Post-esophagectomy gastric outlet obstruction: role of pyloromyotomy and management with endoscopic pyloric dilatation

Michael Lanuti*, Pierre E. de Delva, Cameron D. Wright, Henning A. Gaisser, John C. Wain, Dean M. Donahue, James S. Allan, Douglas J. Mathisen

Massachusetts General Hospital, 55 Fruit Street, Blake 1570, Boston, MA 02114, United States

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Abstract

Objective: Gastric outlet obstruction is common after esophagectomy. Our goal was to determine the incidence of gastric outlet obstruction after esophagectomy with or without pyloromyotomy and analyze its management by endoscopic pyloric dilatation. Methods: Two hundred forty-two patients underwent esophagectomy with gastric conduit from January 2002 to June 2006. Subjects were divided into two groups: Group A had no pyloromyotomy (n = 83) and Group B had a pyloromyotomy (n = 159). Gastric outlet obstruction was strictly defined to include patients with clinical delayed gastric emptying supported by symptoms, barium swallow studies, persistent air–fluid level and dilated conduit on radiography, or endoscopic or surgical intervention to improve gastric drainage. Results: The groups were similar except for a higher percentage of cervical anastomosis and older age (64- vs 61-year-old) in Group A. The overall incidence of gastric outlet obstruction was 15.3% (37/242). Pyloromyotomy did not reduce the incidence of gastric outlet obstruction (Group A 9.6% vs Group B 18.2%, p = 0.078). One patient required a late pyloroplasty. Successful management of gastric outlet obstruction with pyloric dilatation (96.7%, 28/29) was unaffected by pyloromyotomy. There was no difference in length of stay, pneumonia (Group A 27.7% vs Group B 19.5%, p = 0.15), respiratory failure or anastomotic stricture. There was no difference in anastomotic leaks when controlling for the anatomic location of the anastomosis (p = 0.36). Mortality was equivalent between groups (2.4 vs 2.5%, p = 0.96). Conclusion: Pyloromyotomy does not reduce the incidence of symptomatic delayed gastric emptying after esophagectomy. Post-operative gastric outlet obstruction can be effectively managed with endoscopic pyloric dilatation. Routine pyloromyotomy for the prevention of post-esophagectomy gastric outlet obstruction may be unwarranted.

Keywords: Esophagectomy; Esophageal cancer; Gastric outlet obstruction

1. Introduction

Controversy still surrounds the need for pyloric drainage following esophageal substitution with gastric conduit after esophagectomy. Proponents reason that prevention of gastric outlet obstruction (GOO) reduces the incidence of aspiration pneumonia and improves early postoperative outcome. Opposition argues that only a minority of patients develops GOO after esophagectomy, and pyloric drainage may predispose to dumping and duodenal bile reflux, impairing late postoperative functional outcome. Some studies suggest that post-esophagectomy foregut function improves with time, regardless of a pyloric drainage procedure [1,2]. Although randomized controlled trials have addressed the need for pyloric drainage after esophageal substitution, the variables of surgical method, choice of conduit (whole stomach or gastric tube), conduit position, and anastomotic location confound the analysis. Urschel et al. re-evaluated the need for pyloric drainage in 2002 pooling nine randomized, controlled trials [3]. This meta-analysis included 533 patients and concluded that a pyloric drainage procedure at the time of esophagectomy reduced the occurrence of early GOO (p-value = 0.046), but had little affect on mortality, pulmonary morbidity and late postoperative foregut function.

The impetus to perform a drainage procedure after esophagectomy is historically derived from experience with truncal vagotomy for peptic ulcer disease [4]. It became apparent that pyloroplasty or pyloromyotomy could potentially alleviate the emptying delay associated with a vagotomized stomach. In contrast, after esophageal substitution with gastric conduit, delayed gastric emptying was not influenced by either pyloroplasty or pyloromyotomy [5]. Establishing pyloric drainage after esophagectomy with complete vagotomy has not been widely accepted as standard of therapy in high volume esophageal centers.

Pyloromyotomy and Management...
Despite evidence to support gastric drainage procedures following esophagectomy, there is an equivalent body of evidence that attests to the adequacy of spontaneous emptying with an intact pylorus. Interestingly, there are data to suggest that the need for a pyloric drainage procedure may be more related to the size of the gastric conduit, that larger conduits (whole stomach) are more susceptible to gastric stasis [6].

