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Surgical strategies for recurrent hiatal hernia: three-point fundoplication fixation

Yuxiao Chu^{1†}, Yanyang Liu^{1,2,3†}, Rong Hua^{1*} and Qiyuan Yao^{1*}

Abstract

Background The management of a recurrent (symptomatic) hiatal hernia remains controversial. This study aimed to review the outcomes of patients who underwent recurrent repair of hiatal hernias.

Methods Thirteen patients who underwent recurrent hiatal hernia repairs at our hospital between 2018 and 2024 were reviewed retrospectively. The postoperative outcomes and complications of these patients were investigated.

Results Thirteen patients were included in this study. The median time of reoperation from the previous hiatal hernia repair was 3 years (IQR, 2.5–5). Patients with a history of only one repair accounted for 76.9%, whereas those with two repairs accounted for 23.1%. All reoperations were completed laparoscopically. No deaths or readmissions during the 30-day postoperative period were recorded at an average of 30.5 ± 20.9 (6–68) months of follow-up. No other complications or symptoms were recorded, and oral medication was discontinued in eleven (84.6%) patients. The average GERD-Q score was 6.7 ± 1.3 postoperatively, whereas it was 10.4 ± 3.0 preoperatively.

Conclusion We present several surgical strategies for addressing the recurrence of hiatal hernias. The key is not only to accurately close the hernia ring but also to fix the fundoplication to reduce the impact on the tissue around the hiatus to reduce the incidence of recurrence. Our three-point fixation technique showed promising effects in preventing recurrence but needs further study.

Clinical Trial Number ChiCTR2100049995.

Keywords Hiatal hernia, Mesh, Recurrence, Reoperation, Surgical strategy

Introduction

Gastroesophageal reflux disease (GERD) refers to the symptoms and complications caused by the reflux of stomach or duodenal contents into the esophagus. The prevalence of GERD has now reached 13% worldwide [1]. Hiatal hernia, a significant anatomic cause of GERD, has an incidence of up to 20% [2]. Laparoscopic repair of hiatal hernias along with fundoplication has been proven to be the preferred treatment for GERD and hiatal hernias. However, the postoperative recurrence rate of hiatal hernias is high. It has been reported that the recurrence rates range from 25 to 42%, which may put patients at risk of reoperation [3]. At present, the management of recurrent hiatal hernias remains controversial. In this study, we aim to perform a retrospective investigation of

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patients who underwent repair of recurrent hiatal hernias and present the three-point fixation as a surgical strategy to treat recurrent hiatal hernias.

Methods

Patient selection

Patients who underwent recurrent hiatal hernia repair from January 2019 to March 2024 were enrolled in this study. Inclusion criteria: Patients ≥ 18 years of age, underwent hiatal hernia repair before, and presents of recurrences. Exclusion criteria: Patients < 18 years of age, underwent other abdominal or chest surgery before.

Patients were assessed at our hospital prior to surgery. At our center, computerized tomography (CT) and gastroscopy are routinely employed for diagnosing recurrent hiatal hernia. While an enlarged hernia ring may be visible during gastroscopy, CT provides a clearer and more detailed visualization. Figure 1 shows a typical coronal and sagittal CT scan of a recurrent hiatal hernia. The following data were collected: age, sex, body mass index (BMI), symptoms, comorbidities, postoperative hospital stay days, number of previous repairs, use of mesh, type of fundoplication, 30-day readmission, and preoperative and postoperative GERD-Q scores. The data of preoperative hiatal surface area was collected as well [4].

