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Association of comorbidity score with perioperative outcomes following transoral robotic surgery: National analysis

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Abstract

Background: The association of comorbidities with perioperative outcomes after transoral robotic surgery (TORS) is not well-defined in the literature.

Methods: Using the National Cancer Database, 4004 patients with T1-T2 oropharyngeal cancer between 2010 and 2017 were stratified based on their Charlson–Deyo Comorbidity Class (CDCC). Thirty-day unplanned readmissions, 30-day mortality, and 90-day mortality were compared using chi-square test and logistic regression. Hospital length of stay (LOS) was compared using the Kruskal–Wallis test.

Results: LOS was greater for patients with CDCC 2 or 3 compared to CDCC 0 or 1 ($p < 0.001$). Increasing age and CDCC ≥3 were associated with 30-day mortality (CDCC ≥3: odds ratio [OR] 5.55, 95% confidence interval [CI] 1.59–19.45). CDCC ≥3 (OR 2.61, 95%CI 1.09–6.27) was significantly associated with 30-day readmissions.

Conclusion: This national analysis demonstrates greater rates of unplanned 30-day readmissions, longer hospitalizations, and increased 30- and 90-day mortality after TORS in patients with CDCC ≥3.

KEYWORDS

medical comorbidities, minimally invasive surgery, oropharyngeal cancer, readmissions, transoral robotic surgery (TORS)

1 | INTRODUCTION

The incidence of human papillomavirus (HPV)-associated oropharyngeal cancer (OPC) has dramatically increased in the last few decades, while the incidence of HPV-negative OPC has decreased.[1] As a result of the changing demographics of head and neck cancer, the oropharynx is now the most commonly affected subsite of head and neck cancer.[1] After gaining approval from the United States Food and Drug Administration in 2009, transoral robotic surgery (TORS) has emerged as a valuable approach in the surgical treatment of OPC with reduced morbidity compared to open surgical approaches, and preserved

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oncologic outcomes in select patients compared to (chemo)radiotherapy.[2–4] National data indicate increasing use of TORS for OPC, and a potential survival advantage in patients that undergo TORS versus other approaches.[5]

Although there is agreement that comorbidities can significantly impact patient outcomes, there is limited available information on the predictive role of comorbidities on short-term outcomes after TORS. In 2017, Topf et al. investigated factors associated with unplanned hospital readmissions following TORS in their institutional review, although they did not explore the role of comorbidities.[6] There is conflicting evidence regarding the impact of comorbidities on unplanned readmissions in this population in more recent national reviews. Using the Nationwide Readmissions Database, Parhar et al. describe no association between comorbidities and readmissions following TORS, while Goel et al. found a statistically significant association, although their review included all patients with OPC undergoing surgical treatment.[7,8]

The Charlson–Deyo Comorbidity Score was originally developed to predict long-term mortality rates in the presence of multiple medical comorbidities and has been well-validated to predict long-term mortality in patients with cancer, including those with head and neck cancer.[9] It is the comorbidity scoring system currently utilized by the National Cancer Database (NCDB), and mapped by secondary diagnostic codes. Using data from the NCDB, our objective was to investigate the association between medical comorbidities, measured by the Charlson–Deyo Comorbidity Class (CDCC), and perioperative outcomes following TORS for OPC including hospital length of stay, unplanned 30-day hospital readmission rates, and 30- and 90-day mortality.

2 | MATERIALS AND METHODS

2.1 | Database information and patient selection

After the study was determined to be exempt from institutional review board review by Rutgers Robert Wood Johnson University Hospital in New Brunswick, we obtained the 2017 participant user file from the NCDB to perform a retrospective review of patients ≥18 years old diagnosed with squamous cell carcinoma of the oropharynx undergoing TORS. The NCDB is a national registry maintained by the Commission on Cancer of the American College of Surgeons and the American Cancer Society, which collects cases from >1500 facilities and encompasses approximately 70% of newly diagnosed cancers in the United States. There are established criteria to certify the quality of the submitted data, as well as an application process to obtain the data. After distribution of the data, the Commission on Cancer of the American College of Surgeons and the American Cancer Society are not responsible for the analysis and conclusions presented.