Our objective was to examine the incidence and management of GOO in patients who underwent routine esophagectomy with or without a pyloric drainage procedure. Clinical trials that have addressed this issue have traditionally limited their analysis to a single surgical technique. This study was inclusive of diverse techniques of esophageal resection.

2. Materials and methods

The study population included consecutive patients undergoing esophagectomy for benign or malignant disease on the Thoracic Surgery Service of the Massachusetts General Hospital between January 1, 2002 and June 30, 2006. Following local Institutional Review Board (IRB) approval, retrospective chart reviews were performed. Repeat esophagectomy or emergent esophagectomy were excluded. Patients with a history of gastric outlet syndrome, previous gastric procedure or other intestinal reconstruction were excluded, while those receiving induction chemotherapy or radiotherapy were included. The study was inclusive of diverse techniques including transthoracic (Ivor—Lewis), left thoracoabdominal, modified-McKeown, transhiatal and minimally invasive esophagectomy. Demographic, preoperative, intraoperative and outcome measures were recorded. Data was obtained from the medical records, including office charts, anesthesiology records and in-hospital chart. This study was approved by the IRB at the Massachusetts General Hospital. The IRB specifically considered this retrospective chart review, including subject selection and confidentiality, and waived the need for patient consent.

Operative techniques were standardized among surgeons. All conduits were placed in the posterior mediastinum. All except one esophagojejunal anastomosis were created in a two layer—sewn fashion modified from the original description by Sweet [7]. The diameter of the gastric tube and the location of the gastric anastomosis on the conduit were variable. A cervical anastomosis required creation of a long tube and was located close to the fundic tip. Conversely, an intrathoracic anastomosis usually resulted in a shorter, wider conduit and was located in the mid region of the greater curve, close to the gastroepiploic arcade. Lymph node dissections were limited to the mediastinal, gastric and celiac nodes. The use of a pyloric drainage procedure was surgeon dependent. Pyloromyotomy with an omental buttress was the most common pyloric drainage procedure performed.

A jejunal feeding tube was placed in all patients and enteral nutrition was instituted and advanced as tolerated. Nasogastric drainage was maintained on average 4—7 days or until a gastrografin swallow was performed 4—7 days postoperatively to confirm the absence of anastomotic leak or delayed conduit emptying. Delayed gastric emptying was managed with continued nasogastric drainage, institution of prokinetic agents (metoclopramide and/or erythromycin), or endoscopic balloon pyloric dilatation. Clinical symptoms, barium swallow studies, conduit dilatation on radiography or persistent air—fluid level, and retention of food on esophagography supported the diagnosis of GOO. Pyloric dilatations were performed with controlled radial expansion (CRE) esophageal balloon dilators (Boston Scientific Corp., Natick, MA 01760) ranging from 12—20 mm. Endoscopic dilatation was performed using a 10 mm adult flexible esophagoscope (Olympus) where a CRE esophageal balloon was inflated for 2—3 min, achieving a predetermined diameter at each dilatation. Pyloric dilatation was performed until patency of the pylorus was achieved when the 10 mm endoscope could easily traverse the pyloric channel.

A statistical analysis was performed using SAS (Version 9.01) Statistical Software. Statistical significance was defined as p-value of 0.05. Z-test was used for comparison of discrete proportions and logistical regression was used for multivariate analysis. Continuous variables were analyzed with the Student’s t-test and confirmed with the Mann—Whitney U-test.

3. Results

Review of the Thoracic Surgery database at the Massachusetts General Hospital revealed 282 consecutive patients who underwent esophageal resection over a 54-month period. After excluding emergent, redo esophagectomies and reconstructions requiring colon or jejunum, 242 patients were identified for analysis. Patients were divided in two groups based on the use of a pyloric drainage procedure. Pyloric drainage in the form of pyloromyotomy was

### Table 1
Demographic and outcome variables in patients with and without pyloric drainage after esophageal resection with gastric reconstruction

