

Defining the Impact of Surgical Approach on Perioperative Outcomes for Patients with Gastric Cardia Malignancy

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Abstract

Background Gastric cardia cancer is currently treated with several operations. The purpose of the current study was to compare outcomes associated with three common operative approaches.

Methods The ACS-NSQIP Participant Use File was searched to identify all patients with gastric cardia malignancy who underwent total gastrectomy (TG), transhiatal esophagectomy (THE), or thoraco-abdominal esophagectomy (TAE) between 2005 and 2012. Demographic, perioperative risk factors, and outcomes were analyzed.

Results Overall, there were 982 patients identified in the database who met inclusion criteria. The median age was 65 years (range 20–88) and 807 (82.2 %) were male. The number of patients allocated to each approach was 204 TGs (20.8 %), 271 THE (27.6 %), and 507 TAE (51.6 %). All approaches had similar major morbidity, cardiopulmonary morbidity, and 30-day mortality, however, TAE was associated with the highest overall morbidity (TAE 49.9 % vs. TG 40.7 % and THE 43.5 %, $p=0.048$). The independent risk factors predicting mortality were age greater than 65 years, history of myocardial infarction, and postoperative cardiopulmonary morbidity.

Conclusions For patients with proximal gastric cancer, the three most common operative approaches were associated with clinically-significant rates of overall and major morbidity. Approach-associated morbidity should be considered along with tumor location and extent when choosing a technique for resection of gastric cardia malignancy.

Keywords NSQIP · Gastroesophageal junction · GEJ · National Surgical Quality Improvement Program

Background

Tumors of the gastroesophageal junction and gastric cardia present many challenges to the clinician, the first of which is accurate classification. Gastric cardia malignancies are considered separate entities from both esophageal and distal gastric cancers.¹ The methods of characterizing proximal gastric malignancies include the American Joint Committee on Cancer (AJCC) and Siewert classifications which both emphasize commonalities with esophageal cancer.^{2–4} Although gastric cancer incidence and mortality have decreased over the previous several decades, gastric cancer remains the fourth most common cancer and second leading cause of cancer-related death worldwide.⁵ In the USA, gastric cancer is the seventh most common cause of cancer-related death.⁵ In addition, the incidences of proximal gastric adenocarcinoma and esophageal adenocarcinoma have been observed to increase in recent years despite a decrease in the incidence of all gastric adenocarcinomas.^{6–8}

NSQIP Disclaimer The American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in it represent the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or for the conclusions derived by the authors.

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Several different operative approaches are commonly employed for resection of proximal gastric cancers, including abdominal, transthoracic, and thoraco-abdominal. For tumors judged to be more distal and sharing characteristics with other gastric adenocarcinomas, total gastrectomy is often employed as first-line surgical therapy. A recent American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) analysis showed that total gastrectomy had increased rates of major morbidity and mortality when compared to partial gastrectomy; however, this analysis looked at all gastric malignancies and did not differentiate based on disease site.⁹ Likewise, another recent ACS-NSQIP analysis compared gastrectomy to esophagectomy for proximal gastric cancer, but did not parse the surgical approach.¹⁰

More proximal gastroesophageal cancers are typically treated in a manner similar to distal esophageal malignancies requiring gastroesophageal resection for adequate treatment. A recent meta-analysis of transthoracic approaches to esophageal resection shows increased postoperative morbidity but equivalent short-term mortality when compared to abdominal approaches.¹¹ Approach-associated morbidity rates are important, as complications from surgical resection of proximal gastric cancer can lead to delays in adjuvant therapy, which adversely affect oncologic outcomes.^{12–15}

The aim of this study was to characterize the short-term morbidity and mortality associated with various surgical approaches utilized to resect malignancies of the gastric cardia. Additionally, this study sought to characterize risk factors for morbidity and mortality that are common to patients undergoing resection of a gastric cardia malignancy.