We initially queried the NCDB for all patients ≥18 years old with an OPC treated between 2010 and 2017 using topographic and morphologic codes from the International Classification of Disease for Oncology, 3rd Edition. Histologic codes included squamous cell carcinoma including variants (8070–8076, 8083). Topographical codes included the base of tongue [C01.9, C02.4], tonsil/lateral pharyngeal wall [C09.0, C09.1, C09.8, C09.9, C10.2] and other (soft palate [C05.1, C05.2], posterior pharyngeal wall [C10.3], vallecula [C10.0], and overlapping lesion/not otherwise specified [C10.8, C10.9]). The subset of patients undergoing TORS was identified by the robotic surgical approach code. Patients were excluded if they had distant metastatic disease (M1), T3 or T4 tumors, or missing data.

2.2 | Patient variables and statistical analysis

Baseline patient characteristics included a comparison of age, sex, race, insurance status, facility type, tumor site, HPV status, and clinical T and N stage. Patients were stratified based on CDCC: 0, 1, 2, ≥3. The CDCC was calculated based on the presence of certain diagnoses, weighted and categorized by the following point system: 1 point: cerebrovascular disease, chronic pulmonary disease, congestive heart failure, dementia, diabetes without chronic complications, mild liver disease, myocardial infarction, peptic ulcer disease, peripheral vascular disease, rheumatologic disease; 2 points: diabetes with chronic complications, hemiplegia or paraplegia, renal disease; 3 points: moderate or severe liver disease; and 6 points: acquired immunodeficiency syndrome.[10] Patients were considered HPV positive, by the NCDB variable indicating positive testing for high-risk HPV type 16 or 18. Variables among groups were then compared using the chi-square test or Fischer exact test for categorical variables and analysis of variation (ANOVA) or nonparametric equivalent for continuous variables depending on the distribution. Evaluated perioperative outcomes included: 30-day unplanned readmissions, hospital length of stay, 30-day mortality, and 90-day mortality. Variables associated with unplanned 30-day readmissions, 30-day mortality, and 90-day mortality were analyzed using logistic regression. Variables that were statistically significant ($p < 0.10$) on univariable testing were then included in the initial multivariable logistic regression model. A backward elimination procedure was

used to obtain a model containing only predictor variables whose coefficients were significant at the 0.05 level. Estimated odds ratios (OR) and associated 95% confidence intervals (CI) were calculated for each model. The association between CDCC and hospital length of stay was also evaluated as a categorical variable. Patients were stratified into three groups: ≤2 days (25th percentile), 3–5 days, and >5 days (75th percentile). For all analyses, the threshold for statistical significance was set at $p < 0.05$. SPSS v26 software was used for data analysis (SPSS Inc., an IBM Company, Chicago, IL).

3 | RESULTS

Once inclusion and exclusion criteria were specified per the methods, our final sample included 4004 subjects. Of these, 3143 patients (78.5%) had a CDCC of 0, 653 patients (16.3%) had a CDCC of 1, 145 patients (3.6%) had a CDCC of 2, and 63 patients (1.6%) had a CDCC ≥3. Table 1 describes the baseline patient characteristics stratified by CDCC. There were statistically significant differences when comparing most baseline characteristics in each CDCC, including age, race,

TABLE 1 Baseline patient characteristics by Charlson–Deyo Comorbidity Class (CDCC)

