Laparoscopic Gastrectomy is Associated with Lower 30-Day Morbidity, Including Pneumonia, Among Elderly Patients with Gastric Cancer

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INTRODUCTION

Nearly half of all surgeries performed in the U.S. are on patients older than 65 years of age. However, elderly patients tend to have multiple comorbidities with lower physiologic reserve leading to higher rates of perioperative morbidity and mortality. Laparoscopic techniques have shown to improve outcomes in the correct setting, however many surgeons are reluctant to offer this option to elderly patients.

Herein, we focus on the optimal surgical approach for the treatment of gastric cancer (GC). Despite modest improvement in chemo- and immunotherapy, surgical resection for GC represents the best chance for durable remission. Laparoscopic gastrectomy (LG) has been shown to be an effective oncologic alternative to open gastrectomy (OG), yet is underutilized by most centers. The aim of this study was to provide an updated comparison of short-term outcomes for patients with GC who underwent either LG or OG.

MATERIALS AND METHODS

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried to identify patients with GC who underwent non-emergent LG or OG between Jan 2012 - Dec 2018. Post-operative complications were compared between groups using inverse probability of treatment weighted (IPTW) regression models to balance baseline covariates. Multivariable regression models were performed to identify covariates associated with significant outcomes.

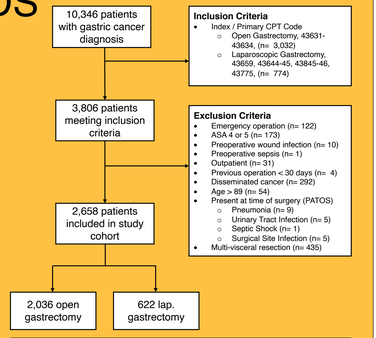


Figure 1: Flow Diagram depicting the selection process for patients included in the present study, noting the specific inclusion and exclusion criteria.

RESULTS

Patient Characteristics: *Continuous* Variables

Variable	Laparoscopic	Open	Unadjusted *p* value	Adjusted *p* value
Demographics				
BMI (kg/m^2)	27.5 (5.99)	27.0 (5.86)	0.048*	0.40
Preoperative Lab Values				
Sodium	139.8 (2.64)	139.7 (2.99)	0.48	0.69
BUN#	16.1 (0.39)	16.1 (0.44)	0.43	0.86
Creatinine#	0.85 (0.29)	0.87 (0.33)	0.12	0.80
Albumin	3.95 (0.53)	3.79 (0.59)	<0.01*	0.94
Total Bilirubin#	0.454 (0.54)	0.449 (0.52)	0.77	0.68
AST#	22 (0.42)	22 (0.48)	0.288	0.39
Alkaline Phosphatase#	74 (0.36)	75 (0.38)	0.72	0.88
WBC^	6.2 (0.32)	6.4 (0.34)	0.13	0.90
Hematocrit	38.1 (5.18)	36.6 (5.41)	<0.01*	0.49
Platelets#	226 (0.31)	226 (0.35)	0.74	0.85

Table 1: Patient continuous variables, listed as mean (standard deviation) before and after inverse probability weighted analysis. AST, aspartate transaminase; BMI, body mass index; BUN, Blood urea nitrogen; WBC, white blood cell count. *p-value < 0.05; #Values listed as geometric mean (log(standard deviation)), calculated using antilog of the log scale mean for weighted analysis.

