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Khalil Masabni
Henry Ford Health, kmasabn1@hfhs.org

Pridvi Kandagatla
Henry Ford Health, pkandag2@hfhs.org

Andrew Popoff
Henry Ford Health, apopoff2@hfhs.org

Ilan Rubinfeld
Henry Ford Health, irubinf1@hfhs.org

Zane Hammoud
Henry Ford Health, zhammou1@hfhs.org

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Is Esophagectomy for Benign Conditions Benign?

Khalil Masabni, MD, Pridvi Kandagatla, MD, Andrew M. Popoff, MD, Ilan Rubinfeld, MD, and Zane Hammoud, MD

Department of Surgery and Division of Thoracic Surgery, Henry Ford Health System/Wayne State University, Detroit, Michigan

Background. **Outcomes data on esophagectomy performed for benign conditions is scarce. Using the National Surgical Quality Improvement Program database, we sought to analyze outcomes of esophagectomy performed for benign conditions.**

Methods. **The National Surgical Quality Improvement Program database was queried for all esophagectomies performed from 2005 to 2015. Outcomes for benign conditions were analyzed and compared with outcomes for malignant conditions.**

Results. **Esophagectomy was performed in 7,477 patients during the study period. Of those, 6,762 underwent esophagectomy for malignant conditions and 715 for benign conditions. For patients with benign conditions, reconstruction was performed using gastric conduit in 631 and colon/intestine in 84. The anastomosis was intrathoracic in 420 and cervical in 295. Benign esophagectomies were more likely to be emergent (10.1% vs 0.4%, $p < 0.001$). In addition, these patients had a longer hospital length of stay (17.2 days vs 14.5 days, $p < 0.001$) and higher occurrence of Clavien-Dindo grade IV complications (25% vs 20%, $p = 0.003$). Mortality was similar at 4%. In patients with benign conditions, reconstruction with colon/intestine had higher occurrence of Clavien-Dindo Grade IV complications (37% vs 23%, $p = 0.006$), surgical wound infections (33% vs 16%, $p < 0.001$), and death (10% vs 4%, $p = 0.017$) compared with gastric reconstruction. Site of anastomosis did not affect outcomes.**

Conclusions. **Benign esophagectomies are associated with significant morbidity. Although the site of the anastomosis does not alter outcomes, use of colon/intestine conduit should be pursued with caution.**

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An esophagectomy is a complex procedure that may be indicated for malignant as well as benign conditions. Esophagectomy for malignant conditions, usually esophageal carcinoma, is known to be associated with significant morbidity and mortality [1–3]. Benign conditions necessitating an esophagectomy can be grouped into three categories: perforation, obstruction, and dysmotility [4, 5]. These can be further divided into more detailed causes, such as traumatic or iatrogenic perforations [6], benign strictures [7], and dysmotility caused by achalasia [8, 9].

Apart from the cause, other factors distinguish a benign esophagectomy from its malignant counterpart. The effects of neoadjuvant therapy are absent in patients undergoing a benign esophagectomy. In addition, benign esophagectomies are usually performed after multiple failed endoscopic interventions, which could pose challenges to the surgeon [10]. Similar to a malignant esophagectomy, however, a benign esophagectomy is also performed in a variety of clinical scenarios. They may be performed in emergent or elective settings. A benign esophagectomy also has many variations that may need to be considered in terms of location of the anastomosis, open versus minimally invasive, choice of conduit, and more.

The high success rates of medical or endoscopic measures, or both, and the few indications to perform a benign esophagectomy lead to a limited amount of data that are available on outcomes of benign esophagectomies. This poses a challenge to surgeons because they may not be able to perform the ideal surgical procedure for patients. Therefore, we should determine outcomes after benign esophagectomies to facilitate perioperative planning and medical decision making. This study used the National Surgical Quality Improvement Program (NSQIP) database to analyze outcomes of benign esophagectomies.

Patients and Methods

Data Source and Study Population

The NSQIP database was queried to identify patients who underwent esophagectomy from January 2005 to December

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Address correspondence to Dr Hammoud, Department of Surgery, Henry Ford Hospital/Wayne State University, 2799 W Grand Blvd, Detroit, MI 48202; email: zhammou1@hfhs.org.

