

Nissen fundoplication improves gastric motility in patients with delayed gastric emptying

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Abstract.

Background: Fundoplication hastens gastric emptying in pediatric patients with gastroesophageal reflux disease (GERD). However, among adult GERD patients with impaired gastric emptying, the degree of improvement offered by fundoplication and the value of pyloroplasty are less well defined. Therefore, we compared outcomes in GERD patients with delayed gastric emptying after fundoplication alone or fundoplication with pyloroplasty.

Methods: Of 616 consecutive GERD patients who submitted to primary fundoplication (601 laparoscopic) between October 1991 and October 1997, 82 underwent preoperative solid-phase nuclear gastric emptying analysis. Of these, 25 had delayed gastric emptying (half-time >100 min). Of 12 patients with emptying half-times between 100 and 150 min, one underwent pyloroplasty at the time of Nissen fundoplication. Of 13 patients with emptying half-times >150 min, 11 had pyloroplasty at the time of Nissen fundoplication. Patients were asked to use a 0 (“none”) to 4 (“incapacitating”) scale to describe the severity of their symptoms of heartburn, regurgitation, dysphagia, bloating and diarrhea preoperatively and at 6 weeks and 1 year postoperatively. Eight patients consented to a postoperative analysis of gastric emptying.

Results: One year after fundoplication, patients with delayed gastric emptying and controls reported a similar improvement in heartburn, regurgitation, and dysphagia, with no increase in undesirable side effects such as bloating and diarrhea. Among the patients with delayed gastric emptying who consented to undergo a repeat gastric emptying study after their operation, fundoplication alone provided a 38% improvement ($p < 0.05$) in gastric emptying, whereas fun-

doplication with pyloroplasty resulted in a 70% improvement in gastric emptying ($p < 0.05$).

Conclusion: Fundoplication improves gastric emptying. The addition of pyloroplasty results in even greater improvement and may have particular value for patients with severe gastric hypomotility.

Key words: Gastroesophageal reflux disease (GERD) — Gastric emptying — Fundoplication — Laparoscopy — Pyloroplasty — Gastroparesis

Nissen fundoplication is the most popular antireflux procedure for children and adults who suffer from symptomatic gastroesophageal reflux disease (GERD) that has proven refractory to medical therapy. Pediatric patients with delayed gastric emptying have been found to have higher failure rates after fundoplication than those with normal gastric emptying [1]. Although fundoplication hastens gastric emptying in pediatric GERD patients by reducing gastric volume [7, 8], the addition of pyloroplasty significantly improves their response rates [1, 2, 3, 4].

In the hypomotile adult stomach, fundoplication also improves gastric emptying [5, 8]. However, the magnitude of this effect and the role for pyloroplasty in this patient population are less well defined [6, 9]. Unresolved gastric dysmotility is associated with an increased incidence of postoperative symptoms after fundoplication [1, 5]. In addition, chronically increased intragastric pressures may predispose a fundoplication to disruption or cause severe gas bloat [3, 9]. More information is needed to stratify GERD patients likely to benefit from a gastric emptying procedure at the time of fundoplication.

Our aim was to clarify, subjectively and objectively, the policy of selective pyloroplasty for patients with delayed gastric emptying undergoing laparoscopic Nissen fundoplication for GERD.

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Table 1. Indications for gastric emptying analysis

Prominent regurgitation, nausea, vomiting
Diabetes
Recurrent aspiration
Retained food in the fasting stomach
Scleroderma
Previous fundoplication with new gastric symptoms
Pyloric channel scarring associated with peptic ulcer disease

Methods

This is a nonrandomized, nonprospective study. Between October 1991 and October 1997, we performed 616 fundoplication procedures for GERD (601 laparoscopic). Of these, 82 patients (13.3%) were referred for preoperative solid-phase nuclear gastric emptying analysis. The indications for gastric emptying analysis are listed in Table 1. Twenty-five patients (4.1%) (eight men, 17 women) suffered from delayed gastric emptying, defined as an emptying half-time >100 min. Normal ranges of gastric emptying in our hospital are listed in Table 2. The mean age of these patients was 44.2 years (range, 17–77). Barium swallow, esopagogastrroduodenoscopy, esophageal motility study, and 24-h ambulatory pH measurement were also performed preoperatively in all patients.

