Why are patients being readmitted after surgery for esophageal cancer?

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Objective: Readmission after surgery is an unwanted adverse event that is costly to the healthcare system. We sought to evaluate factors associated with increased risk of readmission and to characterize the nature of these readmissions in patients who have esophageal cancer.

Methods: A retrospective cohort study was performed in 306 patients with esophageal carcinoma who underwent neoadjuvant chemoradiation followed by esophagectomy at Johns Hopkins Hospital between 1993 and 2011. Logistic regression was used to identify factors associated with 30-day readmission. Readmissions were defined as inpatient admissions to our institution within 30 days of discharge.

Results: The median age at surgery was 61 years; the median postoperative length of stay was 9 days; and 48% of patients had ≥ 1 postoperative complication (POC). The 30-day readmission rate was 13.7% (42 of 306). In univariate analysis, length of stay and having ≥ 1 POC were significantly associated with readmission. In multivariate analysis, having ≥ 1 POC was significantly associated with a >2 -fold increase in risk for 30-day readmission (odds ratio 2.35, with 95% confidence interval [1.08-5.09], $P = .031$) when controlling for age at diagnosis and length of stay. Of the 42 patients who were readmitted, 67% experienced POCs after surgery; 50% of patients who experienced POCs were readmitted for reasons related to their postoperative complication. The most common reasons for readmission were pulmonary issues (29%), anastomotic complications (20%), gastrointestinal concerns (17%), and venous thromboembolism (14%).

Conclusions: Complications not adequately managed before discharge may lead to readmission. Quality improvement efforts surrounding venous thromboembolism prophylaxis, and discharging patients nothing-by-mouth, may be warranted. (J Thorac Cardiovasc Surg 2015;149:1384-91)

See related commentary pages 1392-3.

Hospital readmission rates have been argued to be a key measure of healthcare quality. In 2008, the Medicare Payment Advisory Commission advised the Centers for Medicare and Medicaid Services (CMS) to collect and publish key statistics on readmissions. According to 2004 estimates, unplanned readmissions cost Medicare an estimated \$17 billion in expenditures, or 17% of total spending¹; moreover, the commission reported that $>75\%$ of readmissions within 30 days, and 84% of readmissions within 7 days, were potentially preventable.²

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With the 2012 Patient Protection and Affordable Care Act, the application of CMS payment incentives is expected to increase. Under the Hospital Readmissions Reduction Program, hospitals with higher readmission rates will receive penalties in CMS reimbursement. These penalties, implemented in 2013, currently apply to only heart failure, acute myocardial infarction, and pneumonia, but they are expected to expand to include other conditions in the coming years.² Beginning in 2015, the program will include penalties for readmissions after hip and knee arthroplasty.³ This development has raised considerable interest among providers, patients, and payers in reducing the number of preventable readmissions.

Esophageal cancer has a relatively poor prognosis compared with other cancers and is associated with a high rate of readmission. Thirty-day readmission rates have been reported at 12% to 25%, which is above the national average for all Medicare-billed admissions, and well higher than those for most other cancer surgeries.⁴ However, very little research has focused on factors that predispose patients who have esophageal cancer to readmission after surgery.

In this retrospective study of a single-institution cohort, we set out to evaluate factors associated with an increased risk of 30-day readmission and to characterize the nature of 30-day readmissions after surgery in such patients.

Abbreviations and Acronyms

CI	= confidence interval
CMS	= Centers for Medicare and Medicaid Services
OR	= odds ratio
POC	= postoperative complication
VTE	= venous thromboembolism

Our cohort includes 19 years of data from patients who have esophageal cancer and underwent neoadjuvant chemoradiation and esophagectomy (multimodality therapy) at our institution. We hypothesized that the occurrence of postoperative complications would increase the odds of 30-day readmission among these patients.

METHODS**Study Population**

Using the Johns Hopkins Hospital Cancer Registry, we identified 314 patients with esophageal cancer who were treated, between July 1993 and December 2011, with combined neoadjuvant chemoradiation therapy and subsequent esophagectomy at the Sidney Kimmel Comprehensive Cancer Center. This study was approved by the Johns Hopkins Medicine Institutional Review Board.

