Evaluation of laparoscopic management of recurrent gastroesophageal reflux disease and hiatal hernia: Long term results and evaluation of changing trends

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A R T I C L E   I N F O
Article history:
Received 15 September 2013
Accepted 30 September 2013

Key words:
Gastroesophageal reflux
Hiatal hernia
Redo Nissen
Fundoplication
Laparoscopy

A B S T R A C T

Introduction: Recurrent gastro-esophageal reflux disease (GERD) following fundoplication remains a common problem. This study evaluates a long-term experience with laparoscopic management of these cases.

Methods: From January 1994 to December 2012, 252 patients with recurrent GERD underwent a laparoscopic redo Nissen (LRN) fundoplication with average age of 6.8 years. Eighty-four had previous open fundoplications and 144 previous LNRs. Thirty-two had more than one previous fundoplication.

Results: All procedures were completed laparoscopically. The average operative time was 82 min. The intra-operative complication rate was 5.1%, the most common being a gastrostomy during the mobilization. The average time to full feeds was 1.4 days, and the average hospital stay was 1.6 days. The post-operative complication rate was 3.6%. The wrap failure rate was 6.2%. The most common cause of wrap failure was H/H, with increasing incidence of slipped wrap during the second half. The highest recurrence rate was in patients receiving their LNR before 4 months of age.

Conclusions: Redo Laparoscopic Nissen fundoplication is safe and effective, with the same benefits as a primary laparoscopic Nissen, with low morbidity and quick recovery. A change in the etiology of recurrence suggests that there is a failure to adequately identify and mobilize the GE junction in laparoscopic cases.

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Gastroesophageal reflux disease (GERD) is one of the most common foregut disorder seen in infants and children in United States [1]. Fundoplication is considered in this group of patients for the treatment of GERD refractory to medical therapy or GERD resulting in recurrent aspiration, apnea episodes (sudden infant death syndrome or acute life threatening events), reactive airway disease, neurologic impairment, failure to thrive and esophagitis, and stricture formation [2]. Advances in laparoscopy have significantly changed the practice patterns for the treatment of GERD in pediatric surgery over the last two decades. Prior to 1990’s fundoplication was routinely performed through an open approach, requiring a longer hospital stay, and was associated with increased morbidity. Since its introduction in 1991, laparoscopic anti-reflux surgery has rapidly been incorporated into the management algorithm for GERD by both physicians and surgeons [3]. We reported our experience with laparoscopic fundoplication (LF) in 2005 and showed that it not only is safe and effective in the management of GERD in pediatric population with recurrence rate of only 4%, but results in significantly decreased morbidity and hospitalization and results in improved cosmesis and patient satisfaction when compared to traditional open surgery [4]. As a result, LF has become a standard of care for children with GERD requiring operative intervention.

Despite these advances in surgical care, recurrent GERD following fundoplication, whether performed open or laparoscopically, represents a significant clinical problem. It has been reported to occur in 1.4% to 15.4% of children, requiring re-operations, with higher recurrence rates noted for neurologically impaired children [5,6]. The identification of the cause of failure and the management of these patients remain challenging. Reoperations are more difficult due to obscuration of anatomic planes and adhesions from the previous surgery. Although advantages of laparoscopy and its efficacy are well accepted for primary fundoplication, questions and controversies have been raised for its use and safety for the recurrent disease. We hereby present the largest series reported in literature for redo laparoscopic fundoplication and sought to determine the failure rate after first LF performed at a single institution to investigate the mechanisms of failure and to determine the technical feasibility of laparoscopic revision surgery following previous open and laparoscopic antireflux operations in children.

1. Methods

Institutional Review Board approval was obtained prior to initiation of the study. Records of all children younger than nineteen years of age who underwent redo laparoscopic Nissen fundoplication at Rocky Mountain Children Hospital, Denver, Colorado were retrospectively reviewed over a 19 year period between Jan 1994 and Dec 2012. These patients included those with primary Nissen fundoplication, open or
laparoscopic, performed at our institution and those referred from outside facilities (OSH). Data for both of these groups were analyzed separately. There were no exclusion criteria. Demographics, perioperative, and postoperative information were abstracted from the inpatient and outpatient medical records. Current diagnosis and procedural codes were used for the database search. Data collected included age, gender, weight, symptoms at presentation, past surgical history, operative technique, duration of surgery, intraoperative findings, and complications and outcome variables including time to full feeds, length of stay, and postoperative complications. Variables are expressed as mean ± standard deviation. Statistical analysis was performed using student t test and chi square analysis.

