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Surgical repair of recurrent hiatal hernia

Abstract The surgical management results of recurrent hiatal hernia repair are unknown in the laparoscopic era. The experience of the senior authors (CJF) and (SKM) is reported herein. From 1993 to 2004, 52 patients underwent re-operative hiatal hernia surgery at our center. Preoperative symptoms were heartburn, chest pain, dysphagia, regurgitation and pulmonary manifestations of gastroesophageal reflux disease. Patients had preoperative evaluation by upper endoscopy, pH-monitoring, esophagogram and manometry to assess the mechanism of failure. Pre- and postoperative symptoms were assessed utilizing a standardized questionnaire. Patients underwent laparoscopic repair ($n=18$), open laparotomy ($n=6$) and transthoracic surgery ($n=28$). Ninety-five percent follow-up was achieved with a mean follow-up of 34 months. Thirty-seven percent of patients encountered para-operative complications one of them died due to respiratory insufficiency. Five patients experienced a re-recurrent hernia. The symptom resolution was 65% for dysphagia, 68% for heartburn, 95% for chest pain and 79% for regurgitation. The overall patient satisfaction was 6.94 on a scale of 1–10. There was no significant difference in patient outcome when comparing the operative approaches or disease process. Surgical repair of recurrent hiatal hernias is safe and effective. Laparoscopic surgery is an appropriate alternative approach for recurrent hiatal hernia repair in selected patients.

Keywords Hiatal hernia · Recurrence · Surgery

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Introduction

Laparoscopic surgery for foregut disorders has become the standard of care at many institutions. Improved instrumentation, numerous large series with good early results and technical modifications have made laparoscopic Nissen fundoplication for gastroesophageal reflux disease (GERD) commonplace, in fact the incidence of surgery for this condition has multiplied fourfold in recent years. The frequency of postoperative death and splenic complications has decreased and the overall long-term results are comparable to open Nissen fundoplication. However, the hiatal hernia recurrence rate after laparoscopic hernia repair has been reported as high as 24–42% [1, 2].

Re-operative hiatal hernia procedures are often indicated for intractable chest pain, dysphagia or regurgitation but are technically difficult because of scar formation and distorted anatomy [3, 4]. Proven risk factors for hiatal hernia recurrence are surgeon's inexperience and postoperative vomiting; suspected risk factors include short esophagus, coughing, retching, heavy lifting, premature return to normal activities and obesity [5–7]. There are no series of re-operation for hiatal hernia within the laparoscopic era and thus this report. The experience of the senior authors (CJF and SKM) with surgical repair of recurrent hiatal hernias is reported herein.

Materials and methods

The objective of this study is to report long-term follow-up on laparoscopic and open surgical management of recurrent hiatal hernia after failed antireflux surgery. From 1993 to 2004, 1,400 patients underwent laparoscopic or open antireflux surgical therapy at Creighton University Medical Center. Fifteen of these patients had both primary and re-operative hiatal hernia procedures at our center by senior authors CJF or SKM. An

additional 37 patients were referred from other centers for repair of their recurrent hiatal hernia. The primary procedures performed are shown in Table 1.

Preoperative evaluation

Heartburn, chest pain, dysphagia, regurgitation and pulmonary symptoms were the preoperative symptoms. We used a standardized patient questionnaire (Table 2) to assess pre- and postoperative symptoms. Included also were additional symptoms, medication usage, patient satisfaction on a scale of 1–10 and an overall grading of the operation. Patients were evaluated by esophagogastroscopy ($n=49$), pH-monitoring ($n=14$), an upright esophagogram ($n=49$) and manometry ($n=37$) to determine the mechanism of failure and it's correlation with symptoms.

Esophagram

The esophagrams were performed using single and double contrast techniques. The patient was placed in the upright position and given effervescent crystals by mouth in order to distend the esophagus, stomach and any hiatal hernia. To obtain double contrast images, the patient drank high-density barium to coat the esophagus. The patients were then placed in the prone position and right anterior oblique position. Thin barium was given to distend the esophagus so that single contrast images are obtained that would most sensitively demonstrate the presence of hernias and strictures. Finally, standard upright posterior–anterior and lateral chest roentgenograms were obtained while the patient swallowed barium and any hernia seen was measured (directly off the film) from the gastroesophageal junction (GEJ) to the level of the hemi-diaphragmatic esophageal hiatus. A centimeter ruler was taped to the film cassette and superimposed on the anterior–posterior projection with barium in the distal esophagus. By measuring against the ruler from the proximal extent of the gastric tissue and the gastroesophageal junction and the extrapolated hemi-diaphragm lines at the midline, the size of the irreducible hiatal hernia and the length of the esophagus were determined. These findings were later confirmed by endoscopy.

