Published in final edited form as:

Laryngoscope. 2018 August ; 128(8): 1842–1850. doi:10.1002/lary.27012.

The National Landscape of Unplanned 30-day Readmissions After Total Laryngectomy

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Abstract

Objective—Examine rates of readmission after total laryngectomy and determine primary etiologies, timing, and risk factors for unplanned readmission.

Study Design—Retrospective cohort study

Setting—Nationwide Readmissions Database (NRD)

Subjects and Methods—The NRD was queried for patients who underwent total laryngectomy between 1/2013 - 11/2013. Patient, procedure, admission, and institution-level characteristics were compared for patients with and without unplanned thirty-day readmission. Outcomes of interest included rates, etiology, and timing of readmission. Multivariate logistic regression was used to identify predictors of thirty-day readmission.

Results—There were 2931 total laryngectomies performed in 2013 with an unplanned readmission rate of 17.5%. Postoperative fistula accounted for 13.7% of readmissions. The odds of readmission were elevated for patients undergoing concurrent procedures, including primary tracheoesophageal fistulization (adjusted odds ratio (aOR) 2.44, 95% CI 1.15–5.18, P = 0.02) and/or pedicle graft or flap procedures (aOR 1.73, 95% CI 1.13–2.66, P = 0.01). Additionally, patients with comorbid coagulopathy (aOR 3.04, 95% CI 1.13–8.22, P = 0.03), liver disease (aOR 2.48, 95% CI 1.08–5.71, P = 0.03), and valvular heart disease (aOR 3.18, 95% CI 1.20–8.41, P = 0.02) had increased risk for unplanned 30-day readmission. Private insurance and longer lengths of stay were associated with decreased odds of readmission.

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Conflict of Interest: No potential conflicts of interest relevant to this article were reported.

Meeting Information: Presented at The Triological Society Combined Sections Meeting in Scottsdale, AZ (United States). January 18–20, 2018.

Level of Evidence: 2c

Conclusion—Nearly one-fifth of total laryngectomy patients are readmitted to the hospital within 30 days of discharge. Risk factors identified in this nationally representative cohort should be carefully considered during the post-operative period to reduce preventable readmissions after total laryngectomy.

Keywords

Laryngectomy; readmissions; laryngeal squamous cell carcinoma

Introduction

Total laryngectomy (TL) is the gold standard surgical procedure performed for the treatment of advanced stage laryngeal cancer. In 1991, the Veteran's Administration laryngeal cancer study demonstrated comparable rates of survival for patients with advanced stage laryngeal cancer treated with induction chemotherapy and radiation compared to TL with post-operative radiation.¹ Since this study, organ-preserving therapy with chemoradiation has become more popular and the overall rates of TL have declined.² However despite the increased use of non-surgical protocols, TL is frequently employed when organ-preservation techniques fail. As such, TL is most commonly reserved for those who fail chemoradiation, have extensive disease with contiguous spread or cartilage invasion, or present with a non-functional larynx.³ Despite the accepted indications, TL is known to negatively impact patient quality of life in several domains including speech, eating, aesthetics, and social interactions.⁴⁻⁹

Frequent hospital readmissions associated with laryngectomy expose patients to hospital-acquired infections and complications, increase medical costs, and negatively impact quality of life. In recognition of the negative impact of readmission, the Centers for Medicare and Medicaid Services have included unplanned 30-day readmissions as a quality metric for hospital grading.¹⁰ Additionally, the Affordable Care Act introduced the Hospital Readmissions Reduction Program which penalizes hospitals for excess readmissions for an expanding list of procedures.¹¹ Interestingly, the reduction of readmission rates can be contradictory to the growing pressure on hospitals and providers to shorten hospital length of stay, especially when applied to surgical populations who are at high risk for re-admission.

