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Application of the Eighth Edition American Joint Committee on Cancer Staging System for HPV-Related Oropharyngeal Cancer Treated With Transoral Robotic Surgery

Arvind K. Badhey, MD; Ashley Olson, MA; Sameep Kadakia, MD; Jack Russo, MD; Peter Ting, BS; Mian Khalid, BS; Mike Yao, MD; Marita S. Teng, MD; Eric M. Genden, MD; Brett A. Miles, DDS, MD; Raymond L. Chai, MD

**Objective:** Analyze patients treated with transoral robotic surgery (TORS) in the context of the eighth edition of the American Joint Committee on Cancer (AJCC) staging system.

**Methods:** Retrospective cohort study including 110 human papillomavirus-related oropharyngeal cancer (HPV+OPC) patients with a minimum 1-year follow-up treated with TORS between 2007 to 2016. Kaplan-Meier methods were used to estimate 3-year disease-free survival and assess differences in recurrence.

**Results:** One hundred and ten patients with a median follow-up of 54 months were analyzed. Of those, 85% of patients were male, with a median age of 60. Twenty-two percent of patients received no adjuvant therapy; 43% received adjuvant radiation; and 35% underwent adjuvant chemoradiation. Extracapsular spread was identified in 24% of patients. Overall survival was 100%, with estimated 3-year disease-free survival (DFS) (95% confidence interval) of 87% (77, 93). Under the seventh edition of the AJCC, 5% of patients were stage I; 11% were stage II; 26% were stage III; and 57% were stage IVa. Twenty-seven patients (25%) were upstaged on final pathology, whereas 15 patients (14%) were downstaged. Under the eighth edition of the AJCC, 94% of patients were stage I for both clinical and pathologic staging systems. Six patients (6%) were upstaged on final pathology, whereas six patients (6%) were downstaged. No factors demonstrated statistical significance for DFS. Within pathologic stage I, Kaplan-Meier estimates for DFS did not reach statistical significance.

**Conclusion:** The majority of patients undergoing TORS for HPV+OPC are stage I under the eighth edition of the AJCC staging system, with limited pathologic re-staging compared with the prior system. Oncologic outcomes are favorable for this group. No clinicopathologic features are significant for DFS within pathologic stage I.

**Key Words:** HPV, oropharyngeal cancer, transoral robotic surgery, AJCC staging.

**Level of Evidence:** 2b.

**Introduction**

Human papillomavirus-related oropharyngeal cancer (HPV+OPC) has seen a rapid increase in incidence within the past decade and is characterized by a more favorable prognosis in comparison to non-HPV-related oropharyngeal cancer (HPV-OPC).\(^1\)\(^-\)\(^5\) Within the field of head and neck cancer, there has been a need for an updated staging system that recognizes the unique nature of HPV+OPC in prognosis, tumor biology, outcomes, and management.\(^5\)\(^,\)\(^6\)

An ideal staging system should stratify groups based on survival prognosis, patient population distribution within stages, and a balance of user friendliness with statistical goals.\(^7\) Prior to the release of the most recent edition of the American Joint Committee on Cancer (AJCC), the eighth edition, HPV status was not taken into account when staging patients with oropharyngeal cancer. Multiple studies have shown that the lack of stratification between HPV+OPC and HPV-OPC obscures the differences in patient populations, nodal status, recurrence, and the prognosis observed in these two distinct groups.\(^6\)\(^,\)\(^8\)

A recent comparison of overall survival, conducted by Huang et al., demonstrated that 5-year overall survival of HPV-OPC stage I, II, III, and IV, respectively, was 78%, 58%, 50%, and 30%, versus HPV+OPC 5-year survival of 88%, 78%, 71%, and 74%. Such a high discordance in survival between these two groups emphasizes the difference between the two diseases.\(^8\) In an effort to create a staging system that recognizes HPV+OPC as a separate disease entity, a study by the International Collaboration on Oropharyngeal Cancer Network for Staging (ICON-S) created a framework for pretreatment clinical staging of HPV+OPC.\(^9\) In addition, Haughey

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Laryngoscope 128: May 2018 Badhey et al.: AJCC Staging, TORS, and HPV+OPC 1133
et al., using pathologic data from surgically treated HPV+OPC patients, validated the use of a novel pathologic staging system specific to HPV+OPC. Such a staging system was published in 2017 in the eighth edition of the American Joint Committee on Cancer (AJCC), which introduced novel clinical and pathologic classifications for HPV+OPC.