Persistent or recurrent GERD for the purpose of the study was defined as the need for medical treatment of GERD and/or clinical signs of GERD including evidence of aspiration, worsening respiratory status, dysphagia, or persistent emesis after surgery [7]. Nissen fundoplication was performed in all patients with either clinical and/or radiological evidence of recurrent reflux with or without a gastrostomy tube revision.

A total of 2008 laparoscopic fundoplications were performed by or under the direction of the senior author in patients less than 19 years of age during the nineteen year study period between Jan 1994 and December 2012. Of these, we identified 252 children who underwent redo fundoplication (LNR). Patient characteristics are shown in Table 1. There were 131 (52%) boys and 121 (48%) girls. The mean age was 6.8 ± 0.6 years (range 3 months to 19 years) and weight ranged from 4 to 98 kg. Our study population included 16 patients with congenital heart disease and 50 patients who had neurologic impairment and were primarily G tube fed. Indications for re-do operation are either recurrence of GERD and related symptoms or complication related to fundoplication. The most common symptoms were dysphagia (76%), intolerance to feeds or recurrent vomiting (83%), or inability to gain weight (32%). Fundoplication was performed in the remainder of these children (8%) due to increased risk of cardiac and pulmonary events or worsening reactive airway disease, especially in patients with diagnosis of asthma along with GERD. 83 patients had previously undergone open anti-reflux procedures while 169 patients had a primary laparoscopic procedure. Ninety seven of those were performed at our institution, giving a failure rate of 4.6% for primary LF. All patients had a Nissen fundoplication with the exception of 17 patients with Thal and 2 with Toupet fundoplication, all performed at outside referring facilities. All symptomatic patients underwent upper gastrointestinal (GI) study as part of initial workup on presentation while upper endoscopy and 24 h pH probe study was done in 40.6% and 19.4% patients respectively. Upper GI study was positive for presence of recurrent reflux and/or presence of hiatal hernia in 68%. Gastric emptying study was done in 36 patients as was deemed clinically necessary and was positive for delayed gastric emptying in 16 patients. Re-do procedures in our series were not offered to asymptomatic patients.

2. Technique

All patients referred for redo fundoplication since 1994 were approached laparoscopically irrespective of the approach used for prior surgery. The procedures were performed as described in detail previously [8]. The procedure consisted of extensive adhesiolysis, complete mobilization of the stomach, and takedown of the previous fundoplication. If the upper short gastric vessels were not taken in the previous fundoplication, they were divided at this time to allow a tension free wrap. An adequate length of intra-abdominal esophagus was then re-established, and the crura were approximated with interrupted nonabsorbable sutures. In cases with recurrent hiatal hernia, Teflon pledgeted mattress sutures were used for the crural closure. A lateral relaxing incision was made in the diaphragm to take tension off the crural closure in 10 patients. A diaphragmatic patch (Surgisis, Cook Biotech) was then placed over the new defect. In 3 cases, Crurasoft patch (Bard) was placed directly over the crural repair. A full 360° short (2–3 cm), floppy wrap was then formed around the lower esophagus just above the gastro-esophageal junction at 11 o’clock position with 3 stitches of 2–0 nonabsorbable braided suture. Pyloroplasty was simultaneously performed in 16 patients with evidence of delayed gastric emptying. 3 patients, who have had at least 2 prior fundoplications, required Collis Nissen procedure.

The nasogastric tube was removed at the completion of the procedure prior to extubation, except in cases with intraoperative injury to the esophagus or stomach, where it was left for 48 h postoperatively. In patients with no intra-operative complications, clear liquid diet was started 4 h after surgery and was advanced to soft diet on postoperative day one. Patients were discharged once they met the discharge criteria with adequate oral intake and good pain control, usually on postoperative day 1 or 2. Patients were asked to switch to regular diet after a week of soft diet. Follow-up was a clinical evaluation at 2 weeks, 3 months, and then as needed and varied between 4 months and 10 years (35 ± 30 months).

