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# Predictors of Hiatal Hernia Recurrence After Laparoscopic Anti-reflux Surgery with Hiatal Hernia Repair: a Prospective Database Analysis

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## Abstract

**Background** The aim of this study is to identify factors that can predict hiatal hernia recurrence (HHR) in patients after anti-reflux surgery with hiatal hernia (HH) repair.

**Methods** A single-institution, prospectively collected database was reviewed (January 2002–October 2015) with inclusion criteria of GERD and laparoscopic anti-reflux (AR) surgery with HH repair. Demographics, esophageal symptom scores, and pre- and post-upper gastrointestinal imaging (UGI) were collected. Mesh usage, HH type (sliding, paraesophageal (HH) or type IV), and size were evaluated, and patients who had HHR versus those who did not (NHHR) were compared. Statistical analysis was performed using IBM SPSS v.23.0.0, with $\alpha = 0.05$.

**Results** Three hundred twenty-two patients met inclusion criteria. Mean age was 56.9 ± 14.8 years (60.9% female), and mean follow-up was 19.9 ± 23.8 months. 88.2% underwent total fundoplication and 11.8% underwent partial fundoplication. HHR rate was 15.5%. HHR patients had larger HH than the NHHR group. There was no significant difference between groups for age, gender, BMI, race, and mesh usage. Only 3 patients (10.3%) with HHR reported mild-to-moderate heartburn, regurgitation, and solid or liquid dysphagia at 12-month follow-up. Overall reoperation rate was 1% in this population.

**Conclusions** HHR is correlated with large hernia size. Mesh use and patient BMI were not predictors, and no correlation was identified between HHR and presence of GERD symptoms. Recurrence after repair is not uncommon, but is asymptomatic in most cases. Reoperation is rare and mesh is not routinely needed. Large asymptomatic HHs in the elderly often do not require intervention.

**Keywords** Hiatal hernia repair · Predictors of recurrence · Mesh · Body mass index

## Introduction

Hiatal hernias (HHs) are defined as a prolapse of a portion of the stomach through the diaphragmatic esophageal hiatus and are associated with increased intraabdominal pressure. While most patients remain asymptomatic, those that exhibit symptoms most frequently present with gastroesophageal reflux. Some patients complain of post-prandial fullness, nausea, retching, and vague intermittent epigastric or substernal pain. Others may demonstrate respiratory symptoms, such as dyspnea or bronchospasm, thought to be attributed to extrinsic left atrial compression and progressive laxity of ligaments of the herniated stomach allowing intermittent obstruction with rotation along its long axis causing aspiration of gastric fluid into the tracheobronchial tree, respectively.[1,2] The approach to HH repair is constantly evolving with ongoing debate regarding indications for repair, methods of diagnosis, and optimal surgical technique. With the majority being asymptomatic, surgical repair is reserved for symptomatic patients with large hernias and gastroesophageal reflux disease (GERD) refractory to medical management. Surgical intervention is also indicated for management of complications such as gastric volvulus, bleeding, obstruction, strangulation, perforation, and respiratory compromise due to compression from hernia contents.[3]

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HH can be incidentally found on routine imaging but is typically discovered during GERD evaluation with radiologic studies, manometry, or endoscopy. Barium swallow is the most sensitive test for identifying the presence of sliding hernias > 2 cm and paraesophageal hernias. Closure of the esophageal hiatus is the crucial step in HH repair and for recurrence prevention. Barium studies are often obtained during operative planning; however, a direct correlation between the radiologically predicted hernia size and the size of the hernia defect measured during laparoscopy has not been demonstrated.[4] Laparoscopic approach for HH hernia repair has rapidly increased over the past decade and is now widely accepted as the standard of care for this procedure. Its improved clinical outcomes when compared to the traditional open approach have shown to significantly decrease perioperative complication and 30-day mortality rates.[5]

The rate of radiographic hiatal hernia recurrence after anti-reflux surgery has been reported to be 15 to 60%.[6] The clinical significance of radiologic recurrence is questionable, however, as asymptomatic patients generally do not require reoperation. Use of mesh reinforcement was initiated in an effort to reduce HH recurrence rates; however, its efficacy remains contentious. Recent randomized clinical trials have demonstrated that mesh reinforcement results in equal HH recurrence and symptomatic outcome compared to primary suture repair.[7] Our prospective analysis aims to look beyond the argument for or against the use of mesh, in order to identify both patient factors and hernia characteristics that are predictive of recurrence after laparoscopic anti-reflux surgery with HH repair.