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2015 using Current Procedural Terminology (CPT; American Medical Association, Chicago, IL) codes 43107, 43108, 43112, 43113, 43116, 43117, 43118, 43121, 43122, and 43123. Patients were then divided into malignant (group A) and benign (group B) groups. For patients with benign disease, two subgroup analyzes were performed. The first subgroup analysis studied types of esophageal reconstruction: gastric conduit (group C; CPT codes 43107, 43112, 43117, 43121, and 43122) versus colon/small bowel conduit (group D; identified by CPT codes 43108, 43113, 43116, 43118, and 43123). The second subgroup analysis studied site of anastomosis: intrathoracic anastomosis (group E; CPT codes 43117, 43118, 43121, 43122, and 43123) versus cervical anastomosis (group F; CPT codes 43107, 43108, 43112, 43113 and 43116). A description of the CPT codes is provided in the Supplemental Material. Similar analyses were done for nonemergent patients as well.

Outcomes Measures

Primary outcomes were overall 30-day composite morbidity and mortality. Secondary outcomes were wound infections, hospital length of stay, and readmissions. The composite morbidity outcome was determined based on Clavien-Dindo grade IV surgical complications that result in long-term organ damage [11].

Patient demographics, comorbidities, and surgical profiles were compared. Patient demographics included age, sex, American Society of Anesthesiologists (ASA) Physical Status Classification, and functional status (independent, partially dependent, totally dependent, or unknown) before the operation. Comorbidities included diabetes mellitus, current smoking, hypertension requiring medication(s), history of severe chronic obstructive pulmonary disease (COPD), and dyspnea (at rest, moderate exertion, or none). Surgical variables included wound class (clean, clean/contaminated, contaminated, or dirty/infected), operation time, and emergent versus nonemergent status.

Statistical Analysis

Univariate comparisons between groups A and B, groups C and D, and groups E and F were made for patient demographics, comorbidities, surgical profile, primary outcomes, and secondary outcomes. A similar analysis was done for the nonemergent patients. Categoric variables were compared using the χ^2 test and the Fisher exact test, and continuous variables were compared using the Student *t* test. Nonparametric comparisons were made using the Mann-Whitney *U* test, as appropriate. We then performed logistic regression to derive independent predictors of morbidity and death. All *p* values reported are two-tailed, and *p* of less than 0.05 was considered statistically significant. Data were analyzed using R software (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Malignant Versus Benign Disease

PATIENT DEMOGRAPHICS, COMORBIDITIES, AND SURGICAL PROFILES. Esophagectomy was performed in 7,477 patients during the study period. Of those, 6,762 underwent esophagectomy for malignant disease (group A) and 715 for benign disease (group B). Table 1 summarizes baseline characteristics, comorbidities, and surgical profiles of group A and group B. Patients with malignant disease were older (63.9 years vs 58.0 years; $p < 0.001$), more likely to have a history of diabetes (17.6% vs 8.4%; $p < 0.001$), hypertension (52.1% vs 39.6%; $p < 0.001$), severe COPD (7.9% vs 5.0%; $p = 0.007$), and smoking (25.6% vs 20.7%; $p = 0.004$). They were also less likely to have dyspnea at rest (0.5% vs 1.4%, $p < 0.005$). Most patients in both groups were functionally independent before the operation, but there was a higher proportion of dependent patients among those with benign disease (6.5% vs 1.3%, $p < 0.001$). Patients with benign disease were more likely to have ASA classification IV or higher (14.7% vs 8.4%; $p < 0.001$), contaminated wound classification (8.4% vs 2.8%; $p < 0.001$), dirty/infected wound classification (9.1% vs 0.5%; $p < 0.001$), and emergency operation (10.1% vs 0.4%; $p < 0.001$).

