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Should Transcervical Arterial Ligation Be Performed During Transoral Robotic Surgery?

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1 | Background

Over the past 20 years, transoral robotic surgery (TORS) has cemented itself in the treatment paradigm for human papillomavirus (HPV)-mediated oropharyngeal squamous cell carcinoma (OPC). TORS was first US Food and Drug Administration approved for the management of T1–T2 tumors of the oropharynx in 2009 and then again in 2019 with the debut of the da Vinci SP Surgical system (Intuitive Surgical Inc., Sunnyvale, CA). TORS allows for precise removal of OPC with adequate surgical margins, while preserving critical structures needed for speech and swallowing. Final pathology learned from TORS and neck dissection allows for safe reduction or elimination of postoperative adjuvant therapy.

The feared surgical complication of TORS is oropharyngeal hemorrhage. External carotid artery (ECA) branches (e.g., facial, lingual artery) are routinely encountered during deep dissection. Postoperative bleeding can range from minor bleeding managed conservatively to life-threatening hemorrhage resulting in complications such as hypoxia, airway compromise, hemodynamic instability, and cardiopulmonary arrest [1]. Published bleeding rates in TORS patients range from in 5.4%–13.2% [1–5]. Major/severe bleeding occurs in 1.8%–6.0% of TORS patients [1–4]. To mitigate the risk of postoperative oropharyngeal bleeding, many TORS surgeons have advocated for transcervical arterial ligation (TCAL) of the ECA and its associated branches.

Given the use of TORS in the increasingly more common early-stage HPV-mediated OPC patient, a review of recent data

regarding TCAL and a formal recommendation on whether it should be routinely performed is warranted.

2 | Literature Review

The first study to examine the impact of TCAL on postoperative bleeding was a single-institution, multicenter study by Pollei et al. [1]. While all patients in this study underwent transoral surgery without reconstruction, only 29.7% of the 906 patients underwent TORS. TCAL was performed in 15.6% of cases and was always performed at the time of primary resection. Although there was no significant difference in overall bleeding between the ligated and non-ligated patients, only 1 of the 10 severe bleeds (life-threatening) had undergone prophylactic TCAL. This contrasts with the non-severe bleeding, of which the TCAL group comprised 8 of 39 patients. Five of the severe bleeding patients required TCAL as part of the management of their oropharyngeal hemorrhage. Importantly, there were no reported complications from prophylactic TCAL.

The first study to demonstrate a statistically significant decrease in severe bleeding with TCAL during TORS was a single institution, retrospective review of 265 TORS patients by Kubik et al. [2] TCAL was performed in 28% of patients. Again, there was no difference in overall bleeding rate between ligated and non-ligated patients. However, TCAL significantly reduced the incidence of major and severe bleeding (1.3% vs. 7.8%; $p=0.04$). Of the 74 patients who underwent TCAL, only one patient had major or severe bleeding. Prior radiation therapy was a risk

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factor for major and severe postoperative hemorrhage (14.6% vs. 4.5%; $p = 0.02$).

Similarly, a two-institution, retrospective review of 201 TORS patients by Gleysteen et al. [3] only reported severe bleeding in patients without TCAL (4 of 149). None of the 52 patients who underwent TCAL had severe bleeding. Bleeding complications were mainly seen in anticoagulated or previously radiated patients. There were no reported complications from TCAL.

Stokes et al. [4] published a 13-study systematic review and meta-analysis including 5748 cases and 332 bleeding events (5.8%). Prior radiation therapy was a risk factor for major bleeding with a relative risk of 2.59 (95% CI 1.27–5.26). Four studies including a total of 1494 patients (296 TCAL) assessed the impact of TCAL on TORS bleeding. The overall bleeding rate with and without TCAL was similar. However, there was decreased major bleeding with TCAL (1.4% vs. 3.6%). This difference approached statistical significance with a relative risk of 0.40 (95% CI=0.15–1.07). Notably, only two of the reported 24 major bleeds were in TCAL patients. There was only one report of the use of embolization after TCAL, with no reported emergent tracheotomies, cardiac arrests, or death. The only reported complication from TCAL was first bite syndrome (6%).

Finally, in addition to retrospective studies, the prospective, phase II randomized clinical trial ECOG-ACRIN Cancer Research Group 3311 (E3311) [5] also highlights the benefit of TCAL. In this North American study that started accrual in December 2013, 68 credentialed surgeons performed 495 transoral surgery operations with only one grade V oropharyngeal bleed (0.2%) in a patient who did not undergo TCAL. In January 2016, TCAL was mandated via a protocol amendment and no further grade V events were seen.

TCAL should be performed at the time of the TORS primary resection during concurrent neck dissection. If neck dissection is to be performed separately, ideally neck dissection and TCAL precede the TORS resection. If TORS is used for identification of the unknown primary site (tongue base mucosectomy), it is reasonable to omit TCAL given the more superficial nature of resection and lower overall rates of bleeding and lack of major bleeding [2]. Given the significant increased risk of hemorrhage in previously radiated patients [2–4], TCAL (or oropharyngeal defect flap reconstruction) should be performed even if neck dissection is not planned.

The two general approaches to TCAL are ligation of selective ECA branches (often lingual and facial) or total ligation of the ECA. Preoperative review of imaging is critical to determine the proximity of the resection bed to the ECA and its branches and may influence surgeon selection of vessel(s) to be ligated. For a tonsil primary, the facial artery and sometimes lingual artery are typically high-risk vessels. For a tongue base primary, the lingual artery (particularly the dorsal lingual) is the high-risk vessel. If performing total ligation of the ECA, the vessel should be ligated at an adequate distance from the carotid bulb. Proponents of individual ECA branch ligation cite the risk of retrograde flow. In addition, delayed endovascular embolization is not possible with total ECA ligation. E3311 allowed ligation of either lingual or facial arteries or the total ECA and recommended

that surgeons ligate the arteries [5]; we recommend double ligation of the arteries with 2–0 or 3–0 silk sutures and not dividing the vessel. Kubik et al. found no difference in rates of postoperative bleeding between the two approaches; however, they did report that the only major bleed in a TCAL patient occurred in a patient who received total ECA ligation that had severe postoperative hemorrhage from a lingual artery pseudoaneurysm [2].

3 | Best Practice

Given the significant potential benefit with limited risk of complications, TCAL should be performed concurrently with TORS to decrease the risk of severe postoperative bleeding. Future studies should examine the optimal TCAL approach (selective ECA branches vs. total ligation of the ECA).

Conflicts of Interest

The authors declare no conflicts of interest.

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