<table>
<thead>
<tr>
<th></th>
<th>Pyloric drainage, N = 159</th>
<th>No pyloric drainage, N = 83</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>61 (28—84)</td>
<td>64 (45—83)</td>
<td>0.03</td>
</tr>
<tr>
<td>Clinical GOO</td>
<td>29 (18.2%)</td>
<td>8 (9.6%)</td>
<td>0.08</td>
</tr>
<tr>
<td>GOO requiring intervention</td>
<td>23 (14.5%)</td>
<td>7 (8.4%)</td>
<td>0.18</td>
</tr>
<tr>
<td>Aspiration pneumonia</td>
<td>31 (19.5%)</td>
<td>23 (27.7%)</td>
<td>0.15</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>7 (4.4%)</td>
<td>7 (8.4%)</td>
<td>0.20</td>
</tr>
<tr>
<td>ARDS</td>
<td>5 (3.1%)</td>
<td>2 (2.4%)</td>
<td>0.74</td>
</tr>
<tr>
<td>Mortality</td>
<td>4 (2.5%)</td>
<td>2 (2.4%)</td>
<td>0.96</td>
</tr>
<tr>
<td>Median LOS</td>
<td>11</td>
<td>10</td>
<td>0.18</td>
</tr>
</tbody>
</table>

GOO = gastric outlet obstruction, ARDS = acute respiratory distress syndrome, LOS = length of stay.
performed in 159 patients and 83 patients had no pyloric drainage. The groups were similar except for older age and higher number of females in the no pyloric drainage group (Table 1). The distribution of operative approach in the groups is depicted in Fig. 1. The majority of cases were performed with a transthoracic or thoracoabdominal approach and most transhiatal esophagectomies were performed without a pyloric drainage procedure.

The overall incidence of GOO was 15.3% (37/242) and included those patients with symptoms, delayed emptying on barium swallow, dilated conduit with persistent air-fluid level or retained food on esophagoscopy. There was a trend towards a higher incidence of GOO in the group with pyloric drainage (18.2% (29/159) vs 9.6% (8/83), p-value 0.08) depicted in Fig. 2. The incidence of GOO was lowest in patients undergoing transhiatal esophagectomy (7.1%) where most patients had an intact pylorus (Fig. 3). Multivariate logistical regression controlling for procedure and pyloric drainage continued to show a trend towards higher GOO in the group with pyloric drainage (p-value 0.15). Most episodes of GOO (67.5%, 25/37) occurred within 30 days of surgery, and the timing of the first episode was independent of whether a pyloric drainage procedure was performed (Fig. 4).

The management of GOO varied with severity of symptoms and degree of radiographic obstruction (Table 2). Twenty-nine patients (78%) were managed with endoscopic balloon dilatation. Seven patients (19%) with acute GOO were managed with prolonged nasogastric drainage and prokinetic agents alone. In patients who developed GOO with an intact pylorus (8/83 patients), all but one could be managed successfully with endoscopic balloon dilatation. This patient who presented with delayed GOO was primarily managed with pyloroplasty. Of the 29 patients with GOO in the pyloromyotomy group, seven were managed conservatively as previously mentioned and 22 were definitively managed with endoscopic balloon dilatation of the pylorus. One patient failed serial...
dilatations and required a Roux-en-Y gastrojejunostomy for drainage. An average of 1.6 (range 1–3) endoscopic balloon dilatation sessions were required for symptomatic relief. The presence or absence of a pyloric drainage procedure had no influence on the number of dilatations required for symptomatic relief ($p$-value 0.52). Pyloric dilatation successfully managed GOO in 96.7%.

Pneumonia was the most common morbidity observed (22.3%, 54/242). There was a higher incidence of pneumonia in the no pyloromyotomy group (27.7% (23/83) vs 19.5% (31/159), $p$-value 0.15). On multivariate logistic regression, patient age and acute gastric outlet obstruction emerged as risk factors for pneumonia. Pyloric drainage had no statistical relation to the incidence of pneumonia ($p$-value 0.24). Respiratory failure occurred in 14 patients (5.8%) and was unrelated to the performance of pyloric drainage ($p$-value 0.20). On multivariate logistical regression, pneumonia was the only factor predictive of respiratory failure.