With this in mind, it is important to understand the national epidemiology of readmissions after TL to protect patients from preventable hospitalization and avoid unnecessary costs and penalties. Total laryngectomy has transitioned to a salvage procedure reserved for patients with the greatest disease burden. Therefore, it is important to identify strategies for preventing unnecessary readmissions for this population. Previous studies have examined readmission rates after TL with rates ranging from 11.9–40%.¹²⁻¹⁷ However, these studies had limited sample size and were single center design. In this study we used a large, nationally representative cohort to define unplanned readmission rates and examine the reasons and predictors for readmission in order to identify potential targets for readmission prevention.

Methods

Data Source

We performed a retrospective cohort study using data from the 2013 Nationwide Readmissions Database (NRD) of the Healthcare Cost and Utilization Project (HCUP) from the Agency for Healthcare Research and Quality (AHRQ). We selected the year 2013 as this was the most recent database iteration available at the time of data analysis. The NRD is a publicly available, de-identified database considered exempt by our institution's institutional review board. The 2013 NRD samples data from 21 states and accounts for 49.1% of all US hospitalizations. The database includes longitudinal admission data for over 14 million hospital admissions that can be weighted to estimate over 35 million discharges nationally. Discharge weights provided by the database allow investigators to compensate for over or under-represented types of hospitals and discharges within the sample. All figures reported in this study are weighted estimates that represent 100% of national discharges. For each admission, the NRD contains information about patient-level (demographics, comorbidities, diagnoses, procedures, and disease severity measures), admission-level (admission source, admission type, length of stay, and cost of hospitalization), and institution-level (size, teaching status, ownership, geographic location) characteristics. The NRD classifies procedures using International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM).

Study Cohort

The study cohort included patients age 18 or older who received a total laryngectomy defined using the ICD-9-CM procedure codes 30.3 and 30.4. We excluded patients from the study cohort if they were pregnant or if they died during their index admission. Further, we excluded patients readmitted on the same-day as this could be considered a continuation of the index admission or a transfer to another institution. We excluded those who received their procedure in December as they would have inadequate follow-up for 30-day readmission.

Definition of Index Admission and Readmission

We defined the index admission as the admission wherein patients underwent a total laryngectomy procedure. We defined readmissions as any non-elective readmission occurring within 30 days of discharge from the index admission. Although it was possible for patients to have multiple readmissions within the 30 days after discharge, we performed our analysis comparing characteristics of the index admission for patients with and without at least one readmission. We defined etiologies of readmission as the primary ICD-9 diagnosis code associated with a readmission.

Covariates

Risk adjustment included patient, admission, and institutional characteristics. Patient-characteristics include demographics, primary payer (Medicaid, Medicare, private, and self-pay, no charge, or other), comorbidities, and procedures performed during the index admission. The NRD defines comorbidities using an algorithm described by Elixhauser *et al.*

which groups ICD-9 diagnosis codes into clinically relevant categories and distinguishes comorbidities from the primary reasons for hospitalization.¹⁸ We defined personal history of radiation exposure using the ICD-9 code provided in Table S1.¹⁹ We used the All Patient Refined Diagnosis-Related Groups (APRDRG) scores to account for disease severity.²⁰ We used ICD-9 procedures codes to define procedures performed during the index admission and included those commonly performed alongside the total laryngectomy as well as those that may have been performed after the laryngectomy but before hospital discharge (See table S1).

Admission level covariates included admission source, admission type (elective vs non-elective admission), length of stay, and discharge disposition (routine, skilled nursing facility, home with health care, and transfer to short-term hospital or against medical advice). Institution-level covariates included hospital size, teaching status, ownership, and total laryngectomy procedure volume. Hospital procedure volume was included in the risk adjustment to account for volume-outcome relationships with high and low-volume centers defined as performing >30 and ≤30 procedures each year, respectively. The national median procedure volume was selected as the threshold for high/low volume centers.

Statistical Analysis

We compared index admission characteristics for patients with and without at least one 30-day readmission. We used chi-squared tests to compare categorical variables and Kruskal-Wallis tests for continuous variables.