Surgical methods

Among the thirteen cases, nissen fundoplication was observed in eleven patients and toupet fundoplication in two patients. Two main situations of previous fundoplication were usually observed. (i) In 12 (92.3%) patients, the hiatal hernia ring was significantly enlarged, the position of the original fundoplication relative to the gastroesophageal junction was significantly lowered, and there was an obvious *de novo* fundus

above the fundoplication. These patients often experience severe reflux and eating obstruction symptoms. In these cases, after the hernia ring is closed, the original fundoplication must be removed, and a new fundoplication should be performed. Our center routinely uses three-point fixation around the new fundoplication: one suture of the left posterior side of the fundoplication with the left phrenoesophageal ligament, one suture of the right upper side of the fundoplication with the right phrenoesophageal ligament, and one suture with the right posterior side of the fundoplication with the right diaphragmatic crura. Each fixed point was sutured in figure-of-8-suture with 2–0 nonabsorbable sutures (Ethibond). The suture technique and three-point fixation are presented in Fig. 2.

(ii) In one patient, fundoplication was at the correct position, but the hiatal hernia ring was significantly enlarged. Part of the proximal stomach was herniated upward into the chest. Symptoms of this type were mainly chest distress, pain, and feelings of obstruction. Several main types of adhesions found during surgery are presented in Fig. 3. To address this situation, the adhesion around the hernia ring should be carefully dissociated. After that, fundoplication should be restored back to the abdominal cavity, and the hernia ring should be closed by intermittent suture posterior to the esophagus with 2–0 nonabsorbable sutures (Ethibond). Instead of removing the previous fundoplication, our center normally uses three points. Under these two conditions, the size of the recurrent hernia ring and the strength of the diaphragm crura determine whether the synthetic mesh should be placed. If the diaphragmatic crura is weak and the diameter of the hernia ring is larger than 4 cm, a Dynamesh® synthetic mesh can be placed.

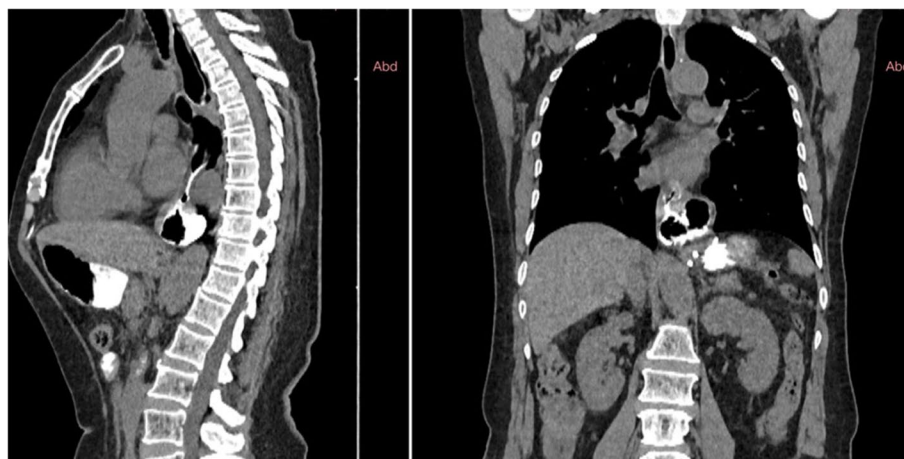


Fig. 1 Typical preoperative coronal and sagittal CT scan of recurrent hiatal hernia