When implementing and evaluating a new staging system, the system must be applied to specific patient populations to demonstrate validity and efficacy. Limited data exists regarding the application of this new staging system to patients treated with transoral robotic surgery (TORS). In this study, we applied and evaluated the eighth edition of the AJCC HPV+OPC staging system to a cohort of patients treated with TORS at a tertiary care academic hospital system.

**MATERIALS AND METHODS**

Data was collected from a prospectively maintained institutional review board-approved (Protocol ISSM 15-2118) multi-hospital database including all patients undergoing TORS within a single tertiary healthcare system. This database includes consecutive patients who underwent surgery between 2007 and 2016. Inclusion criteria for the study were: biopsy-proven oropharyngeal squamous cell carcinoma, either p16-positivity on immunohistochemistry or HPV-positivity with in situ hybridization, and at least 1-year minimum follow-up. p16 positivity was defined as strong and diffuse nuclear and cytoplasmic staining in greater than 70% of the tumor. After application of inclusion criteria, 110 patients were left for analysis.

All patients underwent TORS resection of the primary tumor with at least unilateral, ipsilateral neck dissection by one of five surgeons (R.L.C., E.A.M., M.Y., M.S.T., E.M.G.). Bilateral neck dissections were performed at the discretion of the operating surgeon. Decision for adjuvant therapy was made after multidisciplinary evaluation of margin status, primary tumor size, nodal status, extracapsular spread (ECS), presence of perineural or lymphovascular invasion, performance status, and patient preference.

Demographic data, clinicopathologic characteristics, adjuvant therapy, smoking status, recurrence, and survival were compiled. Using the seventh edition of the AJCC system, all patients in the cohort were initially staged with pretreatment clinical data and then re-staged with final pathologic data. Next, patients were analyzed under the clinical as well as the pathologic staging systems of the eighth edition of the AJCC.

Given the low disease-specific mortality among patients in the cohort, the primary endpoint evaluated was disease recurrence. Time of recurrence was defined as first-detected new disease at local, regional, or distant sites. Disease-free survival (DFS) was defined as time from surgery to either recurrence or death. Univariate and multivariate Cox regression analysis was used to identify clinicopathologic factors associated with disease recurrence. Kaplan-Meier analysis was performed to estimate 3-year DFS for the entire cohort, the eighth edition of the AJCC pathologic stage I group as a whole, and the eighth edition of the AJCC pathologic stage I group stratified by adjuvant therapy and ECS. Log-rank test was used to detect differences in recurrence by ECS and adjuvant therapy. A Fischer’s exact test was used to assess statistical significance in stage changes from clinical to pathologic staging within the AJCC staging systems of both the seventh and eighth editions. All tests were two-tailed; an alpha level of 0.05 was used as the cutoff for significance. Data was analyzed using Stata Statistical Software 14 (StataCorp LP, College Station, TX).

**RESULTS**

The median time of follow-up was 54 months; time of follow-up ranged from 12 to 95 months. The median age was 60, with a range from 41 to 83 years old. Ninety-four patients were male (85%). Thirty-eight patients had at least a 10-pack year history of smoking (35%). Extracapsular spread was identified in 27 patients after surgery (24%). Twenty-four patients did not receive adjuvant therapy (22%). Forty-seven patients received adjuvant radiation (43%), whereas 39 patients underwent adjuvant chemoradiation (35%).

