

Intrathoracic Migration of the Wrap After Laparoscopic Nissen Fundoplication: Radiologic Evaluation

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OBJECTIVE. The purpose of our study was to evaluate the different types of postoperative herniation of the wrap into the thorax after laparoscopic Nissen fundoplication, to propose a clear radiologic definition, and to establish their respective frequencies.

SUBJECTS AND METHODS. Two hundred twenty-six consecutive patients who underwent laparoscopic Nissen fundoplication were studied prospectively. All patients underwent an upper gastrointestinal series before surgery and on the first postoperative day. Radiologic follow-up performed yearly after surgery in 148 patients (65%) consisted of a double-contrast upper gastrointestinal series. Intrathoracic migration of the wrap was diagnosed on radiography when the intact fundoplication wrap herniated partially or entirely through the esophageal hiatus of the diaphragm. The kappa statistic was used to assess inter-observer agreement.

RESULTS. Of the 148 upper gastrointestinal series, 44 intrathoracic migrations (30%) were diagnosed. These examinations were reviewed and allowed us to differentiate two types of migrations. Type I (31 patients) consists of a paraesophageal hernia of a portion of the wrap through the esophageal hiatus with the esogastric junction remaining below the diaphragm. Type II (13 patients) is diagnosed when the entire fundoplication herniates through the hiatus with the gastroesophageal junction located at or above the level of the diaphragm.

CONCLUSION. Intrathoracic migration is an important complication of laparoscopic Nissen fundoplication. Most migrations are small and asymptomatic. We propose a simple and reproducible radiologic definition of two different types of intrathoracic migration of the wrap observed after laparoscopic Nissen fundoplication.

The Nissen fundoplication is the most commonly performed surgical treatment for gastroesophageal reflux. After mobilizing the esophagus and reducing the hiatal hernia if one is present, the surgeon wraps the gastric fundus around the intraabdominal esophagus. A 360° fundoplication is performed to create an antireflux valve. Other authors prefer not to perform a complete fundoplication. For instance, in the Toupet procedure, a 270° posterior hemivalve is created with the anterior side of the fundus [1]. Since 1991, fundoplications are usually performed by laparoscopy. Surgical techniques of the laparoscopic fundoplications are similar to the equivalent open procedures. The laparoscopic approach limits trauma to the abdominal wall and, therefore, decreases the rate of postoperative morbidity [1]. Paraesophageal hernia has been reported as an important complication after open surgical Nissen fundoplication [2]. Another suggests increased frequency of this

complication with the laparoscopic approach [3]. However, the literature is unclear about hernias as postoperative complications of Nissen fundoplication. The purpose of our report is to clearly define the types of hernia of an intact wrap after laparoscopic Nissen fundoplication and to evaluate their frequency.

Subjects and Methods

Over a 5-year period, 226 consecutive patients underwent laparoscopic Nissen fundoplication at our institution. The surgical technique used for these laparoscopic fundoplications has been described previously [4] and was performed by the same surgeon mentioned in the article. Preoperative evaluation included double-contrast upper gastrointestinal studies in all patients to rule out hiatal hernia and peptic stricture. A standard and complete double-contrast technique had been performed in all patients. We used 120 mL of high-density barium, granular effervescent agent, and an IV injection of 20 mg of hyoscine butyl bromide (Buscopan; Boehringer Ingelheim, Berk-

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shire, United Kingdom). These examinations were performed on a digital fluoroscopy unit with the same magnification in all patients. The esophagus was first examined with the patient standing upright in a left posterior oblique position. The stomach and duodenum were examined with the patient in the recumbent position, including images of gastroesophageal junction in the right lateral and slightly prone oblique position. Patients with peptic strictures and short esophagi were not included in our series because these preoperative findings were considered contraindications for Nissen fundoplication [4]. On the first postoperative day, a single-contrast examination using water-soluble contrast agent, meglumine diatrizoate (100 mL of Gastrografin; Schering, Berlin, Germany), was also performed in all patients to exclude too tight fundoplication before the patient was discharged.

Radiologic follow-up consisted of double-contrast studies performed yearly after surgery in all patients except those who refused the examination. Therefore, radiographic follow-up was only available in 148 patients (65%). The studies performed as radiographic follow-up were exactly the same type as the preoperative double-contrast examinations. However, at the end of the examination, we always took an additional upright image in which patients were asked to swallow one mouthful of barium to obtain better opacification of the distal esophagus.

The study was approved by the ethical committee of our institution, and informed consent was obtained from all patients.

