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## Laparoscopic gastroesophageal dissociation in neurologically impaired children with gastroesophageal reflux disease<sup>☆</sup>

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## ABSTRACT

**Purpose:** Neurologically impaired children with severe gastroesophageal reflux disease (GERD) are a challenging group of patients. We theorized that a laparoscopic gastroesophageal dissociation (LGED) may decrease reflux-related readmissions and healthcare visits, and improve quality of life (QOL) for them and their caregivers.

**Methods:** A retrospective review was performed on our pediatric patients that underwent an LGED along with a caregiver survey from 2013 to 2017.

**Results:** Twenty-two neurologically impaired patients (14 months–17 years) with severe GERD underwent an LGED. Patients weighed 7.9–57 kg (avg = 23.8 kg), length of stay ranged from 5 to 20 days (avg = 12 days), estimated blood loss ranged from <5cm<sup>3</sup> to 450cm<sup>3</sup> (avg = 66 cm<sup>3</sup>, median = 25 cm<sup>3</sup>), and duration of operation ranged from 299 to 641 min (avg = 462 min). One death occurred on postoperative day 19 from gram negative sepsis (30-day perioperative mortality of 4.5%). There were a modest number of minor and major complications (follow-up avg. = 13.7 months, range = 2–40 months). There was a decrease in healthcare visits for respiratory illnesses (rated 5/5 from all 13/19 survey respondents) as well as improvements in perceived QOL of the patient (avg = 4.3/5) and caregiver (avg = 4.6/5).

**Conclusions:** Our cohort of patients had a reduction in readmissions and healthcare visits, and improved QOL after undergoing an LGED based on the perceptions of their caregivers. In neurologically impaired patients with severe GERD, an LGED may be a viable alternative to traditional treatments.

**Type of study:** Retrospective case series review.

**Level of evidence:** Level IV evidence: case series without comparison.

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Neurologically impaired (NI) children have a significant risk of gastroesophageal reflux disease (GERD) and aspiration resulting in high numbers of yearly hospitalizations and health care visits [1–3]. These factors lead to a significant decrease in patient and caregiver overall quality of life (QOL) [2,4,5]. In the United States, those children that fail medical management are often treated with a Nissen fundoplication. Debate continues as to whether NI children have a higher fundoplication failure rate, which varies by definition, laparoscopic vs open procedure, and length of follow up [6–10]. Zaidi et al. reported a compiled fundoplication failure rate for neurologically

impaired patients to be 12% to 45% for primary and 20% to 28% in redo funduplications; others have stated 6% to 24% for primary procedures [4,6]. These failures lead to a redo fundoplication 6% to 14% of the time [2]. Most patients with severe, recurrent GERD after a failed fundoplication would have a redo fundoplication or be fed continuously via a gastrojejunal (GJ) or jejunostomy (J) tube. Neither is associated with high rates of success, and all have considerable risks, whether owing to increased operative time because of extensive lysis of adhesions, increased rate of failure for redo funduplications [4], or the challenges of continuous feeds compared to gastric bolus feeds.

Gastroesophageal dissociation (GED), originally termed a total esophagogastric dissociation (TEGD), was first described by Bianchi in 1997 [11]. It has been used in Europe as a redo, rescue, and even as a primary procedure for severe GERD [2,4,6,11,12]. TEGD/GED has been shown to reduce GERD and respiratory complications, improve postoperative nutrition and QOL for NI children, and improve caregiver's perception of being able to care for their child [2,4,6,12]. It has also been shown in retrospective and prospective comparisons to laparoscopic Nissen funduplications to have lower failure rates [2,6] and equal or improved results as an antireflux procedure with less use of antireflux medications post procedure [2]. However, in these

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comparisons, GEDs have longer operating times [2,6], increased ICU care postop [2], increased length of stay (LOS) in ICU postop [2], and increased time to full feeds [2]. Interestingly, there are only limited reports of utilizing this approach in the United States [13]. There are several studies that have shown redo Nissen funduplications can be safely and effectively done laparoscopically; however, there is limited long term follow-up, especially regarding redo Nissen funduplications in NI children [7–10,14–16].

Our experience began in 2013 as a rescue procedure during a redo Nissen fundoplication for a patient who had two previously failed funduplications. We then began researching TEGDs and now have developed a pilot series of a laparoscopic gastroesophageal dissociation (LGED) technique that has been performed on a total of 21 patients (22 total counting the first open procedure). We have also begun an initial, retrospective review of these procedures and surveying the caregivers for patient and caregiver QOL. We theorize that a laparoscopic gastroesophageal dissociation may decrease rates of aspiration and hospital readmissions as well as improve QOL for patients and their caregivers.

