

Perioperative concerns in transoral robotic surgery: Initial experience of four cases

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Abstract

US Food and Drug Administration has recently approved transoral robotic surgery for the treatment of some benign tumors and selected malignant tumors of the head and neck. Robotically-assistance in ear, nose and throat surgery is established and will play an increasingly large role in the future of surgical practice. Anesthesiologists need to modify their management and familiarize themselves with the upcoming robotic procedures to ensure better patient outcomes and improve patient safety.

Key words: Da Vinci surgical system, head and neck cancer, TORS, transoral robotic surgery

Introduction

Engineering technology advancement and advances in medicine and surgery have dramatically changed medical practice. Surgical practice has recently revolutionized with the adoption of computer-assisted robots. Although robots have been around for many years, their use in medical field has increased profoundly only in the last few years.^[1] US Food and Drug Administration (FDA) recently approved transoral robotic surgery (TORS) for the treatment of some benign tumors and selected malignant tumors of the head and neck. Robotically assisted Ear Nose and Throat (ENT) surgery will play an increasingly large role in the future and there is a need to be aware of the implications of the use of robotic surgery in ENT. In this case series of four patients who underwent TORS, we discuss the perioperative concerns for TORS. To our knowledge, this is the first such case series done in India.

Case Reports

All patients described were scheduled for TORS underwent

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preanesthetic evaluation. Preoperative investigations included routine hemogram, liver function tests, kidney function tests, Chest X-ray and electrocardiogram (ECG). Patients were premedicated with ranitidine 150 mg and alprazolam 0.5 mg orally on the night before surgery and on the morning of surgery. Xylometazoline drops were placed in both the nostrils to prevent nasal bleed and glycopyrrolate 0.2 mg intramuscular was given half an hour before shifting them to the operating room (OR). General anesthesia with nasotracheal intubation was planned to facilitate surgical exposure. Fiberoptic bronchoscope was kept standby.

In the OR, routine monitors including ECG, pulse oximeter, noninvasive blood pressure, and capnograph were connected. Anesthesia was induced intravenously (IV) with fentanyl and propofol while neuromuscular (NM) blockade was achieved with IV vecuronium. Trachea was intubated using cuffed polyvinyl chloride (PVC) tube. All the patients were placed in supine position. The urinary bladder was catheterized as the duration surgery was expected to be long. Anesthesia was maintained with a mixture O₂:N₂O (50:50) and isoflurane, maintaining a minimum alveolar concentration (MAC) of 1.0–1.4. NM blockade was maintained with IV boluses of vecuronium, guided by NM monitor. Dexamethasone 8 mg IV was given to prevent airway edema. Paracetamol 1 g IV and ketorolac 30 mg intramuscular were given for intraoperative analgesia. Ondansetron 8 mg was given intravenously to prevent postoperative nausea and vomiting. After surgery, residual NM blockade was reversed and decision to extubate the trachea immediately or after a period of observation was taken depending upon operative course and possibility of airway edema. Patient was shifted to postoperative recovery

room for further monitoring and management. Postoperative analgesia was provided by IV morphine and IV paracetamol (for first 24 h).

Case 1

The patient was a 41-year-old man with a history of tobacco chewing for 2–3 years and diagnosed as carcinoma of the buccal mucosa. Airway evaluation showed a modified Mallampati score of 3. General/systemic examination and investigations were normal. Trachea was intubated with a 7-mm ID nasotracheal tube. Total duration of the surgery was 1 h and 20 min and blood loss was 150 ml. The surgical procedure was uneventful and trachea was extubated on table after reversing NM blockade.

Case 2

The patient was a 50-year-old woman with a history of betel-leaf chewing for 6-7 years duration and diagnosed as carcinoma of the tongue. Airway evaluation showed a modified Mallampati score of 2. Significant history of chest pain 2-3 episodes radiating to back was present. General and systemic examinations were normal, but ECG showed ST–T changes in leads 2, 3, and VI–V6. Echocardiography showed a hypokinetic basal wall with an ejection fraction of 60%. Trachea was intubated with a 6.5-mm ID nasotracheal tube. Total duration of the surgery was 2 h and blood loss was 150 ml. The surgical procedure was uneventful. NM blockade was reversed, but the trachea was not extubated on table after due to suspicion of airway edema and oxygen was given by T-piece for the next 24 h. The trachea was extubated uneventfully thereafter after evaluation of the airway.