The rate of anastomotic strictures requiring dilatation was 30.8%. Performance of a pyloric drainage procedure had no influence on the incidence of anastomotic stricture ($p$-value 0.91). Anastomotic leaks occurred in 5.4% (13/242) of cases and were more common in the no pyloric drainage group. On multivariate logistic regression, anastomotic leaks were unrelated to pyloric drainage when accounting for a higher proportion of esophagectomies with cervical anastomosis in the no pyloromyotomy group (odds ratio for pyloric drainage 0.5–6.6, $p$-value 0.35 and odds ratio for cervical anastomosis 1.8–22.9, $p$-value 0.005).

The median length of stay was 11 days in the no pyloric drainage group and 10 days in pyloric drainage group. There was no difference in the length of stay ($p$-value 0.36). There were no intraoperative deaths. The overall mortality was 2.5% (6/242) and was not influenced by the performance of a pyloric drainage procedure ($p$-value 0.96). Pneumonia and multiorgan system failure were the most common etiologies associated with death.

### 4. Discussion

One of the challenges esophageal surgeons (and their patients) face after esophagectomy for benign or malignant disease is restoration of foregut function. Delayed gastric emptying, gastric outlet obstruction, dumping syndrome, and duodenal bile reflux are all sequelae of esophagectomy that greatly contribute to patient dissatisfaction. The value of adding pyloric drainage to esophagectomy and whether the intervention is of benefit continues to be debated. Several studies have examined the need for pyloric drainage. In 1984, Mannell et al. [8] reported increased pulmonary complications in patients who had an intrathoracic stomach after esophagectomy without pyloric drainage. Mannell et al. also reported that pyloroplasty significantly reduced the incidence of lethal aspiration pneumonia after esophageal substitution with retrosternal stomach [9]. In a frequently cited prospective, randomized study, Wong and colleagues [10,11] reported a higher incidence (13%) of GOO and pulmonary complications in patients who did not undergo a pyloroplasty after Ivor–Lewis esophagectomy. Objective measurements of gastric emptying were obtained with a radio-labeled semisolid meal at 6 months. Patients randomized to no pyloric drainage demonstrated longer emptying times, but this did not necessarily correlate clinically with symptoms. In contrast, Manjari et al. was unable to demonstrate significant differences in the rate of gastric emptying at 6-weeks post-esophagectomy when comparing pyloroplasty, pyloromyotomy and pylorus stretching [12]. In a prospective analysis of transhiatal esophagectomies, Zieren et al. showed no need for pyloric drainage in a randomized study comparing pyloroplasty to intact pylorus with a cervical anastomosis [1].

In contradistinction to some of the previous studies, we found an increased incidence of early and late (>30 days) GOO in patients who underwent a pyloric drainage procedure (18.2 vs 9.6%). Although not statistically significant ($p$-value = 0.08), the trend would suggest a possible correlation. Gastric outlet obstruction was strictly defined to include patients with clinical delayed gastric emptying supported by symptoms, barium swallow studies, or endoscopic or surgical intervention to improve conduit emptying. Aside from an expected loss of coordinated emptying after esophagectomy, we postulate that the higher incidence of early GOO in the pyloric drainage cohort may be associated with incomplete myotomy or postoperative edema at the pyloromyotomy site, and late GOO the result of perhaps stricture at the pyloromyotomy site, intrathoracic redundancy of conduit, or sequelae from duodenal bile reflux.

Transhiatal esophagectomy with cervical anastomosis (N = 28), which represented 12% of our study population, had the least incidence of GOO regardless of pyloric drainage. This has been corroborated by other studies [1,6] and has theoretically been attributed to the more vertical position and superior gravity drainage of a tubularized gastric remnant. Tubularized conduits are less distensible and achieve greater intraconduit pressure over a shorter period of time compared to whole stomach, which is larger and more distensible. Since intraconduit pressures rise in proportion to intraconduit volume, filling of the tubularized conduit overcomes pyloric sphincter-intraudodenal pressure more readily [13,14]. Since we did not employ radioisotope studies to measure gastric emptying, the cause of differences in gastric emptying among the different surgical techniques cannot be determined.

There are several limitations in our study design. This is a single, tertiary-care center experience and our results may not be applicable to all patients or hospital settings. Retrospective and unblinded data gathering introduces several biases into our results and analysis. Optimally, a prospective study examining specific conduit dimensions, anastomotic location, objective measurements of gastric emptying with radioisotope studies, postoperative gastro-esophageal reflux and documentation of dumping would yield stronger conclusions. In addition, pyloric drainage was performed in a disproportionate (~75%) number of patients who underwent Ivor–Lewis or particularly thoracoabdominal esophagectomy where larger conduits were usually constructed. This reflects an inherent bias that larger conduits may be associated with gastric stasis.