The esophagectomy in 7,375 of the 7,477 patients was a nonemergent procedure. These patients were also divided into two groups based on their indicating diagnosis: malignant and benign. The characteristics are reported in Table 1. The significant differences between these two groups included sex (82.1% men vs 52.4%, $p < 0.001$), mean age (63.84 years vs 57.53 years, $p < 0.001$), diabetes mellitus (17.6% vs 8.2%, $p < 0.001$), hypertension (52.1% vs 39.3%, $p < 0.001$), severe COPD (7.9% vs 5.0%, $p = 0.011$), and patients who smoke (25.6% vs 19.6%, $p = 0.001$). Patients in the benign group also tended to be more functionally dependent (4.3% vs 1.2%, $p < 0.001$), less likely to have an ASA classification higher than II (73.3% vs 81.1%, $p < 0.001$), and more likely to have a dirty/infected wound classification (5.0% vs 0.4%, $p < 0.001$). Both groups had a similar rate of patients that had dyspnea at rest (0.4% vs 0.6%, $p = 0.715$).

OUTCOMES. Patients with benign disease had a higher occurrence of Clavien-Dindo grade IV complications (25% vs 20%, $p = 0.003$). Mortality was similar at 4% ($p = 0.330$). Hospital length of stay was longer for patients with benign disease (17.2 days vs 14.5 days; $p < 0.001$). No statistically significant differences were noted for readmission rates (9.1% vs 13.3%; $p = 0.495$) or wound infections (18% vs 17%; $p = 0.283$). In the nonemergent patients, there was no significant difference in the occurrence of Clavien-Dindo grade IV complications (21% vs 20%, $p = 0.356$), wound infections (18% vs 17%, $p = 0.347$), readmission (8.5% vs 13.3%, $p = 0.470$), and mortality (16% vs 19%, $p = 0.165$).

Gastric Versus Colon/Small Bowel Conduit in Benign Disease

PATIENT DEMOGRAPHICS, COMORBIDITIES AND SURGICAL PROFILES. Of the 715 benign esophagectomies, 631 had a gastric conduit (group C) and 84 had a colon/small bowel conduit (group D). Table 2 summarizes the baseline characteristics, comorbidities, and surgical profiles of the two groups. Patients in both groups were a mean age of 58 years ($p = 0.995$), and most were functionally

Table 1. Preoperative Characteristics: Malignant Versus Benign

Characteristics	All Cases			Nonemergent		
	Group A (Malignant) (n = 6,762)	Group B (Benign) (n = 715)	p[a]	Group A (Malignant) (n = 6,732)	Group B (Benign) (n = 643)	p[a]
Male sex, No. (%)	5,552 (82.2)	380 (53.1)	**<0.001**	5,526 (82.1)	337 (52.4)	**<0.001**
Age, mean (SD), years	63.85 (10.15)	58.02 (14.22)	**<0.001**	63.84 (10.15)	57.53 (14.11)	**<0.001**
Diabetes, No. (%)	1,188 (17.6)	60 (8.4)	**<0.001**	1,185 (17.6)	52 (8.2)	**<0.001**
Hypertension, No. (%)	3,524 (52.1)	283 (39.6)	**<0.001**	3,510 (52.1)	253 (39.3)	**<0.001**
Severe COPD, No. (%)	535 (7.9)	36 (5.0)	**0.007**	529 (7.9)	32 (5.0)	**0.011**
Smoking, No. (%)	1,733 (25.6)	148 (20.7)	**0.004**	1,724 (25.6)	126 (19.6)	**0.001**
Dyspnea, No. (%)			**0.005**			0.715
At rest	31 (0.5)	10 (1.4)		29 (0.4)	4 (0.6)	
Moderate exertion	681 (10.1)	75 (10.5)		677 (10.1)	68 (10.6)	
None	6,050 (89.5)	630 (88.1)		6,026 (89.5)	571 (88.8)	
Functional status, No. (%)			**<0.001**			**<0.001**
Independent	6,663 (98.5)	665 (93.0)		6,640 (98.6)	614 (95.5)	
Partially dependent	77 (1.1)	32 (4.5)		74 (1.1)	24 (3.7)	
Totally dependent	14 (0.2)	14 (2.0)		10 (0.1)	4 (0.6)	
ASA classification, No. (%)			**<0.001**			**<0.001**
No disturbance	26 (0.4)	8 (1.1)		26 (0.4)	8 (1.2)	
Mild disturbance	1,247 (18.5)	163 (22.9)		1,243 (18.5)	161 (25.1)	
Severe disturbance	4,915 (72.7)	437 (61.3)		4,902 (72.9)	409 (63.8)	
Life threatening	567 (8.4)	95 (13.3)		555 (8.2)	61 (9.5)	
Moribund	3 (0.0)	10 (1.4)		2 (0.0)	2 (0.3)	
Wound classification, No. (%)			**<0.001**			**<0.001**
Clean	194 (2.9)	27 (3.8)		192 (2.9)	23 (3.6)	
Clean/contaminated	6,347 (93.9)	563 (78.7)		6,326 (94.0)	543 (84.4)	
Contaminated	187 (2.8)	60 (8.4)		184 (2.7)	45 (7.0)	
Dirty/infected	34 (0.5)	65 (9.1)		30 (0.4)	32 (5.0)	
Emergency procedure, No. (%)	30 (0.4)	72 (10.1)	**<0.001**			