Examinations were interpreted by senior abdominal radiologists. Intrathoracic migration of the wrap was considered on gastrointestinal series when the intact fundoplication wrap herniated partially or entirely through the esophageal hiatus of the diaphragm. This situation must be differentiated from disruption of the wrap with recurrent hiatal hernia. The radiographs were analyzed independently by two experienced radiologists. The degree of agreement between observers in the interpretation of the gastrointestinal series to differentiate types of intrathoracic migration was assessed with the kappa statistic.

Results

One hundred four patients presented with the normal postoperative aspect of Nissen fundoplication (Fig. 1), and 44 (30%) were diagnosed with an intrathoracic migration of the wrap. The radiography charts of the 44 patients who developed an intrathoracic migration were reviewed and allowed us to differentiate two types of migration. Type I is defined as a paraesophageal herniation of a portion of the wrap through the esophageal hiatus with the distal esophagus remaining below the diaphragm (Fig. 2). Type II is a herniation of the entire fundoplication through the esophageal hiatus. In this second type, the gastroesophageal junction is located at the level of the diaphragm or above if the upper stomach also herniates after the wrap (Fig. 3). In our series of 44 intrathoracic migrations, 31 patients presented with type I and 13 with type II. In both types, the wrap itself remained intact, without disruption.

The gastrointestinal series were reviewed independently by two radiologists. Agreement between observers in the interpretation of the radiography charts to differentiate migrations of type I or II was good ($\kappa = 0.84$).

Hernia size greater than 5 cm was seen in only 12 (39%) of 31 type I but in 12 (92%) of 13 type II. Hernia size less than 2 cm or 2–5 cm was seen in two (6%) and 17 (55%) of 31 type I patients, respectively, and in zero (0%) and one (8%) of 13 type II patients, respectively.

Hiatal hernia was diagnosed on the preoperative gastrointestinal series in 37 (84%) of the 44 patients who developed intrathoracic migration of the wrap and in 83 (80%) of the 104 patients without postoperative migration. We conclude that the risk of development of intrathoracic migration is not linked

to the preoperative presence of hiatal hernia (chi-square test, $p = 0.705$).

Clinical manifestations of intrathoracic migration included discomfort after meals, retrosternal or epigastric pains, dysphagia, and vomiting. These symptoms were present in nine (29%) of the 31 patients with type I and in seven (54%) of the 13 patients with type II. Five patients required surgical revision: all five presented migration of type II.

Discussion

Gastroesophageal reflux can be treated medically in most patients. However, patients for whom medical treatment fails are indicated for surgery. The Nissen fundoplication is the most widely accepted and most commonly performed antireflux surgical procedure. It creates an antireflux valve by a 360° plication of the gastric fundus around the distal esophagus.

The normal postoperative appearance of Nissen fundoplication and its complications have been described in the radiology literature. The normal postoperative valve appears on upper gastrointestinal series like a pseudotumoral defect of the gastric fundus corresponding to the part of the fundus that is wrapped around the distal esophagus [5]. Postoperative complications include five radiologic findings: too tight fundoplication with narrowing of the distal esophagus and delayed emptying of contrast material into the stomach; complete breakdown of the fundoplication with recurrent hiatal hernia and gastroesophageal reflux; partial disruption of the wrap and fundal outpouchings; slippage of the distal esophagus and adjacent fundus through intact wrap because of suture breakdown between the esophageal wall and the wrap; herniation of an intact fundoplication through the diaphragmatic