Upper endoscopy

The upper endoscopy was performed to determine the presence or absence of cancer, Barrett's esophagus (by direct inspection and biopsy), a peptic stricture, a short esophagus by measuring the distance from the incisors to the proximal aspect of the top gastric folds, gastroparesis as evidenced by the presence of retained food, a Cameron's ulcer and the type and size of the hiatal hernia if present.

Manometry

Manometry was conducted as per standard protocol, but in addition, the fundoplication pressure and relaxation was assessed at each centimeter level. Adequate pressure was determined via two to three wet swallows at each level (normal fundoplication pressure is 20–35 mmHg in our laboratory). Relaxation below 85% at any one level was considered abnormal. Esophageal body dysmotility and wave amplitudes were noted as well.

pH monitoring

Twenty-four-hour pH monitoring was performed selectively on the basis of previously completed positive studies, the response to proton-pump inhibitors and presence of esophagitis on endoscopy. A standard probe was used for the majority of patients, however, the BRAVO capsule was utilized later in the study period. Patients that had a good response to proton-pump inhibitors or esophagitis by endoscopic examination did not undergo pH monitoring.

Indications and operative approach

When the above mentioned evaluation methods demonstrated a surgically correctable disorder that was not or could not be responsive to aggressive medical management, a re-operation was proposed. If an asymptomatic small recurrent hiatal hernia was found, operative intervention was not offered, however, those patients with chest pain and a hiatal hernia were operated upon if the cardiac evaluation was negative and the chest pain remained intractable. Patients with dysphagia were dilated and their response monitored. If a large recurrent hernia was adjacent to the distal esophagus on esophagram and there were no motility or other mechanical explanations for dysphagia the patient was operated upon.

An open thoracotomy was performed when more than 2 cm of gastric tissue was within the mediastinum on upright esophagram, a short esophagus was suspected or the patient had a previous mediastinal dissection. A laparotomy was performed if the patient had two or more prior failed operations. If a patient did not meet the above criteria, the laparoscopic approach was utilized. In a patient who had an abdominal esophagus of less than 2 cm after esophageal mobilization, a Collis gastroplasty was completed.

Table 1 Primary procedures for repair of hiatal hernia

Primary procedure	No. of patients	%
I Laparoscopic Nissen fundoplication	41	79
II Open Nissen fundoplication	8	15
III Laparoscopic Toupet fundoplication	2	4
IV Laparoscopic Hill fundoplication	1	2

Table 2 The symptom grading system administered to patient

Grading	Symptoms							
	Dysphagia	Regurgitation	Heart-burn	Chest pain	Pulmonary symptoms	Nausea/vomiting	Abdominal bloating	Other symptoms
0	None	None	None	None	None	None	None	
1	Minimal: once a week or less	Mild: after straining or large meals	Minimal: episodic—no treatment required	Minimal: episodic	Recurrent cough Nocturnal cough	Occasional episodes of nausea		
2	Moderate: more than once a week, requires dietary adjustment	Moderate: predictable, with position change/lying /straining	Moderate: controlled with medication	Moderate: reason for visit				
3	Severe: preventing ingestion of food	Severe: constant regurgitation with or without aspiration	Severe: interferes with daily activity or not controlled with medication	Severe: interferes with daily activity	Recurrent pneumonitis Asthma Change of voice	Frequent nausea or episodic vomiting	Present	
4						Continuous nausea or frequent vomiting		
5								
Medications	Name How often?							
Duration between redo surgery and re-appearance of symptoms (months)								
Number of times dilation done since redo surgery?								
Satisfaction rate: in relation to symptoms you had there-operation for	(Scale 1–10 with 1 being the least satisfied and 10 the most)							
Grading rate: for results of redo surgery	1: Poor		2: Fair		3: Good	4: Excellent		

Re-operative transthoracic technique

Single lung anesthesia was used with the patient in the right lateral decubitus position. A standard muscle sparing incision was made in the eighth intercostal space. The inferior pulmonary ligament was divided after a thorough exploration of the chest cavity. Esophageal mobilization was performed up to the level of the left main stem bronchus being careful to avoid entrance into the right pleural cavity and to spare the vagus nerves. The branches of the vagus plexus to the left lung were divided between hemoclips. The hernia sac was dissected away from mediastinal structures and the peritoneal cavity was entered through the hernia sac. If this was not possible within 30 min of dissection, a diaphragm counter incision was made below the rib cage to access the peritoneal cavity.

