

Facility Volume and Textbook Oncologic Outcome in Esophagectomy: Is There a Minimum Number of Cases Needed to Assure Quality Cancer Care?

Sujay Kulshrestha, MD^{1,2}; Corinne Bunn, MD^{1,2}; Patrick J. Sweigert, MD²; Emanuel Eguia, MD, MHA, MS²; Fred A. Luchette, MD, MSc^{2,4}; Timothy M. Pawlik, MD, MPH, PhD³; Marshall S. Baker, MD, MBA^{2,4}

¹Burn and Shock Trauma Research Institute, Loyola University Chicago, Maywood, IL; ²Department of Surgery, Loyola University Medical Center, Maywood, IL; ³Department of Surgery, Division of Surgical Oncology, The Ohio State University Wexner Medical Center and James Cancer Hospital and Solove Research Institute, Columbus, OH; ⁴Edward Hines Jr. Veterans Administration Hospital, Hines, IL

Introduction

- Esophageal cancer is one of the most difficult malignancies to treat, with low overall survival and high postoperative morbidity, despite advances in minimally invasive surgery and neoadjuvant therapies.
- Focus on patient outcomes in surgery has identified annual surgical volume as a proxy for quality and called for regionalization of care.
- The Leapfrog Group, a notable proponent of volume standards, recently revised their hospital minimum annual esophagectomy volume standard to 20 procedures, despite only 7% of hospitals reaching this mark in their surveys.
- The goal of this study was to characterize facility factors associated with textbook oncologic outcome (TOO), a recently described composite measure of quality for esophagectomy in esophageal cancer, and to identify a volume threshold associated with quality of care in patients presenting with clinical stage I-III esophageal cancer.

Methods

- We queried the National Cancer Data Base for patients that had esophagectomy for resectable esophageal cancer from 2012 and 2015.
- TOO was defined as a composite of parameters associated with quality for esophagectomy: (1) receipt of neoadjuvant therapy if indicated, (2) negative margins, (3) lymph node assessment, (4) normal length of stay, (5) no 30-d readmission, (6) no 30-d mortality.
- Patients with/without TOO were compared with χ^2 and Fischer's exact tests. Unadjusted TOO rates were evaluated by esophagectomy volume using a funnel plot with 95% confidence intervals (CI) calculated from a binomial distribution around the mean TOO rate.
- Mixed effects logistic regression clustered by facility was used to identify facility factors contributing to achievement of TOO, with a sensitivity analysis to determine optimal volume threshold for TOO.
- Observed to expected TOO rates were calculated and plotted on a caterpillar plot with facility performance classified by the bounds of 95% CI.

Results

Table I: Characteristics of patients included in analysis.

	No textbook outcome (n = 1577, 42%)	Textbook outcome (n = 2141, 58%)	p-value	
Age	<64	814 (52%)	1229 (57%)	<0.001
	65-74	573 (36%)	730 (34%)	
	75+	190 (12%)	182 (8.5%)	
Sex	Male	1293 (82%)	1766 (82%)	0.73
	Female	284 (18%)	375 (18%)	
Race	White	1426 (90%)	1994 (93%)	0.022
	Black	87 (5.5%)	90 (4.2%)	
	Asian/Pacific Isl.	29 (1.8%)	28 (1.3%)	
	Other	35 (2.2%)	29 (1.4%)	
Surgical Approach	Open or NOS	989 (63%)	1255 (59%)	0.012
	MIS	522 (33%)	809 (38%)	
	Conversion	66 (4.2%)	77 (3.6%)	
Facility Type	Community	41 (2.6%)	40 (1.9%)	0.003
	Comprehensive	439 (28%)	499 (23%)	
	Academic/Research	895 (57%)	1326 (62%)	
Facility Volume	Integrated Network	202 (13%)	276 (13%)	<0.001
	Low	1487 (94%)	2099 (98%)	
	High	90 (5.7%)	42 (2.0%)	

Results

Figure I: Funnel plot of facilities performing esophagectomy, 2012-2015.

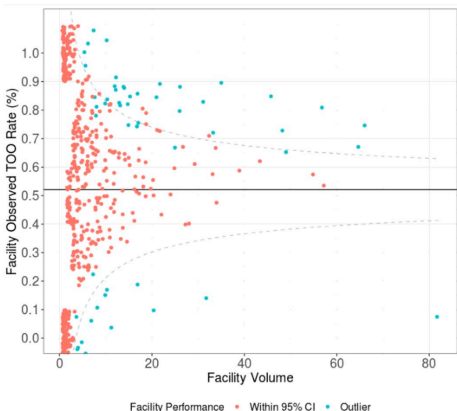
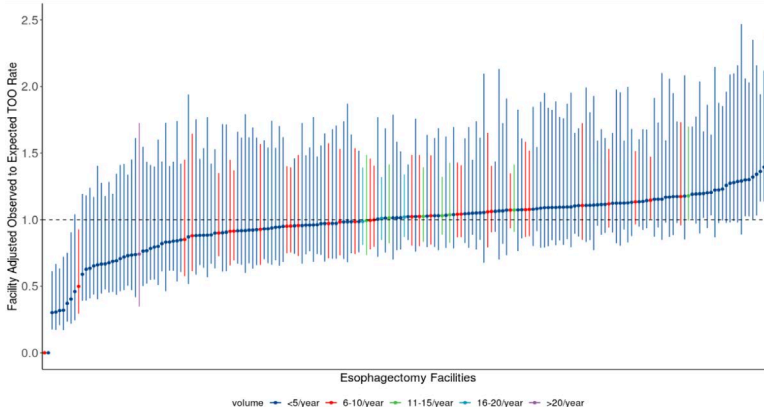


Table II: Results of Sensitivity Analysis with Varying Volume Thresholds

Volume	Odds Ratio [95% CI]	p-value
3	1.29 [1.06, 1.56]	0.01
5	1.12 [0.92, 1.36]	0.27
10	0.96 [0.73, 1.26]	0.74
15	1.06 [0.72, 1.56]	0.78
20	0.48 [0.28, 0.83]	0.01

*Adjusted for age, sex, race, insurance status, educational status, Charlson-Deyo comorbidity score, tumor histology, tumor size, positive lymph nodes, analysis stage, surgical approach, facility type, facility location, distance traveled for treatment, and facility volume.

Figure II: Caterpillar plot of adjusted observed to expected TOO ratios, stratified by mean annual facility volume.



Discussion and Conclusion

- The majority of esophagectomies take place in "low" volume facilities, but with results comparable to those in high volume facilities.
- Only one facility met the Leapfrog threshold of 20 procedures per year.
- On sensitivity analysis, a low threshold volume of 3 procedures per year was associated with improved outcomes; the Leapfrog threshold was not.
- On adjusted analysis, most facilities perform at or above expected levels predicted.
- The only facility factor associated with TOO rate was academic affiliation.
- This suggests that rather than the effect of repeated episodes of care, a strong infrastructure allows for optimal outcome after esophagectomy.
- Volume is an imperfect marker of quality in esophagectomy and focus should be paid to better understanding drivers of high quality outcomes at low volume hospitals, rather than promoting regionalization of care.