Case 3

The patient was a 40-year-old man diagnosed as carcinoma of right tonsillo-lingual sulcus. The patient had received chemotherapy with cisplatin and five cycles of radiotherapy preoperatively. General and systemic examinations were normal. Airway evaluation showed a modified Mallampati score of 3. Preoperative investigations were within normal limits. Trachea was intubated with a 7-mm ID nasotracheal tube. Total duration of the surgery was 1 h and blood loss was 100 ml. The surgical procedure was uneventful and trachea was extubated on table after reversing NM blockade.

Case 4

The patient was a 47-year-old man diagnosed as carcinoma of right tonsillo-lingual sulcus. Airway evaluation showed a MMP score of 1. Patient had subtotal glossectomy and left modified neck dissection 3 years back and wide local excision and marginal mandibulectomy 1 year back. He was also a known hypertensive controlled on amlodipine 5 mg and atenolol 50 mg once a day. Other than history of

radiotherapy, no other significant abnormalities were detected preoperatively. Trachea was intubated with a 7-mm ID cuffed nasotracheal tube. Total duration of the surgery was 3 h and blood loss was around 300 ml. The surgical procedure was uneventful, but the patient was kept electively intubated and oxygen supplementation was given by T-piece for 24 h due to suspicion airway edema. Trachea was extubated after evaluation of the airway.

None of the patients had any postoperative complications. All patients were discharged on the 7th postoperative day.

Discussion

Robotic surgeries offer significant advantages over open surgical procedures. Telerobotic systems have a shorter learning curve, provide three dimensional view, and offer movements which are not possible in laparoscopy. TORS was first developed by Weinstein and O'Malley.^[2] During their early experimental study, using a da Vinci Surgical Robot (Intuitive Surgical, Sunnyvale, CA, USA), they found that TORS was most effective if performed through mouth gags. Further studies of patient safety ultimately led to the first application of TORS in human patients after approval of the US Food and Drug Administration (FDA).

FDA guidelines permit the use of da Vinci surgical system for all benign lesions of the oral cavity, larynx, and pharynx and all T1 and T2 malignancies but exclude all pediatric diseases and lesions that invade the mandible. Dental procedures are also excluded.^[3]

The advantages of TORS

- Allows the surgeon a true 3-dimensional endoscopic vision of the surgical field with accurate depth perception through the use of multiple endoscopes, cameras, and dual eye pieces.
- Enhancement of the limited visualization of the 2-dimensional endoscope and line-of-sight microscope which improves the quality of microsurgery.
- Allows multiple degrees of motion (flexion, extension, supination, pronation) and through robotic scaling converts large movements of the surgeon's hands into small movements of the robotic instruments.^[4,5]
- Filters hand tremors through frequency filters and it is resistant to fatigue.
- Minimally invasive surgery reduces blood loss and blood transfusion, reduces the risk of infection and complications.
- Less postoperative pain and shortened hospital stay.
- Permits surgery to be completed with smaller incision which improves the cosmetic outcome.

The drawbacks of TORS

- Reliance on visual perception rather than tactical stimulus for assessment of tumor resection.
- High cost of acquisition and maintenance of the robotic system compared to open surgery.
- Occupies large amount of space in the OR.
- Any movement can prove disastrous after the robot is docked into the patient.
- Needs to be performed widely to prove its safety and efficacy.

The surgical assistant stands at the head end of patient and assists with suction and retraction. The anesthesiologist and anesthesia machine are located at the patient's feet. The nurse and instrument carts are located on the side of the patient opposite the surgeon to minimize obstruction and maximize communication between surgeon, assistant, and anesthesiologist. Master surgeon's console is placed in one corner of the OR.