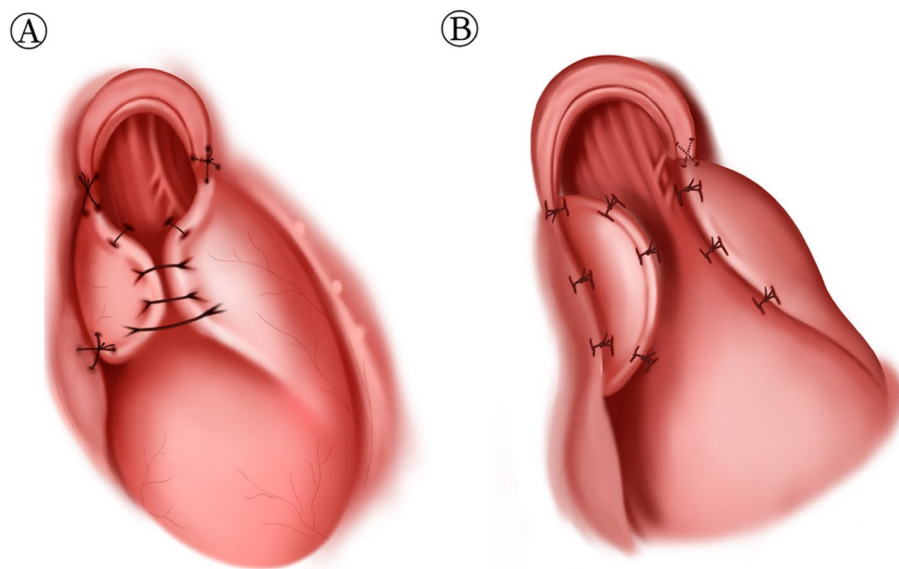


Fig. 2 Schema clarifying the suture technique and three-point fixation. **A** three-point fixation with Nissen fundoplication; **B**, three-point fixation with Toupet fundoplication

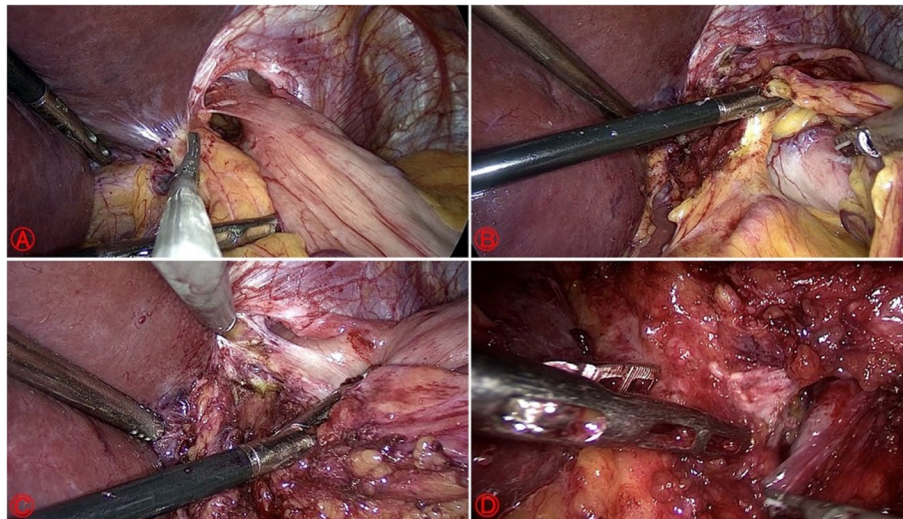


Fig. 3 Typical adhesions observed in surgery. **A** adhesion between the liver and the stomach; **B** adhesion around the lesser curvature of the stomach; **C**, adhesion around the hernia ring; **D**, adhesion of the fundoplication

Follow-up

Thirteen patients were included in this study, completing a mean follow-up of 30.5 ± 20.9 months, with a maximum follow-up of 5 years. All patients were followed up regularly postoperatively. Symptoms such as reflux, epigastric/abdominal pain, heartburn, nausea, and vomiting were recorded. The postoperative GERD-Q score were recorded as well (6.7 ± 1.3).

Results

The preoperative data are presented in Table 1. Thirteen patients who underwent repair of recurrent hiatal hernias were included in this study. Among them, 5 (38.5%) were male, and 8 (61.5%) were female. The average age of the patients was 64.7 ± 5.4 years (range, 54–73 years). The mean BMI was 23.7 ± 3.1 kg/m² (17.8–28.7 kg/m²). Two patients had diabetes, and one patient had hypertension.