All 25 patients with well-documented GERD and delayed gastric emptying underwent fundoplication (24 laparoscopic Nissens, one open redo Nissen). Laparoscopic fundoplication was performed as previously described [6]. After greater curvature mobilization, a 2-cm 360° (Nissen) fundic wrap was fashioned around a 56- to 60-Fr esophageal dilator. Of 12 patients with gastric emptying half-times of 100–150 min, one underwent Heineke-Mikulicz pyloroplasty at the time of fundoplication because of prominent regurgitation in the face of nearly normal lower esophageal sphincter pressures. Of 13 patients with gastric emptying half-times >150 min, 11 underwent pyloroplasty at the time of fundoplication; two refused the operation because of concern for developing postoperative dumping syndrome and diarrhea. Pyloroplasty was accomplished through standard trocars using an electrocautery hook, ultrasonic scalpel, and interrupted 2-0 Neuroton sutures tied intracorporeally [10]. Methylene blue solution was infused through the nasogastric tube to verify that the closure was watertight. The nasogastric tube was removed the next day if a water-soluble contrast exam demonstrated no leak and prompt gastric emptying.

Patients were asked to use a five-point Likert scale to score all typical and atypical symptoms of GERD preoperatively and at 6 weeks and 1 year postoperatively (Table 3). For the purposes of this study, symptom scores for heartburn, regurgitation, dysphagia, bloating and diarrhea were specifically analyzed. Twenty-three patients with delayed gastric emptying and 504 controls completed preoperative symptom surveys. Fifteen patients with delayed gastric emptying and 343 controls had 1 year of follow-up.

Comparisons of pre- and postoperative symptom scores were performed using the Wilcoxon signed rank test. Comparisons of symptom scores in unmatched groups of patients were made using the Wilcoxon rank sum test.

A postoperative gastric emptying study was obtained in eight of 25 patients (32%). Comparison of pre- and postoperative gastric emptying times was performed using the paired samples *t*-test.

Results

Heartburn response to the operation was excellent (Fig. 1) among patients with delayed gastric emptying ($p < 0.01$) and those with normal gastric emptying ($p < 0.001$). Regurgitation improved dramatically (Fig. 2) in both groups (delayed gastric emptying $p < 0.05$; normal gastric emptying $p < 0.001$). Dysphagia also improved significantly (Fig. 3) (delayed gastric emptying $p < 0.01$; normal gastric emptying $p < 0.001$). Bloating and diarrhea remained unchanged in both groups ($p > 0.05$) after surgery (Figs. 4 and 5), although patients with delayed gastric emptying were more likely to report postoperative diarrhea than their peers in the control group ($p < 0.05$). Patients with delayed gastric emp-

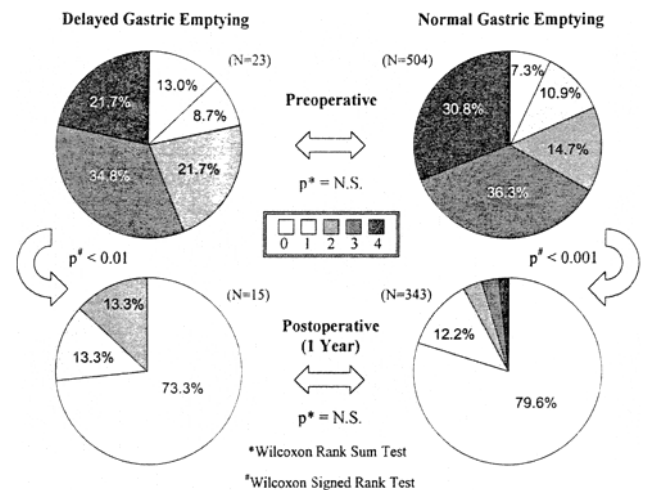
Table 2. Gastric emptying reference values (SD)

Type of patient	Time (min)
Premenopausal women	92.4 ± 15.0
Postmenopausal women	77.0 ± 32.0
Men	77.9 ± 32.0

