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Blind nasogastric tube advancement following esophagectomy

Abstract

Background: Esophagectomy remains the primary curative treatment for esophageal cancer. Postoperatively, surgeons routinely drain the gastric conduit with a nasogastric tube (NGT). This tube is removed after the anastomosis is thought to have healed. Occasionally, patients require replacement of the NGT. Many surgeons are hesitant to place an NGT blindly due to perceived risk of harm to the anastomosis or gastric conduit. Our investigation was carried out to clarify whether the concern of blind NGT placement is justified.

Methods: In phase one, a porcine model of an Ivor-Lewis esophagectomy with a stapled end to side anastomosis was constructed and placed within a thorax model. Nasogastric tube advancement followed by endoscopy with water submersion was conducted to assess for damage or anastomotic leak. The second phase assessed clinical outcomes of minimally invasive Ivor-Lewis esophagectomy with mechanical end to side anastomosis in patients who underwent blind NGT placement at the conclusion of their procedure.

Results: No mucosal injuries, anastomotic leaks or perforations were observed in the model. No injuries were identified to the gastric conduit staple line. Intermittent catching or curling at the anastomosis occasionally occurred but never resulted in injury. Leak test with endoscopic insufflation was negative. Sixty-seven post-esophagectomy patients at a single institution between January 2013 and December 2015 were included in the second phase of our study. Anastomotic leak occurred in four (6%) patients. No gastric leaks, and no gastric tip necrosis occurred. One (1.5%) mortality occurred.

Conclusions: Blind NGT placement did not harm the gastric staple line or cause mucosal injury in the esophagectomy model. No significant anastomotic leaks or gastric conduit leaks were identified in the clinical series. Blind NGT placement following stapled end to side intrathoracic anastomosis is safe and appropriate following esophagectomy.

Keywords: esophagectomy, anastamotic leak, nasogastric tube, NGT, Ivor-Lewis

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Abbreviations: NGT, nasogastric tube; NIH, national institutes of health; SCC, squamous cell carcinoma; TEF, tracheoesophageal fistula

Introduction

Esophagectomy remains the mainstay of treatment for esophageal cancer. The National Institutes of Health (NIH) reports esophageal cancer to be the 18th most common malignancy that accounts for roughly 1% of total cancer cases a year in the US. An estimated 18,440 cases of esophageal cancer will be diagnosed in the US alone this year with 16,170 expected deaths as a result of the disease.[1]

Squamous cell carcinoma (SCC) and adenocarcinoma constitute over 95% of all malignant esophageal tumors. In the past, SCC was by far most the commonly encountered malignancy. In fact, in the 1960s, SCC made up more than 90% of all esophageal tumors in the US. However, the incidence of adenocarcinoma of the esophagus has since significantly grown in Western countries in particular, such that adenocarcinoma now makes up over 60% of US esophageal cancers.[2] Worldwide, SCC still predominates.[3] The NIH reports the 5-year relative survival of esophageal cancer to be 19.9%.

Surgical resection of malignancy of the esophagus carries substantial morbidity and mortality. Mortality rates have been reported as 13% nationally and reach up to 23% at low volume institutions.[4] Complication rates are routinely above 50%.[5–8] The most dreaded complication following esophagectomy is anastomotic leak. A study comparing two groups of 654 patients found an intrathoracic versus cervical anastomotic leak rate of 17.0 and 21.9%, respectively. Particularly, the median incidence of anastomotic leakage in minimally invasive Ivor Lewis esophagectomy has been quoted at 7.8%.[10]

Surgeons try to minimize staple line failure and anastomotic leaks using a variety of practices including buttressing of the staple line, selecting an appropriately sized GIA stapler, oversewing of the staple line, and placing an NGT at the conclusion of the surgery to name a few. NGTs are placed to prevent anastomotic leak. Theoretically, bilateral vagotomy during esophagectomy inevitably impairs the propulsion capabilities of the gastric tube, rendering these patients vulnerable to gastric distention. If distention occurs, tension increases and the staple line is subject to increased pressure, hypothetically reducing local tissue perfusion, and consequently impairing healing.[11] The absence of the serosal layer of the esophagus is also thought to be a cause. Additionally, distention may result in vomiting, which can substantially harm the anastomosis. Generally, if a patient is doing well in the immediate postoperative period, the NGT is pulled, and the patient discharged home.