## Materials and Methods

This is a retrospective analysis of a prospectively collected database that has been populated and maintained at the University of Nebraska Medical Center since 2002. This database was queried for patients with diagnosis of GERD or symptomatic HH, who underwent anti-reflux surgery with concomitant HH repair between January 2002 and October 2015. Only adult patients who underwent primary laparoscopic repair were included in this study. Exclusion criteria included patients under 18 years of age, patients with previous esophageal or gastric operations, and patients with associated gastrointestinal disease that required extensive medical or surgical intervention. Patients with an asymptomatic large paraesophageal hernia (PEH) and patients with other symptoms than GERD were also included. Their symptoms included dysphagia, Cameron's ulcer, intermittent volvulus, and early satiety. No asymptomatic, non-surgical patients with HH were included. The technique used for the anti-reflux surgery with hiatal herniorrhaphy with or without mesh was previously described, and the decision to use partial or total fundoplication was selected based on preoperative manometry.[8] All mesh utilized were absorbable and comprised acellular dermal matrix (LifeCell Corp, Branchburg, NJ), biosynthetic mesh (W.L. Gore & Associates, Inc.), or biologic porcine mesh (LifeCell Corp, Branchburg, NJ). Approval for this study was obtained from our Institutional Review Board.

### Outcomes Measured

Patient demographics, smoking status, and medical and surgical history were collected. Intraoperative data comprised use of mesh during HH repair and hernia characteristics, blood loss, approach conversion, and operative room time. Hernia size was measured in centimeters preoperatively using upper gastrointestinal imaging (UGI) and/or upper endoscopy (EGD), with height above the diaphragm, and this information was used to divide them into three categories: small (≤ 2 cm), moderate (2–4 cm), large (≥ 5 cm). Esophageal symptom scores were assessed using a 14-symptom questionnaire based on frequency that the patients experienced symptoms (0 = never, 1 = once per month, 2 = twice per week, 3 = daily, 4 = several times per day).[8–10] Data on medication use, such as proton-pump inhibitors (PPI), were also collected. Preoperative esophageal studies included UGI, esophageal manometry, and EGD. A preoperative pH study was performed in all patients, unless a large PEH (greater than 5 cm) was present or esophagitis was seen on biopsy. UGI was also performed at 1 year post-operatively or earlier if clinically indicated. Patient outcomes were assessed preoperatively and at 1 (1-mo), 6 (6-mo), and 12 months (12-mo) and at long-term (LT) follow-up. Hernia recurrence was assessed post-operatively with upper GI contrast study (UGI) and was defined as maximal vertical height of a hernia ≥ 2 cm above the diagram, as previously described.[11] Reoperation was offered to patients with post-operative documented GERD, with concurrent esophagitis seen on EGD or pH testing with DeMeester score greater than 14.8.

### Statistical Analysis

Patients were divided into two groups, according to hernia recurrence status: non-recurrence of hiatal hernia (NHHR) and hiatal hernia recurrence (HHR). Comparisons were made between the two groups. Categorical data were presented as frequency, whereas continuous data were expressed as mean ± standard deviation (SD) or median and interquartile range (IQR) according to normality. Esophageal symptom scores consisting of heartburn, regurgitation, and solid and liquid dysphagia were monitored over time for improvement or worsening. The non-parametric sign test with Bonferroni correction was used to determine significant of symptom improvement at 12-month and long-term follow-up. A logistic regression was performed for the variables of age, BMI, smoking status, hernia size, and mesh usage, to assess independent relationship between each variable and hernia

recurrence. All statistical analyses were performed using IBM SPSS v.23.0.0, with $\alpha = 0.05$.

## Results

Out of 691 patients who had anti-reflux surgery in this period, 322 had a concomitant HH repair and returned for UGI. Mean age was 56.9 ± 14.8 years, and majority of patients were female (60.9%) and Caucasian (97.0%). All 322 patients had surgery performed using a laparoscopic approach, with 88.2% and 11.8% receiving a total and partial fundoplication, respectively.