All intraperitoneal adhesions in the hiatal area were cleared 5 cm from the diaphragmatic hiatus. This was completed either through the chest or the counter incision. Great care was taken to preserve the posterior and anterior vagus nerves and the left gastric artery during this dissection. Gastric mobilization was performed down to the mid-portion of the greater curvature by ligating the short gastric vessels with a Harmonic scalpel (Ethicon Endosurgery, Cincinnati, OH, USA).

The fundoplication was then dismantled. Slow and careful mobilization of the right limb of the fundoplication is necessary because its posterior attachments to the previously made crural closure are often dense. The plane between the right posterior limb and the esophagus was usually easy to dissect. If bleeding occurred the dissection plane was considered incorrect. Sharp dissection was utilized throughout. Final attachments were divided and if serosal or full thickness defects were present an interrupted suture closure was completed. The hernia sac was excised.

Large non-absorbable sutures were then placed full thickness through the right and left limbs of the right crus and tagged. Pledget or mesh reinforcement was utilized if the patient had difficulty controlling diaphragm stress factors or poor tissue. The fat pad was dissected off the gastroesophageal junction and the junction of the gastric serosal layer and the longitudinal esophageal musculature was identified. A marking suture was placed 3 cm. proximal to this point. The esophagus was allowed to lie in its native position and if the suture was at the level of or below the diaphragm the patient did not have a short esophagus. If the suture was proximal to the diaphragm then a Collis gastroplasty was performed. The fundoplication was completed using a 2–0 Prolene full thickness pledget reinforced U stitch. At the end of the operation if a perforation had occurred insufflation through a nasogastric tube with the perforation site under water was used to test the closure. The diaphragm closure sutures were tied and the chest wall was closed.

There are six planes of sharp dissection we closely follow: (1) the subhepatic capsule, (2) the medial aspect of the right limb of the right crus extending to the arch and the left limb, (3) the plane between the limbs of the fundoplication, (4) the medial border of the right posterior fundoplication limb, (5) the external or posterior plane between the posterior limb and the previous crus closure and (6) finally in the posterior left lateral adhesions between the posterior limb and the posterior stomach.

Follow-up evaluation

Patient's phone interviews were conducted by a junior co-author using the questionnaire previously described (Table 2), and were completed in 50 patients (96%) with a mean follow-up of 34 months (range 2–91 months). Symptom resolution rates were calculated on patients with grade 2 or 3 symptoms. One patient was lost to follow-up and one died postoperatively.

Results

Fifty-two patients with a mean age of 49 years (range 31–80 years), mean weight of 193 pounds (range 132–260 pounds) and a mean BMI of 31 (range 23–45) underwent re-operative surgery at our center over a period of 11 years. Forty-four (85%) had their primary surgery done by laparoscopy and 8 (15%) by laparotomy. The mean duration between the primary procedure and re-appearance of symptoms was 26 months (range 0–120 months) and time elapsed between procedures was 35 months (range 1–132 months).

The re-operative procedures performed are shown in Table 3. The re-operation was completed laparoscopically in 18 patients and with open surgery in 33 patients. One operation was converted from a laparoscopic approach to an open procedure because of extensive liver adhesions (conversion rate 5.6%). There was significant improvement in symptom scores postoperatively (Table 4). The overall grading of the operation was 3.02 and satisfaction score was 6.94 on a scale of 1–10. The

Table 3 Redo surgical procedures for recurrent hiatal hernias

Re-operative procedures	No. of patients	%
Laparoscopic Nissen fundoplication	15	29
Transthoracic Nissen fundoplication	12	23
Transthoracic Collis Nissen fundoplication	10	19
Open Nissen fundoplication	4	8
Laparoscopic Toupet fundoplication	2	4
Transthoracic Collis Belsey fundoplication	2	4
Transthoracic Dor fundoplication	2	4
Transthoracic Belsey Mark IV fundoplication	2	4
Open Toupet fundoplication	1	2
Laparoscopic Dor fundoplication	1	2