Methods

The ACS-NSQIP is a multi-center, prospectively gathered, and risk-adjusted database. The ACS-NSQIP database includes more than 150 perioperative risk factor and outcomes variables. Details regarding ACS-NSQIP data collection, variables, and analysis have been previously published.¹⁶

The ACS-NSQIP Participant Use File (PUF) was interrogated to identify patients who underwent an operation for malignant neoplasm predominantly located at the gastric cardia (ICD-9 code 151.0 only) at participating NSQIP hospitals from 2005 to 2012. Current Procedure Terminology (CPT) codes were used to group patients by surgical approach. Patients who underwent total gastrectomy (TG) (CPT code 43620, 43621, and 43622), transhiatal esophagogastrectomy (THE) (CPT code 43107), or thoraco-abdominal esophagogastrectomy (TAE) (CPT code 43112 and 43117) were identified. Ancillary PUF fields were used to exclude esophagectomies associated with an intestinal conduit and emergency operations from analysis. There were 204 patients who underwent TG, 271 patients underwent THE, and 507 patients underwent TAE. These patients' clinical

characteristics are detailed in Table 1. The surgical approach was also recoded into a binary categorical variable with the two abdominal (non-thoracotomy) approaches (TG + THE) combined and compared to TAE.

Major morbidity was defined as the occurrence of at least one of the following complications: organ space infection, pneumonia, unplanned intubation, pulmonary embolism, ventilator requirement greater than 48 h, progressive renal insufficiency, acute renal failure, cerebrovascular accident, coma, cardiac arrest, myocardial infarction, deep venous thrombosis, sepsis, septic shock, and return to the operating room.¹⁷ Cardiopulmonary morbidity was defined as the occurrence of at least one of the following complications: pneumonia, unplanned intubation, pulmonary embolism, ventilator requirement greater than 48 h, cardiac arrest, or myocardial infarction. Mortality was defined as death from any cause within 30 days of surgery or death occurring over 30 days from surgery if the operation and mortality were within a single prolonged hospitalization.

Statistics

All continuous variables are reported as median value with interquartile range (IQR) and/or range, or mean value \pm standard deviation. Continuous variables were compared using the Kruskal-Wallis test or the Mann-Whitney *U* test. Categorical variables were compared using the chi-squared test or Fisher's exact test. A 2-tailed *p* value less than 0.05 was considered significant. All appropriate risk factors found to have a univariate *p* value less than 0.10 were included in multivariate analysis. Multivariate analysis was done using binary logistic regression and the backwards stepwise method. All statistical analysis was performed using SPSS Version 22.0.0.0 (SPSS, Inc., Chicago, IL, USA).

Results

Overall, there were 982 patients identified in the database who met inclusion criteria. The median age was 65 years (range 20–88) and 807 (82.2 %) were male. The number of patients allocated to each approach was 204 TGs (20.8 %), 271 THE (27.6 %), and 507 TAE (51.6 %). Patients undergoing TG were older ($p < 0.001$), had lower ASA scores ($p = 0.030$), and were less likely to be male ($p < 0.001$) than those undergoing THE or TAE. Patients in all three groups had similar rates of functional independence, body mass index (BMI), smoking, and alcohol use (Table 1).

The most frequently present preoperative comorbidity for all three approaches was hypertension. There were few differences in preoperative comorbidity rates; however, patients with CHF or renal failure were found exclusively in the TG group, all be it at low levels. Patients undergoing a THE and TAE resection were more likely to receive preoperative

Table 1 Demographics of patients with gastric cardia malignancy by approach

Factor	TG (n=204)	THE (n=271)	TAE (n=507)	p value
Age	65.4±11.7	65.9±10.0	62.9±10.2	<0.001
Sex: Male	144 (70.6)	231 (85.2)	432 (85.2)	<0.001
Female	60 (29.4)	40 (14.8)	75 (14.8)	
Independent Functional Status	200 (98.0)	268 (98.9)	502 (99.0)	0.597
ASA (3/4)	147 (72.4)	211 (77.9)	411 (81.4)	0.030
BMI	27.4 ±6.1	28.0±6.2	28.3±8.3	0.161
Smoking	48 (23.5)	68 (25.1)	121 (23.9)	0.906
Alcohol	10 (4.9)	11 (4.1)	14 (2.8)	0.332

TG total gastrectomy, THE transhiatal esophagectomy, TAE thoraco-abdominal esophagectomy, ASA American Society of Anesthesiologists Physical Class, BMI body mass index

radiotherapy than those undergoing gastric only resection (TG 9.8 %, THE 24.7 %, and TAE 23.9 %, $p<0.001$). Patients undergoing TG were also more likely to have had an operation in the previous 30 days ($p=0.016$) (Table 2).