Mean follow-up of time was 19.9 months [6 months–10 years]. Overall HH recurrence rate was 15.5% (NHHR: $N = 272$; HHR: $N = 50$). Patients who had HH recurrence had larger HH compared to the NHHR group (Table 1). There was no significant difference between the groups for the variables of age, gender, BMI, race, smoking status, fundoplication time, and mesh usage (Table 1). Logistic regression analysis revealed that hernia size ≥ 5 cm was independently associated with recurrence of HH (OR 2.996, CI 1.221–7.353; $p = 0.017$), whereas age ($p = 0.809$), preoperative BMI ($p = 0.784$), smoking status ($p = 0.937$), and use of mesh ($p = 0.560$) were not associated with post-operative recurrence (Table 2).

There was a significant overall improvement of esophageal symptoms at 6-mo and 12-mo follow-up, compared to the baseline, for both groups (Tables 3 and 4). In the NHHR group, there was a significant improvement for heartburn, regurgitation, solid dysphagia, and liquid dysphagia ($p = <0.001$). Even the HHR group had an improvement for heartburn ($p = <0.001$), regurgitation ($p = <0.001$), and solid dysphagia ($p = 0.001$). There was no significant improvement for liquid dysphagia at 6 months ($p = 0.453$) or 12 months ($p = 0.063$). Among all patients with HH recurrence, only 3 patients reported mild-to-moderate heartburn, regurgitation, and solid or liquid dysphagia at 12-mo post-operatively. Mean size of HH recurrence was 4.5 ± 1.4 cm, with majority (42%) being of moderate size. Out of the 50 patients who had a HHR, only 6% ($N = 3$) required a redo HH repair, and all had a large HH. Overall rate of reoperation was 1%.

## Discussion

While recurrence rates of HH after laparoscopic anti-reflux surgery have been studied and reported as 12 to 59%, reliable predictors of hernia recurrence have not yet been identified.[6] Our study found that among patients with HH recurrence, only 10.3% reported gastroesophageal reflux symptoms.

**Table 1** Patient demographics and hernia characteristics between the two groups—$N = 322$

| | NHHR, $N = 272$ | | HHR, $N = 50$ | | $p$-value* |
|---|---|---|---|---|---|
| | $N$ | % | $N$ | % | |
| Age (years)—mean | 57 ± 15.02 | | 57 ± 13.89 | | 0.867 |
| Gender | | | | | |
| Male | 102 | 37.5% | 24 | 48.00% | 0.162 |
| Female | 170 | 62.5% | 26 | 52.00% | |
| BMI (kg/m$^2$)—median | 28.9 (26.1–32.4) | | 29.7 (27.4–33.3) | | 0.085 |
| Race | | | | | 0.715 |
| Caucasian | 244 | 96.8% | 45 | 97.8% | |
| Other | 8 | 3.2% | 1 | 2.2% | |
| Smoking status | | | | | 0.701 |
| Yes | 61 | 29.5% | 12 | 32.4% | |
| Hernia size | | | | | *0.006* |
| Small (≤ 2 cm) | 77 | 36.0% | 5 | 14.3% | |
| Moderate (2–4 cm) | 21 | 9.8% | 1 | 2.9% | |
| Large (≥ 5 cm) | 116 | 54.2% | 29 | 82.9% | |
| Fundoplication type | | | | | 0.478 |
| Nissen | 238 | 87.5% | 46 | 92.0% | |
| Partial fundoplication | 34 | 12.5% | 4 | 8.0% | |
| Mesh use | | | | | 0.391 |
| Yes | 214 | 78.7% | 42 | 84.0% | |
| No | 58 | 21.3% | 8 | 16.0% | |

*HHR* hiatal hernia recurrence, *NHHR* non-recurrence of hiatal hernia, *N* total population