[a] Bold values are statistically significant ($p < 0.05$).

ASA = American Society of Anesthesiologists Physical Status Classification; COPD = chronic obstructive pulmonary disease.

independent before the operation (93.2% vs 91.7%; $p = 0.777$). No significant differences were noted for a history of diabetes (8.4% vs 8.4%; $p = 0.983$), hypertension (39.9% vs 36.9%; $p = 0.678$), severe COPD (5.2% vs 3.6%; $p = 0.698$), and smoking (20.6% vs 21.4%; $p = 0.974$). Similarly, no significant differences were noted for patients' ASA classification IV or higher (14.8% vs 14.3%; $p = 0.874$), contaminated wound classification (8.7% vs 6.0%; $p = 0.571$), dirty/infected wound classification (8.7 vs 11.9; $p = 0.571$), and emergency operation (10.5% vs 7.1; $p = 0.450$). Group C patients were less likely to have dyspnea at rest (1.1% vs 3.6%, $p = 0.049$).

A nonemergent benign esophagectomy was performed in 643 patients. Of these patients, 78 had a colon/small bowel conduit and 565 had a gastric conduit. The characteristics are also reported in Table 2. The only significant difference was that gastric conduit patients were less likely to have dyspnea at rest (0.4% vs 2.6%, $p = 0.010$).

OUTCOMES. Patients with a colon/small bowel conduit had higher occurrence of Clavien-Dindo grade IV complications (37% vs 23%, $p = 0.006$), higher mortality (10% vs 4%, $p = 0.017$), longer hospital length of stay (24.0 days vs 16.3 days; $p < 0.001$), and higher occurrence of wound infections (33% vs 16%; $p < 0.001$). No significant difference was noted for readmission rates (9.3% vs 8.3%; $p = 1.0$).

In the nonemergent cases, patients with a colon or small bowel conduit had a higher occurrence of Clavien-Dindo grade IV complications (35% vs 20%, $p = 0.002$), mortality (25% vs 14%, $p = 0.027$), longer length of stay (24.4 vs 15.45, $p < 0.001$), and a higher rate of wound infection (48% vs 37%, $p < 0.001$). The readmission rate was not significantly different (10% vs 8.1%, $p = 1.00$).

Cervical Versus Intrathoracic Anastomosis in Benign Disease

PATIENT DEMOGRAPHICS, COMORBIDITIES AND SURGICAL PROFILES. Of the 715 esophagectomies performed for benign disease, 420 had an intrathoracic anastomosis (group E) and 295 had a cervical anastomosis (group F). Table 3 summarizes baseline characteristics, comorbidities, and surgical profiles. Patients with an intrathoracic anastomosis were older (59.1 years vs 56.6 years; $p = 0.027$) and more likely to have hypertension (43.3% vs 34.2%; $p = 0.018$). Most patients were functionally independent before the operation (94.0% vs 91.5%; $p = 0.316$).

