, to varying degrees, for which there may be several reasons [30, 31]. The two components of the GEJ competency and distensibility, the diaphragm and the lower esophageal sphincter, are modified during fundoplication, and may, alone or in a combined manner, modify the flow through the GEJ. This increased resistance at the GEJ is inevitable and usually the esophagus adapts its propulsive power, provided that it has sufficient reserves [27–29, 32–34].

The relationship between GEJ transit and symptoms of dysphagia is still incompletely understood. Theoretically, GEJ transit depends on several mechanical parameters including viscosity of the bolus, the pressure gradient across the GEJ, and the resistance to flow across the GEJ. GEJ transit after fundoplication is associated with an elevated intrabolus pressure. This pressure, built up during the time between arrival of the front of the bolus at the GEJ and the actual opening of the GEJ, is required to physically open the GEJ during swallow induced LES relaxation. Scheiffer et al. reported that postoperative dysphagia scores do not relate to manometric parameters but are related to the transit time of both liquid and solid boluses across the GEJ [35]. The reduced GEJ transit efficacy is due to the increased outflow resistance evident from the narrowed and elongated hiatal passage likely due to a reduced GEJ compliance limiting GEJ opening. Common factors of GEJ transit in several studies are impaired GEJ relaxation [27, 36] and minimal diameter of opening of the GEJ [37, 38]. Recent studies of the distensibility of the GEJ with impedance planimetry showed that the least distensible locus (narrowest cross-sectional area) within the GEJ was consistently found at the hiatus in patients who have had Nissen fundoplication [26, 35]. These findings emphasize the importance of the functional balance between intrinsic and extrinsic contractile components of the GEJ in modulating trans-sphincter flow—a balance that is difficult to normalize with surgery. A reduction in the prevalence of dysphagia after fundoplication has been achieved through modifications to operative technique [23, 39, 40].

Too tight a crural repair, too tight or twisted a fundoplication, too long a valve, cause dysphagia. In addition, a malposition or a displacement of the valve of fundoplication (slippage) can lead also to dysphagia. This anomaly is usually associated with recurrent reflux as one of the components of the GEJ, the LES, is not or is no more corrected.

Management

Acute Postoperative Dysphagia

In a small number of patients acute dysphagia occurs in the first 1–2 days following surgery and should be distinguished from the usual postoperative dysphagia experienced by most patients. A swallow X-ray should be performed. If the exam shows contrast passing into the stomach, albeit slowly, and a correct sub-diaphragmatic position of the antireflux valve and stomach, a conservative approach can usually be followed, and swallowing will usually improve over the ensuing few days (see Fig. 23.1).

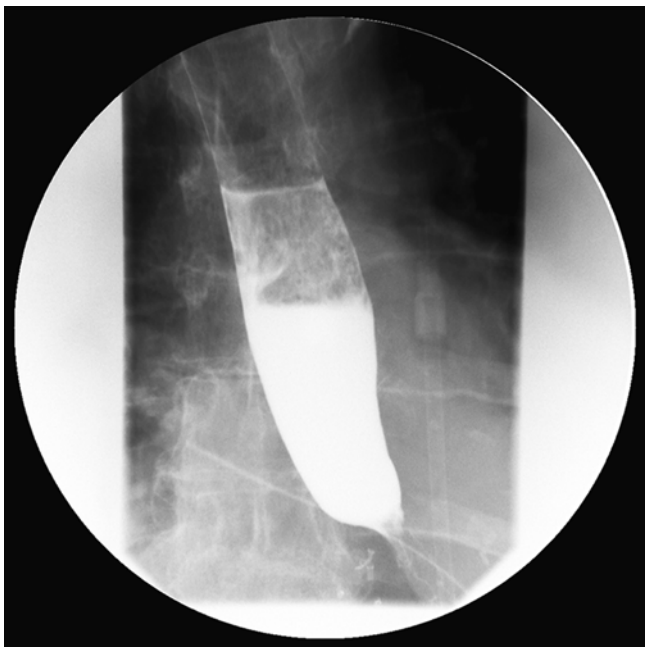

Fig. 23.1 Steroids can possibly accelerate recovery. However, if no contrast passes into the stomach, urgent intervention is necessary. The choice of method is between endoscopy and dilatation versus surgery. In some patients endoscopy and the passage of a large (17 mm or larger) Savary type bougie over a guide wire is followed by improved swallowing, and further intervention is not needed. However, if this fails, it is usually straightforward to undertake a further laparoscopic procedure within the first post-operative week

Persistent Dysphagia

Although dysphagia occurs in all patients in the early postoperative period following fundoplication, the majority of patients are able to swallow normally at late follow-up. A small number of patients experience dysphagia which is persistent and sufficiently severe to require further operative intervention.