Regarding perioperative outcomes, operative times were increased for TAE (391.1±121.2 min) vs. TG (321.1±130.3 min) or THE (294.1±101.1 min) ($p<0.001$). Hospital length of stay was near 14 days for all patients in this cohort, with no differences based on surgical approach. Morbidity (TG 40.7 %, THE 43.5 %, and TAE 49.9 %, $p=0.048$) and major morbidity (TG 32.8 %, THE 32.1 %, and TAE 36.7 %, $p=0.368$) were considerable across all three approaches with

TAE being the most morbid procedure (Fig. 1). Although cardiopulmonary morbidity rates were equivalent across approaches, postoperative myocardial infarction was more common after TAE (2.0 %) compared to TG (0 %) and THE (0.4 %) ($p=0.035$). There was no difference in 30-day mortality by operative approach (Table 3). Additionally, TAE had higher rates of perioperative transfusion ($p=0.035$) when compared to abdominal approaches (Table 4).

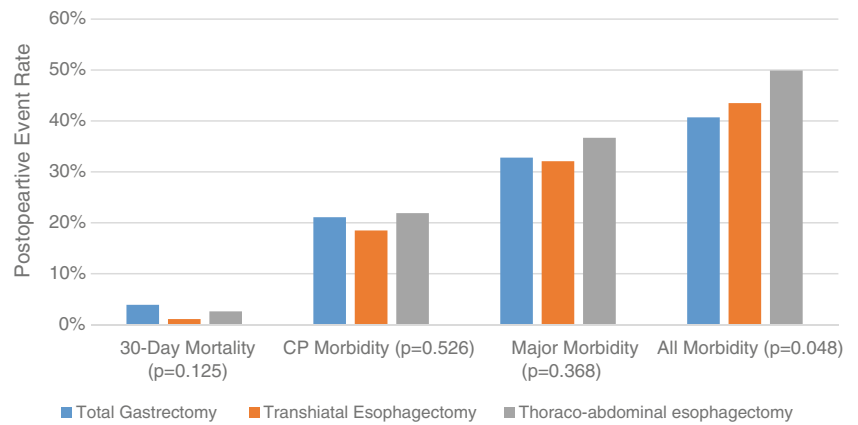
For all patients with proximal gastric cancer undergoing surgery, the factors associated with major morbidity by univariate analysis included smoking ($p=0.042$), alcohol use ($p=0.013$), dyspnea ($p=0.031$), diabetes ($p=0.033$), COPD ($p=$

Table 2 Comorbidities of patients with gastric cardia malignancy by surgical approach

Factor	TG (n=204)	THE (n=271)	TAE (n=507)	p value
Dyspnea	25 (12.3)	18 (6.6)	51 (10.1)	0.104
Diabetes	45 (22.1)	56 (20.7)	88 (17.4)	0.279
COPD	10 (4.9)	13 (4.8)	33 (6.5)	0.530
Esophageal Varices	1 (0.5)	0 (0.0)	1 (0.2)	0.448
CHF	4 (2.0)	0 (0.0)	0 (0.0)	0.002
MI	4 (2.0)	0 (0.0)	4 (0.8)	0.054
Previous PCI	12 (5.9)	18 (6.6)	26 (5.1)	0.681
Previous CTS	8 (3.9)	15 (5.5)	18 (3.6)	0.411
Angina	0 (0.0)	0 (0.0)	6 (1.2)	0.071
Hypertension	112 (54.9)	141 (52.0)	270 (53.3)	0.825
Renal failure	2 (1.0)	0 (0)	0 (0.0)	0.043
Dialysis	1 (0.5)	0 (0)	0 (0.0)	0.208
Stroke	8 (3.9)	9 (3.3)	10 (2.0)	0.283
Bleeding Disorder	8 (3.9)	14 (5.2)	17 (3.4)	0.467
Transfusion	1 (0.5)	0 (0.0)	1 (0.2)	0.448
Weight Loss	39 (19.1)	56 (20.7)	105 (20.7)	0.883
Wound Infection	3 (1.5)	1 (0.4)	2 (0.4)	0.207
Preoperative Chemo	19 (9.3)	31 (11.4)	64 (12.6)	0.458
Preoperative radiation	20 (9.8)	67 (24.7)	121 (23.9)	<0.001
Operation in previous 30 days	7 (3.4)	4 (1.5)	3 (0.6)	0.016