Table 2. Preoperative Characteristics: Gastric Versus Colonic Conduit

Characteristic	All Cases			Nonemergent		
	Group C (Gastric) (n = 631)	Group D (Colonic) (n = 84)	p[a]	Group C (Gastric) (n = 565)	Group D (Colonic) (n = 78)	p[a]
Males, No. (%)	331 (52.5)	49 (58.3)	0.369	294 (52.0)	43 (55.1)	0.695
Age, mean (SD), years	58.02 (14.13)	58.01 (14.93)	0.995	57.56 (14.02)	57.37 (14.78)	0.915
Diabetes, No. (%)	53 (8.4)	7 (8.4)	0.983	47 (8.4)	6 (7.7)	0.980
Hypertension, No. (%)	252 (39.9)	31 (36.9)	0.678	225 (39.8)	28 (35.9)	0.588
Severe COPD, No. (%)	33 (5.2)	3 (3.6)	0.698	30 (5.3)	2 (2.6)	0.443
Smoking, No. (%)	130 (20.6)	18 (21.4)	0.974	109 (19.3)	17 (21.8)	0.711
Dyspnea, No. (%)			**0.049**			**0.01**
At rest	7 (1.1)	3 (3.6)		2 (0.4)	2 (2.6)	
Moderate exertion	62 (9.8)	13 (15.5)		55 (9.7)	13 (16.7)	
None	562 (89.1)	68 (81.0)		508 (89.9)	63 (80.8)	
Functional status, No. (%)			0.777			0.465
Independent	588 (93.2)	77 (91.7)		542 (95.9)	72 (92.3)	
Partially dependent	27 (4.3)	5 (6.0)		19 (3.4)	5 (6.4)	
Totally dependent	12 (1.9)	2 (2.4)		3 (0.5)	1 (1.3)	
ASA classification, No. (%)			0.874			0.897
No disturbance	7 (1.1)	1 (1.2)		7 (1.2)	1 (1.3)	
Mild disturbance	146 (23.2)	17 (20.2)		144 (25.6)	17 (21.8)	
Severe disturbance	383 (60.9)	54 (64.3)		358 (63.6)	51 (65.4)	
Life threatening	85 (13.5)	10 (11.9)		52 (9.2)	9 (11.5)	
Moribund	8 (1.3)	2 (2.4)		2 (0.4)	0 (0.0)	
Wound classification, No. (%)			0.571			0.570
Clean	25 (4.0)	2 (2.4)		21 (3.7)	2 (2.6)	
Clean/contaminated	496 (78.6)	67 (79.8)		477 (84.4)	66 (84.6)	
Contaminated	55 (8.7)	5 (6.0)		41 (7.3)	4 (5.1)	
Dirty/infected	55 (8.7)	10 (11.9)		26 (4.6)	6 (7.7)	
Emergency procedure, No. (%)	66 (10.5)	6 (7.1)	0.450			

[a] Bold values are statistically significant ($p < 0.05$).

ASA = American Society of Anesthesiologists Physical Status Classification; COPD = chronic obstructive pulmonary disease.

No significant differences were noted for a history of diabetes (9.6% vs 6.8%; $p = 0.399$), severe COPD (4.0% vs 6.4%; $p = 0.205$), and smoking (21.0% vs 20.3%; $p = 0.916$). Also, no significant differences were noted for patients' ASA classification of IV or higher (15.0% vs 14.4%; $p = 0.564$), contaminated wound classification (9.5% vs 6.8%; $p = 0.254$), dirty/infected wound classification (10.2 vs 7.5; $p = 0.254$), and emergency operation (11.7% vs 7.8; $p = 0.117$).

There were 643 patients who underwent a nonemergent benign esophagectomy. Of these patients, 371 had an intrathoracic anastomosis, and 272 had a cervical anastomosis. The comparison of these two groups is summarized in Table 3.

OUTCOMES. Occurrence of Clavien-Dindo grade IV complications and wound infections were similar in both groups at 25% ($p = 0.996$) and 18% ($p = 0.992$), respectively. No significant differences were noted in mortality (5% vs 4%, $p = 0.419$) and readmission rates (7.7% vs 10.3%; $p = 1.0$). Patients with an intrathoracic anastomosis had a shorter hospital length of stay (15.7 days vs 19.3 days; $p = 0.008$).