We generated national estimates from the discharge weights provided in the NRD which are calculated based on the stratification and clustering of complex health survey data. We used survey logistic regression to identify predictors of unplanned 30-day readmissions from this survey sample design with unequally weighted data.²¹ We adjusted the regression for the aforementioned patient-, admission-, and institution-level covariates. Results of the multivariate logistic regression are presented as adjusted odds ratios (aOR) and 95% confidence intervals (CI) for each covariate.

We performed all analyses using R Version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria) and considered two-tailed P-value ≤0.05 as statistically significant.

Results

Total Laryngectomy and Readmission

There were 3,389 total laryngectomies performed in the United States in 2013. After excluding patients for age <18 (n=5), death during index admission (n=30), same-day readmission (n=204), and procedures performed during December (n=219), our final cohort for analysis consisted of 2,931 total laryngectomy patients (Figure S1). 90% of the total laryngectomies were performed for malignant neoplasms of the head and neck. Overall, the readmission rate after total laryngectomy was 17.5%. There were more readmissions associated with supraglottic and hypopharyngeal cancers (P = 0.05) (Figure 1). Readmitted patients were typically older than their non-readmitted cohort with median ages of 64

(Interquartile range (IQR) 57–72) and 62 (IQR 55–69) and were more often discharged to a skilled nursing facility (21.5% vs. 14.5%) (Tables 1 and S2).

Timing and Etiology of Readmission

Readmissions after laryngectomy peak in the first several days after discharge from the hospital and decrease over the course of 30 days (Figure 2). The most common reason for readmission was a postoperative fistula, accounting for 13.7% of unplanned 30-day readmissions. Infectious complications, local and systemic, also constituted a substantial portion of the reasons for readmission (Figure 3).

Concurrent Procedures Impact on Readmission

Analysis of procedures performed during the index admission revealed that patients who receive a pedicle graft or flap (30.8% vs. 21.4%, $P = 0.01$) or require post-operative mechanical ventilation for up to 96 hours (10.6% vs 4.9%, $P = 0.01$) were readmitted more frequently. While it failed to reach statistical significance on univariate analysis, a larger proportion of readmitted patients received a primary tracheoesophageal fistulization procedure (8.1% vs. 4.5%, $P = 0.08$) (Table 2). After adjusting for confounders, the odds of readmission for patients who underwent a pedicle graft/flap were 1.73-times (95% CI 1.13–2.66, $P = 0.01$) and 2.44-times (95% CI 1.12–4.86, $P = 0.02$) greater for patients who underwent primary tracheoesophageal fistulization. Additionally, patients who received mechanical ventilation for up to 96 hours post-operatively had 2.33-times (95% CI 1.12–4.86, $P = 0.02$) the odds of readmission compared to those who were not mechanically ventilated (Table 3). Hospital total laryngectomy procedure volume did not predict readmission (Table S3).

Medical Comorbidities Affect Readmission

Patients with at least one readmission more frequently had comorbid coagulopathy (6.8% vs. 2.3%), hypothyroidism (21.9% vs. 14.9%), liver disease (7.4% vs. 2.8%), and cardiac valvular disease (5.9% vs. 1.9%) (Table 1). After adjusting for potential confounders, significant predictors of readmission included coagulopathy (aOR 3.04, 95% CI 1.13–8.22, $P = 0.03$), liver disease (aOR 2.48, 95% CI 1.08–5.71, $P = 0.03$), and valvular disease (aOR 3.18, 95% CI 1.20–8.41, $P = 0.02$). While it did not reach statistical significance after adjustment, there was a trend toward increased odds of readmission associated with hypothyroidism (aOR 1.52, 95% CI 0.96–2.40, $P = 0.07$) (Table 3). Personal history of radiation was not predictive of readmission within 30 days of discharge (Table 3).