Characteristic	CDCC 0, $n = 3143$	CDCC 1, $n = 653$	CDCC 2, $n = 145$	CDCC ≥3, $n = 63$	*p*-value
Age					<0.001
Mean (SD)	59.0 (9.4)	62.4 (9.3)	64.9 (9.6)	63.8 (10.2)	
Sex					0.397
Male	2638 (83.9%)	539 (82.5%)	117 (80.7%)	56 (88.9%)	
Female	505 (16.1%)	114 (17.5%)	28 (19.3%)	7 (11.1%)	
Race					<0.001
White	2917 (92.8%)	580 (88.8%)	130 (89.7%)	53 (84.1%)	
African American	138 (4.4%)	58 (8.9%)	11 (7.6%)	6 (9.5%)	
Other	88 (2.8%)	15 (2.3%)	4 (2.8%)	4 (6.3%)	
Insurance status					<0.001
Private	2024 (64.4%)	302 (46.2%)	56 (38.6%)	14 (22.2%)	
Medicaid	151 (4.8%)	48 (7.4%)	12 (8.3%)	7 (11.1%)	
Medicare	823 (26.2%)	274 (42.0%)	64 (44.1%)	40 (63.5%)	
Uninsured	44 (1.4%)	6 (0.9%)	4 (2.8%)	1 (1.6%)	
Other/not specified	101 (3.2%)	23 (3.5%)	9 (6.2%)	1 (1.6%)	
Facility type					0.006
Non-academic	514 (16.6%)	120 (18.4%)	35 (24.1%)	18 (29.0%)	
Academic	2585 (83.4%)	531 (81.6%)	110 (75.9%)	44 (71.0%)	
Tumor subsite					0.002
Base of tongue	1160 (36.9%)	243 (37.2%)	49 (33.8%)	25 (39.7%)	
Tonsil	1772 (56.4%)	363 (55.6%)	72 (49.7%)	33 (52.4%)	
Other	211 (6.7%)	47 (7.2%)	24 (16.6%)	5 (7.9%)	
HPV status					0.279
Negative	942 (30.0%)	213 (32.6%)	52 (35.9%)	17 (27.0%)	
Positive	1604 (47.3%)	322 (44.4%)	59 (38.1%)	30 (45.5%)	
Unknown	703 (22.4%)	142 (21.7%)	37 (25.5%)	18 (28.6%)	
Clinical T stage					0.042
T1	1576 (50.1%)	334 (51.1%)	67 (46.2%)	21 (33.3%)	
T2	1567 (49.9%)	319 (48.9%)	78 (53.8%)	42 (66.7%)	
Clinical N stage					<0.001
N0: c0	855 (27.5%)	213 (33.0%)	58 (40.6%)	24 (38.7%)	
N+: c1-3	2259 (72.5%)	433 (67.0%)	85 (59.4%)	38 (61.3%)	

insurance status, facility type, tumor subsite, clinical T stage, and clinical N stage. No statistically significant differences were found when comparing sex or HPV status in each CDCC.

Figure 1 and Table 2 summarize the evaluated perioperative outcomes stratified by CDCC. The mean duration of hospital stay increased by CDCC ($p = 0.002$). There were significant differences in the duration of hospital stay in patients with CDCC 0 and 1 versus CDC 2 and 3 ($p < 0.001$ for all); however, the difference between CDCC 0 and 1 ($p = 0.061$) and CDCC 2 and 3 ($p = 0.361$) was not statistically significant. When evaluated as a categorical variable, a significant association was seen with CDCC and hospital length of stay groups. The proportion of patients with a hospital stay ≤2 days decreased as CDCC increased: CDCC 0 ($n = 1155$, 38.2%), CDCC 1 ($n = 226$, 35.8%), CDCC 2 ($n = 44$, 31.2%), CDCC 3 ($n = 14$, 22.2%), $p = 0.001$. Correspondingly, the proportion of patients with a hospital stay of >5 days increased from CDCC 0–2 and was similar between CDCC 2 and 3: CDCC 0 ($n = 525$, 17.4%), CDCC 1 ($n = 128$, 20.3%), CDCC 2 ($n = 46$, 32.6%), CDCC 3 ($n = 18$, 28.6%), $p = <0.001$. Different cutoffs were also explored with similar trends found. There were statistically significant differences between CDCC groups in 30-day mortality (CDCC 0: 0.7%, CDCC 1: 1.6%, CDCC 2: 1.4%, CDCC ≥3: 4.8%, $p = 0.002$) as well as 90-day mortality (CDCC 0: 1.1%, CDCC 1: 2.4%, CDCC 2: 2.8%, CDCC ≥3: 14.3%, $p < 0.001$). The difference in 30-day readmissions between CDCC groups approached statistical significance (CDCC 0: 3.7%, CDCC 1: 3.5%, CDCC 2: 5.5%, CDCC ≥3: 9.5%, $p = 0.068$).