Exposure Assessment

Patient factors, past medical history, and surgical and postoperative stay information were abstracted from the electronic patient record system. Patient factors include age, gender, race, marital status, tumor site, histology, pathologic state, clinical response, comorbidities, and smoking. Patient surgical factors include the American Society of Anesthesiology physical status classification number and surgical procedure. Postoperative factors include length of stay and postoperative complications, which were deduced from surgeon summaries and include unexpected events. Specific categories of postoperative complication data collected include: cardiac, vascular, pulmonary, sepsis and infection, wound infection, anastomotic leak, chylous leak, vocal cord complication, hemodynamic instability, mental health and neurologic complications, and miscellaneous.

Outcome Measurement

Our primary endpoint was 30-day readmission, which we defined as inpatient admission to our institution within 30 days of discharge from a postoperative stay. Thirty-day readmissions were identified from the Johns Hopkins Hospital administrative billing database (Casemix) and were confirmed by looking at the patient's electronic chart. Readmissions include those to the intensive care unit, emergency room, and inpatient wards. Three patients in inpatient rehabilitation who were readmitted to the intensive care unit were counted as readmissions.

Readmissions were identified using our institution's administrative billing database, by subtracting the date of readmission from the discharge date of the inpatient stay associated with the esophagectomy. Patient electronic chart review was used to show whether the readmission was related to the patient's postoperative inpatient stay, and to verify the accuracy of all readmissions identified from the hospital administrative billing database. Categories for readmission include: venous thromboembolism (VTE), anastomotic complications, other pulmonary concerns, gastrointestinal distmotility, cardiac concerns, fever, wound infection, pyloric stenosis, metastasis, and miscellaneous causes.

Statistical Methods

Comparison of means and medians of continuous variables was performed using the Student *t* test (2-sided) and nonparametric Mann-

Whitney *U* test, respectively. Comparisons between proportions for binary and categorical variables were performed using the χ^2 test for homogeneity. Fisher's exact test was used to compare differences in proportions when numbers in cells were <5 units. All hypothesis tests were 2-sided.

Logistic regression was used to identify factors associated with 30-day readmission. Variables identified as significant in univariate models were included as covariates in the multivariable model. We tested for interactions between length of stay and having ≥ 1 postoperative complication. Crude and adjusted odds ratios (ORs) and corresponding 95% confidence intervals (CIs) are reported. All analyses were performed using the Stata SE 12 statistical package (Stata Corporation, College Station, Tex).

RESULTS

A total of 314 patients met the study inclusion criteria. Eight patients were excluded because they died during surgery or before discharge, leaving 306 patients in the study. Characteristics of the study population and the distribution of perioperative and postoperative complications are shown in [Tables 1 and 2](#). The median age at surgery was 61 years. A total of 89% of patients were men; 86% had adenocarcinoma histology; 77% had at ≥ 1 comorbidity; and 84% reported a smoking history with a median of 30 pack-years. Operatively, 78% had transhiatal surgery, and 14% had 3-incision approaches. The median postoperative length of stay was 9 days, with an interquartile range of 8 to 11 days. Cardiac complications (18%) were the most common type, followed by pulmonary (15%). In all, 48% of patients experienced ≥ 1 postoperative complication (POC), and 25% had ≥ 2 POCs.

The distributions of study characteristics for patients who experienced, versus did not experience, a postoperative complication are presented in [Table 3](#). Compared with patients with no postoperative complications, patients who experienced ≥ 1 POC were more likely to be older, female, and African-American; they underwent fewer transhiatal procedures and had longer lengths of stay. Otherwise, patients with, versus without, POCs were comparable in pathologic stage, clinical response, prevalence of ≥ 1 comorbidity, and American Society of Anesthesiology classification.

Crude and adjusted ORs were used to estimate the association between clinical factors and 30-day readmission and are shown in [Table 4](#). In univariate analysis, the odds of 30-day readmission increased by 5% for each day spent in the hospital, a statistically significant increase (OR = 1.05; 95% CI, 1.00-1.08). Patients who experienced ≥ 1 POC were significantly associated with having a 2.8 times greater odds of readmission within 30 days after discharge, compared with those with no POCs (OR = 2.8; 95% CI, 1.39-5.63).

