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Open versus Laparoscopic Hiatal Hernia Repair

Terrence M. Fullum, MD, Tolulope A. Oyetunji, MD, MPH, Gezzer Ortega, MD, MPH, Daniel D. Tran, MD, Ian M. Woods, BS, Olusola Obayomi-Davies, BS, Orighomisan Pessu, BS, Stephanie R. Downing, MD, Edward E. Cornwell, MD

ABSTRACT

Background: The literature reports the efficacy of the laparoscopic approach to paraesophageal hiatal hernia repair. However, its adoption as the preferred surgical approach and the risks associated with paraesophageal hiatal hernia repair have not been reviewed in a large database.

Method: The Nationwide Inpatient Sample dataset was queried from 1998 to 2005 for patients who underwent repair of a complicated (the entire stomach moves into the chest cavity) versus uncomplicated (only the upper part of the stomach protrudes into the chest) paraesophageal hiatal hernia via the laparoscopic, open abdominal, or open thoracic approach. A multivariate analysis was performed controlling for demographics and comorbidities while looking for independent risk factors for mortality.

Results: In total, 23,514 patients met the inclusion criteria. By surgical approach, 55% of patients underwent open abdominal, 35% laparoscopic, and 10% open thoracic repairs. Length of stay was significantly reduced for all patients after laparoscopic repair ($P < .001$). Age ≥60 years and nonwhite ethnicity were associated with significantly higher odds of death. Laparoscopic repair and obesity were associated with lower odds of death in the uncomplicated group.

Conclusion: Laparoscopic repair of paraesophageal hiatal hernia is associated with a lower mortality in the uncomplicated group. However, older age and Hispanic ethnicity increased the odds of death.

Key Words: Paraesophageal hiatal hernia repair, Preoperative risk factors, Laparoscopy.

Division of Minimally Invasive and Bariatric Surgery, Department of Surgery, Howard University College of Medicine, Washington, DC, USA (Drs. Fullum, Tran).

Department of Surgery, Howard University College of Medicine, Washington, DC, USA (Drs. Oyetunji, Ortega, Downing, Cornwell).

Howard University College of Medicine, Washington, DC, USA (Drs. Woods, Obayomi-Davies, Pessu).

Address correspondence to: Terrence M. Fullum, MD, Howard University College of Medicine, 2041 Georgia Avenue, NW, Washington, DC 20060. Telephone: 202-865-1286, Fax: 202-865-3063, E-mail: tfullum@howard.edu.

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INTRODUCTION

Paraesophageal hiatal hernia (PHH) accounts for 5% of all hiatal hernias and occurs with increasing incidence in elderly patients.[1–4] Controversies exist regarding its management.[5–8] Historically, surgical repair has been advocated in all patients with PHH (symptomatic patients and incidental diagnoses). Elective PHH repair has been advocated in patients with mild symptoms for 2 reasons: to prevent potentially lethal complications, such as strangulation, incarceration, perforation, and volvulus, as detailed in the studies by Skinner and Hill,[9,10] and to avoid the significant operative morbidity and mortality associated with emergent PHH repair.[11–14] In recent years, physicians proposing conservative and nonsurgical management have scrutinized this dogma.

Proponents of nonsurgical management suggest that previous beliefs about the natural history and the worsening progression of mildly symptomatic PHH are rare in modern medicine, thus negating the need for elective surgery.[15,16] Stylopoulos et al,[17] using a complex decision analysis, concluded that watchful waiting is a better alternative to elective surgery in mildly symptomatic patients. In addition, a plethora of common comorbid conditions in affected elderly patients caused many surgeons to view surgical intervention as high risk in mildly symptomatic elderly patients.[2,15,17,18] Additional controversy exists regarding the choice of surgical approach.[1,5,6] Before the advent of minimally invasive techniques, open surgeries via transabdominal and transthoracic entry were the indicated management of PHH. Since its introduction in 1992, laparoscopic PHH repair (LPHHR) has emerged at the forefront of PHH treatment.[19] A large dataset of patients across the United States treated with different approaches allows for evaluation of perioperative outcomes and has adequate power to determine factors influencing hospital outcome.[16,20,21]

We hypothesize that mortality is lower after laparoscopic repair than after open repair. To test this hypothesis, the Nationwide Inpatient Sample (NIS) was used to (1) determine whether there is a difference in mortality between the 2 approaches and (2) identify risk factors that may be associated with poor in-hospital outcomes after PHH repair.