Admission Characteristics Predict Readmission

A larger proportion of patients who were readmitted had Medicare as their primary payer (Table S2). After adjusting for confounders, patients had higher odds of readmission to the hospital if their primary payer was Medicaid (aOR 2.00, 95% CI 1.08–3.70) or Medicare (aOR 2.38, 95% CI 1.28–4.43) compared to those with private insurance. Additionally, hospital lengths of stay for 10 days or less had 2.18-times (95% CI 1.07–4.45, $P=0.03$) the odds of being readmitted compared to those hospitalized for 21 days or more (Table S3).

Institutional characteristics were similar for patients who were and were not readmitted (Table S2).

Discussion

It is estimated that approximately 3,000–4,000 total laryngectomies are performed in the United States each year with reported rates of readmission from 11.9–40%.^{2,12–17} Our investigation was designed to confirm the external validity of previous studies, which often suffered from inadequate sample sizes or represented single institution experiences.^{13–17} In our large NRD cohort we identified that 17.5% of TL patients were readmitted to the hospital within 30 days. This rate exceeds the 13.8% readmission rate for all hospitalized patients and is more than double the 8.6% readmission rate for all surgical patients in the 2013 NRD.²²

Wound Infection and Pharyngocutaneous Fistula

As may be predicted, we noted that the most common reason for readmission was a postoperative PCF formation and/or other local infection.^{13,14} Surgical wound complications accounted for ~30% of readmissions, with PCF being the single most common etiology for readmission (13.7% of readmissions). A study by White *et al.* found that the median time for PCF formation/detection was 12 days post-operatively,²³ and Graboyes *et al.* found that the majority of PCF following salvage TL occurred between 2–4 weeks.¹⁴ We observed that patients who were hospitalized during their index admission for less than 10 days had a two-fold higher odds of being readmitted compared to patients hospitalized for 21 days or more. This likely reflects a time-window bias, where patients who are hospitalized for longer periods are more likely to develop post-operative complications that are detected and treated during their index hospitalization compared to those who have shorter lengths of stay and require readmission for complication management. This highlights the conflicting pressures of hospitals and providers to shorten hospital length of stay while reducing the rates or readmission. Perhaps a future cost analysis study is needed to quantitatively analyze the cumulative cost of readmission versus more frequent post-discharge follow-up versus extended length of stay in high risk patients.

Previous studies have identified many factors associated with increased risk of fistula formation including previous radiotherapy, chemoradiation, advanced tumor stage, supraglottic tumor origin, hypopharyngeal involvement, positive tumor margins, concurrent neck dissection, blood transfusion, hemoglobin <12.5 mg/dl, chronic obstructive pulmonary disease, and hypothyroidism.^{23–25} Our data reflect some of these findings, of note supraglottic and hypopharyngeal involvement represent a larger proportion of readmissions (Figure 1). Interestingly, our study did not find that a history of radiation differed between readmitted and non-readmitted patients. Although a recent review demonstrated history of radiation had a relative risk of 1.5 for PCF development,²⁴ other studies have indicated that the risk may be related to the timing of radiation relative to surgery, dose received, and field of radiation.^{16,26,27} One study evaluating predictors of readmission after flap reconstruction also noted that prior radiation therapy did not increase the risk of readmission in their cohort.²⁸ Although our study indicated that prior radiation alone is not a predictor of

readmission, this may be due to an inability to capture and differentiate the specific details of radiotherapy treatment regimens.²⁶ Unfortunately, given the relatively low incidence of PCF in our study, we were not specifically powered to analyze the factors that contribute to PCF formation.

Concurrent Procedures

Concurrent procedures at the time of surgery were also predictors of unplanned 30-day readmission. Specifically, readmission was more likely in patients who received pedicled grafts or free tissue transfer. In a recent study by Graboyes *et al.*, approximately 50% of patients who underwent salvage TL required vascularized free tissue transfer and delayed PCF was the most common presentation among those who were readmitted.¹⁴ The use of vascularized tissue is often an indicator of more complex pre-operative and operative patient characteristics. Given their added complexity, these patients may be at greater risk for post-operative complications and readmission.