Although the difference is not statistically significant, the OR of 30-day readmission for women was more than twice that for men (OR = 2.15; 95% CI, 0.90-5.14). Additionally, the distribution for 30-day readmission did not differ by 5-year categories (1990-1994; 1995-1999; 2000-2004;

TABLE 1. Characteristics of the study population

Patient characteristics (N = 306)	Value
Median age (y [IQR])	61 (53-68)
Gender	
Male	272 (88.9)
Female	34 (11.1)
Race	
White	287 (93.8)
Black/other	19 (6.2)
Marital status	
Not married	43 (14.1)
Married	263 (86.0)
Tumor site	
Upper third	1 (0.3)
Middle third	30 (9.8)
Lower third	185 (60.5)
Distal	2 (0.7)
Gastroesophageal junction/cardia	88 (28.8)
Histology	
Adenocarcinoma	263 (86.0)
Squamous cell	43 (14.1)
Pathologic stage	
Disease free	88 (28.8)
I	38 (12.4)
II	127 (41.5)
III	45 (14.7)
IV	8 (2.6)
Clinical response	
Complete	88 (28.8)
Partial	145 (47.4)
None	73 (23.9)
Comorbidities	
None	71 (23.3)
≥ 1	235 (76.8)
Smoking status	
Never	50 (16.3)
Former	160 (52.3)
Current	96 (31.4)

Values are n (%), unless otherwise indicated. IQR, Interquartile range.

2005-2009; and 2010-2011) or 10-year categories (1990-1999 and 2000-2011) of diagnosis year ($P = .132$ and $.134$, respectively). In multivariate analysis, controlling for age at diagnosis and length of stay, having ≥ 1 POC remained significantly associated with a 2.35 increase in odds of 30-day readmission (OR = 2.35; 95% CI, 1.08-5.10).

Forty-two (13.7%) of the patients were readmitted within 30 days after discharge (Table 5). The median length of time between discharge from the hospital and readmission was 7 days (interquartile range: 4-16 days). The most common reasons for readmissions were pulmonary issues (29%), anastomotic complications (19%), gastrointestinal concerns (17%), and VTE (14%). Of the 42 patients readmitted, 28 (67%) experienced a POC. Of these patients, 40% presented with a pulmonary complaint on readmission, 18% had a VTE, 18% had anastomotic issues,

and 14% had gastrointestinal concerns. Of the 14 (33%) readmitted patients who did not have a POC, only 1 had a pulmonary complaint, and only 1 had a VTE. Three had anastomotic complications, and 3 had gastrointestinal concerns.

For the general analysis of all 42 readmitted patients, types of VTE included pulmonary embolism (4 cases) and deep vein thrombosis (2 cases). Anastomotic complications include issues with strictures, leaks, or dehiscence. Other pulmonary concerns include pneumonia, aspiration, pulmonary effusions, lung abscess, and failure to thrive because of complications such as excess secretions. The gastrointestinal dysmotility issues include nausea, vomiting, and small-bowel obstruction. Cardiac causes of readmission include atrial fibrillation, supraventricular tachycardia, and myocardial infarction. The miscellaneous causes include pancreatitis, facial swelling, and neck abscess. The median charge associated with these 42 readmissions is \$13,033.50. Three patients died during their readmission stay.

DISCUSSION

To develop ways to reduce readmissions, understanding their causes is important. Despite the fact that the interest level in reducing readmissions is high, very little work has been published regarding factors that may lead to readmission in patients who have esophageal cancer. This study demonstrates, in patients who had an esophagectomy, a statistically significant association between having a POC and being readmitted within 30 days of discharge. The subanalysis of the readmission data highlights thrombosis as a common cause of potentially preventable readmissions, and in addition, pulmonary, anastomotic complications, and gastrointestinal issues as major factors predisposing patients to readmission. With increasing financial pressure on hospitals to reduce readmission rates, greater attention is needed to determine how patient care may be improved, as a means to reduce the high readmission rates after esophagectomy.

