Complications of Transoral Robotic Surgery

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KEYWORDS

• TORS • Transoral robotic surgery • TORS complications

KEY POINTS

- Transoral robotic surgery (TORS) is associated with several important complications, including postoperative hemorrhage, dysphagia, and injury to surrounding structures, including nerves and mucosal surfaces.
- It is imperative that surgeons anticipate and recognize complications, and identify patients who may be at higher risk.
- Appropriate preoperative planning, and intraoperative risk mitigation strategies should be employed to ensure patient safety and to prevent unintended complications.

INTRODUCTION/BACKGROUND

Minimally invasive transoral robotic surgery (TORS) has modernized the approach to multiple head and neck disorders, including difficult-to-access oropharyngeal tumors. It has allowed surgeons to offer less morbid approaches, while also capitalizing on a technology that offers improved visualization, enhanced articular movement, and faster recovery. However, as with any new technology, there are inherent risks and complications. Many of these have become more apparent as TORS use becomes widespread. In some cases, complications related to severe bleeding can be catastrophic whereas others, such as tongue and lip injury, are minor. It is prudent to understand what complications can occur with TORS, and how to anticipate and manage them. This article summarizes major and minor complications, including discussion of prevention and management.

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DISCUSSION

Postoperative Hemorrhage

Postoperative hemorrhage is the most common complication following TORS.[1,2] It may occur because of major bleeding from named arterial branches, premature scar sloughing, mucosal tears, or trauma to the surgical bed. Postoperative hemorrhage can range in severity from mild blood spotting in oral secretions to severe bleeding that, in some cases, may result in life-threatening cardiopulmonary compromise or even death. Regardless of severity, it is a feared complication that may be difficult to manage because of the location of bleeding, provider expertise, and provider comfort.

As the volume of TORS cases increase and indications for surgery continue to evolve, surgeons have been better able to understand complication rates as they pertain to postoperative bleeding. A classification system to characterize the severity of postoperative hemorrhage was developed by investigators from the Mayo Clinic in 2013 and has helped frame discussion around the subject.[3] Notably, this includes descriptors characterizing amount of bleeding and management required. Although this has not been universally adopted, it may help frame future discussion and assist with academic research nomenclature.

Overall, postoperative hemorrhage after TORS has been reported as between 1.5% and 18.5%.[1,3–13] By comparison, posttonsillectomy hemorrhage among adult tonsillectomy patients is estimated to be 4.8% nationally.[14] Many of the cited studies are single-institution based, making it difficult to assess national trends. Zenga and colleagues[16] used state-wide databases to query more than 500 TORS cases across multiple states and found that 8% of patients experienced postoperative hemorrhage. Patients typically present with bleeding between 6 and 14 days postoperatively, with most (up to 83.6%) bleeding episodes occurring within 2 weeks of surgery.[3,15,16]

Major or severe bleeding is rare and is reported to occur in between 1.7% and 16.5% of cases.[3,13,15,17] In their retrospective cohort of 906 patients, Pollei and colleagues[3] report major postoperative hemorrhage in 5.4% of cases, and severe postoperative hemorrhage in 1.8% of cases. Kubik and colleagues[15] report a major hemorrhage rate of 2.2% and severe hemorrhage rate of 3.7%. Hay and colleagues[13] report a major rate of 3.3% and severe rate of 1.6%.

Post-TORS fatality is extremely rare, with reported incidence of 0.3% to 0.7%[1,18]; however, when it does occur, it is frequently attributed to severe postoperative hemorrhage.[5] Of the 7 post-TORS deaths reported in a survey study of TORS providers, 4 were attributable to severe postoperative hemorrhage.[1]

Recent studies have attempted to identify risk factors associated with postoperative hemorrhage. In a single-institutional study by Kubik and colleagues,[15] history of radiotherapy, TORS for known primary tumor (vs unknown primary work-up), and lack of transcervical arterial ligation were significantly associated with increased risk of major/severe hemorrhage. Additional risk factors may include recurrent tumors, tumor location (eg, tonsil), comorbidities, and anticoagulation therapy.[1,3,8,17]