Table 3 describes the variables associated with unplanned 30-day readmissions. On multivariable analyses, CDCC ≥3 (OR 2.61, 95%CI 1.09–6.27) and other/nonspecified insurance (OR 2.27, 95%CI 1.14–4.49) were independently associated with unplanned 30-day readmissions, relative to CDCC 0 and private insurance, respectively.

Tables 4 and 5 describe the variables associated with 30- and 90-day mortality, respectively. Due to the low number of events (i.e., 36 deaths) in 30-day mortality outcome, results of the multivariable analyses are not reported owing to concerns of model overfitting. Relative to CDCC 0, CDCC ≥3 was associated with higher 30-day mortality on univariable analyses (CDCC 1: OR 2.55, 95% CI 1.22–5.31; CDCC 2: OR 3.14, 95%CI 0.93–10.65; CDCC ≥3: OR 7.43, 95%CI 2.16–25.59). Relative to CDCC 0, CDCC 1 and CDCC ≥3 were associated with higher 90-day mortality (CDCC 1: OR 2.08, 95%CI 1.14–3.78; CDCC 2: OR 2.35, 95%CI 0.89–6.22; CDCC ≥3: OR 12.16, 95%CI 5.45–27.15).

4 | DISCUSSION

Given the increasing incidence of HPV-associated OPC and the growing national utilization of TORS, gaining insight into predictive factors of perioperative outcomes following TORS is important from a clinical and economic standpoint.[1,5] One factor that has not been well-explored in the literature is how comorbidities specifically affect short-term outcomes following TORS. In our study, we performed a comprehensive investigation into the association between comorbidities and multiple perioperative outcomes, including hospital length of stay, unplanned 30-day readmissions, and 30- and 90-day mortality using the NCDB.

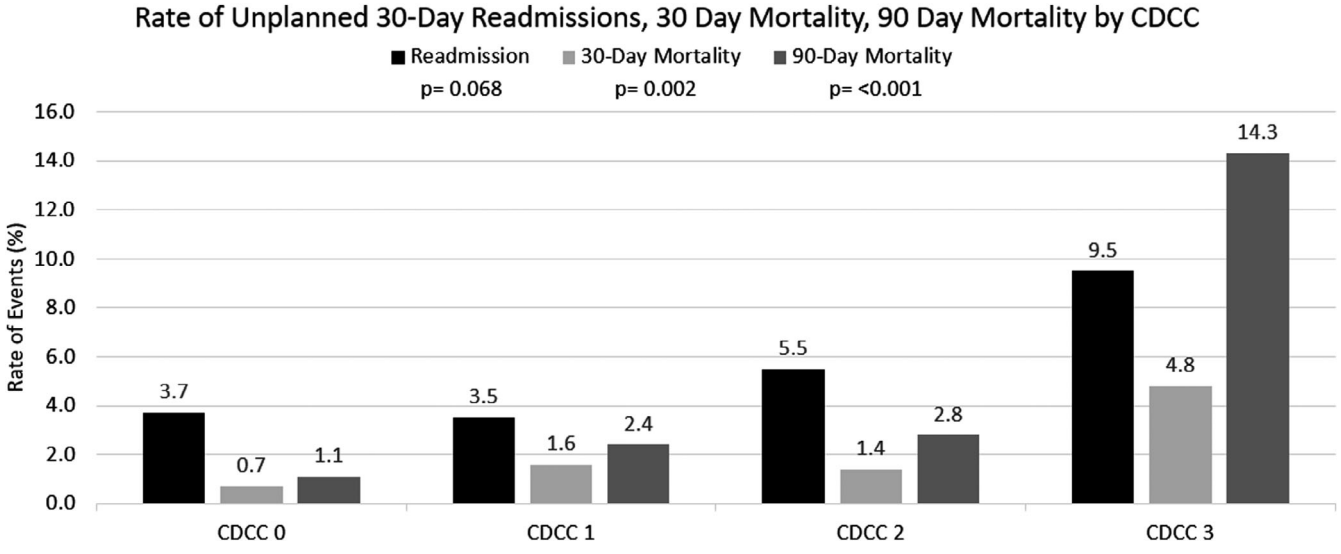

FIGURE 1 Rate of unplanned 30-day readmissions, 30 day mortality, 90 day mortality by Charlson–Deyo Comorbidity Class (CDCC)