Although much work has been done to understand and minimize long-term negative outcomes after esophagectomy, little research has focused on illuminating risk factors associated with readmission. In a more general study of all Medicare inpatient claims and the American College of Surgeons National Surgical Quality Improvement Program, the authors found that readmitted patients were 3.4 times more likely to have a POC, as defined in that program, than were nonreadmitted patients.⁵ Studies in other surgical specialties have aimed to evaluate risk factors associated with 30-day readmission.⁶ To our knowledge, this study is one of the first to identify risk factors associated with 30-day readmission in esophageal cancer patients who underwent neoadjuvant chemoradiation followed by esophagectomy. This investigation underscores the need for

TABLE 2. Perioperative characteristics and postoperative complications

Surgical characteristics (N = 306)	Value
Time from diagnosis to surgery (d)	116 (103-136)
ASA classification	
1	0 (0.0)
2	31 (10.1)
3	260 (85.0)
4	13 (4.2)
5	2 (0.7)
Surgical procedure	
Transhiatal	237 (77.5)
3-incision	43 (14.1)
Ivor Lewis esophagectomy	9 (2.9)
Esophagectomy, NOS	17 (5.6)
Length of stay (d)	9 (8-11)
ICU stay (d)	2 (2-4)
Preoperative stay (d)	0 (0-0)
Postoperative stay (d)	9 (8-11)
Type of postoperative complication	
Cardiac	56 (18.3)
Pulmonary	46 (15.0)
Sepsis and/or other infection	24 (7.8)
Anastomotic leak	22 (7.2)
Wound infection	19 (6.2)
Mental health	13 (4.3)
Vocal cord	11 (3.6)
Hemodynamic instability	11 (3.6)
Chylous leak	10 (3.3)
Vascular	6 (2.0)
Number of postoperative complications	
None	160 (52.3)
1	68 (22.2)
≥2	78 (25.5)

Values are n (%) or median (IQR), unless otherwise indicated. Length of stay includes all time in the hospital, including both preoperative and postoperative days. ASA, American Society of Anesthesiology; NOS, not otherwise specified; ICU, intensive care unit.

increased attention to postoperative care and the period that immediately follows discharge.

Given the high readmission rates after surgery for patients with esophageal cancer, surgeons and the postoperative care team must think creatively regarding ways to improve postsurgery care. One potential opportunity is to include readmitted patients as case presentations at quality improvement conferences to help the team minimize future readmissions. Potential ways to improve follow-up care are e-mail and phone follow-up, along with video and picture messaging, to ensure that patients are meeting expectations for postsurgical recovery. Additionally, although postoperative care is highly personalized for individual patients and cannot be easily standardized, further research should be conducted on how to reduce common causes of readmissions, especially those relating to POCs.

Our study did not find a significant association between shorter length of stay and 30-day readmission rates. Given

TABLE 3. Distribution of characteristics according to occurrence of postoperative complications

Characteristics (N = 306)	No postoperative complications (n = 160; 52%)	≥1 postoperative complication (n = 146; 48%)	P value*
Age (y)	60 (51-66)	63 (55-69)	.01
Gender			.04
Male	148 (92.5)	124 (84.9)	
Female	12 (7.5)	22 (15.1)	
Race			.06
White	154 (96.3)	133 (91.1)	
Black/other	6 (3.8)	13 (8.9)	
Marital status			.25
Not married	19 (11.9)	24 (16.4)	
Married	141 (88.1)	122 (83.6)	
Tumor site			.01
Upper third	1 (0.6)	0 (0.0)	
Middle third	8 (5.0)	22 (15.1)	
Lower third	97 (60.6)	88 (60.3)	
Distal	1 (0.6)	1 (0.7)	
Gastroesophageal junction/cardiac	53 (33.1)	35 (24.0)	
Histology			.25
Adenocarcinoma	141 (88.1)	122 (83.6)	
Squamous cell	19 (11.9)	24 (16.4)	
Pathologic stage			.59
Disease free	40 (25.0)	48 (32.9)	
I	21 (13.1)	17 (11.6)	
II	71 (44.4)	56 (38.4)	
III	23 (14.4)	22 (15.1)	
IV	5 (3.1)	3 (2.1)	
Clinical response			.23
Complete	40 (25.0)	48 (32.9)	
Partial	77 (48.1)	68 (46.6)	
None	43 (26.9)	30 (20.6)	
Comorbidities			.61
None	39 (24.4)	32 (21.9)	
≥1	121 (75.6)	114 (78.1)	
Smoking status			.56
Never	28 (17.5)	22 (15.1)	
Former	86 (53.8)	74 (50.7)	
Current	46 (28.8)	50 (34.3)	
Pack-years smoked (y)	30 (20-50)	30 (20-50)	.73
Time from diagnosis to surgery (d)	113 (102-132)	118 (105-139)	.24
ASA classification			.13
1	0 (0.0)	0 (0.0)	
2	22 (13.7)	9 (6.2)	
3	130 (81.3)	130 (89.0)	
4	7 (4.4)	6 (4.1)	
5	1 (0.6)	1 (0.7)	
Surgical procedure			.00
Transhiatal	135 (84.4)	102 (69.9)	
3-incision	17 (10.6)	26 (17.8)	
Ivor Lewis esophagectomy	0 (0.0)	9 (6.2)	
Esophagectomy, NOS	8 (5.0)	9 (6.2)	