*Significance at $p < 0.05$

**Table 2** Logistic regression for the odds of developing a hiatal hernia recurrence post-operatively

| | OR | 95% CI | | *p*-value |
|---|---|---|---|---|
| Age (years) | 0.997 | 0.971 | 1.023 | 0.809 |
| BMI (kg/m$^2$) | 1.010 | 0.941 | 1.084 | 0.784 |
| Smoking status | | | | |
| No | Reference | | | |
| Yes | 1.034 | 0.454 | 2.356 | 0.937 |
| Hernia size | | | | |
| < 5 cm | Reference | | | |
| ≥ 5 cm | 2.996 | 1.221 | 7.353 | *0.017* |
| Mesh use | | | | |
| No | Reference | | | |
| Yes | 1.400 | 0.452 | 4.338 | 0.560 |

*p*-value is significant if < 0.05

*OR* odds ratio, *CI* confidence interval

Recurrent hernias were more common in patients with large (> 5 cm) hernias. Ultimately, only 6% of these recurrent HH patients required reoperation. Identifying predictors of HH recurrence is the first step towards decreasing the recurrence rate after a laparoscopic repair.

HH size has been studied as a predictor of HH recurrence with varying results. Jones et al. found that larger hernia size (> 5.0 cm) was a significant predictor of recurrence in a study involving 209 patients.[6] A retrospective study of 598 patients reported a higher recurrence rate for large hernias (11.9%) than for small hernias (3.5%).[12] However, in a smaller study comprised 41 patients, hernia size was not found to be a significant predictor of HH recurrence.[13] Likewise, a recent retrospective study at a single institution revealed that hernia characteristics did not seem to affect recurrence rates.[14] A prospective study of 111 patients was not able to show that HH size was a statistically significant predictor of recurrence, but it did note that hernias with a larger intrathoracic stomach component were more likely to recur compared to those limited to gastric cardia and fundus involvement.[15] Our study found hernia size to be a statistically significant predictor with 82.9% of the HHR group having a large (> 5.0 cm) hernia compared to 54.2% of the NHHR group ($p = 0.006$).

Patient age has also been studied as a predictor of HH recurrence. Hashemia et al. found that age was not a significant predictor of HH recurrence after laparoscopic repair of large type III hiatal hernias in a study of 41 patients.[13] A 2017 study of 524 patients found that age greater than or equal to 80 years was not a significant predictor of early recurrence after repair of giant paraesophageal hernias.[16] We also found patient age to not be a statistically significant predictor with the NHHR group having an age of 57 ± 15.02 years and the HHR group having an age of 57 ± 13.89 years ($p = 0.867$).

Additional factors that our study investigated included gender, BMI, race, smoking status, and mesh usage. No significant difference was found between groups for any of these variables. A study of 41 patients also found that gender was not a significant predictor and reported that presenting symptoms, manometric esophageal length, nor 24-h pH score were significant predictors of recurrence after repair of large type III HH.[13] Likewise, a PubMed literature search performed for treatment of giant PEH found that mesh use is not associated with lower recurrence rates.[17]

The high prevalence of radiologic recurrence following HH repair does not directly correlate with symptomatic recurrence. Among the HHR group in our study, only 3 patients (10.3%) reported mild-to-moderate heartburn, regurgitation, or solid or liquid dysphagia at 12-month follow-up. The vast majority of recurrences were discovered incidentally with routine UGI. Only 3% of these patients required reoperation which is consistent with the low rates described in the existing literature.[6,13,18] A retrospective study of 221 patients found a hernia recurrence in eight patients (3.6%); however, seven of these were small sliding type and did not require reoperation.[18] Another study of 209 patients reported a radiologic recurrence rate of 21% with no statistically significant

**Table 3** Symptom improvement over time—NHHR

| | | Improved symptom score compared to preoperative baseline | | | |
|---|---|---|---|---|---|
| | Preop prevalence ($N = 177$) Patients, $N$ (%[a]) | 6 months, $N = 151$ | | 12 months, $N = 150$ | |
| Gastrointestinal | | Improved patients, $N$ (%[a]) | *p*-value* | Improved patients, $N$ (%[a]) | *p*-value* |
| Heartburn | 145 (81.9%) | 125/126 (99.2%) | < 0.001 | 101/105 (96.2%) | < 0.001 |
| Regurgitation | 147 (84%) | 122/126 (96.8%) | < 0.001 | 100/106 (94.3%) | < 0.001 |
| Solid dysphagia | 100 (56.5%) | 77/83 (92.8%) | < 0.001 | 65/71 (91.5%) | < 0.001 |
| Liquid dysphagia | 55 (31.1%) | 44/46 (95.7%) | < 0.001 | 39/40 (97.5%) | < 0.001 |