METHODS

Overview

The NIS is the largest all-payer inpatient care database that is publicly available in the United States. It contains data from 5 to 8 million hospital stays from approximately 1000 hospitals sampled to approximate a 20% stratified sample of US community hospitals. The NIS is drawn from states participating in the Healthcare Cost and Utilization Project, and weights are provided to calculate national estimates.[22] Researchers and policy makers use the NIS to identify, track, and analyze national trends in health care use, access, charges, quality, and outcomes. The large sample size of the NIS enables analyses of rare conditions such as congenital anomalies, uncommon treatments such as organ transplantation, and special patient populations such as the uninsured. Data available within the NIS include patient and hospital demographics, payer information, treatment and concomitant diagnoses, inpatient procedures, inpatient mortality, and length of stay.

Patient Selection

The NIS dataset was queried for patients who underwent open or laparoscopic repair of a complicated or uncomplicated PHH between 1998 and 2005. Open repair included both the transthoracic and transabdominal approaches. Patients were identified according to the relevant *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis and procedure codes **(Table 1)**. ICD-9 codes 553.3 and 552.3 were used to identify patients with uncomplicated PHH and complicated (ie, incarcerated, irreducible, strangulated, or obstructed) PHH, respectively. ICD-9 codes 53.70, 53.72, and 53.75 were used to identify patients who underwent open abdominal PHH repair, whereas ICD-9 codes 53.80 and 53.84 identified patients who underwent open thoracic PHH repair. Patients who underwent LPHHR were identified using ICD-9 codes 53.71, 53.83, and 54.21. Obese and morbidly obese patients were identified with ICD-9 codes 278.0 and 278.01.

Table 1.
ICD-9 Codes Used for Patient Selection

Code	Description
555.3	Diaphragmatic hernia: paraesophageal hiatal hernia
555.2	Diaphragmatic hernia with obstruction: paraesophageal specified as incarcerated, irreducible, strangulated, or causing obstruction
53.70	Repair of diaphragmatic hernia, abdominal approach
53.72	Other and open repair of diaphragmatic hernia, abdominal approach
53.75	Repair of diaphragmatic hernia, abdominal approach, not otherwise specified
53.80	Repair of diaphragmatic hernia with thoracic approach, not otherwise specified
53.84	Other and open repair of diaphragmatic hernia, with thoracic approach
53.71	Laparoscopic repair of diaphragmatic hernia, abdominal approach
52.21	Laparoscopy, peritoneoscopy
52.83	Laparoscopic repair of diaphragmatic hernia, with thoracic approach
278.00	Obesity, unspecified
278.01	Morbid obesity

Statistical Analysis

Statistical analysis was performed with STATA 10.0 statistical software (StataCorp, College Station, TX). Bivariate analysis of categorical data was performed using the χ^2 test. Analysis of continuous data was performed using the *t* test. Bivariate analysis compared length of stay (LOS) and mortality by surgical approach to treat complicated and uncomplicated hernias. Multivariate analysis was performed using multiple logistic regression models, adjusting for age, sex, race, obesity, Charlson score, surgical approach, and complication status. A P value $< .05$ was considered statistically significant. The Charlson score is a comorbidity index that predicts the 10-year mortality for a patient who may have any one or a combination of 22 select comorbid conditions.

RESULTS

A total of 23,514 patients met the inclusion criteria. Patient demographics are shown in **Table 1.** In univariate analysis, mean (median) age was 56 (57) years. A majority of the patients were women (64%) and white (62%). African-American and Hispanic patients each represented approximately 4% of the patient population. Seventeen percent of patients were obese.

When we compared surgical approaches **(Table 2)** we found that 55% of the repairs were performed via the open abdominal approach, 35% by laparoscopy, and 10% by the open thoracic approach. There was no significant difference in odds of death between the open thoracic and open abdominal approaches. In addition, Hispanic ethnicity and age >60 years **(Figure 1)** were associated