Variability in postoperative hemorrhage rate may be associated with surgeon volume. According to a 2013 survey study of 2015 procedures reported by 45 TORS-trained surgeons, there may be a trend toward increased risk of bleeding with fewer TORS cases performed; however, this was not statistically significant.[1] Similar findings have been reported by other groups.[19] In general, overall complication rates are lower among higher-volume surgeons (>50 cases).[1] Comprehensive understanding of anatomy relevant to TORS surgery has been touted as an educational necessity for safe and effective TORS procedures.

Achievement of adequate hemostasis in the operating room is paramount to the prevention of TORS hemorrhage. Although cautery is used in nearly all TORS procedures, it is important to identify and ligate large vessels. Ligation can be accomplished with the use of hemoclips, which have been shown to be effective and safe for vessels greater than 0.5 to 1 mm in diameter.[20]

Prophylactic transcervical arterial ligation has been shown in multiple studies to significantly mitigate severity of postoperative hemorrhage. A meta-analysis of 619 patients showed a significant risk reduction of major and severe bleeding events, although overall bleeding rate was unchanged.[21] This finding is consistent with other single-intuitional data.[15] There is currently no consensus for utility or timing of transcervical arterial ligation during TORS; however, multiple investigators advocate its use. In patients who do not undergo concurrent neck dissection, prophylactic tracheostomy for airway protection may be considered.

In most cases, patients require operative examination for control of bleeding. Prior single and multi-institutional data report operating room take-back rates as high as 71%, regardless of severity.[15] Control of postoperative hemorrhage typically does not require use of the robot. Prior studies have shown adequate control with conventional suction monopolar cautery.[6] At a minimum, most investigators advocate observing patients with sentinel bleeding for at least 1 night.[19] In the case of severe bleeding, transcervical ligation of vessels in the operating room, emergent tracheostomy, or endovascular control of bleeding may be required. However, most postoperative bleeding is managed in the operating room via a transoral approach.[1]

Dysphagia

Dysphagia is the most common functional priority of patients with oropharyngeal cancer, both during and after treatment.[22] Compared with other toxicities of treatment, dysphagia is the most strongly correlated with overall quality-of-life scores, even if it is mild.[23] A survey of 1729 oropharyngeal cancer survivors found that 15.5% showed moderate to high decisional regret with respect to their cancer treatment, and difficulty swallowing was one of the strongest drivers of decisional regret.[24] Furthermore, patient-reported dysphagia has been shown to be associated with increased risk of aspiration pneumonia.[25] Nearly all TORS patients self-report some degree of dysphagia; however, among early-stage patients, approximately 92% start oral intake by hospital discharge and 98% by 1 month postoperatively.[26] When diet outcomes are assessed over time using the Performance Status Scale, Leonhardt and colleagues[27] showed that diet scores decreased from a mean of 96.05 pretreatment to 74.44 ($P<.001$) at 6 months but then returned to baseline at around 12 months.

Another objective metric for measuring the degree of functional dysphagia is gastrostomy tube rates. Among patients with oropharyngeal cancer who are treated with nonsurgical modalities, about 62% received gastrostomy tubes.[28] Regarding prolonged gastrostomy tube dependence, 22.8% were still dependent at 6 months and 8.9% at 12 months.[28] With regard to TORs patients, 3% to 39% of all patients had a perioperative feeding tube placed; however, 0% to 9.5% of patients had chronic gastrostomy tube dependence.[1,27,29–34] However, it is hard to compare these 2 groups directly, because TORS studies tend to have a smaller proportion of patients with advanced-stage disease compared with primary chemoradiation patients. Moreover, a significant proportion of TORS patients also receive adjuvant therapy.