TABLE 2 Perioperative outcomes by Charlson–Deyo Comorbidity Class (CDCC)

Characteristic	CDCC 0, $n = 3392$	CDCC 1, $n = 726$	CDCC 2, $n = 155$	CDCC ≥3, $n = 66$	*p*-value
Unplanned 30-day readmission rate					0.068
	115 (3.7%)	23 (3.5%)	8 (5.5%)	6 (9.5%)	
Mean hospital length of stay (SD)					0.002
	4.1 (5.3)	4.5 (7.9)	5.4 (6.0)	5.7 (6.0)	
Duration of hospital stay					<0.001
0–2 days	1155 (38.2%)	226 (35.8%)	44 (31.2%)	14 (22.2%)	
3–5 days	1343 (44.4%)	278 (44.0%)	51 (36.2%)	31 (49.2%)	
≥5 days	525 (17.4%)	128 (20.3%)	46 (32.6%)	18 (28.6%)	
30-day mortality rate					0.002
	21 (0.7%)	10 (1.6%)	2 (1.4%)	3 (4.8%)	
90-day mortality rate					<0.001
	32 (1.1%)	15 (2.4%)	4 (2.8%)	9 (14.3%)	

Abbreviation: CI, confidence interval.

Inpatient hospital care currently makes up one-third of health care costs, with an average cost of $2607 per day in the United States.[11] As a result there is significant interest in reducing unnecessary days in the hospital postoperatively. Hospital length of stay after TORS may be affected by a number of variables and reported rates vary significantly in the literature. Richmon et al. described an institutional protocol for rapid discharge after TORS with a mean hospital LOS of 1.5 days in a cohort of 94 patients.[12] Increased medical comorbidities and delayed initiation of oral diet were the only factors predictive of a longer hospital stay in their study.[12] Similar to their results, we found a significant relationship between CDCC and hospital length of stay. The proportion of patients with a rapid discharge after TORS (≤2 days) decreased as CDCC increased. This may theoretically be due to delayed oral diet initiation or pain control, which may present a challenge in patients with more comorbidities, as common analgesics may be contraindicated in patients with certain medical conditions. Similarly, the proportion of patients with a prolonged hospital stay (>5 days) increased from CDCC 0 to 2, and was similar between CDCC 2 and ≥3. This finding would most likely be attributed to the increased risk of perioperative medical and surgical complications in patients with higher comorbidity burden, although this information is not available in the NCDB.[13]

Similar to the additional costs incurred with longer hospital stays, unplanned readmissions in surgically treated patients with oropharyngeal or laryngeal cancer have been associated with an increased cost of $15000.[14] Understanding predictors of unplanned readmissions allows identification of high-risk patients and optimization of discharge planning. Topf et al. performed the first investigation into risk factors for unplanned 30-day admissions after TORS.[6] These occurred in 7.7% of patients, most commonly due to bleeding, dehydration, and uncontrolled pain, but their analysis did not investigate the potential impact of comorbidities on readmissions.[6] In more recent national reviews, there is conflicting evidence. Using the Nationwide Readmissions Database, Parhar et al. describe no association between comorbidities and readmissions following TORS, while Goel et al. found a statistically significant association, although their review included all patients with OPC undergoing surgical treatment.[7,8] In our cohort, unplanned 30-day readmissions were independently associated with a CDCC ≥3. Given that oropharyngeal bleeding is generally the most common reason for unplanned readmissions after TORS, the increased risk of bleeding in the presence of medical comorbidities is multifactorial. These patients may have platelet dysfunction or coagulopathies, especially in those with hepatic or renal conditions. Alternatively, patients with cardiovascular disease may be at increased risk of bleeding due to utilization of anticoagulants or antiplatelet agents.[6,15] Of note, the NCDB only captures readmissions to the index hospital, which translates to the lower reported rates of readmissions seen in the NCDB versus the Nationwide Readmissions Database. Other common causes for unplanned readmissions after TORS include dehydration and pain control. Rehydration may be more complex in patients with certain medical comorbidities and require admission as opposed to management in the emergency department alone. Parhar et al. stratified CDCC differently and did not separately analyze CDCC ≥3, which may account for the differences in results between studies.[7]