Interestingly, our study demonstrated that tracheoesophageal fistulization predicted readmission. In contrast to the single-institution retrospective study by Graboyes *et al.*, where TEP had lower odds of readmission, we found that these procedures conferred greater odds of readmission with 27.4% of patients readmitted within 30 days.¹⁴ There are several complications that can occur with these devices including infection, aspiration, dislodgement, and wound breakdown.^{29–33} Graboyes *et al.* attributed the lower risk of readmission with primary TEP to patient selection related to primary vs. salvage surgery.¹⁴ Also, patient motivation and social considerations factor into an individual's candidacy for TEP placement.³⁴ It is also possible that improper selection of patients for primary TEP may contribute to the higher rates of readmission. Previous literature noted that primary and secondary TEP have similar complication rates, but primary TEP was noted to have a higher success rate than secondary.^{33,35–37} Nonetheless, our data strongly suggest that although long-term outcomes are the same or superior with primary TEP placement, the patient remains vulnerable to readmission and proper patient selection is crucial. Long term cost effectiveness analysis and a large scale prospective trial regarding TEP would be necessary to reconcile the conflicting data.

Comorbid Conditions

Our study highlights several characteristics that are associated with increased risk of readmission. There is extensive literature on the pre-operative co-morbid conditions that may result in poor wound healing, including but not limited to diabetes, immunocompromised state, hypoalbuminemia, and hypothyroidism.^{23,38,39} Despite not reaching statistical significance on multivariate analysis, our study suggests that patients with hypothyroidism, may be at increased risk of 30-day readmission. It has been reported that hypothyroidism is frequently observed after TL procedures.⁴⁰ Our results highlight the importance of thyroid function evaluation on the part of the surgical team in order to correct this modifiable risk factor for readmission.

Additionally, our study highlights several non-modifiable risk factors for readmission. Conditions such as coagulopathy, liver disease, and valvular disease all conferred greater

odds of readmission.^{41,42} Recent data indicate higher odds of readmission in patients with prior or new prescription antiplatelet or anticoagulant agents.^{13,43} Our results highlight that patients with impaired hemostasis, from organic or iatrogenic coagulopathies, may be at higher risk for poor outcomes and readmission and could benefit from meticulous perioperative management with the help of our medicine colleagues.

Lastly, we found that post-operative mechanical ventilation for up to 96 hours was associated with greater odds of readmission. Prolonged intubation, or failure of extubation is more likely to occur in patients with more extensive comorbidities, longer operative times, or intraoperative complications necessitating ventilator support. In addition, institutional culture may prevent the acceptance of early extubation protocols. Nevertheless, it is reasonable that patients that cannot be weaned off ventilator support safely in the operating room, run the risk of readmission.

Institutional and Admission Characteristics

In this study, the majority of TL procedures were performed in large, metropolitan teaching centers (Table S2). Hospital bed size, teaching status, and procedure volume did not demonstrate increased risk for readmission. The contribution of these factors to readmission risk has been debated in the surgical literature.^{44,45} Referral centers with higher procedure volume may have more experience preventing and treating postoperative complications.⁴⁶ However, large metropolitan referral centers may attract more complex cases and surgeons in these settings may have lower thresholds to operate when clinically appropriate.^{45,47} Case-complexity and quality of postoperative care may counterbalance each other when it comes to hospital readmissions and could explain the lack of differences in readmission risk associated with these institution level characteristics. Ultimately, more granular data on degree of case complexity and post-operative management is necessary to evaluate this question.