TG total gastrectomy, THE transhiatal esophagectomy, TAE thoraco-abdominal esophagectomy, COPD chronic obstructive pulmonary disease, CHF congestive heart failure, MI myocardial infarction, CTS cardiothoracic surgery, PCI percutaneous coronary intervention

Fig. 1 Comparison of mortality, cardiopulmonary morbidity, major morbidity, and all morbidity by approach



<0.001), history of myocardial infarction ($p=0.003$), hypertension treated with medication ($p=0.011$), perioperative transfusion ($p=0.034$), prior cardiothoracic surgery ($p=0.003$), and preoperative chemotherapy ($p=0.016$). On multivariate analysis, alcohol use ($p=0.023$, OR=2.30), COPD

($p=0.001$, OR=2.69), history of myocardial infarction ($p=0.041$, OR=9.26), hypertension treated with medication ($p=0.034$, OR=1.35), perioperative transfusion ($p=0.034$, OR=1.45), prior cardiothoracic surgery ($p=0.050$, OR=2.54), and operation in the previous 30 days ($p=0.049$, OR=2.94) were

Table 3 Univariate analysis of outcome measures by surgical approach

Factor	TG (n=204)	THE (n=271)	TAE (n=507)	p value
Operative time	321.1±130.3	294.1±101.1	391.1±121.2	<0.001
SSI	11 (5.4)	26 (9.6)	39 (7.7)	0.237
Deep SSI	5 (2.5)	10 (3.7)	5 (1.0)	0.035
Organ space infection	20 (9.8)	18 (6.6)	32 (6.3)	0.245
Dehiscence	3 (1.5)	7 (2.6)	5 (1.0)	0.219
Pneumonia	25 (12.3)	28 (10.7)	70 (13.8)	0.455
Reintubation	14 (6.9)	26 (9.6)	60 (11.8)	0.130
Pulmonary embolism	6 (2.9)	5 (1.8)	12 (2.4)	0.736
Ventilator >48H	25 (12.3)	22 (8.1)	62 (12.2)	0.185
Progressive renal insufficiency	2 (1.0)	0 (0.0)	6 (1.2)	0.194
Acute renal failure	4 (2.0)	3 (1.1)	8 (1.6)	0.694
UTI	6 (2.9)	9 (3.3)	15 (3.2)	0.973
Stroke	4 (2.0)	0 (0.0)	0 (0.0)	0.002
Coma	2 (1.0)	0 (0.0)	1 (0.2)	0.180
Cardiac arrest	4 (2.0)	4 (1.5)	11 (2.2)	0.825
MI	0 (0.0)	1 (0.4)	10 (2.0)	0.035
Transfusions	22 (10.8)	23 (8.5)	70 (13.8)	0.080
DVT	6 (2.9)	10 (3.7)	25 (4.9)	0.436
Sepsis	25 (12.3)	29 (10.3)	55 (10.8)	0.793
Septic shock	15 (7.4)	14 (5.2)	39 (7.7)	0.402
Return to OR	22 (10.8)	27 (10.0)	70 (13.8)	0.239
30-day mortality	8 (3.9)	3 (1.1)	13 (2.6)	0.125
CP morbidity	43 (21.1)	50 (18.5)	111 (21.9)	0.526
Any morbidity	83 (40.7)	118 (43.5)	253 (49.9)	0.048
Major morbidity	67 (32.8)	87 (32.1)	186 (36.7)	0.368
Hospital LOS	14.7±11.8	13.0±10.7	14.6±11.1	0.084

