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# Laparoscopic Paraesophageal Hernia Repair: Advanced Age Is Associated with Minor but Not Major Morbidity or Mortality

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- BACKGROUND:** Large studies have documented the safety of laparoscopic paraesophageal hernia (PEH) repair in the general population. Even though this condition affects primarily the elderly, data on the short-term outcomes of this procedure on the oldest-old are lacking.
- STUDY DESIGN:** The NSQIP database was analyzed for all patients undergoing laparoscopic PEH repair in 2010 and 2011. Chi-square, Fisher's exact, and 2-tailed Student's *t*-test were used to compare baseline characteristics, morbidity, and mortality. Binary logistic regression was used to control for confounding variables. Odds ratios (OR) with 95% confidence intervals (CI) were reported when applicable.
- RESULTS:** A total of 2,681 patients undergoing laparoscopic PEH repair were identified. The mean ( $\pm$ SD) age of the cohort was  $63 \pm 14$  years. We identified 313 patients (11.7%) aged 80 years and older. Using regression analysis, advanced age (OR 1.7, 95% CI 1.1 to 2.7,  $p = 0.009$ ), American Society of Anesthesiologists class 3 or 4 (OR 1.4, 95% CI 1.0 to 2.1,  $p = 0.045$ ), gastrostomy placement (OR 2.4, 95% CI 1.3 to 4.7,  $p = 0.007$ ), and significant recent weight loss (OR 2.1, 95% CI 1.1 to 4.1,  $p = 0.037$ ) were independently associated with development of overall morbidity. Mortality (1% vs 0.4%,  $p = 0.16$ ) and serious morbidity (5.8% vs 3.7%,  $p = 0.083$ ) were not significantly different between the older and younger groups. Minor morbidity was higher in the older group (8.3% vs 3.5%, OR 2.5, 95% CI 1.6 to 3.9,  $p < 0.001$ ).
- CONCLUSIONS:** In an assessment of modern nationwide practice, laparoscopic PEH repair is performed with minimal morbidity and mortality. Elective repair in patients aged 80 years or older is not associated with significant differences in mortality or major morbidity compared with younger patients. (J Am Coll Surg 2014;218:1187–1194. © 2014 by the American College of Surgeons)
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Laparoscopic paraesophageal hernia (PEH) repair represents a complex minimally invasive procedure with increased morbidity and mortality compared with non-PEH antireflux surgery.<sup>1</sup> Large studies have demonstrated the safety of laparoscopic repair in the general population, with improved outcomes over time, as a testament to the evolving experience with the procedure.<sup>2</sup>

**Disclosure Information:** Nothing to disclose.

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Primarily elderly patients are affected by PEH, and their proportion among the US population is growing. Data from the US Census Bureau demonstrate that the elderly population is growing more rapidly than the general population.<sup>3</sup> This growth is expected to continue, and the population aged 85 years and older is projected to double from 2003 to 2030.<sup>4</sup> Overall, the elderly in North America will represent 20% of the entire population by 2030.

Most published series of laparoscopic PEH repair demonstrate that this procedure is commonly performed in the elderly, reflecting patient populations with a median age between 64 and 70 years.<sup>2,5-8</sup> Studies suggest worse outcomes in older patients undergoing PEH repair, but they report on earlier surgical experience from the previous decade.<sup>2,9-11</sup> Furthermore, minimal data are available on outcomes in octogenarians and older patients. Despite

**Abbreviations and Acronyms**

ASA	= American Society of Anesthesiologists
CPT	= Current Procedural Terminology
NSQIP	= National Surgical Quality Improvement Program
OR	= odds ratio
PEH	= paraesophageal hernia
SSI	= surgical site infection

the lack of epidemiologic data, PEH are likely to become more prevalent as the general population ages.

The objective of this study was to evaluate the short-term outcomes associated with laparoscopic PEH repair in a nationwide sample, and identify the safety of the procedure in patients aged 80 years or older.