Our attitude is to carefully monitor patients during the first 3 months, with a careful evaluation of the evolution of dysphagia and weight monitoring. Endoscopic dilation is proposed in the case of severe grade dysphagia. It is repeated in the case of partial response. Persists of dilatation, dysphagia recurs quickly, a new radiological assessment is carried out looking for any expansion of the lower esophagus, and persisting narrowing of the GEJ, which testifies to the importance of the obstacle to the evacuation. If this is the case, a re-intervention is programmed. The most common causes of this complication are a tight closure of the pillars of the diaphragm, or a too-tight valve. If there is no sign of suffering of the esophagus and the state of nutrition is maintained, the conservative attitude can be continued on the basis of the importance of discomfort described by the patient. A fairly common cause of this persistent dysphagia, without worrying radiological sign, is the "twisted" fundoplication. This technical error is usually associated with the technique of Nissen without mobilization of gastric fundus and consists in a phenomenon of rotation (twist) of the esophagus on its axis, caused by a tension of the gastric fundus. Response to dilatation is usually very low, and reoperation is habitually necessary.

Late Onset Dysphagia

The later onset of dysphagia in the postoperative course is usually caused by an anatomical change of the antireflux mechanism, the valve and/or the cruroplasty. Usually these anatomical abnormalities are easily detected by radiology or endoscopy. Intrathoracic migration of the valve, slippage of the valve on the stomach, diaphragmatic fibrosis and paraesophageal hernia are the most common causes, and all can be corrected only by a surgical approach [41–44].

Postoperative Gas-Related Symptoms

The normal mechanism of ventilation of the stomach occurs mainly during transient relaxations of LES, not associated with swallowing. They are caused by gastric distension which provokes a vagovagal reflex leading to a steep drop in the pressure of the LES [45]. Concomitantly, coordinated events inhibit the contraction of the pillars of the diaphragm and cause a longitudinal contraction of the esophagus and aboral displacement of the LES. This mechanism may overcome the gastric valve effect and allow draining air through the GEJ. Fundoplication, essentially ensuring the length of the subdiaphragmatic zone of high-pressure, reduces cranial displacement and relaxation of the LES in response to axial stretch and vagal nerve stimulation [19], thereby air venting. Both partial and 360° fundoplication alter the belching pattern by reducing gastric belches and increasing supra-gastric belches [46]. The first serve to vent ingested air from the stomach, whereas the latter are esophageal belches that do not allow air ventilation from the stomach. Consequently, fundoplication reduces air venting, which causes gas-related symptoms. Postoperative gas-related symptoms are demonstrated to be common after fundoplication.

The so-called gas bloat syndrome is characterized by abdominal bloating, epigastric pain, and difficulty belching. Frequent bowel movements and excessive flatus may be related symptoms. In the long-term, decreased belching ability, increased rectal flatulence and bloating were reported by up to 70, 95.5, and 79.2 % patients, respectively [47]. However, there is a very high variability in the definition and how to quantify this problem. In addition, incidence of post-fundoplication symptoms should be compared with the

preoperative incidence of the same symptoms. "Wind-related" symptoms may appear, improve or disappear following laparoscopic fundoplication, confirming that some of these symptoms are part of the spectrum of reflux symptomatology [48–51]. In a recent randomized trial comparing Nissen fundoplication and medical therapy, bloating and flatulence were reported by 40 vs 28 %, and 57 vs 40 %, respectively [52]. In a similar randomized trial, heartburn, regurgitation, and belching were reported less frequently in the group randomized to surgery than among those randomized to medication, with no significant differences in 'difficulty swallowing,' 'wind from the bowel,' and nausea [51]. Moreover, some patients with gastro-esophageal reflux develop the habit of air-swallowing [48]. This entails subconscious repetitive swallowing, presumably in response to the regurgitation of gastric content into the esophagus. Long-term sequential follow-up study demonstrated a significant reduction in the incidence of dysphagia and flatulence, in contrast to the results for abdominal bloating [6]. There was no significant difference in the incidence of side effects between partial and total fundoplication [6, 53].

Some authors suggest that the relative risk of one of these problems occurring is in part determined by the type of fundoplication performed. The incidence of these side effects are discordant, some reporting lower rates for partial fundoplication, others reporting similar rates [6, 40, 46, 54]. The rates of inability to belch (7.8 vs. 15.7 %) and gas bloating (22.5 vs. 35.9 %) by a recent meta-analysis comparing 270° and 360° fundoplication [40, 55] and the prevalence of increased flatulence were also similar to the results of the only randomized trial that compared increased flatulence after 270° and 360° LPF (67.2 vs. 74.6 %) [47]. Long-term follow-up of partial anterior vs Nissen did not demonstrate any difference after 10–15 years [6, 56].