Data expressed as mean ± 2 SD

Table 3. Symptom severity scores

Score	Degree of severity
0	None
1	Rare
2	Moderate
3	Severe
4	Incapacitating

**Fig. 1.** Comparison of pre- and postoperative heartburn severity scores reported by patients with normal and delayed gastric emptying.

tying who underwent fundoplication with pyloroplasty had pre- and postoperative symptom scores similar to those for patients who had fundoplication alone ($p > 0.05$). In particular, symptoms of rapid gastric emptying (diarrhea) or alkaline reflux gastritis (nausea, epigastric pain) were no more prevalent in patients after pyloroplasty than in those without pyloroplasty.

Gastric emptying half-times improved to the normal range in all eight patients studied postoperatively (Table 4). In patients who had fundoplication alone, there was a 38% improvement in emptying ($p < 0.05$). In patients who had both fundoplication and pyloroplasty, there was a 70% improvement ($p < 0.05$).

Discussion

Fundoplication diminishes the storage capacity of the gastric fundus and prevents the reflux of gastric contents. Repair of hiatal hernia eliminates food trapping above the diaphragmatic crura. These manipulations lead to a more rapid delivery of gastric contents to the antral pump, thus facili-

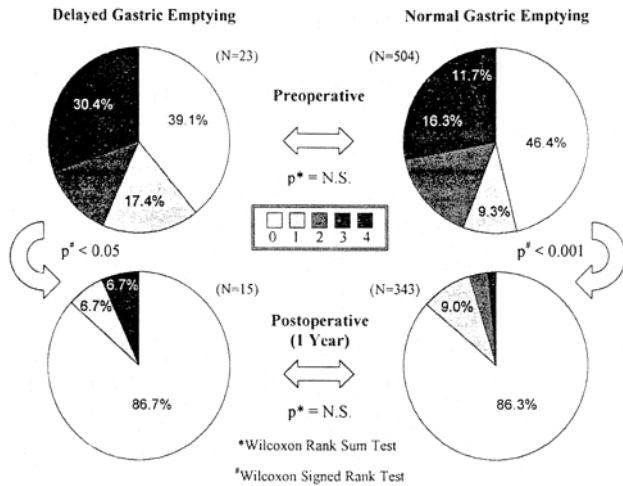


Fig. 2. Comparison of pre- and postoperative regurgitation severity scores reported by patients with normal and delayed gastric emptying.

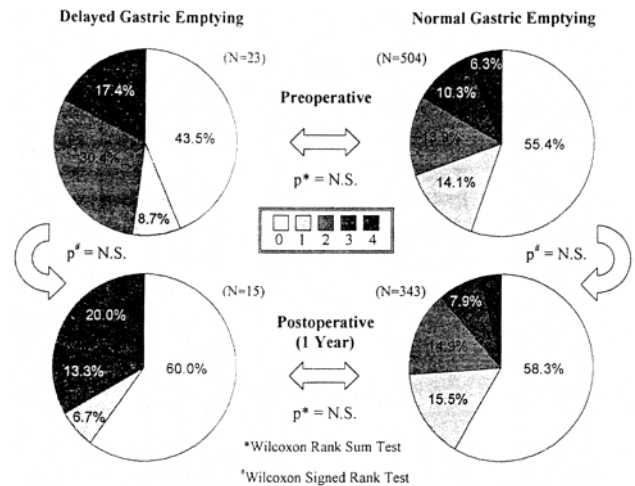


Fig. 4. Comparison of pre- and postoperative bloating severity scores reported by patients with normal and delayed gastric emptying.

