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Associations between pre-, post-, and peri-operative variables and health resource use following surgery for head and neck cancer

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ABSTRACT

Objective: We examined associations between pre-, post-, and peri-operative variables and health resource use in head and neck cancer patients.

Methods: Patients (N = 183) who were seen for a pre-surgical consult between January 2012 and December 2014 completed surveys that assessed medical history, a patient-reported outcome measure (PROM) of dysphagia, and quality of life (QOL). After surgery, peri-operative (e.g., tracheostomy, feeding tube) and post-operative (e.g., complications) variables were abstracted from patients' medical records.

Results: Multivariate regression models using backward elimination showed that pre-surgical University of Washington Quality of Life (UW-QOL) Inventory and M.D. Anderson Dysphagia Inventory (MDADI) composite scores, documented surgical complications, and having a tracheostomy, were all significant predictors of hospital length of stay, explaining 57% of the total variance ($F_{(5, 160)} = 18.71$, $p < .001$). Male gender, psychiatric history, and lower pre-surgical MDADI scores significantly predicted thirty-day unplanned readmissions (30dUR). Pre-surgical MDADI composite scores also significantly predicted emergencey department (ED) visits within 30 days of initial hospital discharge ($p = .02$).

Conclusions: Assessment of PROMs and QOL in the pre-surgical setting may assist providers in identifying patients at risk for prolonged LOS and increased health resource use after hospital discharge.

Introduction

Head and neck cancer (HNC) is the sixth most common malignancy in the world, and its incidence is rising rapidly worldwide [1]. Most HNC tumors (90%) are squamous cell carcinomas occurring in the oral cavity, pharynx, and larynx [1]. Treatments for HNC have changed dramatically over the past few decades, owing largely to the advancements in multimodality therapy and improvements in radiotherapeutic and surgical techniques [2]. For HNC patients diagnosed with early stage disease, surgical excision is considered a standard treatment [3]. For locally advanced disease (stages III, IVA, IVB), which makes up more than 50% of HNC cases, patients typically undergo surgery either before or after chemoradiation (or radiation) [2]. However, patients undergoing surgery are at increased risk for significant complications

and health resource use [4,5]. Measures of health resource use such as hospital length of stay (LOS), readmissions, and emergency department (ED) visits, are considered markers of surgical quality of care, and are increasingly tied to hospital reimbursements in the age of affordable care [6–9]. In HNC, the average LOS after surgery is 5–9 days [10,11], rates of hospital readmission after initial discharge range from 3.1% to 16% [12–16], and almost one-third of patients have at least one visit to the ED [17]. These high rates of health resource utilization make HNC one of the most costly cancers to treat [18,19], and contribute to increased patient morbidity and mortality [10,14,20,21]. A clearer understanding of factors that contribute to increased health resource use could help clinicians identify "at risk" patients and identify appropriate benchmarks and targets for future quality improvement efforts.

Previous research has identified a number of pre-, post-, and peri-

operative variables that are associated with increased health resource use in HNC. For example, pre-operative variables such as older age, poor functional status, comorbidities, and substance use (e.g., tobacco, alcohol) have been associated with prolonged LOS and hospital readmissions [21–23]. A medical history including hypertension, a normal/ underweight BMI, and depressive symptoms have been associated with increased risk for ED presentation [17]. With regard to peri-operative factors, prophylactic percutaneous gastronomy tube (PEG) placement has been associated with lower rates of hospital readmissions [24,25], and airway management with tracheostomy has been associated with prolonged LOS [26]. Finally, in terms of post-operative factors, medical/surgical complications (e.g., pneumonia, wound infection, hemorrhage) have been associated with prolonged LOS and readmissions [12,16,22,27]. In fact, in a study of 1058 patients undergoing HNC surgery, Graboyes [12] found that patients who experienced a complication during or after their index hospitalization were 11.9 times more likely than patients without complications to be readmitted to the hospital within 30 days of discharge.