(Continued)

TABLE 3. Continued

Characteristics (N = 306)	No postoperative complications (n = 160; 52%)	≥1 postoperative complication (n = 146; 48%)	P value*
Length of stay (d)	8 (7-9)	11 (9-17)	.00
ICU stay (d)	2 (2-3)	4 (2-6)	.00
Preoperative stay (d)	0 (0-0)	0 (0-0)	.06
Postoperative stay (d)	8 (7-9)	11 (9-17)	.00

Values are n (%) or median (IQR), unless otherwise indicated. *P values were computed using nonparametric Mann-Whitney U test, χ^2 test for homogeneity, Fisher's exact test. ASA, American Society of Anesthesiology; NOS, not otherwise specified; ICU, intensive care unit.

that our study involved a single institution, the possibility of an association should be explored in subsequent studies. Previous work has suggested that neoadjuvant chemoradiation does not increase POCs, morbidity, or mortality after

esophagectomy; therefore, this factor was unlikely to be a confounder in our study.⁷

Regarding specific causes of readmission, previous work⁸ with the national Surgical Quality Improvement Program data has shown that the perioperative incidence of VTE events in patients who undergo esophagectomy is 7.3%. Our results concur with the conclusion that VTE is a significant cause of readmission. In addition, further research must be conducted on the potential for thromboprophylaxis to be continued after discharge. One strong step in that direction would be to study how best to utilize VTE prophylaxis after discharge, and whether it is appropriate for all patients or only a subset of high-risk patients. Studies in other surgical specialties, including general surgery, otolaryngology, plastics, vascular, and urology, have reported that the Caprini Risk Assessment Model may be

TABLE 4. Assessment of the association between clinical factors and 30-day readmission among patients with esophageal cancer treated with combined neoadjuvant chemoradiation and surgery

Characteristics (N = 306)	Crude OR	95% CI	P value	Adjusted OR	95% CI	P value
Age at diagnosis (y)	1.03	(0.99-1.06)	.099	1.02	(0.99-1.06)	.258
Gender						
Male	1.00	Referent				
Female	2.15	(0.90-5.14)	.084			
Race						
White	1.00	Referent				
Black/other	1.19	(0.33-4.28)	.787			
Histology						
Adenocarcinoma	1.00	Referent				
Squamous cell	0.61	(0.21-1.78)	.368			
Surgical procedure						
Transhiatal	1.00	Referent				
Other procedure	0.78	(0.34-1.78)	.560			
ASA classification						
2	1.00	Referent				
3	1.55	(0.45-5.37)	.491			
4 or 5	2.33	(0.41-13.26)	.250			
Pathologic stage						
Disease free	1.00	Referent				
I	1.52	(0.46-4.97)	.490			
II	2.33	(0.99-5.46)	.052			
III	0.98	(0.28-3.43)	.969			
IV	1.43	(0.16-13.12)	.753			
Clinical response						
Complete	1.00	Referent				
Partial	2.29	(0.99-5.29)	.053			
None	1.06	(0.37-3.08)	.914			
≥1 comorbidity	1.33	(0.59-3.02)	.493			
Smoking status						
Never	1.00	Referent				
Former	0.84	(0.35-2.02)	.692			
Current	0.75	(0.28-1.97)	.560			
Length of stay (d)	1.05	(1.00-1.09)	.030	1.02	(0.97-1.07)	.468
≥1 postoperative complication	2.80	(1.39-5.63)	.004	2.35	(1.08-5.10)	.031

Adjusted ORs were adjusted for: age at diagnosis, length of hospital stay, and having ≥1 postoperative complication. The category of "Other procedure" includes 3-incision; Ivor Lewis esophagectomy; or esophagectomy, not otherwise specified. Bold indicates significance. OR, Odds ratio; CI, confidence interval; ASA, American Society of Anesthesiology.