TG total gastrectomy, THE transhiatal esophagectomy, TAE thoraco-abdominal esophagectomy, SSI surgical site infection, UTI urinary tract infection, MI myocardial infarction, DVT deep vein thrombosis, OR operating room, CP cardiopulmonary, LOS length of stay

Table 4 Univariate analysis of outcome measures by surgical approach

Factor	Abdominal approach (n=475)	TAE (n=507)	p value
Operative time	305.7±115.2	391.1±121.2	<0.001
SSI	37 (7.8)	39 (7.7)	0.955
Deep SSI	15 (3.2)	5 (1.0)	0.016
Organ space infection	38 (8.0)	32 (6.3)	0.304
Dehiscence	10 (2.1)	5 (1.0)	0.153
Pneumonia	54 (11.4)	70 (13.8)	0.250
Reintubation	40 (8.4)	60 (11.8)	0.077
Pulmonary embolism	11 (2.3)	12 (2.4)	0.958
Ventilator >48H	47 (9.9)	62 (12.2)	0.245
Progressive renal insufficiency	2 (0.4)	6 (1.2)	0.289
Acute renal failure	7 (1.5)	8 (1.6)	0.894
UTI	15 (3.2)	15 (3.2)	0.999
Stroke	4 (0.8)	0 (0.0)	0.054
Coma	2 (0.4)	1 (0.2)	0.613
Cardiac arrest	8 (2.2)	11 (2.2)	0.581
MI	1 (0.2)	10 (2.0)	0.012
Transfusions	45 (9.5)	70 (13.8)	0.035
DVT	16 (3.4)	25 (4.9)	0.221
Sepsis	53 (11.2)	55 (10.8)	0.877
Septic shock	29 (6.1)	39 (7.7)	0.328
Return to OR	22 (10.8)	70 (13.8)	0.094
30-day mortality	11 (2.3)	13 (2.6)	0.801
CP morbidity	93 (19.6)	111 (21.9)	0.372
Any Morbidity	201 (42.3)	253 (49.9)	0.017
Major morbidity	154 (32.4)	186 (36.7)	0.160
Hospital LOS	13.8±11.2	14.6±11.1	0.051

TAE thoraco-abdominal esophagectomy, SSI surgical site infection, UTI urinary tract infection, MI myocardial infarction, DVT deep vein thrombosis, OR operating room, CP cardiopulmonary, LOS length of stay

independent factors associated with major morbidity. The only independent factor protective for major morbidity was preoperative chemotherapy ($p=0.005$, OR=0.50).

The factors which were associated with mortality included age greater than 65 years old ($p=0.003$), dyspnea ($p=0.009$), diabetes ($p=0.022$), COPD ($p=0.019$), history of myocardial infarction ($p=0.015$), hypertension ($p=0.031$), renal failure ($p=0.048$), operation within the previous 30 days ($p=0.044$), any morbidity ($p<0.001$), major morbidity ($p<0.001$), and major morbidity ($p<0.001$). On multivariate analysis, the independent predictors of 30-day mortality were age greater than 65 years ($p=0.003$, OR=8.34), history of myocardial infarction ($p=0.004$, OR=21.89), and cardiopulmonary morbidity ($p<0.001$, OR=27.03) (Table 5).

Discussion

Analysis of the ACS NSQIP data shows that there is significant morbidity associated with all surgical approaches to

resection of proximal gastric cancer. TAE proved to be the most morbid of procedures likely because of the additional thoracic field. It is important to note that the study population was contained to patients diagnosed with proximal gastric cancer, excluding patients coded as esophageal cancer. Although the utilization of TAE could indicate appropriate surgical management of a more aggressive gastroesophageal junction lesion that may engender more complications, in this dataset, there were identical rates of neoadjuvant chemoradiotherapy between the THE and TAE groups, suggesting that choice of surgical technique was more surgeon specific than patient or cancer specific. These data indicate that when oncologic equipoise is present, the least morbid approach should be considered.