Although a variety of factors have been identified as predicting health resource use in HNC surgical patients, the utility of these findings in guiding processes of care has been limited. One possibility is that researchers may not have identified all the variables needed to develop patient risk profiles for increased health resource use. For example, QOL is a multi-dimensional construct of an individual's subjective assessment of the impact of an illness or treatment on his or her physical, psychological, social, and somatic functioning and general well-being [28,29]. It represents the gap between one's functional status and ideal standard [30]. Self-report measures of QOL are patient-centered and have been shown to be consistent predictors of hospitalizations and mortality rates in a variety of chronic diseases (e.g., COPD, heart and kidney disease), even after adjustment for clinically relevant factors [31–33]. QOL is also a critical consideration in the management of HNC, but studies have largely examined it as an outcome of treatment as opposed to a predictor of clinical outcome [34].

Another factor that may be important for the assessment of risk profiles for increased health resource use in HNC is dysphagia. Dysphagia is a common side effect of HNC and its treatment. Measures of dysphagia include instrumental examinations of swallowing physiology and bolus transport, most commonly videofluoroscopy, and patient-reported outcome measures (PROMs). While clinical assessment of dysphagia is valuable in determining extent of mechanical disability, PROMs have gained in popularity among HNC clinicians because they standardize patient reporting of perceived dysphagia and provide insights into the impact of swallowing dysfunction on patient QOL [35]. Research in other cancers has shown that routine functional and symptom assessment with PROs may confer clinical benefits including increased rates of symptom discussions between patients and clinicians [36–38], intensified symptom management by clinicians in response to patient reports [38,39], and fewer ER visits and hospitalizations [40]. However, such linkages have yet to be established specifically in HNC. Given the above and the finding that perceptions of both QOL and dysphagia prior to treatment have been associated with survival in HNC [41], it may be useful to explore the role that pre-surgical QOL and dysphagia could play in predicting post-surgical resource use among patients with HNC.

Another issue that could be affecting the translation of research findings is that insufficient attention has been paid to factors across the entire clinical care pathway when looking at predictors of health resource use. Instead, studies have largely examined pre-operative or post-operative factors in isolation. Taking a more holistic approach that considers pre-, post-, and intra-operative factors as predictors of different types of outcomes (e.g., LOS, ED visits, and readmissions) would be more consistent with the realities of clinical care and could highlight potential targets for quality improvement across the care continuum ranging from treatment planning to hospital discharge. Since assessing and identifying modifiable risk factors on quality metrics may reduce

overall cost and burden on limited hospital resources, this study examined whether pre-, peri-, and post-operative factors predict hospital LOS, thirty-day unplanned hospital readmissions (30dUR), and ED visits in HNC surgical patients.

Methods

Procedures

This retrospective medical record review was approved by the Icahn School of Medicine at Mount Sinai Institutional Review Board (IF1718786). As part of their routine initial surgical consult visit, new HNC patients are asked to complete the "Patient First" Questionnaire, which includes a pre-operative medical assessment, and questions about the patient's medical history, QOL, and dysphagia. Completed questionnaires were scanned into the electronic health record (EHR) as part of a larger quality improvement data collection project.

For this study, patient eligibility criteria included: (1) being newly diagnosed with squamous cell carcinoma (SCC) of the head and neck or a salivary gland tumor, (2) having a surgical consult in the Department of Otolaryngology-Head and Neck Surgery between January 2012 and December 2014, (3) completing the "Patient First" questionnaire, and, (4) undergoing surgery at Mount Sinai Hospital for HNC. There were no exclusion criteria. Research staff abstracted data from the Patient First questionnaire into a secure database along with clinical and demographic data from the EHR for eligible patients. This data was then linked to health resource use data obtained from the Mount Sinai Data Warehouse (MSDW), which has clinical and operational data derived from patient care at the Mount Sinai Hospital and Mount Sinai Faculty Practice Associates.

Data collection

Outcome variables

Data abstracted from the MSDW included LOS (defined as number of days from surgery to hospital discharge, and categorized as low = ≤ 4 days, medium = 5–9 days, or high = > 9 days, based on national averages for LOS after HNC surgery) [10,11], presence/absence of a 30-day unplanned readmission (30dUR) to Mount Sinai Hospital for a postoperative occurrence likely related to the principal surgical procedure [42,43], and presence/absence of an ED visit within 30 days of initial hospital discharge.

Predictor variables

Sociodemographics. Age, gender, marital status, and ethnicity (Hispanic vs non-Hispanic) were abstracted. Race is not routinely entered into the medical record at Mount Sinai, so this data was not available.

Disease characteristics. Tumor site (i.e., oral cavity, oropharynx, hypopharynx, and larynx) and clinical stage at diagnosis.

