

## Trends and Outcomes of Minimally Invasive Surgery in Emergency Ventral Hernia Repair from the National Inpatient Sample, 2016-2021.

Andrea Carolina QUIROGA-CENTENO<sup>1</sup>, Juan Paulo SERRANO-PASTRANA<sup>1</sup>, Sergio Alejandro GÓMEZ-OCHOA<sup>1</sup>

<sup>1</sup>Department of Surgery, Universidad Industrial de Santander, Bucaramanga, Colombia.

### Aim

The benefits and risks of minimally invasive surgery (MIS) in emergency ventral hernia repair (eVHR) remain poorly characterized. This study aims to evaluate trends, patient selection, and outcomes of MIS in eVHR.

### Methods

Retrospective analysis of adult patients who underwent eVHR between 2016-2021 using the National Inpatient Sample. Clinical outcomes and total charges across surgical approaches (open, laparoscopic, and robotic) were assessed using multivariable regression models extensively adjusted for demographics (age, sex, race/ethnicity, income quartile, and primary payer), hospital characteristics (hospital size, teaching status, and geographic region), surgical factors (hernia type, mesh use and type), and comorbidities (chronic heart failure, hypertension, coronary artery disease, chronic valve disease, chronic obstructive pulmonary disease, complicated diabetes mellitus, obesity, chronic kidney disease, chronic liver disease, metastatic cancer, chronic malnutrition, solid tumor, depression, cirrhosis, peripheral vascular disease, and bowel resection).

### Results

A total of 39,716 patients were analyzed, with most undergoing open eVHR (n=31,619), followed by laparoscopic (n=6,347) and robotic (n=1,750) approaches. Robotic eVHR usage increased from 1.5% in 2016 to 8.6% in 2021 (**Figure 1**). Patient characteristics were generally similar between the laparoscopic and robotic groups, but the type of hernia repaired differed significantly between approaches (p<0.001) (**Figure 2**).

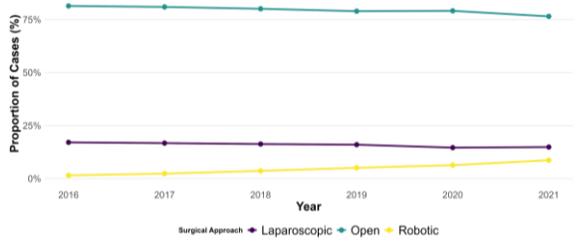


Figure 1. Trends in surgical approach for eVHR

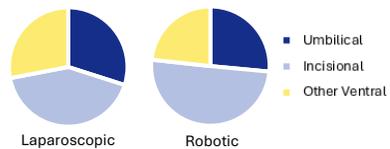


Figure 2. Distribution of hernia type by surgical approach.

After multivariable analysis, laparoscopy was significantly associated with lower in-hospital mortality, shorter length of stay (LOS), and reduced surgical site infection (SSI) rates compared to open surgery. Robotic eVHR was linked to significantly shorter LOS but higher costs compared to open surgery, and to longer LOS, higher costs, and increased SSI risk compared to laparoscopy (**Table**).

Comparative Outcomes of Surgical Approaches for Emergency Ventral Hernia Repair  
 Odds Ratios and Absolute Differences with 95% Confidence Intervals

Outcome	Laparoscopic vs. Open	Robotic vs. Open	Robotic vs. Laparoscopic
Mortality <sup>1</sup>	0.65 (0.46-0.93) p = 0.017 <sup>1</sup>	0.49 (0.23-1.03) p = 0.062 <sup>1</sup>	2.59 (0.73-9.22) p = 0.141 <sup>1</sup>
SSI <sup>1</sup>	0.25 (0.12-0.51) p < 0.001 <sup>1</sup>	0.14 (0.02-1.04) p = 0.055 <sup>1</sup>	8.06 (1.75-37.12) p = 0.007 <sup>1</sup>
LOS <sup>2</sup>	-1.12 (-1.28 to -0.95) p < 0.001 <sup>2</sup>	-1.14 (-1.47 to -0.81) p < 0.001 <sup>2</sup>	2.26 (1.52 to 3.00) p < 0.001 <sup>2</sup>
Total Charges <sup>3</sup>	-2, 420(-5,253 to \$ 413) p = 0.094 <sup>3</sup>	15, 557(10,027 to \$21,087) p < 0.001 <sup>3</sup>	38, 609(23,437 to \$53,781) p < 0.001 <sup>3</sup>

<sup>1</sup> Mortality and SSI are presented as odds ratios with 95% confidence intervals <sup>2</sup> LOS values represent absolute differences in days  
<sup>3</sup> Total charges represent absolute differences in US dollars

### Conclusions

The use of MIS in eVHR has gradually increased over time, primarily driven by the adoption of robotic surgery. However, the open approach remains the most commonly utilized method, largely due to the clinical condition of patients in emergency settings. Laparoscopic repair was independently associated with improved outcomes, though residual confounding is likely despite extensive adjustment. Robotic surgery was linked to higher costs and a greater risk of SSI and LOS compared to laparoscopic repair.