The ACS-NSQIP dataset does not collect information regarding the use of laparoscopy prior to 2010 and therefore was not analyzed in this study. One possible explanation for the differences in morbidity, besides an additional operative field, is the difference in laparoscopy utilization and diffusion to practice for each procedure. The first laparoscopic partial

Table 5 Analysis of predictors of major morbidity and mortality

Factor	Uni MMorb <i>p</i> value	Multi MMorb <i>p</i> value	MMorb OR	MMorb OR 95 % CI	Uni Mort <i>p</i> value	Multi Mort <i>p</i> value	Mort OR	Mort OR 95 % CI
Age >65	0.355				<0.001	0.003	8.34	2.10–33.08
ASA (3/4)	0.592				0.132			
BMI >30	0.404				0.645			
Sex	0.650				0.490			
Smoker	0.042	0.086			0.702			
EtOH	0.013	0.023	2.30	1.12–4.57	0.872			
Steroid	0.764				1.000			
Dyspnea	0.031	0.477			0.009	0.435		
Diabetes	0.033	0.303			0.022	0.199		
COPD	<0.001	0.001	2.69	1.52–4.78	0.019	0.511		
CHF	0.122				0.094	0.340		
MI	0.003	0.041	9.26	1.09–78.40	0.015	0.004	21.89	2.69–178.57
HTN	0.011	0.034	1.35	1.02–1.78	0.031	0.458		
Renal failure	0.120				0.048	0.081		
CVA	0.056	0.175			0.139			
Weight loss	0.104				1.000			
Bleeding disorders	0.391				0.246			
Preiop Transfuse	0.034	0.034	1.45	1.04–2.34	0.513			
Prev CT Surg	0.003	0.050	2.54	1.32–4.87	1.000			
Prev PCI	0.139				0.574			
Prior Op 30D	0.074	0.049	2.94	1.00–8.60	0.044	0.058		
Preop Chemo	0.016	0.037	0.61	0.39–0.97	1.000			
Preop radiation	0.998				0.801			
Abdominal approach	0.160				0.801			
Any morbidity					<0.001	0.800		
CP morbidity					<0.001	<0.001	27.03	7.73–94.57
Major morbidity					<0.001	0.787		

Uni univariate, *Mmorb* major morbidity, *OR* odds ratio, *CI* confidence interval, *Mort* mortality, *ASA* American Society of Anesthesiologists, *BMI* body mass index, *EtOH* Alcohol use of two drinks per day within 2 weeks of surgery, *COPD* chronic obstructive pulmonary disease, *CHF* congestive heart failure, *MI* history of myocardial infarction, *HTN* medication treated hypertension, *CVA* cerebrovascular accident, *Prev* previous, *CT* cardiothoracic, *Op* operation, *30D* 30-days, *TAE* thoraco-abdominal esophagectomy, *CP* cardiopulmonary

gastrectomy for cancer was reported in the early 1990s and laparoscopic total gastrectomy in the early 2000s. Laparoscopic gastrectomy for malignancy has proved to be a safe alternative to open surgery in a randomized controlled trial published in 2005 with at least equivalent long-term outcomes.¹⁸ The first minimally invasive esophagectomy was performed much later with the first randomized controlled trial showing equivalent improved short-term outcomes published in 2012.¹⁹ In the future, increased utilization of minimally invasive esophagectomy may help to decrease the gap in morbidity and length of stay as compared to open abdominal approaches.

In selecting an appropriate operative intervention for gastric cardia malignancy, there are still many variables to consider. The ability to perform a complete oncologic resection remains the cornerstone of operative resection; however,

additional factors including patient age, comorbidity status, extent of gastroesophageal involvement, histologic type, and the risks inherent to each operation should also be factors into surgical decision making.²⁰ Multi-modality treatment of proximal gastric cancer has been shown to improve outcomes but delays from surgical complications have been shown to lead to delays in adjuvant therapy as well as increased rates of early recurrence.^{12,13,21} In patients with significant comorbidities who are more likely to experience surgical complications, selection of the least morbid approach that will achieve an R0 resection is paramount to improving outcomes.