Medical history and comorbidities. History of prior cancer (yes/no), psychiatric illness (yes/no), smoking (never, former, or current smoker), alcohol use (never, former, active-social drinker, active-abuse), and illicit drug use (yes/no) were abstracted from the EHR, in addition to completion of neo-adjuvant/adjuvant treatment (e.g., chemotherapy, chemoradiation), and HPV status (P16 positive, P16 negative, or not tested). Food intake changes in the past month were categorized as either unchanged/eating more than usual or eating less than usual. Presence or absence of the following relevant comorbidities was also assessed: chronic pulmonary disease (i.e., chronic obstructive pulmonary disease, pulmonary fibrosis, and severe asthma with at least 1 previous hospital admission because of an asthma exacerbation), chronic artery disease (CAD; i.e., prior myocardial infarction or having a coronary stent/bypass graft), hypertension (i.e., carrying a diagnosis of hypertension and being on antihypertensive medication), hepatic disease (i.e., known chronic hepatitis, elevated liver enzymes on at least

2 occasions over the year before surgery, or known cirrhosis), vascular disease (i.e., known peripheral vascular disease or a history of a cerebrovascular accident), hypothyroidism (i.e., known diagnosis of hypothyroidism and being on thyroid hormone supplementation or an elevated preoperative thyroid-stimulating hormone), diabetes, GI problems, renal disease, and neurological disorders.

Peri- and post-operative variables. Operative procedures were classified as either lower (e.g., laryngoscopy, tracheostomy, skin grafts or local flaps, parotidectomy, and neck dissection with or without partial glossectomy) or higher risk (e.g., laryngopharyngectomies, any major skull base surgery, or operations needing a free-flap). Perioperative variables included type of surgery (i.e., open or transoral robotic surgery; TORS), management of airway via tracheostomy (yes/no), and PEG placement during surgery (yes/no). Post-operative variables included medical complications related to the index procedure occurring during the index hospital admission [15,27], or surgical complications occurring either during the index admission or within 30 days of hospital discharge. Medical complications included cardiovascular (e.g., myocardial ischemia), pulmonary, neurologic, infectious (e.g., sepsis), and miscellaneous complications (e.g., deep venous thrombosis, renal insufficiency). Surgical complications included wound infection, fistula formation, flap donor and recipient site complications, hematomas, dehydration, anemia, tracheostomy complications, and bleeding at the surgical site, and performance of additional or unexpected surgical procedures.

QOL. Patients completed the University of Washington Quality of Life (UW-QOL) v4 survey [22], prior to surgery, as part of the Patient First Questionnaire. The UW-QOL is a validated head and neck cancer-specific health-related survey that consists of 12 domain-specific items (i.e., pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder function, taste, saliva, mood, and anxiety) [44,45]. Each domain item is scored from 0 to 100, with 100 being the best possible response. An overall QOL score was determined by averaging across all 12 domains (Cronbach's alpha = 0.82).

Dysphagia. Patients completed the M.D. Anderson Dysphagia Inventory (MDADI) prior to surgery, as part of the Patient First Questionnaire. The MDADI is a 20-item self-administered questionnaire that describes a patient's perception of their swallowing abilities and their swallowing-related quality of life [46]. Given widespread adoption in clinical research over the past two decades, the MDADI is arguably the principal PROM of perceived dysphagia in HNC research. [35] Items are scored on a 5 point Likert-type scale (1 = strongly disagree to 5 = strongly agree). A composite score summarizes overall performance in the physical, emotional, and functional subscale domains. Scores are normalized to range from 20 (extremely low functioning) to 100 (high functioning). Although a standardized cut-off has yet to be established, a study of 1136 HN patients found that composite scores < 57 are indicative of significant deficits in swallowing function (e.g., aspiration, non-oral diet, feeding tube dependence). Cronbach's alpha was 0.96 in this study, suggesting strong internal consistency.

Data analysis

Data were analyzed using SPSS version 24 (SPSS Inc, Chicago, IL). Demographic, clinical, and QOL data were summarized via descriptive statistics. Differences between patients who were either readmitted or visited the ED and those who did not were analyzed using Chi-Square tests. Univariate comparisons of UW-QOL and MDADI composite scores based on disease stage were conducted using one-way Analysis of Variance (ANOVA) and adjusted for multiple comparisons using Tukey's HSD (honestly significant difference) test. Univariate ANOVAs were also conducted to compare pre-surgical MDADI composite scores based on LOS. Independent t-tests were used to compare pre-surgical scores on the MDADI based on 30dUR and ED visit status.