Finally, we noted that hospitalizations paid for by Medicare or Medicaid had increased likelihood of readmission two-fold. Even after controlling for patient and hospital characteristics, this increased risk cannot be explained by our analysis, however similar findings have been noted in other readmission literature and likely represent unmeasured patient level confounders correlated with insurance.⁴⁸

Limitations

Our study has a number of limitations. Our findings rely on the medical record documentation and the reliability of the administrative codes which both can be variable. Second, our study only includes data from 2013, however the number of patients roughly matches the national yearly estimates and is relatively recent, so we believe it is an accurate estimator of the current practice trends and outcomes.² Additionally, the NRD lacks information regarding post-operative outpatient chemotherapy or radiation since it only includes data from inpatient hospitalizations.¹⁵ Finally, cancer staging information was not available. Despite, these limitations, we feel that the strength of this study lies in the nationally representative sample size with enough power and a sufficiently high event rate to identify actionable predictors of readmission.

Conclusion

Readmission after total laryngectomy is a frequent occurrence. This nationally representative database study highlights important areas and risk factors for readmission, and should serve as a springboard for more targeted, in depth studies on the risk factors identified by our analysis.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

RF was supported by the National Center for Advancing Translational Sciences under award 5TL1TR001434-02. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Figure 1.
The percentage of total laryngectomies with and without a readmission by subsite.

Figure 2.
Readmissions decrease over the course of 30 days after discharge.

Figure 3.
Top ten readmission diagnoses.

Table 1

Patient level characteristics of total laryngectomy patient with and without at least one unplanned 30-day readmission.

	Total Laryngectomy with no readmissions (n = 2417)	Total Laryngectomy with 1 readmission (n = 514)	P
Age, median [IQR]	62.0 [55.0, 69.0]	64.0 [57.0, 72.0]	0.01
Female, n (%)	493 (20.4)	134 (26.1)	0.11
History of Radiation, n (%)	493 (20.4)	102 (19.9)	0.89
Median household income category for patient's zip code, n (%)			0.49
25th percentile	784 (33.1)	146 (28.7)	
26–50th percentile	688 (29.0)	166 (32.5)	
51–75th percentile	586 (24.7)	115 (22.5)	
76–100th percentile	315 (13.3)	83 (16.3)	
Comorbidities, n (%)			
Alcohol Abuse	254 (10.5)	55 (10.8)	0.93
Anemia	317 (13.1)	98 (19.0)	0.06
Congestive Heart Failure	135 (5.6)	24 (4.7)	0.66
Chronic Pulmonary Disease	818 (33.9)	209 (40.7)	0.11
Coagulopathy	57 (2.3)	35 (6.8)	0.01
Depression	263 (10.9)	59 (11.4)	0.86
Diabetes Mellitus	269 (11.1)	78 (15.1)	0.14
Diabetes Mellitus with Complications	46 (1.9)	6 (1.2)	0.47
Drug Abuse	59 (2.4)	14 (2.8)	0.79
Hypertension	1215 (50.3)	283 (55.1)	0.28
Hypothyroidism	360 (14.9)	112 (21.9)	0.03
Liver Disease	67 (2.8)	38 (7.4)	0.01
Fluid and electrolyte disorders	633 (26.2)	141 (27.4)	0.76
Metastatic Cancer	733 (30.3)	157 (30.5)	0.96
Neurologic Disease	131 (5.4)	18 (3.6)	0.34
Obesity	114 (4.7)	27 (5.1)	0.82
Peripheral Vascular Disease	166 (6.9)	41 (7.9)	0.65
Psychiatric Disorder	44 (1.8)	16 (3.0)	0.30
Renal Failure	93 (3.9)	27 (5.2)	0.41
Solid tumor without metastasis	244 (10.1)	44 (8.5)	0.54
Valvular Disease	46 (1.9)	31 (5.9)	0.01
Weight Loss/Malnutrition	572 (23.7)	146 (28.3)	0.21
APRDRG Severity Scale[†], n (%)			0.08
Minor/Moderate loss of function	1309 (54.2)	234 (45.5)	
Major loss of function	929 (38.4)	223 (43.4)	

	Total Laryngectomy with no readmissions (n = 2417)	Total Laryngectomy with 1 readmission (n = 514)	P
Extreme loss of function	179 (7.4)	57 (11.1)	

Abbreviations: IQR: Inter Quartile range

[†]Variables defined by HCUP criteria⁴⁹

Table 2

Procedure-level characteristics of total laryngectomy patient with and without at least one unplanned 30-day readmission.