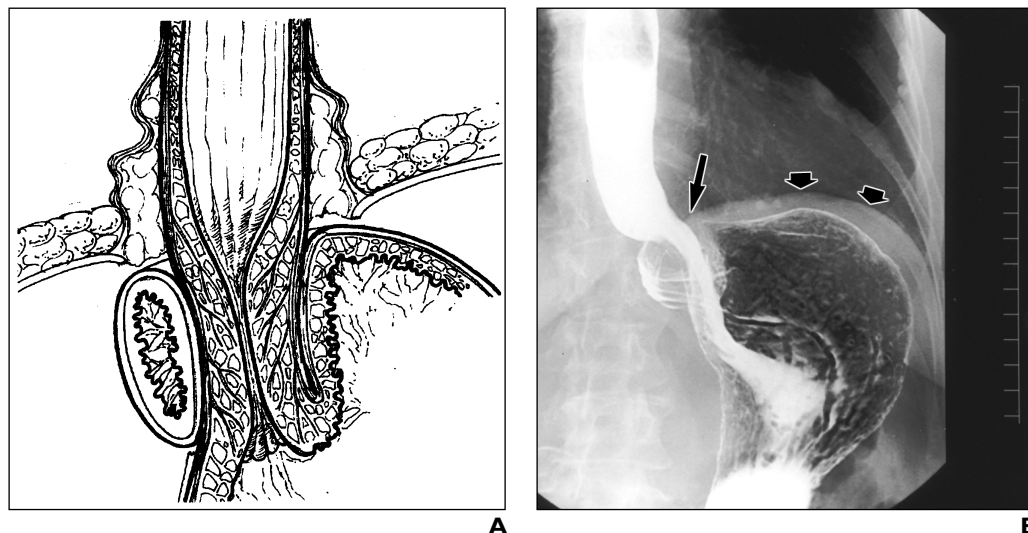
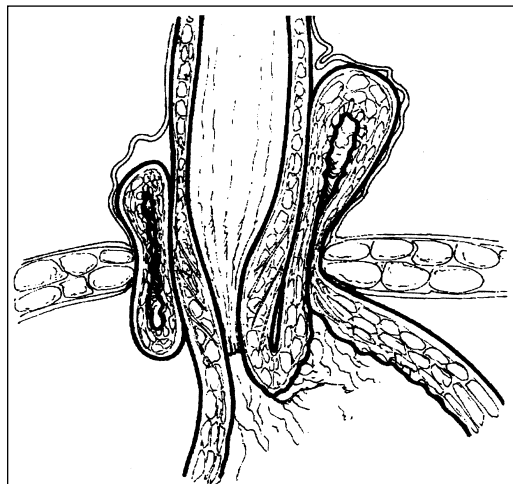


Fig. 1.—Normal laparoscopic Nissen fundoplication in 67-year-old woman. **A** and **B**, Diagram (**A**) and fluoroscopic upright frontal image (**B**) show normal postoperative appearance of Nissen fundoplication. Fundus is wrapped around lower esophagus. Wrap and gastroesophageal junction project entirely below diaphragm. Level of esophageal hiatus (long arrow, **B**) and diaphragm (short arrows, **B**) are indicated.

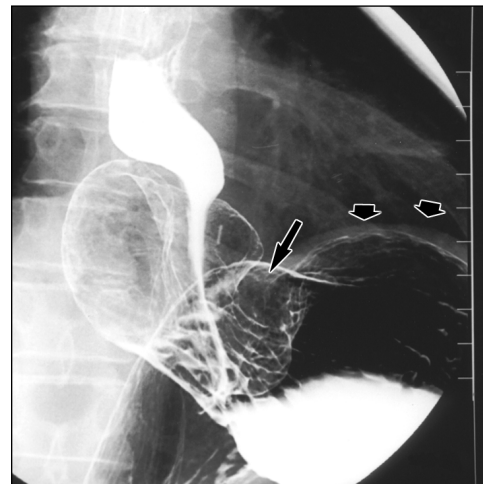
Migration of the Wrap After Laparoscopic Nissen Fundoplication

Fig. 2.—Type I intrathoracic migration of wrap in 54-year-old man.

A and B. Diagram (**A**) and fluoroscopic upright frontal image (**B**) show paraesophageal herniation of portion of wrap through esophageal hiatus. Distal esophagus remains below diaphragm. Levels of esophageal hiatus (*long arrow, B*) and diaphragm (*short arrows, B*) are indicated.



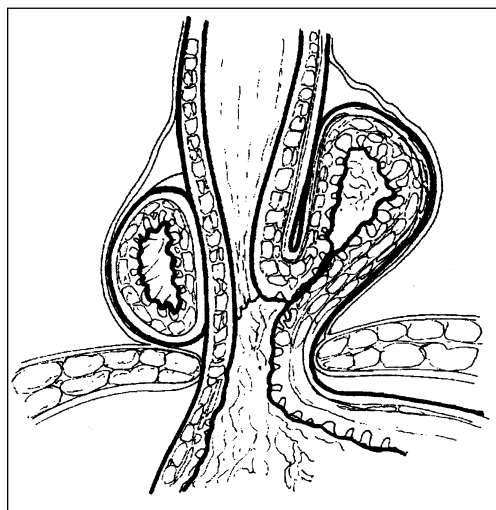
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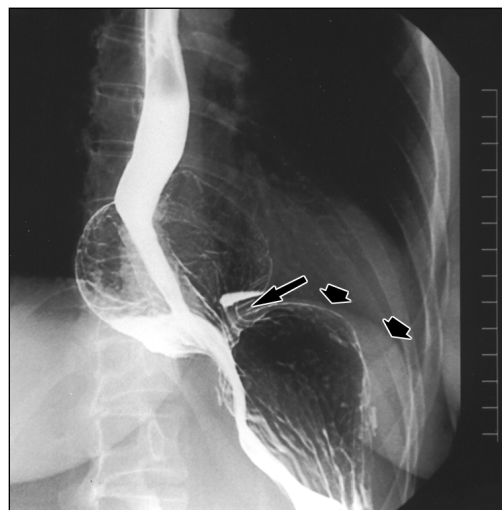
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Fig. 3.—Type II intrathoracic migration of wrap in 49-year-old man.