To identify independent predictors of each of the study outcomes (i.e., LOS, ED visits, and 30dURs), univariate analyses were conducted.

Demographic, clinical, and QOL variables were independently assessed based on a criterion of $p \leq .05$. Variables meeting this threshold were then entered into multivariate regression (for LOS, a continuous outcome) and logistic models (for ED visits and 30dURs, which are dichotomous outcomes) with backward selection to eliminate non-significant parameters. For the logistic regressions, odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were estimated. Two-tailed tests of significance and confidence intervals were based on the $p \leq .05$ level.

Results

Two-hundred eighty-seven medical charts were reviewed; 17 were excluded because the patient did not have SCC or a salivary gland tumor, and 104 (39%) were excluded due to there being no record of the patient completing the Patient-First questionnaire. No significant differences between survey responders and non-responders were found based on available medical and sociodemographic data in the EHR. Although reasons for non-completion are unknown, it is possible that surveys were either not administered by clinic staff, not completed by the patient, or never scanned into the EHR. Average patient age was 64 years (range = 28–95 years; SD = 11.29). Other demographic and medical characteristics of the remaining 166 eligible patients are presented in Table 1. Twenty-three percent of patients underwent low risk surgical procedures and 77% underwent high risk procedures. Average LOS was 4.90 days (SD = 4.7 days); 55% of patients had a LOS of < 4 days (short), 32% had a LOS of 5–9 days (medium), and 12% had a LOS of > 9 days (long). Airway was managed during surgery with a tracheostomy for 61 patients (N = 37%); average time to decannulation was 7 days (SD = 7; Range = 0–41 days). Twelve patients experienced medical complications prior to discharge. These included infections (N = 4 of 12; 33%), cardiovascular (25%), pulmonary (25%), and miscellaneous events (17%). In addition, 25 surgical complications were noted. Seven of these required return to the operating room during the index hospitalization. The remaining surgical complications noted prior to discharge (N = 18) included wound problems (N = 5), fistulas (5), hematoma (4), and donor or flap recipient site complications (4).

Eleven patients (of 166; N = 6%) visited the ED and 18 (11%) had a 30dUR. No patients visited the ED or were readmitted more than once. Average length of time from hospital discharge to an ED visit was 6.70 days (SD = 25.8; Range = 1–151 days), and average length of time from hospital discharge to a 30dUR was 11.89 days (SD = 7.01; Range = 3–23 days). Reasons for ED visits included surgical site bleeding (27%), fever (27%), swelling (18%), pain (18%), and dysphagia (10%). Reasons for 30dUR were: surgical site bleeding (33%), wound infection (17%), fistula (17%), dehydration (11%), anemia (11%), and tracheostomy complications (11%). Chi-square comparisons showed that patients who received a PEG ($X^2 = 13.10$, p < .001) or had a history of psychiatric illness ($X^2 = 3.62$, p < .05) were significantly more likely to visit the ED. Patients with a tracheostomy ($X^2 = 3.70$, p < .05) were more likely to have a 30dUR.

Overall, patients reported good QOL regardless of disease stage. Average UW Composite scores ranged from 88.93(SD = 10.49) to 84.11(SD = 17.37). Average MDADI composite scores ranged from 88.11(SD = 15.01) to 80.04(SD = 18.26); only 9 patients (5%) scored below 57. No significant differences in either pre-surgical MDADI or UW-QOL composite scores based on disease stage were found. Univariate ANOVA revealed significant differences on the MDADI by LOS (short, medium, or long) F = 4.96, p = .01. Namely, patients who had the longest hospital LOS (> 9 days) had significantly (p < .05) lower pre-surgical MDADI composite scores (M = 69.30, SD = 22.10), than patients who had either medium (M = 80.94, SD = 17.68) or short (M = 85.24, SD = 13.70) hospital LOS. Patients who visited the ED had significantly lower pre-surgical MDADI composite scores (M = 63.03, SD = 17.86) relative to those who did not (M = 85.01,

Table 1
Sample descriptives (N = 166 patients).