This analysis also demonstrates the importance of considering patient comorbidities when deciding to operate for proximal gastric cancer. A history of advanced age combined with prior myocardial infarction, renal failure, or a recent operation was associated with the highest risk and should trigger a

specific informed discussion with the patient prior to proceeding with resection. The analysis did show modifiable risk factors associated with major morbidity. Patient's alcohol consumption of greater than two drinks a day within 2 weeks of operation was independently associated with major morbidity. This indicates that patients should be counseled regarding alcohol cessation in the preoperative period. Additionally, having a history of another operation performed within 30 days was associated with major morbidity. While it's not always possible to delay definitive cancer treatments due to a previous operation, clinicians should reconsider scheduling of multiple invasive procedures in temporal proximity.

This study has several limitations. In order to investigate proximal gastric cancer, gastric cardia malignancy was used as a surrogate diagnosis code. Gastric cardia malignancy is not a perfect surrogate for proximal gastric cancer and represents a weakness in the current ICD-9 code classification that is a component of the ACS-NSQIP database. In future iterations of diagnostic coding, it may be beneficial to redefine terminology used to report tumor location. The ACS NSQIP database does not collect cancer-specific variables including cancer staging, histologic grading, margin status, and resection status. The database also does not collect oncologic outcomes. Unfortunately, this limits the ability of the analysis to account for stage-specific differences in the utilization of neoadjuvant therapy and/or radical surgical resection that may be more risky, but simultaneously more likely provide optimal long-term oncologic outcomes. Finally, ACS-NSQIP data does not supply information regarding hospital or operative surgeon procedural volumes and specialty training that is likely to influence patient outcomes.^{22–24}

Conclusion

In proximal gastric cancer, all three operative approaches were associated with clinically significant rates of major morbidity. Abdominal approaches are utilized with less frequency but are associated with significantly decreased morbidity. The ability to perform a complete oncologic resection, morbidity by approach, tumor location, margin status, clinical staging, and other patient risk factors all need to be considered in concert when selecting an operative approach for gastric cardia cancer.

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Primary Discussant

Kyle A. Perry, M.D. (Columbus, OH)

Thank you for sharing this nicely presented study examining the surgical approaches utilized to manage proximal gastric cancers. Proximal gastric cancer presents a challenging clinical dilemma, and consideration of oncologic outcome, the rate of return to normal functional status post-operatively, and perioperative risk all play an important role in planning the operative approach. This study aimed to identify predictive factors that predispose patients to major morbidity following esophagectomy or extended total gastrectomy in order to guide clinical decision making. In light of this, why was the decision made to combine the total gastrectomy and transhiatal esophagectomy groups in the multivariate analysis? These operations are associated with different risks and consequences, and it seems that analyzing them separately may identify different predictors for

postoperative complications. Also, you noted significant differences between the patient populations undergoing esophagectomy and gastrectomy. Is it possible that a subset of the total gastrectomy patients was undergoing palliative surgery for inability to tolerate oral intake rather than a curative operation? If so, how might this influence the interpretation of the results. Congratulations again on an excellent presentation, and thank for the opportunity to discuss it.

Closing Discussant

Dr. Day

We thank the Dr. Perry for these insightful comments and questions.

Regarding the grouping of cases, initially each of the approaches was separately analyzed. However, there was recognition that the combined abdomino-thoracic approach may have a different complication profile compared to the two non-thoracotomy approaches (total gastrectomy and transhiatal esophagogastrectomy). The separate analysis yielded similar results to the combined analysis, but due to the small number of some comorbidities, the 95 % confidence intervals were very large. Since both groups had similar outcomes for the same disease, the decision was made to combine the analysis for increased power in the face of small numbers, allowing the potential to specifically comment on the morbidity of thoracotomy.

Regarding the use of total gastrectomy as a palliative maneuver, it is possible that some individuals underwent surgery without curative intent. Unfortunately, oncologic intent and stage of disease cannot be obtained from the NSQIP PUF. This having been said, we believe that most patients undergoing palliation for gastric cardia cancer would not have a total gastrectomy as the operation of choice in that scenario. Given the contemporary cohort, stenting, partial gastrectomy, bypass, or palliative feeding tube placement, which were excluded from the analysis, seem to be more likely surgical palliation options for this disease.