Using pretreatment clinical data under the system in the seventh edition of the AJCC, five patients were stage I (5%); 11 patients were stage II (10%); 41 patients were stage III (37%); and 53 patients were stage IVa (48%). When patients were re-staged using pathologic data under the system in the seventh edition of the AJCC, five patients were stage I (5%); 12 patients were stage II (11%); 29 patients were stage III (26%); 63 patients were stage IVa (57%); and one patient was stage IVb (1%). Under the pathologic as well as the clinical staging systems in the eighth edition of the AJCC, 103 patients were stage I (94%) and seven were stage II (6%). Table I shows patients staged under the pathologic system in the eighth edition of the AJCC and stratified by adjuvant therapy, ECS status, recurrence, death, and smoking.

Figure 1 demonstrates the shift in staging between the seventh edition of the AJCC pretreatment clinical staging and the eighth edition system. All patients within the seventh edition stage I, II, and III groups...
were now stage I in the eighth edition system. Within stage IVa under the seventh edition of the AJCC system, 87% of patients were re-staged to stage I in the eighth edition system.

Table II demonstrates the change in staging from pretreatment clinical staging to pathologic staging following surgery for both the seventh and eighth editions of the AJCC systems. Significantly more patients were both upstaged and downstaged with the old seventh edition system when compared to the eighth edition system. Forty-two 42 patients (39%) underwent a change in staging after surgery under the seventh edition of the AJCC classification, whereas only 12 patients (12%) had a change in stage with the eighth edition of the AJCC system.

Overall survival was 100%, with estimated 3-year DFS of 87% (95% confidence interval [CI] = 77%–93%) for the cohort. For stage I patients under the pathologic system of the eighth edition of the AJCC, estimated 3-year DFS was 88% (95% CI = 78%–94%). Ten out of 11 patients (90.9%) with recurrent disease were pathologic stage I as per the eighth edition of the AJCC. Of the 11 patients who recurred, eight (72.7%) recurred distantly; two (18.2%) presented with local recurrences; and one patient (9.1%) had a regional recurrence. Within pathologic stage I of the eighth edition of the AJCC, gender, smoking status, ECS, adjuvant therapy, and number of positive nodes demonstrated no statistical significance for recurrence on either univariate or multivariate analysis (Table III). Table IV represents a summary of the recurrences found in this cohort. Kaplan-Meier estimates for pathologic stage I patients of the eighth edition AJCC stratified by both adjuvant therapy and ECS showed no statistical difference in 3-year DFS (Figs. 2 and 3).

**DISCUSSION**

This study provides the first application of the eighth edition of the AJCC staging classification to HPV+OPC patients treated with TORS in the literature. In applying the new staging system to this patient population, our study provided multiple insights. We determined that patients within the eighth edition of the AJCC pathologic stage I had exceptionally good outcomes both in overall and in disease-free survival. We also were able to highlight the changes implemented by the eighth edition of the AJCC staging system by showing the previous discrepancies between clinical and pathologic staging under the seventh edition of the AJCC. Previous studies have emphasized the critical role of pathology-derived risk stratifications in formulating effective postoperative adjuvant therapy regimens. This aim is tied to a unique aspect of surgically managed patients, for which pathologic analysis can help avoid the adverse effects of adjuvant therapy. It is also

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**TABLE II.** Changes in Clinical TNM Staging to Pathologic TNM Staging.

<table>
<thead>
<tr>
<th>AJCC Seventh Edition No. (%)</th>
<th>AJCC Eighth Edition No. (%)</th>
<th>Fischer’s Exact Test P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent 68 (62%)</td>
<td>98 (89%)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Upstaged 27 (25%)</td>
<td>6 (6%)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Downstaged 15 (14%)</td>
<td>6 (6%)</td>
<td>.0101</td>
</tr>
</tbody>
</table>

AJCC = American Joint Committee on Cancer; TNM = tumor, node, metastasis.
essential that clinical and pathological staging is consistent. Our findings demonstrate that staging with the eighth edition of the AJCC is significantly more consistent between clinical and pathologic staging when compared to the seventh edition in patients treated with TORS.