## 1. Methods

### 1.1. Selection criteria

All patients have neurologic impairment (NI) with diagnoses such as cerebral palsy, microcephaly, seizure disorders, or Down syndrome and other genetic syndromes. Each patient was determined to have moderate/severe reflux by a pediatric gastroenterologist and had failed maximal medical therapy (PPIs and/or distal feeding) prior to being referred. Most of our patients had at least one Nissen fundoplication, whereas 3 had the LGED as a primary procedure. Unfortunately, owing to the retrospective nature of this evaluation not every patient was managed by the same gastroenterologist nor did each have the same standardized work up, but all were determined to have been treated with maximum medical therapy prior to referral. Similarly, their reasons for referral also varied greatly but included recurrent aspiration events, failure to thrive, failure of GJ or J tube feeds, or documented reflux after failure of their fundoplication.

### 1.2. Description of procedure and postoperative care

In the initial technique for the LGED, the esophagojejunal (EJ) anastomosis was performed with the assistance of the Intuitive Surgical da Vinci Robot (5 patients), with the perception that the increased range of motion of the wristed instruments and stereoscopic visualization provided by the robot would improve the difficult dissections for the redo procedures and ease of creating an intracorporeal anastomosis.

The next iteration used an End to End Anastomosis Stapler (EEA), whereas we now perform a laparoscopic hand sewn anastomosis.

Incisions are made as for a typical redo fundoplication with the addition of a 12 mm trocar in the right lower quadrant and a 5 mm trocar cephalad to the gastrostomy tube site. Please see Fig. 1 for a diagram of port placements.

Almost all our patients had one or more prior operations and required extensive lysis of adhesions. The anterior and posterior vagus nerves are dissected off the distal esophagus, and attempts are made to preserve at least one of these nerves. No pyloroplasties were performed in our series of patients. Once the gastroesophageal junction (at least 2 cm of distal esophagus) is mobilized into the abdomen, the hiatal defect is closed while anchoring the esophagus to the crura at the cardinal positions. An Endo-GIA stapler is then used to transect the esophagus at the lowest healthy part. The jejunum is then transected with another Endo-GIA stapler at approximately 25 cm distal to the ligament of Treitz. The alimentary (Roux limb) is passed towards the hiatus in a retrocolic, retrogastric manner, with care taken to ensure that the limb is not twisted. In 6 of the more recent patients, the alimentary limb was passed in an antecolic, antegastric manner. An antimesenteric enterotomy is made 2 cm proximal to end of the alimentary limb and the staple line is removed from the esophagus creating an end to side, isoperistaltic anastomosis. A leak test is performed by distally occluding the jejunum with an atraumatic bowel grasper, while submerging the esophagojejunal (EJ) anastomosis under irrigation while the patient is in Trendelenburg position. An anesthesia team member instills air through nasal jejunal tube until the jejunum becomes mildly dilated and the absence of bubbles is confirmed. The alimentary limb is further anchored to the surrounding tissue and Petersen's defect is closed. A stapled side to side, functional end to side jejunojejunostomy is created approximately 30 cm distal to the EJ anastomosis. The mesenteric defect at the jejunojejunostomy is also closed with interrupted sutures. Please see Fig. 2 for a drawing of the completed LGED procedure. Lastly, drains are placed anterior and posterior to the EJ anastomosis. Postoperatively, our typical patient is extubated, admitted to the pediatric intensive care unit with a nasojejunal tube to low intermittent suction (operatively placed through the EJ anastomosis), 2 drains to bulb suction, and the gastrostomy tube to gravity drainage.

Following an early perioperative death, explained fully in the results section, our postoperative protocol has evolved to 5 days of broad spectrum intravenous antibiotics (ceftriaxone and metronidazole). Postoperatively an upper gastrointestinal (UGI) study is performed with water soluble contrast to evaluate for leaks at the anastomoses. Patients are fed and medications are given via a gastrostomy tube in the remnant stomach. Patients are also allowed to restart feeds by mouth following a negative UGI.

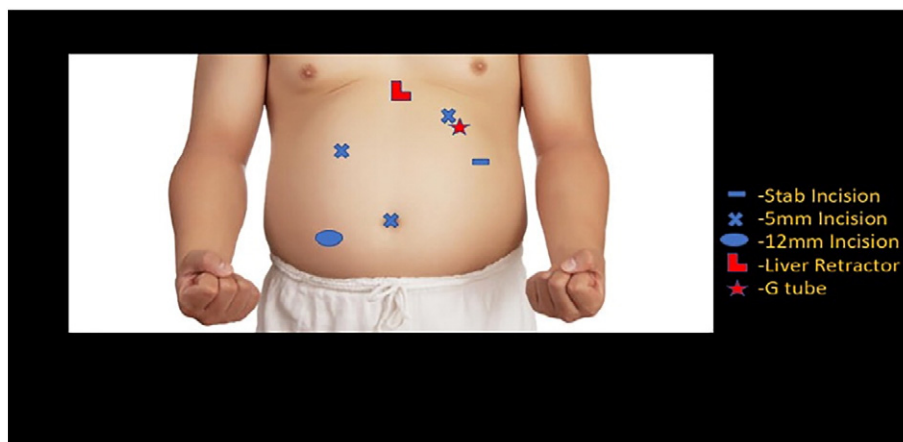


Fig. 1. Diagram of port placement for an LGED.

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