TABLE 3 Variables associated with unplanned 30-day readmission

	Univariable analyses			Multivariable analyses		
Characteristic	**Odds ratio**	**95% confidence interval**		**Odds ratio**	**95% confidence interval**	
CDCC						
0	Ref.			Ref.		
1	0.96	0.61	1.52	0.92	0.58	1.46
2	1.54	0.74	3.21	1.44	0.69	3.04
≥3	2.77	1.17	6.56	2.61	1.09	6.27
Age (per 1 year)	1.01	0.99	1.03			
Sex						
Male	Ref.					
Female	0.86	0.54	1.37			
Race						
White	Ref.					
African American	1.14	0.57	2.27			
Other	1.48	0.64	3.42			
Insurance status						
Private	Ref.			Ref.		
Medicaid	0.67	0.27	1.67	0.64	0.26	1.60
Medicare	1.37	0.97	1.95	1.31	0.92	1.88
Uninsured	0.53	0.07	3.87	0.51	0.07	3.72
Other/not specified	2.31	1.17	4.56	2.27	1.14	4.49
Facility type						
Academic	Ref.					
Non-academic	1.06	0.68	1.64			
Tumor subsite						
Base of tongue	0.89	0.63	1.27			
Tonsil	Ref.					
Other	1.07	0.58	1.98			
HPV status						
Positive	Ref.					
Negative	1.06	0.74	1.53			
Unknown	0.76	0.48	1.18			
Clinical T stage						
T1	Ref.					
T2	1.39	1.00	1.93			
Clinical N stage						
N0: c0	Ref.					
N+: (c1–c3)	0.94	0.66	1.34			

The CDCC was originally developed to predict long-term mortality rates in the presence of multiple medical comorbidities, and has been modified over time.[16,17] It has been well-validated to predict long-term mortality in patients with cancer, including those with head and neck cancer.[9] Given the low perioperative mortality after TORS, national databases provide sufficient patient numbers to allow an analysis of predictive factors that would otherwise require pooling data from a significant number of institutions. In this study, CDCC 1 and ≥3 were associated with increased 90-day mortality, while only CDCC ≥3 was associated with 30-day mortality after TORS.

TABLE 4 Variables associated with 30-day mortality

	Univariable analyses		
Characteristic	**Odds ratio**	**95% confidence interval**	
CDCC			
0	Ref.		
1	2.55	1.22	5.31
2	3.14	0.93	10.65
≥3	7.43	2.16	25.59
Age (per 1 year)	1.07	1.04	1.11
Sex			
Male	Ref.		
Female	0.77	0.30	1.99
Race			
White	Ref.		
African American	0.96	0.23	4.01
Other	[a]		
Insurance status			
Private	Ref.		
Medicaid	1.70	0.38	7.57
Medicare	3.26	1.63	6.54
Uninsured	[a]		
Other/not specified	2.78	0.62	12.44
Facility type			
Academic	Ref.		
Non-academic	1.94	0.97	3.96
Tumor subsite			
Base of tongue	0.69	0.32	1.46
Tonsil	Ref.		
Other	2.15	0.87	5.35
HPV status			
Positive	Ref.		
Negative	1.41	0.62	3.21
Unknown	2.64	1.23	5.66
Clinical T stage			
T1	Ref.		
T2	1.23	0.65	2.34
Clinical N stage			
N0: c0	Ref.		
N+: (c1–c3)	0.41	0.21	0.77

[a]Zero events in the group.