In the nonemergent patients, there was no significant difference in the occurrence of Clavien-Dindo grade IV complications (42% vs 41%, $p = 0.753$), rate of mortality (16% vs 16%, $p = 0.924$), rate of wound complications (39% vs 39%, $p = 0.917$), and rate of readmission (11.5% vs 4.8%, $p = 0.763$). Patients with an intrathoracic anastomosis had a shorter length of stay (15.16 days vs 18.44 days, $p = 0.013$).

Multivariate Analysis

The forest plot in Figure 1 depicts the multivariate logistic regression analysis for 30-day morbidity and 30-day Clavien-Dindo grade IV complications in all patients with an esophagectomy. The predictors for a Clavien-Dindo grade IV complication included age (odds ratio [OR], 1.02), emergent status (OR, 2.32), race (OR, 1.36), diabetes (OR, 1.27), hypertension (OR, 1.22), COPD (OR, 1.90), smoking (OR, 1.27), functional dependence (OR, 2.18), and ASA exceeding III (OR 1.49). The negative predictors were the creation of a gastric conduit (OR, 0.67) and a malignant diagnosis (OR, 0.77). For death, the

Table 3. Preoperative Characteristics: Thoracic Versus Cervical Anastomosis

Characteristic	All Cases			Nonemergent		
	Group E (Thoracic) (n = 420)	Group F (Cervical) (n = 295)	p[a]	Group E (Thoracic) (n = 371)	Group F (Cervical) (n = 272)	p[a]
Males, No. (%)	212 (50.5)	168 (56.9)	0.103	188 (50.7)	149 (54.8)	0.342
Age, mean (SD), years	59.10 (14.13)	56.55 (14.25)	**0.027**	58.61 (13.94)	56.13 (14.24)	**0.039**
Diabetes, No. (%)	40 (9.6)	20 (6.8)	0.399	36 (9.7)	17 (6.2)	0.275
Hypertension, No. (%)	182 (43.3)	101 (34.2)	**0.018**	160 (43.1)	93 (34.2)	**0.027**
Severe COPD, No. (%)	17 (4.0)	19 (6.4)	0.205	16 (4.3)	16 (5.9)	0.471
Smoking, No. (%)	88 (21.0)	60 (20.3)	0.916	77 (20.8)	49 (18.0)	0.445
Dyspnea, No. (%)			0.471			0.379
At rest	4 (1.0)	6 (2.0)		1 (0.3)	3 (1.1)	
Moderate exertion	45 (10.7)	30 (10.2)		41 (11.1)	27 (9.9)	
None	371 (88.3)	259 (87.8)		329 (88.7)	242 (89.0)	
Functional status, No. (%)			0.316			0.374
Independent	395 (94.0)	270 (91.5)		357 (96.2)	257 (94.5)	
Partially dependent	14 (3.3)	18 (6.1)		12 (3.2)	12 (4.4)	
Totally dependent	8 (1.9)	6 (2.0)		1 (0.3)	3 (1.1)	
ASA classification, No. (%)			0.703			0.524
No disturbance	7 (1.7)	1 (0.3)		7 (1.9)	1 (0.4)	
Mild disturbance	97 (23.1)	66 (22.5)		95 (25.6)	66 (24.4)	
Severe disturbance	253 (60.2)	184 (62.8)		234 (63.1)	175 (64.8)	
Life threatening	57 (13.6)	38 (13.0)		34 (9.2)	27 (10.0)	
Moribund	6 (1.4)	4 (1.4)		1 (0.3)	1 (0.4)	
Wound classification, No. (%)			0.254			0.694
Clean	17 (4.0)	10 (3.4)		14 (3.8)	9 (3.3)	
Clean/contaminated	320 (76.2)	243 (82.4)		308 (83.0)	235 (86.4)	
Contaminated	40 (9.5)	20 (6.8)		29 (7.8)	16 (5.9)	
Dirty/infected	43 (10.2)	22 (7.5)		20 (5.4)	12 (4.4)	
Emergency procedure, No. (%)	49 (11.7)	23 (7.8)	0.117			

[a] Bold values are statistically significant ($p < 0.05$).