Table 1 Demographics and Symptom Distribution Preoperatively

Characteristic	Data
Gender, n	
Female	8
Male	5
Age, years	
Mean $\pm$ SD	64.7 $\pm$ 5.4
Range	54–73
BMI, kg/m ²	23.7 $\pm$ 3.1
Hypertension	1
Diabetes	2
Symptom distribution, n	
Dysphagia	10
Heartburn/reflux	9
Regurgitation	7
Epigastric/abdominal pain	4
Nausea	3
Chest pain	3
Vomiting	2
Asymptomatic	1
Symptom number per patient, n	
0	1
1	7
2	3
3	2
GERD-Q score	10.4 $\pm$ 3.0
Prior repair data	
Time from initial repair to recurrent repair, year, median	3
Range	2–10
Numbers of prior repairs, n	
1	10
2	3
Prior repair types, n	
Laparoscopic operation	10
Open abdominal operation	2
Endoscopic operation	1
Prior fundoplication types, n	
Nissen fundoplication	10
Toupet fundoplication	2
No fundoplication	1
Hiatal surface area, cm ²	14.4 (4.3–22.9)

All patients were symptomatic, with reflux and heartburn being the most common symptoms. In terms of the GERD-Q score, all but one patient achieved a score over 8, with an average of 10.4 ± 3.0 (range, 6–15). One patient presented with incarceration and gastric retention and required emergency surgery. The average length of time from prior hiatal hernia repair to revision was

Table 2 Intraoperative Findings (under line 102)

Intraoperative fundoplication finding	Data
Urgency, n	
Elective	12
Emergency	1
Operative recurrent hiatal hernia repair, n	
Suture repair only	8
Suture repair with a mesh	5
Mesh choice, n	
Biological	0
Synthetic	5
Type of re-do anti-reflux procedure, n	
Nissen fundoplication	9
Toupet fundoplication	3
No fundoplication	1
Hiatal recurrent defect location operative finding, n	
Anterior hiatal defect	8
Posterior defect	4
Circumferential defect	1
Operative time, min	134.1 $\pm$ 62.3
Postoperative average hospital stays days, d	5.5 $\pm$ 3.7

4.3 $\pm$ 2.4 years (range, 2–10 years). Ten patients (10/13, 76.9%) had a history of only one repair. The remaining three patients (3/13, 23.1%) had a history of two repairs. The technique used prior to repair in 12 patients was closure of the hiatus; one patient underwent endoscopic cardia reduction. Ten patients had Nissen fundoplication, and the remaining two patients had Toupet fundoplication. The median of hiatal surface area was 14.4 (range, 4.3–22.9) cm².

The intraoperative and surgical findings are presented in Table 2. All operations were completed laparoscopically, and 5 patients had mesh reinforcement. All but one patient removed the prior fundoplication and had fundoplication reconstruction, 9 Nissen fundoplications, and 3 Toupet fundoplications. The postoperative hospital stay length was 5.5 ± 3.7 days (range, 1–14 days). The mean operation time was 137.0 ± 62.3 min.

The postoperative patient information is presented in Table 3. No deaths or readmissions during the 30-day postoperative period were recorded. All patients completed the follow-up, with a median follow-up period of 26 months. Two patients reported heartburn and reflux when hungry. The condition of patients can be relieved after eating. No other complications or symptoms were recorded, and oral medication was discontinued in the other eleven patients. No patients experienced recurrence of hiatal hernia or reoperation for symptoms. The GERD-Q score was 6.7 ± 1.3 postoperatively. Only two patients achieved a score greater than 8. A typical

Table 3 Postoperative Patients' Information (under line 114)

Postoperative patients' information	Data
Mean follow-up time, months	30.5 ± 20.9
30-days readmission	0
Recurrence rate	0
Medication use	2
Symptom distribution, n	
Dysphagia	1
Heartburn/reflux	0
Regurgitation	1
Nausea	0
Epigastric/abdominal pain	0
Vomiting	0
GERD-Q score	6.7 ± 1.3

postoperative coronal and sagittal CT scan of a patient is presented in Fig. 4.

Discussion

The purpose of this study was to perform a retrospective investigation of patients who underwent repair of recurrent hiatal hernias and present the three-point fixation as a surgical strategy of recurrent hiatal hernia. The results showed that fixation of the left and right sides of fundoplication with the phrenoesophageal ligament can effectively ameliorate patients' symptoms and reduce the incidence of recurrence.