Almost all patients in our cohort were stage I under both clinical and pathologic staging in the eighth edition of the AJCC system. This may be due to the fact that TORS primarily is utilized for patients with early T-stage disease. Additionally, patients with advanced disease or obvious ECS may be preferentially treated with upfront CRT. However, within stage I, our patient population is very heterogeneous in terms of overall treatment modalities used for the same stage. Previous studies have emphasized the critical role of pathology-derived risk stratifications in formulating effective postoperative adjuvant therapy regimens. Most patients with pathologic evidence of ECS are treated with adjuvant chemoradiation. Our study demonstrated no statistical difference between patients with and without ECS. This finding is consistent with multiple publications in the literature, suggesting that ECS may not represent an adverse prognostic factor or be associated with worse survival in patients with HPV+OPC.

The current seventh edition TNM staging system does not effectively represent the prognosis of HPV+OPC, although it is acceptable for HPV-OPC. For this reason, among others, a new clinical staging system was determined to be both necessary and feasible for HPV+OPC. Although the incidence of head and neck cancer has been decreasing overall, HPV+OPC has rapidly increased. Lydiatt et al. highlights that due to the shift in disease patterns, the seventh edition of the AJCC has lost the ability to adequately provide hazard discrimination to create meaningful stages. This results in the observation that the majority of patients, regardless of prognosis, are skewed toward stage III/IV.

The need for a new staging system is best demonstrated by this inability to distinguish survival outcomes between stages I to IVa. The utility of a staging system lies in its ability to provide survival data to help divide patients into similar groups with comparable survival, which in practice aids in informing a patient about their disease. The primary role of staging is to provide information about overall survival and not recurrence. A good staging system should be able to describe the life history of a disease, reflect survival, and incorporate additional factors that may impact tumor burden. Although anatomic disease extent is the most predominant portion of the current TNM staging system, the need to integrate nonanatomic prognostic factors is paramount in diseases such as HPV+OPC. Staging for HPV+OPC is a step toward the broader incorporation of molecular and genetic information into tumor staging, making prognosis and survival estimates more patient-specific.

HPV+OPC is now understood to be a unique disease entity, with a drastically different tumor biology when compared to HPV-OPC. Not only does the disease have a unique molecular basis and anatomic

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### TABLE III.

Analysis of Clinicopathologic Factors on Recurrence Within AJCC Eighth Edition Pathologic Stage I.