Most surgeons are hesitant to place an NGT blindly due to perceived risk of harm to the anastomosis or the gastric conduit. During the esophagectomy it is relatively easy to guide an NGT using endoscopy, palpation, or visualization. However, once the patient is awake, on the floor, or in the emergency room, clinicians often balk at the placement of an NGT. This unwillingness may cause a delay in essential gastric decompression. Our investigation was carried out to clarify whether the concern of blind NGT placement is justified.

Materials and methods

A porcine tissue block (Animal Technologies, Inc., Tyler, TX) was used to create an Ivor Lewis esophagectomy model within a thoracic simulator (VATS Trainers, LLC. Lansing, MI).[12] Esophagectomy with end to side anastomosis was constructed with a 25 EEA (Medtronic, Minneapolis, MN) stapler. Once created, blind NGT placement was performed. This was to simulate a similar experience as to that employed intraoperatively. The NGT was first blindly advanced to 40 cm from the model's incisors for a total of 50 passes. Following this the conduit and anastomosis were inspected endoscopically. After visual inspection, insufflation from the endoscope was used while the model was submerged. The NGT was subsequently advanced 60 cm (50% more than ideal) for an additional 50 passes, followed by repeated assessment endoscopically.

The second portion of this study was a retrospective review of esophagectomy patients between January 2013 and December 2015. All methods were carried out in accordance with relevant guidelines and regulations. All experimental protocols were approved by the Institutional Review Board of Albany Medical College. Informed consent was obtained from all subjects. Patients who underwent Ivor Lewis esophagogastrectomy with intrathoracic stapled end to side anastomosis who had blind NGT placement were included. Patients undergoing laryngoesophagectomy, cervical anastomosis, jejunal and colonic interposition, and visualized placement of the NGT were excluded. Primary endpoints in this group included difficulties placing the NGT, and anastomotic and gastric conduit leaks.

Results

Model Evaluation: Endoscopic evaluation of 50 Blind NGT placements to 40 cm showed no mucosal injuries, leaks, or perforations to the gastric conduit or anastomosis. After 50 additional exaggerated NGT passes to 60 cm (50% further than routinely performed), repeat evaluation was performed. The NGT became lodged in the "hypopharynx" of the model 7 times (7%), but never failed to advance past the anastomosis uneventfully.

Clinical evaluation: A total of 67 patients who underwent esophagectomy at our institution between the years of January 2013 and December 2015 were examined and included in this study. Three patients (4.5%) had their NGT inadvertently removed prior to extubation, usually a result of endotracheal tube change or oropharyngeal care. All three had their NGT repositioned blindly. Anastomotic leak occurred in four patients (6%). No gastric leaks were identified in this group. No gastric tip conduit necrosis occurred. One (1.5%) mortality occurred in the study.

Discussion

Esophagectomy remains the mainstay treatment for esophageal cancer. However, resection of the esophagus is associated with substantial morbidity and mortality. The most considerable complication being anastomotic leak due to gastric staple line failure.

Some clinicians see placement of an NGT as a potential source of injury or disruption to the anastomosis and conduit. This concern also exists for physicians performing sleeve gastrectomy and Roux en Y gastric bypass. Surgeons are frequently contacted regarding patients in the Emergency Room by providers who question the safety of placing an NGT due to concern for damage to the anastomosis.

Blind placement of an NGT has been presumed to increase the chance of dehiscence of the staple line, despite absence of data demonstrating this. Although numerous studies have researched the strength of the staple line by assessing the pressure required to induce a leak in the resected portion of the stomach, no study had explored the effects of blind NGT insertion on the staple line. This is an important clinical question. We set out to confirm the safety of blind NGT placement, first in a well-described simulation model, and then in our esophagectomy patients.[12]

No damage was observed at the staple line following NGT placement. Accurate anatomical conditions were reconstructed to the best of our abilities by setting the porcine model into a tissue model that transitioned from the chest to the abdomen in a non-uniform manner, across a simulated hiatus using the VATS simulator. NGT placement required the clinician to pass the tube based on tangible feedback only. The clinician was blinded to clinical clues. To account for clinical error involving over-advancement of an NGT, half of the passes were advanced to a distance 50% greater than the ideal distance. In our porcine version, this meant the tube had to strike a distal structure, the pylorus, and then either bend or coil. No injuries, leaks, or perforations were found after "over placement."