Table 2.
Patient Demographics

Overall Patient Demographics			Patient Demographics by Surgical Approach and Year		
Variable	N	%	Open Abdominal (%)	Laparoscopic (%)	Open Thoracic (%)
All patients	23,514				
In-hospital mortality	393	1.67			
Approach					
Open Abdominal	13,011	55.33			
Laparoscopic	8281	35.22			
Open thoracic	2222	9.45			
Gender					
Female	15,119	64	8668 (57.3)	5114 (34)	1307 (8.6)
Male			4321 (51.7)	3124 (37.38)	912 (10.9)
Age (y)	56.15 (Mean)	57 (Median)	58	54	57
<60	16,796	71	8604	6604	1588
>60	6700	28	4394	1673	633
Ethnicity					
White	14,575	62	7953 (54.5)	5254 (36.05)	1368 (9.39)
Black	942	4.04	578 (61.36)	271 (28.77)	93 (9.87)
Hispanic	899	3.82	455 (50.61)	324 (36.04)	120 (13.35)
Obesity	3891	16.55	2742 (70.47)	922 (23.70)	227 (5.83)
Hernia status					
Uncomplicated	19,921	84.72	10258 (51.49)	7859 (39.45)	1804 (9.06)
Mortality			137 (1.34)	45 (0.57)	22 (1.22)
Complicated	3593	15.28	2753 (76.62)	422 (11.75)	418 (11.63)
Mortality			158 (5.75)	16 (3.79)	15 (3.6)
LOS	5.99 (Mean)	4 (Median)	6.91	3.81	8.75

with significantly increased odds of death **(Table 3)**. Male sex and obesity status did not influence odds of death.

Mortality rate in the uncomplicated group was 1.02%. Fifty-one percent of uncomplicated hernias were repaired by the open abdominal approach ($P < .001$). Mortality with the laparoscopic approach (0.57%) was significantly less ($P < .001$) in the uncomplicated group compared with the open abdominal approach (1.34%) and the open thoracic approach (1.22%). In the uncomplicated hernia group, laparoscopic repair was associated with a 49% reduction in odds of death compared with the open abdominal approach (odds ratio [OR], 0.51 [95% confidence interval [CI], 0.34–0.75]; $P = .001$).

Complicated hernias were present in 15% of the patients. The overall in-hospital mortality rate was 1.67%. Mortality in the complicated group was 5.26%. Seventy-seven percent of complicated hernias were repaired using the open abdominal approach ($P < .001$). On multivariate analysis, complicated hernia status was associated with a 2-fold increase in odds of death (OR, 2.02 [95% CI, 1.52–2.67]; $P < .001$) in the entire patient population **(Figure 2)**. In the complicated hernia group, laparoscopic repair was associated with a 41% reduction in odds of death compared with open repair, but the reduction was not statistically significant (OR, 0.59 [95% CI, 0.30–1.19]; $P = .142$). African-American ethnicity and age >80 years were associated with increased odds of death.

Compared with the open abdominal approach, LOS was significantly reduced for all patients who had laparoscopic repair and was increased for patients undergoing trans-

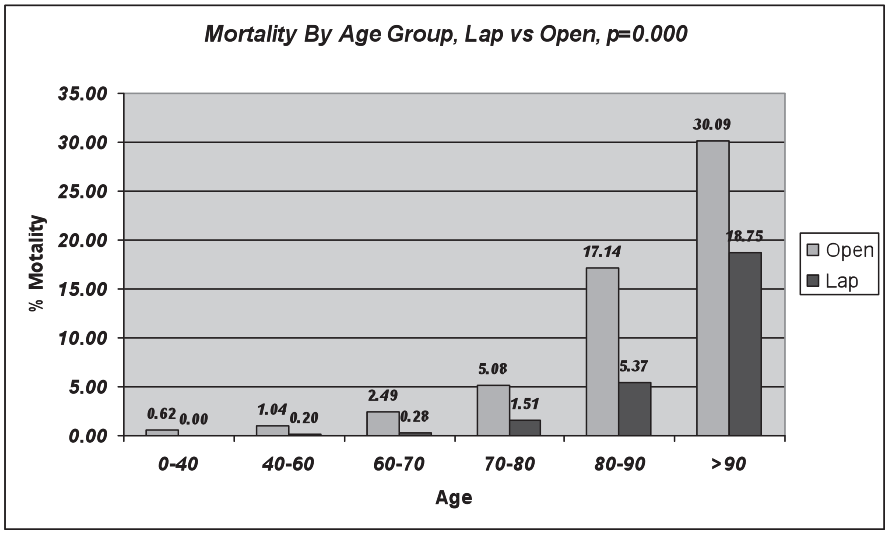

Figure 1. Mortality by age group: laparoscopic versus open, $P = .000$.