Nasotracheal intubation with a north-facing RAE tube is routinely done for airway stability and to provide more room for the surgeon to operate [Figure 1]. If postoperative ventilation is planned, patient tolerates the nasal tube better. In case of orotracheal intubation, the tube has to be sutured to the face. It is important to secure the endotracheal tube properly to prevent any kinking, obstruction or disconnection since the head end is far away and intraoperative airway access is limited. Intraoperatively vigilant capnography and airway pressures monitoring are important for early detection of endotracheal tube malfunctions.

Endotracheal tube selection is dependent on the type of TORS being performed. If tumor resection encroaches upon



Figure 1: The Da Vinci Surgical System is about to be docked into the patient's oral cavity. To prevent compression from mouth gag and to provide room for surgery, the patient is nasally intubated and the circuit is taken away from the surgical field

the larynx or pyriform sinus, a laser endotracheal tube is used, otherwise a wire-reinforced or PVC endotracheal tube can be used. If there is concern of significant development of laryngopharyngeal edema and airway compromise, the reinforced tube should be exchanged to a PVC tube.

If the case involves the use of an operating laser, then standard patient safety measures should be implemented (covering the head and neck with moistened towels, taping and covering the patient's eyes, eye protection for OR personnel, laser endotracheal tube, and so forth). IV access should be secured properly and IV extension tubing can be attached to bring the drug infusion port close to the anesthesiologist. If major blood loss is expected intraoperatively, additional IV lines can be easily accessed in one of the lower limbs.

The da Vinci Surgical Robot consists of a master surgeon's console, a surgical cart, and a robotic patient side-cart. The robotic patient-side cart has three robotic arms — two laterally placed arms, which hold instruments, and a centrally placed arm for the endoscopic camera.^[6] The robotic patient side cart is brought into position at a 30° angle to the OR table. This configuration permits introduction of the three robotic arms through the mouth and into the patient's upper airway. Patient's eyes are protected using plastic safety goggles and the teeth are protected with a moulded dental guard.

The operating surgeon then places a mouth gag or retractor in the patient to gain surgical exposure. Sterile draped robotic arms are placed into surgical position [Figure 2] The stem (the connecting part which supports the table to the ground) of the operating table is often positioned toward the head-end of the table. TORS requires docking of robot as close as possible to the patient's head to aid in surgical resection. The foot (the ground part) of the robot will be blocked by the stem of operating Table if positioned in the usual way.



Figure 2: Trans-oral robotic surgery in progress

This is avoided by inducing anesthesia with patient placed 180° rotated position or the table/the patient has to be either rotated 180° after induction of anesthesia. These practical points should be considered while inducing the patient for TORS. Caution should be exercised while inducing obese patients in this position since the weight bearing area of the operating table is now shifted to the opposite side.

Once the robot is docked into the final position, movement of the patient should be avoided by maintaining adequate plane of anesthesia and muscle relaxation. The OR personnel should be trained to rapidly detach the robotic system in case of emergency.

To minimize sympathetic stimulation we employed beta blockers and fentanyl in all cases. After the surgery was completed, the Valsalva maneuver is performed to confirm a bloodless surgical field. A final assessment of the airway is made by the surgical team and following that the robotic arms, dental guard, and mouth gag or retractor are removed from the patient. If there is significant laryngopharyngeal edema or there is concern that airway compromise might develop, the trachea is not extubated until resolution of the edema. We could not extubate the trachea in two of our patients due to the suspicion of airway edema.

The FDA approval of TORS may further allow for other clinical applications of robotic surgery in the head and neck. TORS use in sleep surgery,^[6] skull base surgery,^[7-9] pediatric airway surgery,^[10] and free-flap reconstruction^[11,12] has been reported. Recent studies have also suggested that robot-assisted thyroid surgery may be an alternative treatment option to traditional open thyroid surgery in the near future.^[13,14]

TORS benefits the patient, operating surgeon, and anesthesiologist and improves the overall outcome. Advantages to the surgeon include improved surgical precision, better visualization, and easier instrument control. When compared with standard open surgical approaches, TORS offers significant potential benefits to patients. TORS use may avoid a disfiguring mandibulotomy, tracheostomy, and minimize or possibly eliminates the need for chemoradiation therapy. Decreased blood loss, risk of wound infection, and postoperative pain facilitates for a shorter recovery time with a quicker return to preoperative speech, swallowing, and quality of life.

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