TABLE 5. Characteristics of 30-day readmissions

Characteristic (N = 42)	Value
Time since last discharge (d)	7 (4-16)
Length of stay during readmission (d)	5 (2-11)
Total charge for readmission (\$)	13,033.50 (4608.00-17,168.00)
Mean total charge for readmission (\$)	23,721.00
Cause of readmission*	
Other pulmonary issues	12 (28.6)
Anastomotic complications	8 (19.0)
Gastrointestinal issues	7 (16.7)
Venous thromboembolism	6 (14.3)
Cardiac issues	4 (9.5)
Fever of unknown etiology	3 (7.1)
Miscellaneous	3 (7.1)
Pyloric stenosis	2 (4.8)
Wound infection	1 (2.4)
Metastasis	1 (2.4)
Year of readmission, by category	
1990-1994	0 (0.0)
1995-1999	9 (21.4)
2000-2004	15 (35.7)
2005-2009	16 (38.1)
2010-2011	2 (4.8)

Values are n (%) or median (IQR), unless otherwise indicated. The "miscellaneous" category includes pancreatitis, facial swelling, and neck abscess. *Five patients had 2 primary reasons for readmission, so both reasons were included.

an effective method to identify patients who are at high risk for developing a VTE within 30 days after discharge.⁹⁻¹¹

Additionally, given the many gastrointestinal and pulmonary complications that linked aspiration, another potential quality improvement measure is to discharge patients on a nothing-by-mouth diet and reevaluate their dietary status during follow-up. Further efforts to address pulmonary, anastomotic, and gastrointestinal complications are warranted and should be explored.

The limitations of this study include the retrospective methodology and the single-institution design. Future studies that include multiple institutions may be beneficial to explore the role institutional differences or case volume may play in readmission rates after esophagectomy. Another limitation is that patients readmitted to outside hospitals were not included in the readmission dataset, and therefore, the true readmission rate may be higher than reported. A study of lung cancer patients found that 17% of patients were readmitted to hospitals other than the admitting institution.¹² However, we are very meticulous about follow-up care, and we work hard to "own" our patients' care. We encourage them to return to our institution for any and all problems after their surgery, so we do not believe the loss of 30-day readmissions to other hospitals was very high. An additional limitation is an institutional bias toward performing esophagectomy via a transhiatal approach when indicated. An appropriate next step is to conduct a study using the Society of Thoracic Surgeons National Database to verify the generalizability of these findings.

In conclusion, the association between POC and 30-day readmission discovered in this study provides a foundation for future research and innovative quality improvement programs to reduce readmission rates, improve patient care, and lower healthcare costs.

Conflict of Interest Statement

Authors have nothing to disclose with regard to commercial support.

You can watch a Webcast of this AATS meeting presentation by going to: http://webcast.aats.org/2014/files/Monday/20140428_355PM_415PM_Sneha_Shah.mp4

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Key Words: Thirty-day readmission, postoperative complications, length of stay, esophageal cancer, neoadjuvant chemoradiation plus surgery, multimodality therapy, outcomes

Discussion

Dr Mark B. Orringer (*Ann Arbor, Mich*). Ms Shah, a beautifully presented paper. This paper adds to the growing reality that a "successful" esophagectomy is more than healing incisions,

and discharge from the hospital on postoperative day 5 to 10. An esophagectomy of any type in experienced hands can now be performed with low–single-digit hospital mortality. But an esophagectomy, by any measure, is a morbid operation, often performed, as you have pointed out, after neoadjuvant chemotherapy and radiation therapy in patients with multiple comorbidities.

Recovery is influenced far less by the length of the incision or the number of port sites than by the adjustment to altered gastric capacity, diminished appetite and taste for food, postvagotomy cramping and diarrhea after eating, impaired swallowing after recurrent laryngeal nerve injury, home wound care after an anastomotic leak or wound infection, and the thromboembolic complications in patients who are sedentary and become dehydrated after hospital discharge.