In the clinical setting, Anastomotic leak occurred in four (6%) patients. Three (4.5%) patients had their NGT inadvertently removed and required replacement without complications. Of the four leaks, three met Grade 1 criteria of the Surgical Infection Study Group and resolved without surgical intervention (Table 1).[13] None were thought to be a result of NGT placement. One anastomotic leak resulted in, or from tracheoesophageal fistula (TEF) on Postoperative day 9. It was felt that this patient had an iatrogenic injury to the left mainstem during surgery which was not attributable to NGT placement. Despite attempts to control the TEF, the patient ultimately succumbed to this complication. This accounts for the single mortality in this series of patients.

Table 1 Anastomotic Leak Classification

Esophagectomy Complications Consensus Group	Surgical Infection Study Group
Type I: Local defect requiring no change in therapy or treated medically	Grade 1 (radiologically or endoscopically detected): without clinical signs
Type II: Localized defect requiring interventional but not surgical therapy	Grade 2 (minor clinical): local inflammation
Type III: Localized defect requiring surgical therapy.	Grade 3 (major clinical): severe disruption with sepsis
	Grade 4 (conduit necrosis): confirmed by endoscopy.

Two commonly referenced classification systems for anastamoic leak following esophagectomy[9,13]

Nausea, vomiting, ileus, and obstruction are all indications for NGT decompression in postoperative esophagectomy patients. Many of these circumstances are a consequence of temporary postoperative delayed gastric emptying and gastroparesis. Thus, many patients in these situations can be treated conservatively with bowel rest, NPO, and decompression via the NGT. Delay in placement of the NGT can

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have detrimental consequences due to the resulting gastric distention and risk of aspiration. The risk of aspiration for these patients is tremendous, particularly in patients undergoing reintervention with bronchoscopy, esophagogastroduodenoscopy, and surgery. Substantial pressure can be placed onto the staple line, and abdominal fascial and skin closures. Furthermore, aspiration of gastric substances, additional patient discomfort, increased latency of time to diet advancement, and lengthier hospitalizations can all result. Many providers are hesitant to place an NGT in postoperative esophagectomy patients due to worry that iatrogenic staple line injury and resulting anastomotic leak will occur. Our porcine model and subsequent clinical series demonstrate the concern is unjustified.

Our research has a number of limitations. Most notably, the porcine model does not exactly replicate all of the variables associated with a postoperative patient. Perhaps this simplifies placement when compared to a patient. Also, the NGT was passed into the porcine model without first passing through the nares or pharynx. These anatomical structures in a living patient may serve as resistance to NGT placement that is not well replicated in our model, possibly permitting for an easier, less traumatic placement. Additionally, although humans and pigs share very similar anatomical composition, the porcine model does vary slightly. Most notably, the stomach wall of the pig is thicker than the stomach wall found in humans. Also, our study only looks at stapled end to side anastomosis. Therefore, our data does not include hand sewn, side to side, or cervical anastomosis and it must be considered that each of these scenarios is potentially very different and our data cannot be extrapolated to include those situations.

Our overall anastomotic leak rate (6%) was well within the standard, and was lower than most database entrees.[6,9,14] There is disagreement on the effectiveness of technical maneuvers, such as buttressing or oversewing the staple line, in preventing anastomotic leak.[15–17] Consequently, we completed our procedures without performing these adjuncts. Our results show the staple line integrity created in esophagectomy is unaffected by blind NGT placement. In addition to blind placement following esophagectomy, we strongly believe that NGT gastric decompression should be performed in other clinical situations without hesitation if warranted.

Conclusion

The anastomosis and gastric staple line created in an Ivor-Lewis esophagectomy appears to tolerate blind NGT placement without complication. No substantial mucosal injury, leak, or perforation occurred in our porcine model. No complications occurred in our postoperative esophagectomy patients, and anastomotic leak rate was low compared to benchmarks. Given that NGT placement can be safely performed immediately after surgery when the anastomosis is most delicate, we argue that it can be done safely in patients who develop postoperative complications and require an NGT. Aversion to blind insertion of an NGT in postoperative esophagectomy patients appears unsubstantiated, and data suggests that blind NGT placement is appropriate in patients with stapled end to side thoracic esophageal anastomosis.

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Conflicts of interest

Erin Harris and Dr. Thomas Fabian have no conflicts of interest or financial ties to disclose.

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