<table>
<thead>
<tr>
<th>Univariate</th>
<th>HR</th>
<th>95% CI</th>
<th>P Value</th>
<th>HR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.32</td>
<td>0.08</td>
<td>1.24</td>
<td>0.098</td>
<td>0.30</td>
<td>0.127</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking Status</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Nonsmoker</td>
<td>0.88</td>
<td>0.23</td>
<td>3.44</td>
<td>0.857</td>
<td>0.57</td>
<td>2.50</td>
</tr>
<tr>
<td>Smoker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No ECS</td>
<td>1.83</td>
<td>0.52</td>
<td>6.51</td>
<td>0.350</td>
<td>2.21</td>
<td>10.48</td>
</tr>
<tr>
<td>ECS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjuvant Therapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.83</td>
<td>0.20</td>
<td>16.4</td>
<td>0.588</td>
<td>1.80</td>
<td>18.4</td>
</tr>
<tr>
<td>RT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRT</td>
<td>2.49</td>
<td>0.29</td>
<td>21.4</td>
<td>0.406</td>
<td>2.24</td>
<td>21.8</td>
</tr>
<tr>
<td>No. of Positive Nodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.34</td>
<td>0.06</td>
<td>2.06</td>
<td>0.242</td>
<td>0.33</td>
<td>3.27</td>
</tr>
<tr>
<td>1</td>
<td>1.37</td>
<td>0.23</td>
<td>8.22</td>
<td>0.730</td>
<td>1.47</td>
<td>14.51</td>
</tr>
<tr>
<td>2</td>
<td>0.94</td>
<td>0.13</td>
<td>6.71</td>
<td>0.949</td>
<td>0.77</td>
<td>7.02</td>
</tr>
<tr>
<td>3+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AJCC = American Joint Committee on Cancer; CI = confidence interval; CRT = adjuvant chemoradiation; ECS = extracapsular spread; HR = hazard ratio; RT = adjuvant radiation.
<table>
<thead>
<tr>
<th>Primary Site and Laterality</th>
<th>T-stage</th>
<th>N-stage</th>
<th>No. Positive Nodes</th>
<th>Smoking Hx</th>
<th>ECS History</th>
<th>Time of Recurrence (months)</th>
<th>Treatment</th>
<th>AJCC Eighth Edition</th>
<th>AJCC Seventh Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right tongue base</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>N</td>
<td>NA</td>
<td>Primary resection Base of tongue/vallecula recurrence</td>
<td>4</td>
<td>BOT/vallecula recurrence: CRT</td>
<td>I</td>
</tr>
<tr>
<td>Right tonsil</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>N</td>
<td>NA</td>
<td>Primary resection + CRT Lung metastasis</td>
<td>42</td>
<td>RUL recurrence: VATs resection</td>
<td>I</td>
</tr>
<tr>
<td>Right tonsil</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>Y</td>
<td>N</td>
<td>Primary resection + CRT Pharyngeal/cervical recurrence and lung/bone metastasis</td>
<td>3</td>
<td>Recurrence and mets: Chemo and immunotherapy</td>
<td>I</td>
</tr>
<tr>
<td>Left tongue base</td>
<td>1</td>
<td>2b</td>
<td>2</td>
<td>N</td>
<td>Y</td>
<td>Primary resection + XRT Left tonsil recurrence</td>
<td>21</td>
<td>Left tonsil recurrence: Resection and CRT</td>
<td>I</td>
</tr>
<tr>
<td>Right tonsil</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>N</td>
<td>Y</td>
<td>Primary resection + XRT Left neck recurrence</td>
<td>32</td>
<td>Left neck recurrence: Resection</td>
<td>I</td>
</tr>
<tr>
<td>Left tonsil</td>
<td>2</td>
<td>2b</td>
<td>2</td>
<td>N</td>
<td>N</td>
<td>Primary resection + XRT Tracheal recurrence New tracheal recurrence Lung metastasis</td>
<td>16</td>
<td>Tracheal recurrence: Resection/ CRT Lung recurrence: XRT Second tracheal recurrence: Total laryngectomy Second lung recurrence: Immunotherapy</td>
<td>I</td>
</tr>
<tr>
<td>Right tonsil</td>
<td>2</td>
<td>2b</td>
<td>4</td>
<td>N</td>
<td>N</td>
<td>Primary resection + CRT Liver/lung metastasis</td>
<td>19</td>
<td>Liver recurrence: Resection and chemo Second liver/lung recurrence: Chemo</td>
<td>I</td>
</tr>
<tr>
<td>Right tonsil</td>
<td>2</td>
<td>2b</td>
<td>2</td>
<td>Y</td>
<td>Y</td>
<td>Primary resection + XRT Bronchial tree recurrence</td>
<td>20</td>
<td>Bronchial tree recurrence: CRT</td>
<td>I</td>
</tr>
<tr>
<td>Right tongue base</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N</td>
<td>N</td>
<td>Primary resection + CRT Lung metastasis</td>
<td>21</td>
<td>LLL recurrence: VATs Second lung recurrence: Chemo</td>
<td>I</td>
</tr>
<tr>
<td>Right tongue base</td>
<td>1</td>
<td>2b</td>
<td>8</td>
<td>Y</td>
<td>Y</td>
<td>Primary resection + CRT Lung metastasis</td>
<td>33</td>
<td>RLL recurrence: VATs resection</td>
<td>II</td>
</tr>
<tr>
<td>Left tonsil</td>
<td>1</td>
<td>2c</td>
<td>3</td>
<td>N</td>
<td>N</td>
<td>Primary resection + CRT Bone and liver metastasis</td>
<td>34</td>
<td>RLL recurrence: VATs resection</td>
<td>I</td>
</tr>
</tbody>
</table>