Several studies sought to compare functional outcomes after primary TORS compared with primary radiation therapy. Hutcheson and colleagues[35] reviewed 257 patients with oropharyngeal cancer treated with either TORS or radiation therapy and showed that 22.7% had moderate to severe dysphagia (Dynamic Imaging Grade

of Swallowing Toxicity grade ≥2) postoperatively, but this decreased to 6.7% at 3 to 6 months posttreatment. The degree of persistent moderate to severe dysphagia was not significantly different from the radiotherapy group.[35] The ORATOR trial was the first randomized controlled trial that sought to compare radiotherapy with TORS resection and neck dissection, with the primary end point being swallowing-rated quality of life at 1 year.[36] The trial showed that the mean total MD Anderson Dysphagia Inventory (MDADI) scores at 1 year were 86.9 in the radiotherapy group compared with 80.1 in the TORS and neck dissection group ($P = .042$), but the difference did not meet the threshold for a clinical meaningful difference.[36]

Predictors of postoperative swallowing dysfunction include T stage, nodal stage, base of tongue location, and adjuvant therapy. Patients with T3 to T4 tumors, current smokers, and concurrent chemoradiation were more likely to have gastrostomy tube dependence.[28] In contrast, increasing nodal status was a predictor of poorer MDADI outcomes.[34]

NERVE INJURY

There is a low rate of nerve injury either from surgical technique or for paresis of the lingual nerve caused by pressure on the tongue from the mouth gag. A survey of 2015 procedures performed by 45 TORS-trained surgeons reported a 0.6% rate of inadvertent lingual nerve injury, 0.9% rate of temporary hypoglossal nerve injury, and 0.1% permanent hypoglossal nerve injury.[1]

MUCOSAL, CORNEAL, AND DENTAL INJURY

Although bleeding is the most common complication, additional complications may include injury to the teeth, lips, cornea, or adjacent mucosal surfaces around the site of surgery.[1] It is imperative that surgeons exercise caution when docking the robot and that their assistants monitor for unplanned collisions with surrounding structures. Few studies have cataloged these types of injury; however, some studies suggest they are rare events.[4] Early experiments designed to intentionally injure human cadavers with TORS misuse were largely reassuring and established early safety metrics for human TORS.[37] Regardless, multiple investigators advocate that adequate protection of the teeth, lips, and eyes is imperative. Cost-effective custom-molded dental guards using thermoplastic nasal splint material, and commercially available adhesive safety goggles, are among some of the recent innovations that have been introduced.[1,37,38]

MORTALITY

In the initial study of the safety of transoral lateral oropharyngectomy, Holsinger and colleagues[39] showed a 2.6% mortality in the immediate postoperative period. The mortality after TORS resections of oropharyngeal lesions has now been assessed with several national and institutional studies and noted to be low.[2] A review of 305 TORS patients treated nationally in the United States from 2010 to 2013 showed a 30-day postoperative mortality of 0.7%.[18] For deaths reported to the Food and Drug Administration, the mortality nationwide was approximately 0.3% from 2009 to 2015.[2] Aubry and colleagues[17] conducted an institutional study of 178 TORS patients treated from 2009 to 2014 and showed a 1.1% postoperative mortality.

SUMMARY

TORS is a valuable surgical tool that has permitted substantial innovation in the way clinicians evaluate and manage complex disorders in head and neck surgery.

However, with its increasingly widespread use, clinicians have also gained valuable insight into its inherent risk profile and associated complications. This article summarizes major and minor complications and discusses prevention and management therein. Continued investigation and discussion of postoperative complications is imperative as this novel surgical tool continues to be implemented in daily practice.

CLINICAL CARE POINTS

- The most common complication following TORS is postoperative hemorrhage, which is reported to occur with an incidence between 1.5% and 18.5%.
- Although dysphagia is a common functional complication, most patients are able to tolerate a regular diet and regain functional performance within 12 months after surgery.
- Overall, TORS is a safe procedure; however, mortality has been reported, usually caused by severe postoperative hemorrhage. Surgeons should exercise caution and anticipate potential complications by ensuring adequate knowledge of anatomy, considering transcervical artery ligation when indicated, and using safe surgical techniques

DISCLOSURE

The authors have nothing to disclose.

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