Recurrence of hiatal hernia is the main cause of hiatal hernia reoperation, and it is also a challenge for surgeons [5]. As the repair of a hiatal hernia is different from other hernia repairs, the hiatus cannot be sutured entirely to ensure that the esophagus can function normally in the chest and abdominal cavity. Many factors contribute to the recurrence of hiatal hernias, including the size of the

primary hernia ring, the use of mesh prior to surgery, and the decrease in strength in front of the esophagus [6]. Postoperative recurrence of hiatal hernia can be roughly divided into radiologic recurrence and symptomatic recurrence. Surgical intervention is often not required for asymptomatic radiologic recurrence [7]. Patients with recurrent GERD symptoms can be treated with medication first. If effective, surgical intervention is also not needed. Otherwise, surgical intervention is necessary. According to a study of 307 patients, the incidence of symptomatic recurrence of hiatal hernia postoperatively was 20.8% [3]. Another study reported that the radiologic recurrence rate of hiatal hernias was approximately 16% one year after surgery and 39% five years after surgery [8]. Similarly, a study reported that the incidence of hiatal hernia recurrence was as high as 57% [9].

The recurrence of hiatal hernias is closely related to the size of the primary hernia defect. It has been reported that if the defect size is greater than 5 cm, the incidence of recurrence significantly increases to approximately 16% [3]. Another study compared the recurrence incidence of defects larger and smaller than 5 cm, indicating that defects larger than 5 cm had a higher recurrence rate (11.9%) than defects smaller than 5 cm (3.9%) [10]. However, one study reported that the size of the defect is not a factor of anatomic recurrence [11].

The increased tensile strength of the diaphragmatic esophageal ligament anterior to the esophagus is a physiologic factor of recurrence, and the recurrence of esophageal hiatal hernia tends to occur anterior to the esophagus. Through intraoperative investigation, we observed 8 (61.5%) anterior or left-anterior defects, 4 (30.8%) posterior defects, and 1 (7.7%) circumferential defect, which is consistent with the findings of Linnaus et al., who analyzed 130 recurrent hiatal hernia videos and revealed that anterior recurrence of hiatal hernia was



Fig. 4 Postoperative coronal and sagittal CT scans

most common (67%) [12]. Similarly, in another observational study, the anterior recurrence rate was 67% in 108 patients [13]. Recurrent hiatal hernias may result from the shortening or retraction of the abdominal esophagus postsurgery, along with increased pressure in the anterior esophagus due to the presence of folding collaterals. These factors ultimately weaken the diaphragmatic–esophageal ligament anterior to the esophagus, enlarging the hiatus hernia and leading to recurrence. Consequently, late postoperative recurrence of hiatal hernia predominantly occurs anterior to the esophagus, whereas early recurrence is often attributed to failed posterior hernia repair.

According to the findings we observed intraoperatively, almost all the prior funduplications were removed, which is consistent with the guidelines for esophageal hiatal hernia issued by the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) in 2013, which mentioned that for recurrent hiatal hernias, it is necessary to take down the entire exposure fundoplication and the left and right crura [14]. In addition, an adequate length of the abdominal esophagus must be freed. However, the guidelines do not specify whether mesh reinforcement is needed. Furthermore, recent updates to relevant guidelines and consensus statements have not provided new guidance on recurrent hiatal hernias [15, 16].

To decrease recurrence, many surgeons choose to use mesh at the hiatus intraoperatively. Mesh is often cut into a U shape and placed over the posterior crural region for repair [17]. However, according to a random controlled trial, the recurrence rate was more than 50% in both the mesh and nonmesh-reinforced study groups [9]. Through the findings of our study and other studies, most recurrences resulted from anterior defects as opposed to failure of posterior suture. If the mechanism of recurrence of hiatal hernia is dilation of the hiatus, rather than disruption of the prior repair, the use of mesh would be debatable. Several surgeons have attempted to place the mesh anteriorly or use a reverse-C shape [18]. However, long-term results are needed to prove the benefits.