We did not find a statistically significant increase in pulmonary morbidity, length of hospital stay, mortality or rate of anastomotic stricture when comparing an intact
pylorus to pyloromyotomy after esophageal substitution with gastric conduit. Ninety-seven percent of patients who developed early or late GOO could be managed with pyloric dilatation with endoscopic means despite an intact pylorus or previous pyloromyotomy. Bemelman et al. [15] demonstrated similar success with endoscopic pyloric dilatation more than a decade ago in a small study of patients who developed GOO after esophagectomy with an intrathoracic anastomosis. We therefore conclude that pulmonary morbidity, mortality and the incidence of early and/or late GOO are not influenced by pyloromyotomy after routine esophagectomy with gastric conduit. There appears to be less incidence of GOO with the transhiatal technique. Finally, gastric outlet obstruction can be successfully managed postoperatively with endoscopic balloon dilatation in most situations.

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References


Appendix A. Conference discussion

Dr H. Hansen (Copenhagen, Denmark): What decision criteria do you have for doing pyloromyotomy or not? In this retrospective series? Is it depending on the surgeon? Is there any medical reason to make that decision?

Dr Lanuti: I think it’s a very good question, which I did not address. One of the variables was that it was surgeon’s choice whether they would perform a pyloromyotomy or not. So there was inherent bias introduced by the surgeon as to whether they would perform a pyloromyotomy, and that clearly is a weakness of a retrospective study. The other things that were variable include conduit dimension, width, and location of anastomosis. Clearly those who had a cervical anastomosis had a longer tube and the gastrocervical anastomosis was performed close to the fundic tip. Those who had intrathoracic anastomosis usually had a wider tube, and that anastomosis was closer to the epiploic arcade.

Dr S. Mattioli (Bologna, Italy): Your data are fairly uncommon. I would expect to have the same problems at least with the pyloromyotomy group and the no pyloromyotomy. You advocated edema and the feature of the gastric conduit. Edema can be accepted as a cause in the first 10 days, not later. And I do suspect that there were technical problems in the pyloromyotomy group, because it’s really hard to explain why the pyloromyotomy did worse than no pyloromyotomy. So I think you should review that in this retrospective study.

Dr Lanuti: It’s very hard to control for the technique of pyloromyotomy with seven surgeons. It clearly is a confounder and perhaps might explain the incidence of pyloric outlet in the early phase. In the late phase, perhaps it’s stricture.

Dr P. Thomas (Marseille, France): Did you manage your nasogastric tube in the same manner in both groups?

Dr Lanuti: We didn’t do any prospective measurements of gastric drainage.

Dr O. Kshivets (Siauliai, Lithuania): I certainly agree with your conclusion. Twenty years ago I performed pyloroplasty on all patients, but last several years I haven’t performed pyloroplasty and have had no problem. My question is, what percentage do you have with pyloric stenosis 5, 6, 7 years after esophagectomy without pyloroplasty?

Dr Lanuti: Well, the study only ranged 4 years. I don’t have 5-year follow-up for you. Overall, the incidence of delayed gastric outlet obstruction (defined as occurring > 30 days from operation) in all the esophagectomies was in the range of 5%. It was 2.4% in patients who did not undergo any pyloric drainage procedure.

Dr M. Zielinski (Zakopane, Poland): Would you say a few words about the results of medical treatment of this complication. In what percent was it successful, and how durable were the results of the medical treatments if they were successful? And I have the same question regarding the balloon dilatation of the pylorus. How durable were the results? How often should it be repeated, how many times?

Dr Lanuti: To answer your second question first, the durability of endoscopic pyloric dilatation, there was a range of 1—3 dilatations that successfully managed pyloric stenosis, and there was only one patient that failed, so it was 97%. Those that were managed conservatively, a much smaller group, were managed with prolonged nasogastric tube drainage, or prokinetic agents such as metoclopramide, or erythromycin. The durability of conservative management is quite low. I didn’t analyze it, but I think successful management was probably less than 30%.