Age was the only other clinical variable associated with perioperative mortality. The perioperative mortality rate for all surgically treated patients with head and neck cancer was recently reported as 0.84% by Bukatko et al. using the NCDB.[18] In their review, the clinical variables with the strongest relationship with perioperative mortality were CDCC and tumor stage.[18] Catastrophic oropharyngeal bleeding has been reported as a rare source of major perioperative morbidity and mortality after TORS. In a survey of TORS surgeons in 2013, there were a total

TABLE 5 Variables associated with 90-day mortality

	Univariable analyses			Multivariable analyses		
Characteristic	**Odds ratio**	**95% confidence interval**		**Odds ratio**	**95% confidence interval**	
CDCC						
0	Ref.			Ref.		
1	2.52	1.40	4.55	2.08	1.14	3.78
2	3.37	1.29	8.76	2.35	0.89	6.22
≥3	15.71	7.17	34.42	12.16	5.45	27.15
Age	1.07	1.05	1.10	1.06	1.03	1.09
Sex						
Male	Ref.					
Female	1.19	0.63	2.23			
Race						
White	Ref.					
African American	2.24	1.01	4.98			
Other	1.21	0.29	5.02			
Insurance status						
Private	Ref.					
Medicaid	3.20	1.28	8.02			
Medicare	3.30	1.90	5.70			
Uninsured	[a]					
Other/not specified	2.59	0.76	8.79			
Facility type						
Academic	Ref.					
Non-academic	1.89	1.09	3.27			
Tumor subsite						
Base of tongue	0.80	0.45	1.42			
Tonsil	Ref.					
Other	2.83	1.45	5.53			
HPV status						
Positive	Ref.					
Negative	1.39	0.73	2.64			
Unknown	2.76	1.54	4.98			
Clinical T stage						
T1	Ref.					
T2	1.57	0.94	2.60			
Clinical N stage						
N0: c0	Ref.					
N+: (c1–c3)	0.41	0.25	0.66			

[a]Zero events in the group.

of 6 (0.3%) perioperative mortalities out of 2015 cases, all due to postoperative bleeding.[19] More recently, prophylactic arterial ligation has been shown in multiple systematic reviews to be associated with a reduced risk of major and severe bleeding after TORS.[20,21]

Our study included a number of limitations. As with all studies involving national databases, selection bias, incomplete data, and coding errors limit its use. Additionally, prior studies have demonstrated that the NCDB may underestimate patient comorbidity information,

which is drawn from hospital discharge face sheets.[10] As mentioned above, readmissions to nonindex facilities are not captured, which underestimates the readmission rate. Hospital length of stay may be also affected by variables not available in the NCDB including additional complex reconstruction, tracheostomy, or gastrostomy tube placement. Information on previous treatment is not available in the NCDB. Specifically, previous radiation therapy has been shown to be a risk factor for postoperative hemorrhage after TORS, which may affect the perioperative variables investigated in this study, but was unable to be taken into account in analyses.[22] Finally, information on the presence of specific medical comorbidities is not available in the NCDB, only the CDCC. It is likely that certain conditions (e.g., those that require antithrombotic medications) would be associated with comparatively worse perioperative outcomes in this patient population.

In summary, the presence of medical comorbidities increases the complexity of care in patients with oropharyngeal cancer undergoing TORS. Perioperative outcomes are significantly worse in those with CDCC ≥3, who had an alarmingly high 90-day mortality of 14%. Although this represents a small number of patients and the overall mortality rate remains low in other groups, significant caution should be exercised in this population. However, alternatives may be limited as increased comorbidity burden may be a contraindication to chemotherapy. Treatment decisions should be made in the context of a multidisciplinary tumor board. Information on interventions to reduce morbidity in this specific population is limited, but one recent study found that patients with head and neck cancer attending presurgical clinic had a significant reduction in readmissions, which may be especially beneficial to patients with more comorbidities.[23] Multidisciplinary perioperative pathways (e.g., enhanced recovery after surgery) have shown promise toward improving outcomes in other surgical disciplines, but are in their infancy in TORS.[24,25] These have the greatest potential to improve outcomes in high-risk patients with higher medical comorbidity burden.

5 | CONCLUSIONS

This analysis of the NCDB demonstrates greater rates of unplanned 30-day readmissions, longer hospitalizations, and increased 30- and 90-day mortality in patients with CDCC ≥ 3.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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