Laparotomy Nissen
  + Thoracoscopic lengthening
  + truncal vagotomy/antrectomy (Bilroth I)
	1	2

Table 4 Pre- and postoperative symptom evaluation

Symptoms (score 0–3)	Preoperative scores (mean ± SD)	Postoperative scores (mean ± SD)	P value
Heartburn	1.72 ± 1.05	0.84 ± 0.98	< 0.0001
Dysphagia	1.6 ± 1.25	0.82 ± 1.06	< 0.0003
Regurgitation	1.08 ± 0.94	0.42 ± 0.71	< 0.0001
Chest pain	1.21 ± 1.34	0.31 ± 0.72	< 0.0002
Satisfaction grade (score 1–10)	6.94 ± 2.82		
Personal grading (score 1–4)	3.02 ± 0.99		

symptom resolution for chest pain was 95%, for regurgitation 79%, for heartburn 68% and for dysphagia 65% (Table 5). Symptom improvement was similar between the laparoscopic and open laparotomy groups (Table 6). Chest pain was resolved in 83% of patients undergoing the laparoscopic approach ($n = 6$), in 100% of those with a laparotomy ($n = 1$) and in 93% of those undergoing a thoracotomy ($n = 15$).

The mean operating time was 4 h (range 1–7 h) and the mean hospital stay was 6 days (range: 2–14 days). The estimated blood loss during procedures was 300 ml (range: 50–1,000 ml).

Intraoperative and/or early postoperative complications were encountered in 19 patients (37%). All perioperative complications are shown in Table 7. One death occurred in a mentally challenged patient who vomited in the early postoperative period, herniating his stomach into the chest. Open re-operative surgery was performed. The patient developed respiratory failure postoperatively, and after 2 weeks the family withdrew care. One patient lost 350 cc of blood at a trocar site. Seven patients experienced intraoperative perforations but all were recognized and closed at surgery. No patients experienced septic complications as a result of the inadvertent gastric wall openings.

Delayed complications during the postoperative period were encountered in 11 patients (23%). These included persistent dysphagia ($n = 2$), the gas bloat

Table 5 Symptom resolution for all surgical recurrent hiatal hernia repairs

Symptoms	Resolution[a] (%)
Chest pain ($n = 22$)	95
Regurgitation ($n = 19$)	79
Heartburn ($n = 34$)	68
Dysphagia ($n = 31$)	65

[a]Resolution means decrease in symptom scores to 0 or 1

Table 7 Perioperative complications in recurrent hiatal hernia repair

Complications	No. of patients (%)
Pneumothorax	3 (6)
Intraoperative perforation	7 (13)
Atelectasis	2 (4)
Arrhythmia	2 (4)
Myocardial infarction	1 (2)
Pericardial effusion	1 (2)
Apnea due to epidural block	1 (2)
Bleeding	1 (2)
Death due to respiratory failure	1 (2)
Total	19 (37)

syndrome ($n = 2$), a disrupted fundoplication ($n = 1$), a recurrent hiatal hernia ($n = 5$) and a suture granuloma within the distal esophagus ($n = 1$). Of the five patients experiencing a recurrent hernia three were operated upon transthoracically and the other two by the laparoscopic approach. The probable cause of recurrence in one patient was uncontrollable vomiting who also had the gas bloat syndrome and eventually required a pyloroplasty.

Discussion

Our study presents the largest series of recurrent hiatal hernia repairs in the laparoscopic era. Subjective symptom outcome results are satisfactory with symptom resolution ranging from 65% for dysphagia to 95% for chest pain (Table 6). Complication rates were acceptable in relation to other series [2, 9]. The laparoscopic approach was equivalent to open laparotomy when comparing symptom outcome, although the groups were not totally comparative because of selection criteria bias. Patient outcome with thoracotomy was similar to the abdominal approaches in terms of symptom resolution including chest pain.