*NHHR* non-hiatal hernia recurrence, *Preop* preoperative, *N* total population

*Significant alpha level cutoff of 0.025 is used instead of 0.05 due to multiple comparisons

[a] Percent improved calculated using denominator as number of patients who replied and were symptomatic preoperatively

**Table 4** Symptom improvement over time—HHR

| Gastrointestinal | Preop prevalence ($N = 36$) Patients, $N$ (%[a]) | Improved symptom score compared to preoperative baseline | | | |
|---|---|---|---|---|---|
| | | 6 months, $N = 32$ | | 12 months, $N = 29$ | |
| | | Improved patients, $N$ (%[a]) | $p$-value* | Improved patients, $N$ (%[a]) | $p$-value* |
| Heartburn | 29 (80.1%) | 23/25 (92.0%) | < 0.001 | 21/23 (91.3%) | < 0.001 |
| Regurgitation | 30 (83.3%) | 22/25 (88.0%) | < 0.001 | 22/23 (95.7%) | < 0.001 |
| Solid dysphagia | 18 (50.0%) | 14/16 (87.5%) | 0.001 | 14/14 (100%) | 0.001 |
| Liquid dysphagia | 7 (19.4%) | 5/6 (88.3%) | 0.453 | 5/5 (100%) | 0.063 |

*HHR* hiatal hernia recurrence, *Preop* preoperative

*Significant alpha level cutoff of 0.025 is used instead of 0.05 due to multiple comparisons

[a] Percent improved calculated using denominator as number of patients who replied and were symptomatic preoperatively

difference in post-operative symptom scores.[6] In opposition to the aforementioned studies, a study of 108 patients found that patients with a recurrent hernia had more chest pain, increased early satiety, and worse physical functioning than patients with no recurrent hernia.[19]

The retrospective nature of the study is a major limitation. Despite having a retention rate of 43.8% after 1 year post-operatively, we were able to follow enrolled patients for a mean of 19.9 months. Since this study comprised a review of 13 years of a prospectively collected database, most of patients who lost to follow-up after a year include elderly and deceased patients due to unrelated reasons, such as cardiopulmonary problems. Our recurrence rate was within the previously established range, and our large sample size allowed us to isolate significant predictors of HH recurrence. Our post-operative follow-up did consist of both objective and subjective data. An UGI was routinely obtained at 12-mo follow-up visits. Esophageal symptom scores were monitored post-operatively using the same 12-symptom questionnaire. The potential for response bias is an inherent limitation of these surveys. Post-operative pH monitoring could be used as an objective measurement; however, its cost would likely outweigh benefits given the low prevalence of symptomatic HH recurrence and need for reoperation.

## Conclusion

In conclusion, this study showed that hernia size is independently associated with higher hiatal hernia recurrence rates. Our results differ from some of the existing literature in that the use of mesh, preoperative BMI, and age did not impact the rate of HHR recurrence. Based on these findings, we suggest that patients with large hernias (> 5 cm) may benefit the most from long-term screening for symptomatic recurrence. Post-operative barium studies should be reserved for patients with symptomatic recurrence only. If a symptomatic patient is diagnosed with HH using CT, X-ray, endoscopy, or manometry and meets criteria for surgical intervention, a routine preoperative barium study may still be warranted in order to evaluate size and determine if there is a higher likelihood of recurrence.

**Author Contribution** The contribution of each author, as defined by the ICMJE guidelines, is as follows: PRA: data acquisition, analysis, and interpretation; drafting and revision; final approval; accuracy and integrity; BP: data acquisition, analysis, and interpretation; revision; final approval; accuracy and integrity; MM: data acquisition, analysis, and interpretation; revision; final approval; accuracy and integrity; SP: data acquisition, analysis, and interpretation; drafting; final approval; accuracy and integrity; DO: design of work, data acquisition, analysis, and interpretation; revision; final approval; accuracy and integrity.

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## Compliance with Ethical Standards

Approval for this study was obtained from our Institutional Review Board.



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