A and B. Diagram (**A**) and fluoroscopic upright slightly left posterior oblique image (**B**) show herniation of entire fundoplication through esophageal hiatus. Gastroesophageal junction is located at level of diaphragm. Levels of esophageal hiatus (*long arrow, B*) and diaphragm (*short arrows, B*) are indicated.



A



B

tion [6]. This last complication, which we have called intrathoracic migration of the wrap, is the subject of our study.

In 1973, Balison et al. [7] first reported herniation of the fundoplication into the thorax after transthoracic Nissen fundoplication. Alrabeeh et al. [2], in a pediatric study, found that 16% of the patients had postoperative paraesophageal hernia in an upper gastrointestinal series.

Laparoscopic Nissen fundoplication is now as safe and as effective as open surgery and is widely performed [1]. However, some complications might be peculiar to this procedure. Watson et al. [3] suggested that the incidence of paraesophageal hernia might be higher after a laparoscopic procedure than after open fundoplication. To clarify this question, we established a radiologic follow-up protocol, routinely performed after each laparoscopic Nissen fun-

doplication. The protocol consisted of an upper gastrointestinal series performed systematically on the first postoperative day and then yearly. This follow-up protocol was realized in all patients of our series, even asymptomatic patients except those who refused long-term follow-up evaluation. Intrathoracic migration of the wrap was found in 44 (30%) of 148 patients who underwent laparoscopic Nissen fundoplication and who accepted the radiologic follow-up.

Herniation of the Nissen fundoplication should be suspected in patients who present with dysphagia, nonspecific abdominal or chest pain, vomiting, or even symptoms of obstruction in gastric incarceration. However, this complication might be more frequent than that reported because most of the patients with this condition remain asymptomatic. In our series, only nine of the 31 patients with migra-

tion of type I and seven of the 13 patients with migration of type II presented clinical manifestations of varying intensity. In other words, 28 (64%) of the 44 patients with radiologically visualized intrathoracic migration did not present with clinical manifestations. In comparison, 79% of the patients without migration of the wrap did not have any clinical symptoms.

The incidence of this complication is higher after laparoscopic fundoplication than after an open procedure, for which a frequency of 9% has been reported [8]. There are several possible explanations: prompt mobilization of the patient due to less postoperative pain may induce inappropriate physical exercise that raises intraabdominal pressure during the first postoperative days. More extensive periesophageal dissection may occur than that during open fundoplication; lack of intraperi-

toneal postoperative adhesions may follow the laparoscopic approach [3].

The literature is sometimes unclear about the type of hernia seen as a complication of Nissen fundoplication, using indistinctly the term of paraesophageal hernia or herniation of the fundoplication. We propose to call intrathoracic migration of the wrap the herniation of an intact fundoplication wrap through the diaphragmatic hiatus. Like other authors, we have differentiated two types of intrathoracic migration of the wrap [9]. In both types, the wrap itself remained intact, without disruption. Type I, 70% of the migration in our series, consists of a paraesophageal hernia in which a portion of the wrap, usually the posterolateral aspect, herniates through the esophageal hiatus with the cardia remaining under the diaphragm. We found 30% of type II consisting of herniation of the entire fundoplication and even sometimes the upper stomach through the hiatus. In our experience, migration of type II leads to hernia of greater size and to more clinical manifestations. The five pa-

tients in our series who required repeated operations all presented with migration of type II.

In conclusion, intrathoracic migration of the wrap after laparoscopic Nissen fundoplication is an underreported complication because postoperative follow-up usually does not include barium studies. Double-contrast upper gastrointestinal series allowed us to differentiate two types of intrathoracic migration of the wrap. Type II, with the limitation of a small number of patients, seems to lead to more clinical manifestations and reoperations.

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