Patient Characteristics: *Categorical* Variables

Variable	Laparoscopic	Open	Unadjusted *p* value	Adjusted *p* value
Demographics				
Gender - Female	309 (49.7)	857 (42.1)	<0.01*	0.93
Age < 50	84 (13.5)	196 (9.63)	-	-
Ages 50-69	269 (43.3)	924 (45.4)	0.022*	0.62
Ages ≥70	269 (43.3)	916 (44.5)	-	-
Comorbidities				
Dyspnea – moderate#	37 (6.0)	140 (6.9)	0.55	0.68
Partially Dependent^	8 (1.3)	48 (2.4)	0.33	0.99
Diabetes Mellitus	111 (17.9)	466 (22.9)	<0.01*	0.73
Ascites	0 (0.0)	3 (0.2)	0.34	0.33
COPD	25 (4.0)	90 (4.4)	0.67	0.30
CHF	5 (0.8)	13 (0.6)	0.66	0.56
Renal Failure	1 (0.2)	3 (0.2)	0.94	0.74
Dialysis	1 (0.2)	7 (0.3)	0.47	0.40
Weight loss$^{\Delta}$	28 (4.5)	193 (9.5)	<0.01*	0.59
Steroid use+	23 (3.7)	64 (3.1)	0.50	0.87
Hypertension~	331 (53.2)	1129 (55.5)	0.33	0.76
Bleeding Disorder	16 (2.6)	47 (2.3)	0.70	0.89
Blood Transfusion	7 (1.1)	59 (2.9)	0.012*	0.88
Chemotherapy	1 (0.2)	11 (0.5)	0.049*	0.90
Radiation Therapy	2 (0.3)	3 (0.2)	0.19	0.87
ASA Class 3	392 (63)	1444 (71)	<0.01*	0.84

Table 2: Patient categorical variables, listed as patient count (percentage of patients with given variable who underwent specified surgical approach) before and after inverse probability weighted analysis. CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists. ^Dyspnea with moderate exertion, ~Functional Status – partially dependent, $^{\Delta}$Weight loss >10% of total body weight within 3 months, +Steroid use in the past 6 months, ~Hypertension requiring medication, *p value < 0.05.

Multivariable Logistic Regression Analysis for Pneumonia

Covariate	Initial Model	Final Model
Laparoscopic approach	0.4 (0.2, 0.7)*	0.4 (0.2, 0.7)*
Any Dyspnea	1.8 (1.0, 3.3)*	2.0 (1.1, 3.5)*
COPD	1.3 (0.6, 2.8)	-
Transfusion	1.1 (0.4, 3.0)	-
Diabetes Mellitus	0.90 (0.6, 1.4)	-
Steroid Use	1.3 (0.5, 3.3)	-
Weight Loss	2.2 (1.3, 3.9)	2.2 (1.3, 3.9)*
Age 50-69	0.9 (0.4, 1.9)	0.9 (0.4, 2.0)
Age 70-89	1.4 (0.7, 2.9)	1.5 (0.7, 3.3)
BMI > 30.0	1.6 (1.0, 2.4)	1.5 (1.0, 2.4)
BMI < 18.5	1.5 (0.6, 3.6)	1.5 (0.6, 3.8)
Creatinine > 3.0	0.4 (0.02, 5.9)	-
Creatinine 1.5-3.0	1.3 (0.6, 2.6)	-
Albumin > 3.9	1.1 (0.5, 2.4)	1.0 (0.6, 1.8)
Albumin 3.0 – 3.9	1.5 (0.7, 3.1)	1.4 (1.0, 1.9)*
Sex - Male	1.1 (0.8, 1.7)	-

Table 5: Multivariable logistic regression analysis for the outcome 'pneumonia'. Covariates were chosen based on clinical relevancy. Data presented as odds ratio and (95% confidence interval). The Final Model was calculated using backward selection statistics. Covariates with *p* value < 0.16 were chosen for the final model whereas the remainder were eliminated. * $p < 0.05$. Final C statistic 0.67.

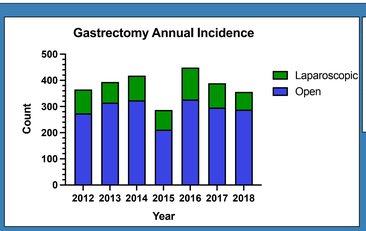


Figure 2: Annual incidence of gastrectomy cases included in the unweighted analysis from years 2012-2018, as defined by surgical approach.