Table 3.
Risk Factors Associated with Poor Outcomes in Uncomplicated Versus Complicated Cases of PHH

Risk Factors	Uncomplicated			Complicated		
	Odds Ratio	*P* Value	(95% CI)	Odds Ratio	*P* Value	(95% CI)
Approach (reference open abdominal)						
Laparoscopic	0.509	.001	0.34–0.75	0.594	.142	0.29–1.19
Open thoracic	1.065	.816	0.62–1.83	0.966	.917	0.51–1.82
Age (y) (reference <40)						
≥40 to <60	1.823	.212	0.71–4.68	0.816	.82	0.14–4.69
≥60 to <70	2.847	.042	1.04–7.82	2.78	.189	0.60–12.78
≥70 to <80	6.977	.000	2.79–17.37	4.07	.065	0.91–18.12
≥80 to <90	19.04	.000	7.57–47.88	11.477	.001	2.65–49.65
>90	61.64	.000	22.37–169.84	14.999	.001	3.22–69.73
Race (reference white)						
African American	1.77	.163	0.79–3.93	2.12	.048	1.00–4.46
Hispanic	2.65	.002	1.42–4.91	1.86	.104	0.88–3.93
Sex (reference female)						
Male	0.899	.560	0.63–1.28	1.29	.183	0.89–1.87
Obesity	0.52	.116	0.23–1.17	0.39	.367	0.05–2.99

thoracic repair **(Table 4)**. Patients with complicated hernias remained in the hospital 3.8 days longer ($P < .001$) than patients with uncomplicated hernias. Obesity and age <60 years were associated with shorter hospital stays. Insured patients, male sex, and African-American and Hispanic ethnicities were associated with increased LOS.

DISCUSSION

Hiatal hernias occur partly because of gradual enlargement of the diaphragmatic hiatus. They are generally classified as sliding hiatal hernias (type I), which result from the fixed location of the gastroesophageal junction (GEJ)

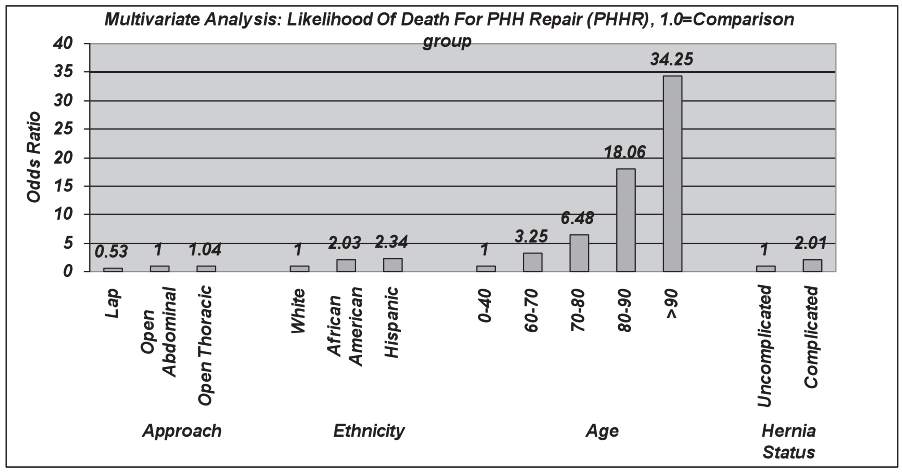

Figure 2. Multivariate analysis: likelihood of death for PHH repair, 1.0 = comparison.

above the hiatus, or as paraesophageal hiatal hernias (type II), in which the fundus of the stomach has herniated through the crural defect but the GEJ remains in its natural anatomic position. Mixed hiatal hernias (type III) are a mixture of type I and type II, in which there is migration of the GEJ into the chest and herniation of a portion of the fundus. Short esophagus (type IV) is caused by foreshortening as a result of esophagitis from gastroesophageal reflux. Type III-IV surgical correction of PHH improves symptoms and averts potentially lethal complications associated with PHH. However, significant operative morbidity and mortality have been reported in PHH repair.[5,6,17] The analysis showed that surgical approach, age >60 years, complicated hernia status, and ethnicity are independent risk factors for increased odds of in-hospital mortality and increased LOS. Male sex and obesity did not affect the risk of in-hospital mortality.