Table 6 Pre- and postoperative symptom evaluation for redo laparoscopic versus open surgery

	Heartburn		Dysphagia		Regurgitation		Chest pain		Satisfaction	Grading
	Pre	Post	Pre	Post	Pre	Post	Pre	Post		
Redo lap	1.94 ± 1.06	0.89 ± 0.96	1.26 ± 1.13	0.67 ± 1.06	1.33 ± 0.91	0.33 ± 0.59	0.34 ± 1.34	0.35 ± 0.86	7.06 ± 3.08	3.0 ± 1.03
Redo open	1.59 ± 1.04	0.81 ± 1.00	1.78 ± 1.29	0.91 ± 1.06	0.93 ± 0.94	0.47 ± 0.78	1.35 ± 1.33	0.29 ± 0.64	6.87 ± 2.70	3.03 ± 0.98

Patients who underwent primary laparoscopic hiatal hernia repair ($n = 44$) required revision within 2.5 years versus 5 years for patients who underwent open surgical repair ($n = 8$). Symptoms recurred after 20 months in the laparoscopic group and after 55 months in patients who had prior open hiatal hernia repair. Further follow-up is necessary to validate the re-operative approach because of this prolonged symptom recurrence interval. There are several possible reasons for earlier recurrent symptoms after the laparoscopic approach including an earlier return to normal activity and less adhesion formation. The long-term results in terms of hernia recurrence were not different between an open thoracotomy and the laparoscopic approach.

In our experience it is important to control postoperative vomiting. Two major complications resulted due to vomiting. The single death was a result of this problem and one patient with intractable vomiting recurred after the second operation and required yet a third procedure. Progress has been made [10] for early postoperative patients but the problem of intractable late postoperative vomiting remains. An exhaustive history from the patient and family, including a diaphragm stress questionnaire is necessary, if this problem is suspected. It is particularly common in profoundly retarded patients

Liberal use of intraoperative endoscopy was important in this series. Seven perforations were experienced but all were recognized either directly or with the assistance of endoscopy. The laparoscopic operations are particularly prone to missed perforations as visualization is not equivalent to open surgery. Endoscopy is also helpful during laparoscopic surgery for recognition of a remaining hiatal hernia or an incompletely dismantled fundoplication. It is important for the surgeon to perform the endoscopy as gastroenterologists are often not available and they are inexperienced with intraoperative findings.

The controversy concerning the short esophagus remains and yet thoracotomy with Collis gastroplasty was used frequently in our series. The hernia recurrence rate after thoracotomy with and without Collis gastroplasty when performed by Pearson [11] was 2% on the long term. This is far superior to other series such as a recent report by Ferri [12] in which hernias recurred in 44% of patients after laparotomy and 23% on short-term follow-up after laparoscopic paraesophageal hernia repair. This is not the only series that reports a greater than 40% recurrence rate [13]. The left transthoracic approach provides several advantages including complete skeletonization of the esophagus to the level of the left main stem bronchus, easier preservation of the vagal nerves, fresh dissection planes, excellent exposure for the crus closure and easier performance of a Collis gastroplasty if needed. In our series 13 patients required esophageal lengthening.

The transthoracic approach is best suited for identifying and treating the short esophagus. Abdominal surgeons do not believe in the short esophagus because they are not afforded the thoracic view and the ability to fully mobilize the esophagus. If one skeletonizes the gastroesophageal junction (GEJ) there is no doubt about the point at which the gastric serosa interfaces the longitudinal muscle of the esophagus, the true GEJ. If this point remains above the diaphragm there is no abdominal esophagus and thus the patient has a short esophagus. Our criterion was that the GEJ must lie 2 cm below the diaphragm, the normal length of the esophageal abdominal segment. If this criterion was not met a Collis gastroplasty was performed.

Thoracotomy can be associated with long-term chest wall pain and respiratory complications are more common. However, in this series these problems were obviated. Epidural anesthesia was used routinely and all patients underwent preoperative pulmonary function tests if a thoracotomy was planned. Patients with severe pulmonary dysfunction were cared for by a pulmonologist in the postoperative period.

Remaining questions include the role of mesh reinforcement and the Collis gastroplasty. In addition, further research is needed to more accurately predict patients who will encounter recurrent hiatal hernias. Long-term randomized mesh trials with objective hernia recurrence follow-up are underway but a good alternative for the short esophagus is still needed as the Collis gastroplasty often renders the patient symptomatic with heartburn and acid regurgitation.

Conclusion

Recurrent hiatal hernia repair is indicated when symptoms match anatomical findings. Patience in finding the correct operative planes will minimize complications and the use of the transthoracic approach allows accurate identification and treatment of the short esophagus.

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