	Total Laryngectomy with no readmissions (n = 2417)	Total Laryngectomy with 1 readmission (n = 514)	P
Procedures, n (%)			
Central Venous Catheter Placement	115 (4.8)	28 (5.5)	0.71
Packed RBC Transfusions	320 (13.2)	93 (18.1)	0.10
Pedicle Graft or Flap	517 (21.4)	159 (30.8)	0.01
Percutaneous Gastrostomy	358 (14.8)	84 (16.3)	0.64
Radical Neck Dissection	262 (10.8)	58 (11.4)	0.85
Regional Lymph Node Excision	484 (20.0)	73 (14.2)	0.11
Tracheoesophageal Fistulization	110 (4.5)	41 (8.1)	0.08
Invasive Mechanical Ventilation for <96 hours	117 (4.9)	54 (10.6)	0.01

Abbreviations: IQR: Inter Quartile range

Table 3

Patient- and procedure-level predictors of unplanned 30-day readmission.

	aOR (95% CI)	P Value
Age groups		
18–34	0.53 (0.06–4.35)	0.55
35–49	1.19 (0.50–2.87)	0.69
50–64	1.25 (0.72–2.18)	0.43
65	1 [Reference]	
Sex		
Female	1.42 (0.92–2.2)	0.12
Male	1 [Reference]	
History of Radiation	0.91 (0.57–1.46)	0.70
Median household income category for patient's zip code[‡]		
25 th percentile	1 [Reference]	
26–50 th percentile	1.46 (0.89–2.37)	0.13
51–75 th percentile	1.12 (0.67–1.87)	0.67
76–100 th percentile	1.33 (0.75–2.34)	0.33
Comorbidities		
Alcohol Abuse	0.83 (0.44–1.56)	0.57
Anemia	1.36 (0.82–2.26)	0.23
Congestive Heart Failure	0.56 (0.23–1.36)	0.20
Chronic Pulmonary Disease	1.18 (0.78–1.78)	0.44
Coagulopathy	3.04 (1.13–8.22)	0.03
Depression	0.91 (0.46–1.82)	0.8
Diabetes Mellitus	1.36 (0.81–2.28)	0.25
Hypertension	1.20 (0.81–1.78)	0.36
Hypothyroid	1.52 (0.96–2.40)	0.07
Liver Disease	2.48 (1.08–5.71)	0.03
Metastatic Disease	1.07 (0.71–1.61)	0.76
Neurologic Disease	0.54 (0.19–1.50)	0.24
Obesity	1.45 (0.55–3.81)	0.46
Peripheral Vascular Disease	0.85 (0.40–1.79)	0.66
Renal Failure	0.88 (0.36–2.15)	0.78
Valvular Disease	3.18 (1.20–8.41)	0.02
Weight loss/malnutrition	1.10 (0.71–1.70)	0.67
Procedures		
Central Venous Catheter Placement	0.98 (0.44–2.18)	0.97
Packed RBC Transfusions	1.27 (0.75–2.14)	0.37
Pedicle Graft or Flap	1.73 (1.13–2.66)	0.01

	aOR (95% CI)	P Value
Percutaneous Gastrostomy	1.05 (0.60–1.81)	0.88
Radical Neck Dissection	0.97 (0.56–1.69)	0.93
Regional Lymph Node Excision	0.70 (0.39–1.25)	0.22
Tracheoesophageal Fistulization	2.44 (1.15–5.18)	0.02
Invasive Mechanical Ventilation for <96 hours	2.33 (1.12–4.86)	0.02

Abbreviations: aOR: adjusted odds ratio

[†]Variables defined by HCUP criteria⁴⁹