ASA = American Society of Anesthesiologists Physical Status Classification; COPD = chronic obstructive pulmonary disease.

positive predictors included age (OR, 1.06), race (OR, 3.02), COPD (OR, 1.62), functional dependence (OR, 2.05), ASA exceeding III (OR, 1.68), and a dirty/infected wound classification (OR, 1.48). The negative predictor for death was the creation of a gastric conduit (OR, 0.34).

Comment

Esophagectomy for malignant disease is known to be associated with significant morbidity and mortality. An early meta-analysis by Earlam and colleagues [12] showed a 20% mortality rate for esophagectomy performed for squamous cell carcinoma. With advancements of operative techniques and perioperative care, morbidity and mortality rates decreased significantly.

Rao and colleagues [13] found a mortality rate of 12% among 361 patients who underwent a transhiatal esophagectomy for malignant disease. Brown and colleagues [14] studied outcomes of minimally invasive 3-hole esophagectomies and minimally invasive Ivor Lewis esophagectomies and found the rate of Clavien-Dindo grade III, IV, or V complications to be 34.7% and 59.0%, respectively.

A study by The Society of Thoracic Surgeons analyzed outcomes of 4,321 patients with esophagectomy and found the mortality was 3.1% and the major complication rate was 33.1% [15]. These findings are similar to results from this large series, where mortality rate was 4% and the occurrence of Clavien-Dindo grade IV complications was 20% in patients with malignant disease.

Esophagectomy for benign disease is also associated with significant morbidity and mortality. Young and colleagues [16] studied 255 patients with esophagectomy for benign disease. The mortality rate was 5%, rate of one or more complications was 56%, and median hospital stay was 14 days [16]. Other studies examining esophagectomy for benign disease reported mortality rates ranging from 2% to 5% [10, 13, 17, 18]. These findings are similar to results from this large series, where the mortality rate was 4% and the occurrence of Clavien-Dindo grade IV complications was 25% in patients with benign disease. The mean length of stay was 17.2 days. The higher morbidity rate and longer hospital length of stay compared with patients with malignant disease might be explained by the higher percentage of operations being performed as emergencies (10.1% vs 0.4%; $p < 0.001$).