AJCC = American Joint Committee on Cancer; CRT = adjuvant chemoradiation; ECS = extracapsular spread; Hx = history; LLL = left lower lobe; N = no; NA = nonapplicable; N-stage = node stage; RLL = right lower lobe; RUL = right upper lobe; T-stage = tumor stage; XRT = radiotherapy; Y = yes.
predisposition, but it also responds more favorably to specific therapies.\textsuperscript{24–26} HPV+OPC has a presentation unlike HPV-OPC, for which patients with lower tumor (T) stages (T1/T2) have high N-stage disease.\textsuperscript{27,28} Within the seventh edition of the AJCC, N-stage carries significant weight in overall stage assignment and thus prognostication.\textsuperscript{29} Within the revised staging system, patients previously classified as N1 to N2b all fall within the N1 category.\textsuperscript{30} This in turn has shifted the overall stage stratification, creating a system more reflective of the prognosis of HPV+OPC. This allows for a paradigm shift within a subset of HPV+OPC, in which various stages of neck disease are considered equal from an outcomes standpoint. Finally, this creates a cohort of patients previously classified as stage IV who are now stage I, a fact that has a powerful impact on both patient understanding and disease management.

Prior to the release of the eighth edition of the AJCC, multiple studies compared preliminary staging models, including the ICON-S and MDACC models.\textsuperscript{7,31,32} Mizumachi et al. confirmed the efficacy of the eighth edition of the AJCC with a cohort of 111 patients and demonstrated a significant difference in 3-year overall survival between stages within the new system.\textsuperscript{33} Horne et al. further supported the eighth edition of the AJCC by applying the system to a cohort of over 8 thousand patients. Our study was consistent with this large-scale study, showing the majority of patients within the new staging system were stage I.\textsuperscript{34}

Within the literature, multiple studies have supported a surgical approach to early and intermediate stage HPV+OPCs. Moncrieff et al. showed that patients with T1 and T2 disease, when treated with single-modality primary surgery, had equivalent levels of local control to primary CRT.\textsuperscript{35} Kass et al. demonstrated a similar point, with emphasis placed on the consequences of overtreatment in patients with HPV+OPC. This brings focus to the role of primary surgical therapy as a means of which to potentially de-escalate curative therapy for patients with HPV+OPC and protect patients from the long-term sequelae of nonsurgical therapy.\textsuperscript{36} Additionally, Olsen et al. demonstrated the effectiveness of transoral surgery as a single-treatment modality for HPV+OPC.\textsuperscript{37}

In a recent study by Haughey et al., over 700 patients treated with primary surgery for HPV+OPC were analyzed through different staging systems. When comparing our data, many of our outcomes and findings were similar. Most patients were early stage: stage I or stage II. Overall survival was upward of 85%, with a similar median follow-up time. Patients had similar rates of adjuvant therapy, none of which showed significant differences in disease-free survival. Due to a broad definition of primary surgery, including TORS, transoral laser microsurgery, direct transoral resection, and open surgery, as well as a large study population, Haughey et al. were able to make stronger conclusions regarding survival and significant pathologic risk factors.\textsuperscript{10} However, the hallmark difference within our study was the exclusive focus on patients undergoing TORS. Whereas broad conclusions on surgical management of HPV+OPC cannot be made with our data, very specific and targeted conclusions about our patient population and TORS as a treatment modality for HPV+OPC are reasonable.

This study was not without its limitations. A relatively small study size with excellent overall survival is inherently underpowered to determine statistical differences due to pathologic risk factors, as was the case with this study. In addition, a comparison with HPV-OPC patients may have provided additional meaningful data. Finally, in any analysis of long-term outcomes and survival, a longer minimum follow-up would be necessary to improve the power of the survival curves.

**CONCLUSION**

In our analysis and application of the eighth edition of the AJCC TNM staging system to patients treated at a tertiary referral center, the majority of patients undergoing TORS for HPV+OPC were stage I. This study demonstrates that patients classified under the eighth
edtion of the AJCC have limited pathologic re-staging. Within pathologic stage I, favorable oncologic outcomes were observed in patients who underwent TORS as the primary treatment modality, with adjuvant therapy as indicated by pathologic data.

BIBLIOGRAPHY