Sex	%		%		%
Male	75	**Prior cancer history**	9	**Neo-adjuvant treatment**	
Female	25			Chemotherapy	< 1
		History of psychiatric illness	11	Chemoradiation	3
Ethnicity				None	96
Hispanic	4	**Smoking history**			
Non-Hispanic	75	Never smoked	41	**Prophylactic PEG Placement**	11
Unknown	21	Former smoker	46		
		Current smoker	13	**Prophylactic NG tube placement**	2
Marital status					
Married	73	**Alcohol history**		**PEG placed prior to hospital discharge**	30
Not married	27	Never	37		
		Active drinker – social	52	**PEG placed after hospital discharge**	13
Type of HNC		Active drinker – abuse	10		
Oral cavity	36	Former Drinker	4	**Tracheostomy**	37
Oropharynx	41				
Hypopharynx	2	**History of illicit drug use**	6	**TORS**	18
Larynx	14				
Paranasal Sinus and Nasal Cavity	2	**Food intake in past month**		**Adjuvant treatment**	
Salivary gland	5	Unchanged or more than usual	74	Radiation	26
		Less than usual	26	Chemoradiation	20
Stage at Diagnosis				None	54
I	22	**Comorbidities**			
II	17	Chronic Pulmonary Disease	5		
III	19	Chronic Artery Disease	12		
IV	42	Hypertension	51		
		Hepatic disease	4		
HPV Status		Vascular disease	< 1		
Not tested	61	Hypothyroidism	12		
P16 Positive	27	Diabetes	14		
P16 Negative	12	GI problems	15		
		Renal disease	< 1		
		Neurological disorder	8		

Note: x^2 = **Chi-Square;** HNC = Head and Neck Cancer; PEG = percutaneous endoscopic gastrostomy tube; TORS = Transoral Robotic Surgery, EMR = elec. Hospital readmissions and ED visits are within 30 days of initial discharge following HNC surgery.

SD = 14.55; t = −4.91, p < .001). There was also a trend for patients with a 30dUR to have lower pre-surgical MDADI composite scores (M = 75.72, SD = 15.07) compared with those who were not readmitted (M = 83.60, SD = 16.85), but it was not statistically significant (t = −1.90, p = .07).

LOs

Univariate regressions showed that type of HNC (specifically, laryngeal cancer), experiencing reduced food intake in the month prior to surgery, having lower MDADI and UW-QOL composite scores at the surgical consult visit, having a prior smoking history and/or history of cancer, undergoing open as opposed to robotic (TORS) surgery, experiencing a surgical complication (inpatient or outpatient), and having a PEG or tracheostomy were all independently significantly associated with increased LOS (p ≤ .05). A stepwise multiple regression analysis was then performed to predict LOS from these eight variables. After a backward elimination process, the final model revealed that MDADI and UW-QOL composite scores, documented surgical complications, and having a tracheostomy significantly predicted LOS, F(5, 160) = 18.71 p < .001, R^2 = 0.57 (see Table 2).

Given that surgical site infections in HNC microvascular construction remain a significant postoperative complication and could possibly confound findings for LOS, we combed through the EHR and identified 4 patients who underwent microvascular construction. LOS ranged from 11 to 29 days, which is significantly higher than the average LOS for the overall sample. Based on this, analyses were re-run with these cases removed, but the overall findings did not significantly change.

Readmissions

Of all the predictor variables that were examined, univariate

Table 2
Final multivariate linear regression model for LOS.

	B	SE	t	95% Confidence interval		Adjusted R2
				Lower	Upper	
Constant	15.54	2.78				.57
Type of HNC	–	–	–	–	–	
Food Intake Decrease in past month	–	–	–	–	–	
MDADI Composite	−.08	.02	−2.83**	−.13	−.02	
UW QOL Composite	−.08	.03	−2.50*	−.14	−.02	
Hx of Cancer	–	–	–	–	–	
Hx of Smoking	–	–	–	–	–	
Surgical Complication	3.77	.97	3.90**	1.85	5.68	
PEG	–	–	–	–	–	
Tracheostomy	4.33	.84	5.15**	2.66	6.01	
TORS	–	–	–	–	–	

Note: Hx = History HNC = Head and Neck Cancer; MDADI = M D Anderson Dysphagia Inventory; UWQOL = University of Washington Quality of Life survey; PEG = percutaneous endoscopic gastrostomy Tube; TORS = Transoral Robotic Surgery.
* p < .01,
** p < .001

regressions showed that only male gender, having a documented psychiatric history, lower MDADI composite scores prior to surgery, and having a PEG were independently significantly associated with 30dURs (p ≤ .05). When these variables were collectively entered in a multivariate logistic regression model using backward stepwise elimination (see Table 3), findings showed that 30dURs were only significantly

Table 3

Final multivariate logistic regression models for unplanned readmissions and ED visits.