Surgical Approach

PHH repair was most commonly performed via the open abdominal approach. However, numerous studies have demonstrated the safety, efficacy, and durability of LPHHR, but its acceptance as the procedure of choice has not been universal, and no randomized controlled trials comparing the open versus laparoscopic approach exist.[1,3,7,13,14,23–30] Proponents of the open approach argue that LPHHR is associated with a high recurrence rate and intraoperative and postoperative complications, and they tout open PHH repair's comparable, if not superior, results.[31–33] Among the 389 patients with in-hospital mortality, 85% had undergone open repair compared with 15% who had undergone laparoscopic repair. In complicated hernia cases, 92% of patients who died had open hernia repairs. Although there was a clear advantage in mortality rates with LPHHR, it was not possible to identify specific patient circumstances that might have affected mortality given the nature of the collected data in this study. Observable differences (eg, comorbid conditions, geographical variables, complications) that could affect outcome were adjusted using multivariate analysis. LPHHR was found to significantly reduce the odds of death, by 48%. This finding largely agrees with previous studies comparing the open and laparoscopic approaches. Once a hernia became complicated, the overall mortality rate was lower with the laparoscopic approach, but the mortality difference compared with the open repair group was not significant. Therefore, the mortality advantage of LPHHR was lost once the hernia became complicated. This finding supports the opinion that early laparoscopic intervention in asymptomatic patients may be beneficial.

Age

On average, PHH was diagnosed in patients between ages 60 and 70 years.[34] Advanced age was considered an increased operative risk because of the multiple comorbidities in the elderly population. In this study, 46% of patients undergoing PHH repair were older than 60 years. On multivariate analysis, patients aged 60 years or older had a 3-fold increase in the odds of death. These odds increased exponentially every decade thereafter. In patients aged 60 years and older, <27% of repairs were performed laparoscopically despite the demonstrated safety and efficacy of LPHHR in elderly patients.[3,35] Furthermore, nonelective PHH repair has been identified as an independent risk factor, with as high as a 7-fold increase in mortality specifically in elderly patients.[8,36] Given these findings, 2

issues require attention. First, a significant percentage of the elderly patients who underwent open repairs were predisposed to a higher morbidity and mortality. Second, in light of a significant increase in mortality associated with nonelective PHH repair, the benefit of "watchful waiting" for the asymptomatic uncomplicated hernia versus early elective repair deserves a reassessment. In this study, the overall mortality in patients older than 60 years was 26%. This translated to a 48-fold increase in mortality compared with that in individuals younger than 60 years. We theorized that with a patient's advancing age, a previously uncomplicated hernia will likely become complicated, thus requiring urgent or emergent repair. Therefore, "watchful waiting" may prove a costly gamble for physician and patient alike, exchanging the lower risk of an early elective laparoscopic repair for the potentially time-dependent accumulating risk of significant morbidity and mortality.

Complicated Hernia Status

PHHs found to be incarcerated, strangulated, or obstructed were classified as complicated hernias. These hernias made up 15.4% of all identified cases. The mortality rate in this group was 5.3%. With advancing age, the percentage of patients with complicated hernias increases, reaching 51% in the category of patients aged 90 years and older. Compared with uncomplicated hernias, complicated hernias resulted in a 2-fold increase in the odds of in-hospital mortality and increased LOS by 3 days. In the complicated hernia group, 88.3% of patients received open paraesophageal hiatal hernia repair compared with 60.6% of patients in the uncomplicated group.

Ethnicity

It is unclear why African-American and Hispanic patients had significantly increased odds of death compared with white patients. The exact nature of the problem is beyond the scope of this study. However, 29% of hernias in African-American patients were repaired laparoscopically compared with 36% in white and Hispanic patients. In addition, it did not appear that African-American or Hispanic patients had significant differences in mortality from complicated hernias.

Obesity and Sex

It was unclear why obesity had a protective role in patients with PHH. Even though obese patients had a significantly reduced LOS compared with nonobese patients, the reduction in mortality odds was not significant. In addition, male sex did not appear to increase the risk of mortality in PHHR, and there was an associated significant half-day increase in LOS. Although there is a general perception that obese individuals are at increased risk of adverse outcomes with operative intervention, once appropriate comorbidities are adjusted for, there is no difference in outcome.

Study Limitations

There are limitations to this study. Our assessment was limited to in-hospital morbidity and mortality. Patients who had adverse outcomes after discharge were not reported and thus could not be included in the study. Because of the nature of the collected data, specific clinical aspects of patients that might have contributed to poor outcomes were not able to be identified. Not all symptomatic hernias were complicated, and not all complicated hernias were symptomatic. Finally, there was no accounting for differences in patient management, the complex nature of the repair, and socioeconomic variables.

CONCLUSION

Surgical approach, age, complicated hernia status, and ethnicity are independent risk factors for mortality in patients undergoing PHHR. Watchful waiting, particularly for patients older than 60 years, may delay intervention when the hernia is uncomplicated or asymptomatic. Once the hernia becomes complicated, urgent surgical intervention subjects the patient to increased morbidity and mortality. It would be prudent to consider early elective LPHHR to maximize safety and reduce hospital LOS.

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