Despite this disparity in reports, the treatment of "wind-related" side effects, when troublesome for the patient, is difficult. Implementing changes in diet and allowing sufficient time for "wind-related" symptoms to improve will result in a satisfactory outcome in many patients.

There are few published reports describing the outcome of endoscopic or surgical revision primarily for troublesome "wind-related" side effects. Indication for surgical redo is considered in 4–5 % of patients [42, 57]. Conversion to a lesser degree of fundoplication was associated with a good outcome in the small numbers of patients in one study [58]. These results were not confirmed in others reports [44, 59].

Other Side Effects

Early satiety, nausea, vomiting and bloating and diarrhea are recognized side effects of anti-reflux surgery.

They can be part of the gas-bloat syndrome, resulting from the inability to vent gas from the stomach to the esophagus, they can also be caused by alterations in gastric emptying or result from vagal injury. Gastric emptying becomes normal or accelerated after surgery in the majority of patients with symptoms suggesting a delay in gastric emptying (20–40 % of patients with GERD) [60–62]. Yet, if severe, this delay may contribute to reflux or promote reflux disease and was identified as a factor for unsatisfactory results after anti-reflux surgery [63]. Some surgeons combine fundoplication with gastric drainage, commonly pyloroplasty, when pathological delayed gastric emptying has been objectified [64–66]. Postoperative gastroparesis can also be caused by eso-gastric surgery (19 %) and vagal damage [67]. Actual incidence of vagal damage after antireflux surgery is completely unknown [68]. Vagus dysfunction, measured indirectly by the response of plasma PP to insulin-induced hypoglycemia, has been identified in 10 % of patients after partial fundoplication, without impact on gastric emptying and symptomatology [60, 68]. The vast majority of patients show signs of gastroparesis during the first 3 to 6 months after surgery, in the form of early satiety, bloating, and flatulence. After 1 year, these symptoms have improved 90 % of the patients [69]. The finding of postoperative symptoms suggesting delayed gastric emptying among patients with antireflux operations followed for >1 year was usually associated with delayed gastric emptying pre-operatively [70]. The impact of vagal dysfunction/injury on the side effects can be extrapolated from the experience of reoperation after failed fundoplication/recurrent hiatal hernia. Indeed, redo procedures require extensive dissection at the gastroesophageal junction due to major anatomic disturbances and may lead to vagal nerve injury. In this particular context, delayed gastric emptying appears not as a significant complication [42, 57]. Moreover, uni- or bilateral vagotomy is performed by some surgeons to increase the length of the esophagus in case of short esophagus. No impact on gastric emptying was observed in a series of 150 patients operated for complex para-esophageal hernias and hiatal hernia recurrence [71].

The primary objectives in gastroparesis treatment are decreasing symptoms and improving nutrition. The severity of gastroparesis dictates management. Mild to moderate gastroparesis can be managed medically with dietary modifications, nutritional supplements, pro-motility agents, and anti-emetics.

A spasm of pylorus may be the cause of gastroparesis. Endoscopic treatment (dilatation balloon or intrasphincteric injection of botulinum toxin) can be discussed. Pneumatic dilation results remain uncertain. In addition, studies did not highlight clear therapeutic benefit of intrasphincteric injection of botulinum toxin [72]. Gastric electrical stimulation demonstrated significant subjective and objective improvement

up to 10 years after device placement in patients with severe gastroparesis [73].

Surgical indications remain exceptional. In major gastric stasis, with daily symptoms and important nutritional impact, a surgical treatment should be discussed only when all other options have failed. If the motor disorder is strictly limited to the stomach, partial or subtotal gastrectomy may be considered [74].

New onset diarrhea may occur in up to 33 % of post-fundoplication cases and is typically mild, low in volume, and worse after meals [75, 76]. The cause of post-fundoplication diarrhea is thought to be a result of vagal injury, small bowel bacterial overgrowth, rapid gastric emptying, and reduced gastric relaxation or exacerbation of underlying irritable bowel syndrome, and attributing diarrhea to a specific etiology can be quite difficult. Reports noted that as many as 33–66 % of patients who underwent antireflux surgery had pre-existing irritable bowel syndrome and stressed the value of obtaining a comprehensive preoperative gastrointestinal history in patients undergoing laparoscopic antireflux surgery [75, 77]. Diarrhea responds favorably to antimotility drugs, antibiotics for small bowel overgrowth, or cholestyramine [67]. Severe or uncontrollable diarrhea occurred in the minority of patients [78]. Surgical procedures should be reserved for patients presenting with complex clinical situations, mixing gas-bloating, altered gastric emptying or dumping syndrome, in whom medical treatment fails [77, 78].

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