Unplanned Readmission		B	P-value	OR	95% Confidence Interval		Adjusted R2
					Lower	Upper	
							.19
	Constant	−.30	–				
	Gender	2.23	.04	9.32	1.14	76.15	
	PEG	–	–	–	–	–	
	Psychiatric History	1.52	.02	4.57	1.29	16.13	
	MDADI Composite	−.05	.01	.95	.92	.99	
ED visits							.16
	Constant	−16.76	–				
	Dx Stage	–	–	–	–	–	
	MDADI Composite	−.07	.02	.94	.88	.99	
	Surgical Complications	–	–	–	–	–	
	Tracheostomy	–	–	–	–	–	

Note: Hx = History HNC = Head and Neck Cancer; MDADI = M D Anderson Dysphagia Inventory; PEG = percutaneous endoscopic gastrostomy Tube, Dx = diagnosis.

predicted by male gender (OR 9.32; 95% CI 1.14–76.15; p = .04), psychiatric history (OR 4.57; 95% CI 1.29–16.12; p = 02), and lower pre-surgical MDADI scores (OR 0.95; 95% CI 0.92–0.99; p = .006).

ED visits

Univariate regressions showed that lower pre-surgical MDADI scores, having more advanced stage disease, requiring a tracheostomy, and experiencing surgical complications were significantly independently associated with ED visits (p ≤ .05). When these variables were collectively entered in a multivariate logistic regression model with backward stepwise elimination (see Table 3), the only significant predictor of ED visits was MDADI composite scores (OR 0.94; 95% CI 0.88–0.92; p = .02).

Discussion

To our knowledge, this is the first study to demonstrate that pre-surgical dysphagia and QOL is associated with post-surgical health service use including LOS, 30dURs, and ED visits in HNC patients. Notably, dysphagia was predictive of increased health service use across study outcomes. Overall, findings suggest that preoperative QOL and PROM assessment can provide significant information that could be used along with other oncological parameters to refine evaluation of prospective patients' tolerance of surgery and post-surgical recovery.

A major strength of this study was its inclusion of variables, including QOL measures and PROMs, from the entire hospital course to predict multiple hospital outcome variables. Previous studies have examined predictors of LOS, readmission, or ED visits separately, or pre- or post-surgical factors separately, and have generally used QOL measures and PROMs as outcomes rather than predictors. The current study identified variables before, during, and after surgery that may predict health service use, such as pre-surgical QOL and dysphagia scores, complications, or tracheostomy placement. The fact that the MDADI was associated with health service use outcomes across a variety of HNC tumor types is not surprising given that all the different HN tumor locations are complicit in swallowing issues, albeit in different ways [47–49]. However, even though the presence of dysphagia has been associated with malnutrition, dehydration, and poor healthcare outcomes, including high healthcare expenditure in HNC [50–53], self-report measures like the MDADI are rarely administered in clinical care as part of routine pre-surgical assessment. While it is true that the MDADI assesses subjective reports of swallowing difficulty and therefore cannot discriminate between the dysphagia of patients with specific types of HNC (e.g., laryngeal cancer vs. oral cancer) [35], many patients may have baseline dysphagia that might not be severe enough

to be recognized by a clinician or considered immediately relevant when formulating the plan of care. Although this study was exploratory in nature, our findings suggest that implementation of validated dysphagia screening tools like the MDADI in the pre-surgical setting is feasible and may allow for the early identification of dysphagia and development of clear procedures to optimize healthcare resources and improve clinical pathways.