3. Results

All procedures were successfully completed laparoscopically. There were no open conversions. Operative times ranged from 25 to 270 min with an average of 82 min with longer operative times for patients with prior open fundoplications. Average operative time for the first 120 cases was 100 min which improved to an average of 64 min for the later 132 cases (Fig. 1). The average time to achieve goal enteral feeds was 1.4 days, and the average length of stay was 1.6 days. Patients who underwent pyloroplasty and those with intraoperative complication were able to tolerate enteral feeds by postoperative day 3 or 4 and were discharged home between days 3 and 5 postoperatively (Table 2).

Hiatal hernia was seen in 118 of 252 patients requiring redo Nissen, with 78 patients in the latter half of the study (Fig. 1). Of these patients, 16 had prior repair of hiatal hernias (9 at OSH and 7 at our institution). All recurrent hernia repairs were done using Teflon pledgets and mattress sutures. Our study population comprised of patients from our institution and those referred from outside institutions. For patients from our institution, hiatal hernia was seen in 8% of the population at the time of primary fundoplication. Of these, 5.7% of the patients were found to have recurrence of hiatal hernia at their first redo fundoplication. We have not had any second recurrences for hiatal hernias, suggesting zero likelihood for a second complication, with the use of pledged sutures. Partial or complete dehiscence of wrap was seen equally for both halves of the study and was present in 22% of our population. Over the last 3 year period, an increasing incidence of slipped or malpositioned wraps was noticed and was seen in nine patients compared to presence of hiatal hernia in ten patients over the same time period. We were unable to identify any obvious intraoperative pathology in 5 patients where the initial wrap was done at our hospital. All these patients presented with recurrence of GERD symptoms. Upper GI study suggested the presence of reflux without any obvious wrap migration or disruption. This was followed by upper endoscopy which was reported as

Table 1. Characteristics and outcome parameters of patients undergoing redo laparoscopic Nissen fundoplication.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Results</th>
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<tbody>
<tr>
<td>Total No. of patients undergoing redo Nissen</td>
<td>252</td>
</tr>
<tr>
<td>Age (years)</td>
<td>6.8 ± 0.6</td>
</tr>
<tr>
<td>Male:Female</td>
<td>1:1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>25.5 ± 1.9</td>
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possible hiatal hernia. All 5 of these patients are free of GERD symptoms following the redo surgery. 32 patients had multiple redo procedures, ranging between 2 and 5 prior procedures. 107 children who presented for redo Nissen had their first Nissen at less than a year of age and wrap failures were noticed within 20 months. Redo procedure was required in 17 of these children within the first year. Nine had developed hiatal defects, and 8 had signs and symptoms of GERD with no hiatal hernia on re-operation.

We had 9 inadvertent gastrotomies made during wrap mobilization and 4 enterotomies during extensive lysis of adhesions, and all were identified and repaired laparoscopically. The intraoperative complication rate was higher for patients who underwent prior open procedures when compared to the patients in whom laparoscopic approach was utilized (3.9% vs 1.2%, p < 0.05). However, this difference may be reflective of sicker and more technically challenging patients in the referred open patient group. Our postoperative complication rate was 3.2% with a secondary wrap failure rate of 6.3% and was similar irrespective of the prior approach used. Secondary wrap failure rates were similar for neurologically intact and neurologically impaired children. There were 2 delayed perforations at 48 h requiring laparoscopic re-exploration and primary repair. One patient developed severe gagging and retching in the immediate postoperative period resulting in incarcerated para-esophageal hernia which was reduced and repaired on the 4th post-operative day. This patient had a soft patch placed over the crural defect. A second patient with a crural patch had the patch erode into the esophagus 18 months later and required operative removal. One patient, who underwent his third fundoplication (had 2 previous surgeries at OSH), developed esophagogastric fistula; he was taken back to operating room where fistula takedown, repair of esophagus and stomach, and revision of wrap were performed. 4 patients experienced postoperative dysphagia of which one needed single dilation at 3 weeks post-op. All patients with secondary wrap failure underwent re-redo fundoplication and are doing well. 2 of them currently are on antireflux medications with only mild symptoms. There was no intraoperative or postoperative mortality.