You have presented a retrospective analysis of 306 esophagectomies for cancer, performed over the course of 18 years. Some of these data warrant emphasis. Nearly 78% had a transhiatal esophagectomy; 77% or more had ≥ 1 comorbidity; and 52% had an uncomplicated postoperative course, but nearly half did not. The most significant factors associated with postoperative complications were middle-third tumor location, chronic renal failure, surgical procedure (you had fewer postoperative complications in your patients with thromboembolism than in those who underwent transthoracic esophagectomy), length of stay, and having ≥ 1 postoperative complication.

It is sobering that having ≥ 1 postoperative complication was associated with a 2-fold increase in the risk of a 30-day readmission. This 30-day readmission rate was nearly 14%, and the most common causes were: other pulmonary issues (29%); anastomotic complications (19%); gastrointestinal dysmotility in 17%, presumably from dumping; and venous thromboembolism in 14%.

Your report raises some important questions. In the 18-year period spanned by this work, preconditioning of patients for major thoracic surgery, for many of us, has become a mantra, an absolute adherence to abstinence from cigarette smoking for 3 weeks before surgery, walking 2 to 3 miles a day, and using an incentive spirometer. This preoperative conditioning has been a key factor in avoidance of a routine intensive care unit (ICU) stay and reducing postoperative thromboembolic and pulmonary complications.

So, on to the first question: Only 4% of our patients with thromboembolism in the past 10 years have required postoperative intensive care, because they are better prepared for their operations, and they have fewer postoperative complications as a result. They go home walking and understanding the importance of ambulation. They are out of bed quickly. So, Ms Shah, isn't your group more aggressive in preconditioning these patients now than, say, 18 years ago? Does your reported ICU-stay median of 2 days reflect your current practice?

Ms Shah. Dr Orringer, thank you very much for your thoughtful comments and questions. It is an honor to have you as our discussant, and thank you for your review of our article.

I think that is an excellent question. We did look at whether the time period in which patients had surgery influenced any of the variables, and we did not find a significant difference between that 2-day ICU stay and other lengths of stay. I do agree that it would make sense if overall ICU stay decreased over time with improved preoperative conditioning. However, when we separated those who had postoperative complications, the length of stay

remained fairly constant over time and the incidence of complications were distributed evenly among the different time periods.

Dr Orringer. So your patients routinely go to an ICU after the surgery?

Dr Stephen C. Yang. Yes.

Dr Orringer. I agree with you that larger-volume esophageal surgery centers often treat patients who have come from quite a distance, and they are discharged home to the care of their family and referring physicians. Dehydration from poor oral intake, failure to thrive, thromboembolic events, atelectasis, and pneumonia after returning home are often treated at the local hospital by the local doctors, without the patient coming back to the "mother house" where the operation was done.

So, my second question: Do you not feel that the 14-day readmission rate that you have reported is likely a significant underestimation of the true rehospitalization rate, particularly when we have heard that the 90-day mortality is double the 30-day mortality in this population? Something is going on beyond 30 days, and I think all of us are realizing that this 30-day period is likely inadequate follow-up. Have you started to initiate more-careful postoperative follow-up for longer periods of time, which I think may have to become the standard for us?

Ms Shah. I agree with you, sir. I think it is an interesting point, because multiple studies have documented this failure to follow up on patients because they do come from so far away. Multiple studies have indicated that readmission rates for tertiary-care hospitals are lower than the national average, presumably because patients are readmitted to other local hospitals. There is no published literature for patients who undergo esophagectomy that estimates what this percentage is. However, for lung patients, about 17% of readmitted patients are readmitted to outside hospitals.

I agree with you completely regarding follow up, that in the 30-day period after discharge, we need to follow up sooner. I think you saw that the median time to discharge was only 7 days, and oftentimes follow-up appointments happen 3 weeks after discharge. So we need to be very aggressive in that first 7-day period.

Dr Orringer. Finally, we now have protocols for preoperative conditioning and postoperative clinical pathways for what happens in the hospital each day after the operation.

What we are lacking, however, and this report certainly stimulates correction, are specific, well constructed, postdischarge protocols for the management of the jejunostomy tube, the anastomotic leak, the feeding jejunostomy, etc., rather than just telling the patient to hang up a bag and connect to a pump.

Are you using such protocols? Do you plan to use such protocols? It sounds like this is a sort of call-to-arms that we need to have such protocols established.