Although some variables that we identified as significant predictors of health service use (e.g., surgical complications, having a PEG tube) were consistent with findings from other published studies [12,15,54], there were some differences. For example, studies have identified marital status as a significant predictor of health service use [11,54]. It is possible that our sample may have been too small to detect significant differences. Differences in the way certain variables were measured may have also led to differences in findings. For example, Dziegielewski [15] measured whether patients had a tracheostomy at discharge, whereas we examined whether or not a tracheostomy was used to manage airway during surgery. Patients who have a tracheostomy at discharge may have had more advanced cancers, which may in turn increase their odds of readmission. In our study, relatively healthy patients could have had a brief tracheostomy placed and were perhaps decannulated prior to discharge.

Limitations

This study had various limitations. First, the study has the limitations inherent to all retrospective medical record reviews [55]. Second, there were a small number of events (n = 18 readmissions and 11 ED visits). This could have contributed to the wide confidence intervals for the reported risk factors. Larger scale studies with more events are needed to fully test the explanatory power of the multivariable models. Third, patients may have sought care for postoperative problems elsewhere, resulting in an underestimation of the rate of unplanned readmissions and ED visits. Supporting this idea, using data collected from a nationally representative sample, Chen et al found that one-fifth of all readmissions following HNC in the US did not occur at the index hospital [16]. This is especially relevant in the New York metro area, where transportation issues and a large number of medical centers may result in patients seeking care at a variety of facilities. Fourth, although our otolaryngology surgical oncology practice is diverse, our findings are based on a single academic medical center and might not reflect all otolaryngology practices. Fifth, owing to the nature of the study, we cannot completely rule out the possibility that lower QOL and dysphagia scores may reflect other hidden predictors of poor prognosis. Nevertheless, we found no relationship between disease stage and either UW-QOL or MDADI scores. Although the small sample size could

have been a factor, this finding was likely due to the fact that patients reported relatively good average pre-surgical QOL and swallowing function regardless of disease stage (Range = 84.11–88.93 out of 100 on the UWQOL , with higher scores indicating better QOL, and 80.04–88.11 out of 100 on the MDADI , with higher scores indicating better swallowing function). Future prospective investigations using larger and possibly more homogenous samples are needed to better clarify associations between QOL, dysphagia, and health service use in this population.

Clinical implications

Our findings suggest that QOL measures and PROMs, which are inexpensive and often quickly and easily administered, may be useful in predicting post-surgical health resource use. This underscores the importance of routinely collecting QOL and PROM data in clinical practice as they could complement other prognostic factors in the pre-operative setting. For example, pre-operative counseling with a speech-language pathologist (SLP) may lead to shorter hospital LOS and lower rates of hospital readmission after total laryngectomy. In addition to preparing patients to cope with the physiological and anatomical changes and possibly reducing anxiety, pre-operative visits with an SLP can also provide prophylactic intervention as appropriate and address current swallowing complaints that may or may not be resolved with surgery. These visits could also help set up a good rapport for post-operative therapeutic intervention and help the patient prepare for an earlier discharge by beginning the educational process of how to engage in post-operative self-management. In this sense, improved patient education in the pre-op setting could contribute to the reduced likelihood of ED visits and hospital readmissions that are related to patient self-care issues.

Integration of QOL measures and PROMs in routine clinical care may also help identify which patients would benefit most from different treatment programs. Despite the fact that patients' subjective reports of their dysphagic symptoms do not always reflect the actual physiology of the swallow [56–58], patients who indicate that their swallowing function is compromised prior to surgery may benefit from more up front intervention. For example, based on this information the SLP could suggest possible behavioral interventions or compensatory strategies to deal with the patient's dysphagic symptoms while they wait for surgery. QOL measures and PROMs could also be used to identify patients who are at risk for increased health service use so they can be targeted to improve discharge planning and coordination of hospital care. This information is valuable to clinicians who often place the focus of increased resource utilization on social, patient, and disease related factors despite data, which indicates that a large number of barriers to quality improvement initiatives for surgical patients center around institutional resources and providers themselves [59–61]. Therefore, inexpensive strategies are needed to identify patients at risk for increased health resource utilization, such as routine QOL and PROM evaluations. Such strategies have the potential to be accepted by providers, do not require significant institutional resources, and could potentially reduce health resource use in the HNC setting.

Conflict of interest

None of the authors have any actual or potential conflicts of interest including any financial, personal, or other relationships with other people or organizations within that could inappropriately influence their work.

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