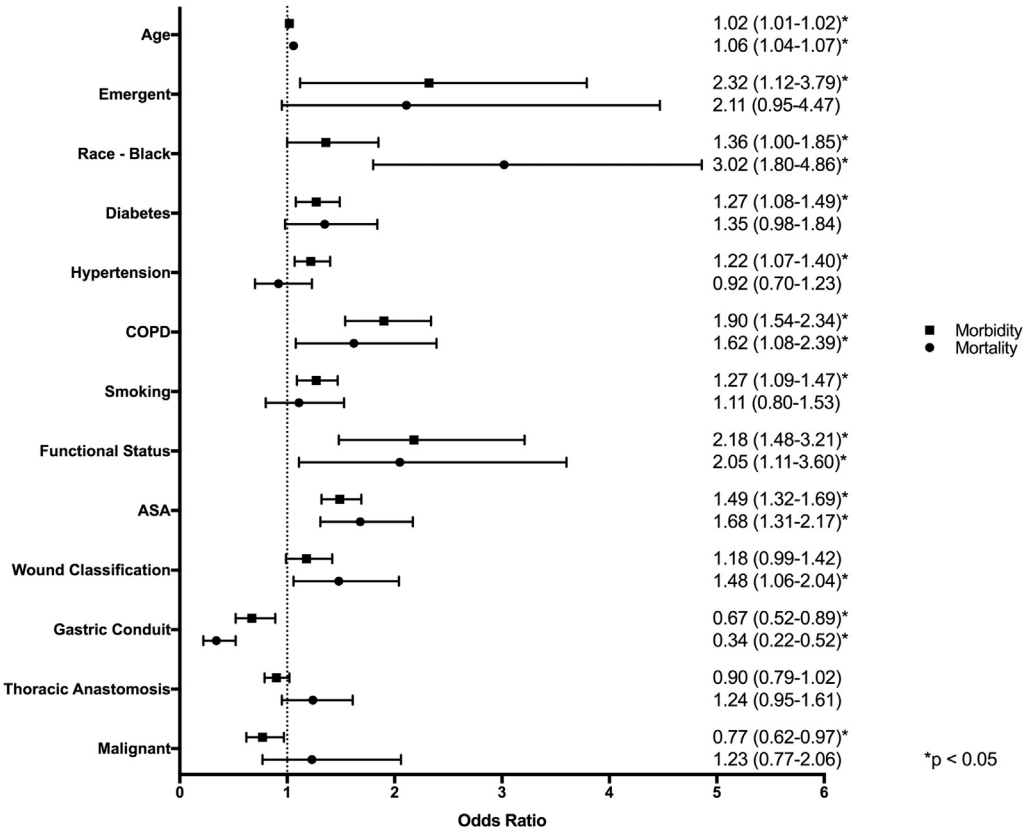

Fig 1. Predictors for morbidity and mortality. The solid squares show the odds ratio and the horizontal lines show the 95% confidence interval. (ASA = American Society of Anesthesiologists Physical Status Classification; COPD = chronic obstructive pulmonary disease.)

Available data are limited on outcomes of different conduits used for esophageal reconstruction in patients with benign disease. Most studies have small patient populations, some pool benign and malignant esophagectomies, and some do not stratify outcomes by the type of conduits used. In an early report by Waters and colleagues [19], total thoracic esophagectomy, followed by reconstruction with a gastric conduit, had a perioperative mortality of 5%. Pinotti and colleagues [20] evaluated patients with an advanced megaesophagus who underwent esophagectomy and cervical gastroplasty and found a mortality rate of 4.18%. Curet-Scott and colleagues [21] studied 53 consecutive patients with benign disease who underwent esophageal resection, followed by colonic interposition, and found the mortality rate was 3.8% and complication rate was 26.4%.

Another study by Young and colleagues [16] found the type of conduit had no effect on early morbidity or mortality. They studied 255 patients who underwent esophagectomy for benign disease, and reconstruction was performed with stomach in 168 patients (66%), colon in 70 (27%), and small bowel in 17 (7%). The mortality rate was 5%, and the rate of having at least one complication was 56%. Median hospital stay was 14 days [16].

To the best of our knowledge, our study is the largest study to date that analyzes outcomes of patients undergoing esophageal reconstruction after esophagectomy for benign disease. Gastric conduits were used for esophageal reconstruction in 631 patients and colon/small bowel conduits were used in 84. Outcomes from this study favor the use of gastric conduits.

No differences in morbidity or mortality exist between intrathoracic or cervical anastomosis in patients undergoing esophagogastric anastomosis after esophageal resection for cancer [22]. However, limited data exist on the effect of anastomosis site on outcomes of benign esophagectomies. Young and colleagues [16] studied 255 patients undergoing a benign esophagectomy. The anastomosis was intrathoracic in 144 patients (57%) and cervical in 111 (43%). They found that the location of the anastomosis did not affect early morbidity or hospital mortality [16].

Our study is the largest to evaluate the site of anastomosis in patients with a benign esophagectomy. Of 715 patients who underwent a benign esophagectomy, 420 had intrathoracic and 295 had cervical anastomosis. The only significant difference was that patients with a cervical anastomosis had a longer hospital length of stay (19.3 days vs 15.7 days; $p = 0.008$).

A limitation of this study is the use of retrospective and observational data from the NSQIP database. Variables are not always precisely defined or coded after an esophagectomy. NSQIP provides data on only the first 30 postoperative days, and thus, long-term outcomes cannot be determined. Postoperative functional outcomes are not included in the NSQIP database. Examining these

outcomes could give further insight into the quality of life measures of patients who have undergone a benign esophagectomy. Other possible detrimental variables not included in the database include preoperative pulmonary function tests, surgical techniques, and previous esophageal interventions. Finally, hospital participation in NSQIP is voluntary, and thus, outcomes determined from participating hospitals might not be generalizable to other hospitals.

Conclusion

Benign esophagectomy has a similar mortality to a malignant esophagectomy but is associated with a significantly higher morbidity. Although the site of the anastomosis does not alter outcomes, use of colon/intestine conduit should be pursued with caution.

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