4. Discussion

Laparoscopic Nissen fundoplication has changed the way GERD is managed in both adults and children. The first LF was described in 1991 by Dallemagne et al. followed 2 years later by Georgeson et al. and Lobe et al. advocating this approach in children [3,9]. Low morbidity of the procedure has led to wide acceptance for the surgical treatment by both physicians and patients, and LF has become the standard of care for the treatment of GERD [10]. We reported our largest series with 1048 LFs in pediatric population in 2005 with no procedural mortality. Clinical results were comparable to the traditional open fundoplication with a recurrence rate of only 3.2% and with a significant decrease in morbidity and hospitalization [4]. Pulmonary benefits afforded by this minimally invasive approach potentially play even a greater role in neurologically impaired children, premature infants and intensive care population, where the complication rates are higher and the ability to avoid respiratory complications has an additional benefit [11]. Recurrence rate and need for redo procedure in patients younger than a year of age are higher (6.4%) possibly due to immature tissues and differential growth. Although controversial, the growth and respiratory advantages of fundoplication in this population outweigh the minimal risk and morbidity associated with redo procedures [11,12]. The laparoscopic approach also provides improved and magnified visualization decreasing the chances of vagus nerve injury which has been shown to decrease the incidence of bloating, dysphagia, and other symptoms associated with fundoplication postoperatively [13]. 10% of our

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**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
<td>Operative time (min)</td>
<td>82.4 ± 3.7</td>
</tr>
<tr>
<td>Intraoperative complication</td>
<td>5.1%</td>
</tr>
<tr>
<td>Postoperative complication</td>
<td>3.2%</td>
</tr>
<tr>
<td>Time to goal feeds (days)</td>
<td>1.4 ± 0.1</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>1.6 ± 0.09</td>
</tr>
<tr>
<td>Wrap failure after redo Nissen</td>
<td>6.3%</td>
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patient population provided a history of stomach flu leading to severe retching prior to the recurrence of GERD related symptoms which has been shown previously an important contributor in early failures. LF is successful in more than 95% of cases; however, failure of fundoplication has been reported over time with failure rates ranging from 2% to 24% after open and from 3% to 19% after laparoscopic antireflux procedures [14]. Despite the popularity gained by laparoscopic approach for the initial fundoplications, there have been a relatively slow acceptance and significant criticism for its use in redo LF in children. It is secondary to the advanced laparoscopic skills required for redo procedures secondary to adhesions and distortion of anatomical planes which is even more significant when the initial procedure is an open fundoplication. Pacilli et al. in 2007 report a failure rate of 42% for redo procedures, in contrast to 6% reported in our earlier series with 118 patients [15]. Our current series included more complex patients with 13% with more than 2 prior fundoplications. Despite these challenges, we were still able to achieve a secondary failure rate of 6.3% with no increased complications and improved operative times than our previous series which further highlights the concept of the learning curve [8].

The present study is focused on the results of laparoscopic redo fundoplication, trying to identify the mechanism of initial wrap failure. In our series, the pattern of anatomic failure was similar to that reported in the adult literature after open and laparoscopic procedures [16]. Hiatal hernia (including intrathoracic wrap migration and paraesophageal hernia) and wrap disruption were the leading causes for recurrence requiring redo surgery followed closely by misplaced or malpositioned wraps which were especially noticed during the last 3 years of the study and were only seen in LFs referred from OSH. Lopez et al. in 2008 advocated extensive dissection well above the diaphragm deep into the mediastinum and reported secondary wrap failure rates of 20% [17]. It has been suggested that minimal esophageal mobilization during laparoscopic fundoplication decreases postoperative wrap transmigration and the need for a redo operation and it has been recommended that the dissection should be focused around the crura and GE junction and not extend into the mediastinum [18]. Additionally, the use of pledges in cases of recurrent hiatal hernias is a key to reduce the secondary wrap failure rate, as shown in our current series. The recent increase in the incidence of slipped fundoplication suggests that there is failure to adequately identify and mobilize the gastro-esophageal junction in laparoscopic cases. It may be a result of an attempt to minimize mediastinal and crural dissection, factors implicated in development of hiatal hernia and fundoplication recurrence in our earlier series and also by St Peter et al. in 2011 [18]. The extent of optimal dissection is difficult to define but can slowly be understood and achieved with experience. We emphasize that exposure of hiatus, gastric anatomy, and formation of an optimally positioned floppy wrap are the keys to success.