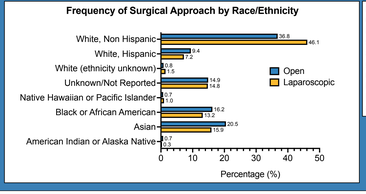


Figure 3: Comparison of the frequency of surgical approaches to gastrectomy by race/ethnicity. Data included from unweighted analysis.

Unadjusted Comparison of 30-Day Complications

Variable	Laparoscopic	Open	*p* value
Any Complication	124 (19.9)	616 (30.3)	<0.01*
Pneumonia	10 (1.6)	80 (3.9)	<0.01*
Any Surgical Site Infection	30 (4.8)	150 (7.4)	0.027*
Myocardial Infarction	5 (0.8)	19 (0.93)	0.77
Mortality	6 (0.96)	29 (1.4)	0.38
Sepsis	13 (2.1)	70 (3.4)	0.091
Perioperative Transfusion	36 (5.8)	206 (10.1)	<0.01*
Failure to wean ventilator	10 (1.6)	23 (1.1)	0.35
Return to Operating Room	29 (4.7)	102 (5.01)	0.73
Readmission	39 (6.3)	214 (10.5)	<0.01*
Discharge to Facility	37 (6.0)	206 (10.1)	<0.01*
Total Length of Stay (Days)	5 (3-7)	7 (5-9)	<0.01*

Table 3: Unadjusted comparison of 30-day complications. Categorical variables represented as total count (percentage). Continuous variables represented as median (interquartile range). * $p < 0.05$.

Analysis of 30-Day Complications by Age

Variable	Ages <50	Ages 50-69	Ages ≥70
Any Complication	1.2 (0.6-2.1)	0.7 (0.5-0.9)*	0.6 (0.5-0.8)*
	63 (21.9)	317 (25.4)	453 (34.7)
Pneumonia	0.4 (0.1-2.8)^	0.6 (0.3-1.5)	0.4 (0.2-0.9)*
	8 (2.8)	34 (2.7)	60 (4.6)
Any Surgical Site Infection	1.6 (0.5-4.5)	0.8 (0.5-1.3)	0.6 (0.3-1.0)*
	16 (5.6)	96 (7.7)	83 (6.4)
Perioperative Transfusion	1.7 (0.6-4.7)	0.8 (0.5-1.4)	0.6 (0.4-0.9)*
	17 (5.9)	99 (7.9)	172 (13.2)
Mortality	----	0.2 (0.0-3.3)	1.3 (0.7-2.4)
	0 (0.0)	10 (0.8)	41 (3.1)
Readmission	0.5 (0.2-1.5)	0.5 (0.3-0.9)*	0.6 (0.4-1.0)*
	22 (7.6)	114 (9.1)	147 (11.3)
Discharge to Facility	1.7 (0.1-2.7)^	0.9 (0.6-2.0)	0.6 (1.1-2.2)*
	7 (2.4)	53 (4.3)	233 (17.9)

Table 4: Comparison of 30-day complications by age group within the inverse probability weighted analysis for laparoscopic / open gastrectomy. Variables selected based on clinical relevancy. TOP data represented as odds ratio (95% confidence interval) and BOTTOM data represented as patient count (percentage of specific outcomes by age group). ^Comparison may not be reliable based on low sample size. * $p < 0.05$.

CONCLUSIONS

The elderly population experienced higher rates of any complication following surgical resection for gastric cancer and underwent laparoscopic gastrectomy less often when compared to younger patients. Elderly patients who underwent a laparoscopic approach had lower odds of 30-day comorbidities, including pneumonia, perioperative transfusion, readmission and discharge to a skilled facility compared to an open approach. Altogether, this data suggests further exploration of laparoscopy as the preferred surgical approach for the treatment of gastric cancer, with the elderly realizing the most benefit.

FUTURE DIRECTIONS

Studies assessing long-term and patient-reported outcomes for laparoscopic vs open gastrectomy for gastric cancer are warranted, as well as exploration of the decision-making process for surgical approach in the elderly.