**METHODS**

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database from January 2010 to December 2011 was used. Prospectively collected data were entered in the database by trained clinical reviewers, and they included preoperative risk factors and laboratory values, intraoperative variables, and 30-day postoperative mortality and morbidity. Patients undergoing laparoscopic PEH repair were identified based on procedure-specific Current Procedural Terminology (CPT) codes introduced in 2009 (43281, 43282). Patients aged 80 years and older were compared with younger patients in terms of baseline variables and 30-day outcomes.

The use of mesh was identified through CPT coding, as was performance of an esophageal lengthening procedure (43338, 43282) and placement of a gastrostomy tube (43246, 43830, 43653). Patients undergoing a concurrent bariatric procedure or emergent PEH repair were excluded.

Baseline demographics and characteristics were analyzed. Comorbidities were grouped into 5 categories. Congestive heart failure within 30 days, myocardial infarction within 6 months, previous percutaneous coronary intervention, previous cardiac surgery, and history of angina within 30 days before the index procedure were considered cardiac comorbidities. History of hypertension, amputation, revascularization procedure, rest pain, and gangrene were considered vascular comorbidities. Impaired sensorium, coma, transient ischemic attack, cerebrovascular accident, hemiplegia, paraplegia, quadriplegia, and tumor involving the central nervous system were considered neurologic comorbidities. Pulmonary comorbidities included history of COPD, current pneumonia, and preoperative ventilatory dependence. Hepatic comorbidities included ascites and esophageal varices. Renal comorbidities included acute renal failure and the need for renal replacement therapy. Body mass index

was calculated based on the documented height and weight. The American Society of Anesthesiologists (ASA) physical classification system was used as a baseline characteristic (ASA 1, healthy patient; ASA 2, mild systemic disease; ASA 3, severe systemic disease; ASA 4, severe systemic disease that is a constant threat to life; ASA 5, moribund patient who is not expected to survive without the operation). Patients were grouped per severity of systemic disease (ASA 1 and 2 vs ASA 3 and 4). Diabetes, history of active smoking, wound classification, weight loss >10% within 6 months, and chronic steroid use were analyzed individually. Anemia was defined as hematocrit less than 38%.

The primary outcome was 30-day overall morbidity. Serious morbidity and mortality were secondary outcomes. Serious morbidity was defined as the postoperative occurrence of cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, bleeding requiring transfusions, cerebrovascular accident, coma lasting more than 24 hours, pulmonary embolism, ventilatory dependence longer than 48 hours, organ space infection, wound dehiscence, progressive or acute renal failure, sepsis, or septic shock. Overall morbidity included the occurrence of any event mentioned previously, as well as urinary tract infection, deep venous thrombosis, unplanned intubation, pneumonia, peripheral nerve injury, and superficial or deep surgical site infection (SSI). Superficial, deep, and organ-space occurrences were analyzed separately as SSI. Complications were also grouped per organ system involved. Septic complications included the development of sepsis or septic shock.

Approval for this study was obtained from the Dartmouth Committee for the Protection of Human Subjects, and the NSQIP administration. Analysis was performed using SPSS for Macintosh version 21 (IBM). Categorical variables were compared using the chi-square and Fisher's exact test. Continuous variables were analyzed using the 2-tailed Student's *t*-test. Results were reported as frequency for categorical, and mean ( $\pm$ standard deviation) for continuous variables. Missing variables were treated with listwise deletion; frequencies were reported as valid percentages within the known variables. Odds ratios (OR) with 95% confidence intervals (CI) were reported when applicable. A *p* value <0.05 was considered statistically significant. Multivariate binary logistic regression was performed using all variables with *p* < 0.1 on univariate analysis.

**RESULTS**

A total of 2,914 patients underwent elective PEH. Laparoscopic repair was performed in 2,681 (92%) patients. Of those, 85 (3.2%) and 53 (2%) patients underwent

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