

### Anesthesia for tracheal resection and anastomosis: What is new!

The perioperative management of tracheal lesions is challenging. Tracheal surgeries are required in congenital anomalies, traumatic tracheal injuries (e.g., post-intubation), tracheomalacia, vascular anomalies, and tracheal tumors. The management modalities include segmental resection with primary anastomosis in roughly 80% of patients when the tracheal tumors are operable.<sup>[1,2]</sup> However, other patients may undergo segmental resection with prosthetic reconstruction or placement of T-tube stent depending upon the pathological cause. The conventional surgical approach of tracheal lesions is being reconsidered given newer modalities of endoscopic interventions. The newer bronchoscopic approaches for tracheal lesions have not only provided an alternative to surgical interventions but also, wherein surgical resection was not feasible is being managed by bronchoscopic interventions. Also, these bronchoscopic interventions may be suitable for high-risk populations due to associated comorbidities. This has enabled the management strategy from a surgical approach to a minimally invasive endoscopic approach to improve the patient's overall quality of life by alleviating symptoms. The other newer advancement relates to the use of high-flow oxygen and the availability of equipment for its delivery. These have renewed the ventilatory strategies for maintaining oxygenation during the endoscopic interventions. The use of THRIVE and high flow oxygen delivery devices has improved patient safety by providing the extended duration of apnea for bronchoscopic interventions.<sup>[3,4]</sup>

This issue of the journal publishes a review article wherein the authors have extensively elaborated upon the perioperative management of patients posted for tracheal resection and anastomosis.<sup>[5]</sup> Such surgeries are indeed challenging for surgeons as well as anesthesiologists. As anesthesiologists, channelizing the strategy and anticipating/preparing for possible complications is a must. Meticulous assessment and diligent planning for management should commence right from the preoperative period. Certain aspects of perioperative management need special mention for anesthesiologists:

- All the relevant imaging should be reviewed beforehand and the severity of mass effect and/or the involvement of mediastinal structures should be assessed. Virtual scanning with 3D reconstruction imaging is the newer
- upcoming modality for better visualization and real-time assessment of the airway.
- The presence of a surgical team during induction for managing the surgical airway, in case if the need arises, is of utmost importance. As a limitation, access to the surgical airway is feasible for anesthesiologists only in case of upper tracheal lesions, where cricothyroidotomy through the front of neck access could be proficiently performed. Therefore, in the case of management of distal tracheal lesions, the availability of surgeon expertise as a backup plan for emergent scenarios is a must.
- Rigid bronchoscopy (RB) should be readily available for ventilation distal to tumor compression to manage a life-threatening airway compromise.
- Incision congruent thoracic epidural could be a prudent choice as an adjunct to anesthesia and analgesia.
- Administering sedatives and paralyzing agents after ensuring adequate glottic view is a discreet course of action. However, potential tracheal compression beyond the vocal cords upon further advancement of endotracheal tubes must be anticipated.
- Elective mechanical ventilation may be mandated in case of neuronal involvement of tracheal tumors, e.g., phrenic or recurrent laryngeal nerve. Therefore, close communication between surgeons and anesthesiologists is important.
- Early extubation is extremely advisable as far as possible. Postoperative care must include instructions for the propped-up position, mild-to-moderate neck flexion, and routine use of steroids to combat airway inflammation and edema. Cervical splints or a thick chin to sternum suture may be a reasonably helpful aid to ensure adequate flexion. If at all, reintubation is required, it should preferably be done under the guidance of fiber-optic bronchoscopy to ensure optimal placement of an endotracheal tube in the anticipated edematous airway and prevent suture dehiscence.
- Regarding the induction techniques, few more alternatives may be explored, depending upon the patient profile, equipment availability, etiology of the disease, and location of the tracheal lesion. The techniques include:
  - (a) Non-intubation tracheal resection: This technique is being increasingly utilized along with a variety of methods for sedation and general anesthesia, maintaining spontaneous ventilation. Supplemental oxygenation is vital to the prevention of hypoxemia. High flow nasal oxygenation (HFNO) is a widely accepted

modality in this regard. Another upcoming modality with spontaneous respiration using intravenous anesthesia and HFNO, i.e., STRIVE-Hi, is evolving for maintenance of oxygenation and patent airway during tracheal interventions. Other key components of the technique include the use of total intravenous anesthesia (TIVA) using propofol/dexmedetomidine/fentanyl/ketamine as per the discretion of the concerned anesthesiologist or inhalational based anesthesia with the placement of supraglottic airway devices. Nevertheless, drugs and equipment for endotracheal intubation and controlled mechanical ventilation should also be prepared and performed in case of desaturation ( $SpO_2 < 90\%$ ) and persistent hypercapnia ( $paCO_2 > 60\text{mmHg}$ ). Intraoperative management includes permissive hypercapnia, a high index of vigilance for peripheral oxygen saturation ( $SpO_2$ ) measured through pulse oximetry, and other hemodynamic parameters. This non-intubation technique has especially been found to provide promising results in patients with upper tracheal lesions, being approached through the transcervical surgical method. The advantages of the technique include minimal risk for airway-related trauma, overcoming the possibility of residual neuromuscular paralysis, better overall postoperative recovery profile, and reduced length of the hospital of stay. Contraindications to the technique include uncompensated cardiovascular co-morbidities, American Society of Anesthesiologists (ASA) physical status III or more, central or peripheral neuronal diseases, uncontrolled reactive airway diseases, impaired pulmonary functions with  $FEV1 < 60\%$ , severe pleural effusion, and hemodynamic instabilities.

- (b) Extracorporeal Membrane Oxygenation (ECMO): This technique is being highly encouraged nowadays in patients where specific anatomic derangements or patient-related comorbidities impair adequate oxygenation and ventilation. Other emergent indications include critical airway obstruction or failure of conventional oxygenation/ventilation techniques. Whenever indicated, placement of ECMO catheters before induction of anesthesia is a judicious alternative. It is prudent to anticipate and place the catheters well in advance for an emergent situation in high-risk patients. A veno-venal cannula placed with a single double-lumen catheter (right internal jugular) or two cannulae (usually femoral and jugular) is a

feasible approach. Another modality includes veno-arterial ECMO which can be executed through peripheral cannulation (femoral) or central cannulation (right atrium and descending thoracic aorta). As a drawback, these modalities remain invasive, and the set-up may not be available in all the places as the majority of cases for tracheal interventions are performed in non-cardiac operation rooms (ORs).

- (c) Another technique for induction and securing the airway is to commence the case with RB followed by tracheal dilatation and negotiating the endotracheal tube through it. Further steps for cross-field ventilation have been aptly mentioned in the literature.

Future directions: During the intervention for distal tracheal lesions, while the anastomosis is being performed, two lungs could be separately ventilated; one with the conventional technique of connecting a sterile breathing circuit attached to the anesthesia workstation and the other one through transnasal humidified rapid-insufflation ventilatory exchange (THRIVE). However, further research regarding the utility of THRIVE during tracheal reconstruction and anastomotic surgeries could turn out to be a valuable perspective. Apneic oxygenation techniques during tracheal reconstruction surgeries could be studied for their assets and liabilities.<sup>[6,7]</sup>

In conclusion, anesthesia for tracheal resection and anastomosis surgeries requires utmost coordination and vigilance on the part of surgeons and anesthesiologists. Pragmatic anticipation and skillful management of untoward complications are of paramount importance.

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