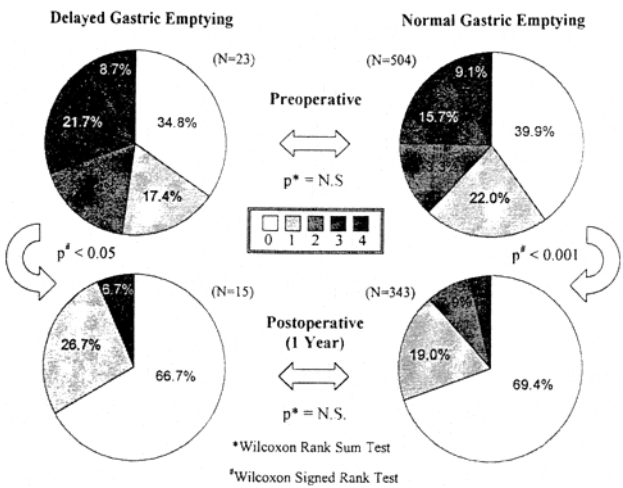


Fig. 3. Comparison of pre- and postoperative dysphagia severity scores reported by patients with normal and delayed gastric emptying.

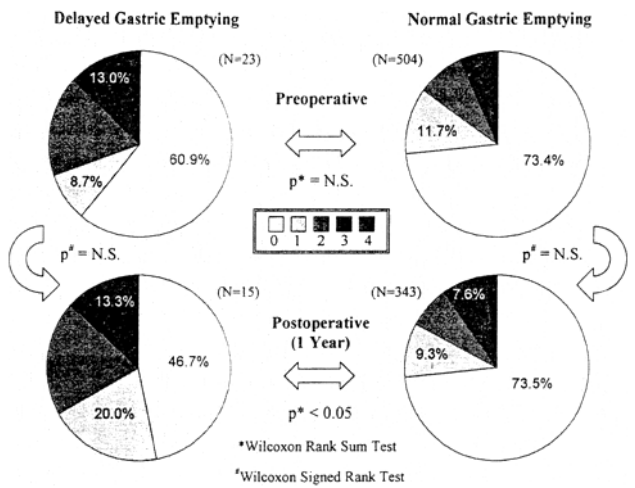


Fig. 5. Comparison of pre- and postoperative diarrhea severity scores reported by patients with normal and delayed gastric emptying.

tating gastric emptying. The addition of pyloroplasty lessens outflow resistance and thereby independently promotes gastric emptying.

For the most part, patients who were found to have mildly delayed gastric emptying (half-times between 100 and 150 min) underwent fundoplication alone, which led to the normalization of gastric emptying. Conversely, most patients with moderate to severe gastric dysmotility (emptying half-time >150 min) had fundoplication with pyloroplasty, leading to a greater improvement in transit time than that observed in patients who had fundoplication alone. Our decision to use a gastric emptying half-time of 150 min as the threshold for pyloroplasty was arbitrary, but the emptying improvement that we observed suggests that this threshold is appropriate.

It has been suggested that pyloroplasty may cause excessive risk of postoperative dumping when combined with fundoplication [11, 12]. Although fundoplication alone, or fundoplication with pyloroplasty, did not result in a worsening of the symptoms typically attributed to dumping (bloating and diarrhea) in our series, patients with delayed

Table 4. Gastric emptying half-times (mean ± SD) in patients with gastric emptying delay

	PREOP (min)	POSTOP (min)	p-value ^a
Fundoplication	123.6 ± 26.5 (n = 13)	76.4 ± 16.5 (n = 5)	<0.05
Fundo/pyloroplasty	206.7 ± 79.0 (n = 12)	60.7 ± 4.0 (n = 3)	<0.05

Data expressed as mean ± SD
^a t-test

gastric emptying preoperatively were more likely to report postoperative diarrhea than patients with normal gastric emptying. Although part of this discrepancy may be explained by preoperative differences in diarrhea that do not reach statistical significance (Fig. 5), it is our belief that fundoplication (with or without pyloroplasty) may unmask underlying small bowel dysmotility by delivering gastric contents more rapidly to the small bowel. In any case, the extremely high rate of satisfaction reported by these patients

suggests that this degree of diarrhea is regarded as an acceptable tradeoff for diminished GERD.

We advocate the study of solid-phase nuclear gastric emptying for all patients with retained food in the stomach, prominent symptoms of nausea or vomiting, or a history of ulcer, diabetes, or prior esophagogastric surgery. Patients with mild delays in solid-phase emptying are well served by fundoplication alone. Lacking a randomized study, we recommend the addition of pyloroplasty to fundoplication for patients with moderately to severely delayed gastric emptying.

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