Another potential area of importance is the careful selection of these patients and the identification of the need for additional preoperative evaluation and procedures when needed [19]. Delayed gastric emptying was identified in 16 patients in our series, and a simultaneous pyloroplasty was performed which contributes to our low secondary recurrences.

Limitations of our study are a possible loss of follow up for some of our patients due to either transition of care to adult physicians and surgeons or migration of family to distant areas. Also, we did not have a comparison group to open fundoplication due to the inherent bias of such an approach at our institution.

We emphasize that, although technically challenging, laparoscopic approach for redo fundoplication can be utilized with low morbidity and mortality in infants and children, offers the same advantages as the first laparoscopic procedure, is safe in the hands of experienced laparoscopic surgeon, and should be considered as a primary approach. Although the learning curve for redo procedures is steep, procedure can be performed effectively once these skills are mastered.

References


Discussion

Discussant: Prof AGOSTINO PIERRO (Toronto, ON): I would like to ask you something related to our experience in London. We have also done laparoscopic redo fundoplication as you presented but the main problem, and in fact we published this, is that the redo fundoplication is associated with a great number of recurrences of gastroesophageal reflux again. Now you presented the cause of this recurrent gastroesophageal reflux but how many in your series had yet another recurrence of gastroesophageal reflux? And how long did you follow your patients up?

Response: DR SAMIKSHA BANSAL: Our followup ranged from four months to 10 years, and our usual followup strategy is that we follow up our patients two weeks postoperatively and then after three months. After that the patients follow up with their gastroenterologist depending on the symptomatology and they are referred back to us if they are having any symptoms.

For the recurrence rates as I mentioned in one of my slides we had a recurrence rate for the redo Nissens which was 6.3%. We did have a few patients with multiple recurrences but I think the total number was seven patients. It was very, very low, and I remember your published study. I was surprised that the recurrence rate that you published I think in 2008 was 42%, if I’m correct.

PIERRO AGOSTINO: Yes, so we had a much higher recurrence rate. How do you explain this difference, which is not only our group that reported that, but, other groups have also reported that as well.

SAMIKSHA BANSAL: I think there are certain points technically and also in the preoperative evaluation which we want to emphasize to
achieve the low recurrence rates we have in our manuscript. We have to be very careful about evaluating these patients because in 16 of our patients we performed pyloroplasty because we found evidence of delayed gastric emptying. Had we avoided that careful preoperative evaluation, in my understanding, those patients would have been in the recurrence group. During the technical aspect, I think the important points are to carefully completely take down the whole wrap even if you don’t see any pathology at the time, which we saw in a few of our patients. We did not recognize any pathology but still would take down the wrap. In many patients we would see that the short gastric vessels, especially in the superior portion and also in the posterior portion were not completely divided which can be a cause for the tension on the wrap. Once you divide the short gastric vessels, it creates a tension-free wrap which again leads to a low recurrence rate. The rest of the points we have emphasized in our papers is that the wrap has to be correctly positioned at the 11 o’clock position. It has to be short, a 2 to 3-cm wrap, and it has to be a floppy wrap. The mobilization of the esophagus and the crural dissection is of paramount importance. Again it is a fine line between causing a hiatal hernia versus causing a slipped Nissen so it has to be really optimal, and that comes with experience.

AGOSTINO PIETRO: Well in London we had a different experience although we follow the same principles for the operation.

MODERATOR: Dr. Rothenberg, did you want to make a comment?

Response: DR STEVEN ROTHENBERG (Denver, CO): I think Sami pointed out the essential technical points very well. Two keys – one is that I think obviously hiatal hernia is the greatest problem and you should never dissect up into the hiatus. You should never take down the phrenoesophageal ligament, but I think what we’re seeing now is that surgeons are not adequately identifying the GE junction and they are forming the wrap around the GE junction, so patients are having recurrent reflux. Even though the wrap looks grossly intact, it’s too low. I think it is key to identify the GE junction, make sure the wrap is above that, so that does require some degree of esophageal mobilization but never up through the hiatus.

Another thing is that we believe is very important in all these recurrences we used pledgeted sutures to support the hiatus and perhaps we should be doing that at the initial procedure and that’s the thing I struggle with because I hate to put foreign bodies in but I think we prevented re-recurrences by buttressing the hiatal repair.