The pathophysiology of recurrent hiatal hernia may result from widening of the anterior and left lateral portions. According to the opinion of Linnaus [12], more attention is needed on the ‘tightness’ of the initial hiatal closure. The balance between a tension-free hiatus and tight closure of the hiatus is difficult to achieve. Even if a surgeon can tightly close the hiatus, pressure anterior to the esophagus always exists. Therefore, we tried to solve this problem through fixation via fundoplication in the abdominal cavity. Additional fixation points have been reported previously. Mendis et al. performed a technique in which bilateral esophageal fixation was incorporated to reduce recurrence [19]. However, we fixed the left and

right sides of fundoplication, with the phrenoesophageal ligament acting as a form of additional phrenoesophageal membrane repair. The phrenoesophageal ligament is involved in the stabilization of the gastroesophageal junction in the abdomen against reflux [20]. Similarly, Elmaleh et al. confirmed the importance of the phrenoesophageal ligament in reducing GERD [21]. In the study of Indja et al., they reconstructed the phrenoesophageal ligament by suturing the esophagus with the crura and showed good results [22]. While we fixed the left and right part of fundoplication with the phrenoesophageal ligament and the right crura. The esophagus and the fundoplication were also sutured, which may decrease the tension and the risk of dysphagia. Through our fixation, fundoplication was firmly maintained to reduce the impact of fundoplication against the hiatus to maintain the tensile strength of the hiatus. The last fixation of the fundoplication with the right diaphragmatic crura prevented the shift of fundoplication to further decrease the pressure of the hiatus.

Eleven patients (84.6%) achieved complete recovery after the operation, and no symptoms or complications were recorded. Additionally, the medications were abandoned three months after the operation. The average operation time was 137 ± 57.4 min, which is significantly less than Linnaus’s 198 min (153–237 min) [12]. The average length of hospital stay was 5.5 ± 3.7 days. Considering that 11 (84.6%) patients were over 60 years old, a shorter operation time was safer. According to the GERD-Q score results, 11 patients achieved a score < 8 and did not have any symptoms. We theorize that three-point fixation would be an effective measure to prevent the recurrence of hiatal hernias and make the operation easier and more valid. However, further investigations and prospective clinical studies are needed to confirm these findings.

There are several limitations in our study. The first limitation is the small sample size. However, this is unavoidable because of the low incidence of recurrent hiatal hernias. Additionally, we lack postoperative imaging results for these patients, such as CT or endoscopy, to confirm improvements in patients. However, the indications for reoperation are usually based on the symptoms of patients. Thus, we assume that symptoms and the GERD-Q score are more significant.

Conclusion

Recurrent hiatal hernia repair is challenging. We present several surgical strategies for addressing this issue. Fixation of the left and right sides of fundoplication with the phrenoesophageal ligament can effectively reduce the impact on the tissue around the hiatus hernia ring

to reduce the incidence of recurrence as a form of additional phrenoesophageal membrane repair.

Abbreviations

GERD	Gastroesophageal reflux disease
CT	Computerized tomography
BMI	Body mass index
SAGES	The Society of American Gastrointestinal and Endoscopic Surgeons

Authors' contributions

Yuxiao Chu and Yanyang Liu conceived of the presented idea. Yuxiao Chu developed the theory and performed the computations. Rong Hua verified the analytical methods. Qiyuan Yao supervised the findings of this work.

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Data availability

The data that support the findings of study are available on request from the correspondings author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Huashan Hospital (No. 2021–610). The study protocol followed the provisions of the Declaration of Helsinki of 1995 (as revised in Brazil, 2013). Informed consent to participate was obtained from all of the participants in the study.

Consent to publication

Written informed consent for publication was obtained from all participants.

Competing interests

The authors declare no competing interests.

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