Ms Shah. I agree with you, and I think that, as of now, there has not been a standardization of postoperative care for patients, just because each patient presents so differently, and the needs of patients are so different. I think it would be valuable to explore and to study whether certain standardizations of those protocols could be beneficial, and I think that would be a fabulous quality improvement research project to pursue, based on this research.

Dr Orringer. It was a pleasure to read the article, and congratulations.

Ms Shah. Thank you so much, sir.

Dr Orringer. You did a good job for a medical student, and even for a resident.

Ms Shah. Thank you.

Dr Steven R. DeMeester (*Los Angeles, CA*). Congratulations on a very nicely presented paper, interesting topic. I am curious how you analyzed length of stay. Did you do that as a continuous variable, or did you break it into segments of time? I ask because in my clinical experience, at least, some patients do extremely well—they fly through the surgery and recovery and they are out early. Then you have a group of patients who have some small complication, and they linger for a few extra days or maybe 1 week longer. Finally, you have the third group that just have a horrible course, and they are there for 1 or 2 months or longer. So, my question is: Were there differences as to why and how often patients from each of these 3 groups got readmitted? Did you look at that at all?

Ms Shah. So, to answer your first question, we looked at length of stay as a continuous variable. To look at why they were readmitted, we did not subsection the group that way. I think that would be a valuable next step to take. But I think what was interesting was that we thought length of stay might be predictive of readmission, but we found that, in our study population, it was not.

We also looked at the correlation between length of stay and postoperative complication to make sure that we were not measuring the same information with 2 variables. So when we did the R-squared value and the Pearson test, we found that, no, they were actually different. The R-squared value was 0.23.

So I think doing the study that you suggested with length of stay, and breaking it down that way, would be very valuable. But length of stay was not, for our patients, related to readmission.

Dr Thoralf M. Sundt III (*Boston, Mass*). Thanks. Terrific job. Two questions. Did you account at all for family support? Is there a way to account for family support and the impact on readmission?

Ms Shah. Right. So we did not, and that is something that is a limitation of our study because that is very clearly beneficial and important in the postoperative period. So that is an excellent point.

Dr Sundt. The related question is: How often are patients discharged to a skilled nursing facility (SNF)? If we look at the things that we can change, as opposed to the things we cannot change, one is making the decision about whether this person's care should transition to an SNF before they go home. What percentage of patients went from your hospital to an SNF?

Dr Yang. I can answer. We did a study approximately 5 years ago, and that was approximately 13% as well. So, 13% either went to a skilled nursing home or had skilled nursing at their home.

Dr Sundt. So, the question is: Should that percentage be higher? If you were more liberal about discharging to an SNF, would you be able to drive down these readmissions? I do not know how you would do that study, but that would be interesting.

Dr Yang. Yeah, it gets a little complicated. But I agree; I think if we do more skilled nursing, that might help. I mean, we are all stretched, and we have only a certain number of midlevels to check up on these patients. The hospital does not really give us a lot of resources. It is actually a very tough job to get people to a skilled nursing home these days. By the time we find a bed for them, they are actually ready to go home.

Dr Sundt. I could imagine that different payers may have different attitudes about SNFs. So, you might almost have a randomized study based on payer.

Dr Yang. Sure.

Dr Sundt. The payers that are more likely to let you discharge somebody to an SNF—are their readmission rates lower than those for a payer with which it is so hard to get patients into an SNF? I do not know.

Dr Yang. That is great. Actually, we could look at that retrospectively just for some baseline data, but thank you.

Dr Michael S. Mulligan (*Seattle, Wash*). I am having a very brief moment of clarity so I am going to make a comment, but I do not have a question. The comment is that the respiratory complications are the ones that tend to drive readmission. That is the area where we have the greatest impact with preoperative preparation and training, and that is where adjunctive measures and prescriptive behaviors after surgery have a great role at home.

I think the gap lies in standardization of criteria for discharge—because these patients are not the ones who are breathing comfortably, with clear chest radiographs. They are the patients who have subtle findings that suggest that they are likely to deteriorate, and then they deteriorate once they are home and bounce back (to the hospital).

So I think we have punch lists and criteria for transfer from the postanesthesia care unit to the floor, to the ICU, but we do not have such regimented criteria for discharge to home. I think if we focus on 1 area at a time, such as respiratory status, we could standardize criteria for discharge and limit the number of predictable bounce-backs. Just a thought. Thank you for your presentation.