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Case Report

Unique Use of Transnasal Humidified Rapid Insufflation Ventilatory Exchange in Laryngeal Surgery to Avert Tracheostomy

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Abstract

Anesthesia for airway surgeries pose a higher risk of airway complications and need special skills and techniques due to shared airway. Transnasal Humidified Rapid Insufflation Ventilatory Exchange (THRIVE) has unique applications for apneic anesthesia in laryngeal procedures. We describe two cases of laryngeal mass biopsy with a very narrow glottis and subglottic, which would have required tracheostomy perioperatively. They were done successfully under apneic anesthesia using THRIVE which provided safe apnea of 13–15 min, a tubeless field and avoided invasive tracheostomy contributing to enhanced patient recovery.

Key words: Trans nasal humidified rapid insufflation ventilatory exchange, Apnoeic anaesthesia, Tracheostomy, Laryngeal surgeries

INTRODUCTION

Transnasal Humidified Rapid Insufflation Ventilatory Exchange (THRIVE) is a technique that allows delivery of up to 70 l of oxygen/min at 37°C, with absolute humidity of 44 mg H_2O/L and an FiO_2 up to one.[1] It helps to achieve apneic oxygenation, washes out pharyngeal dead space, minimizes work of breathing, provides positive end-expiratory pressure up to 7 cm H_2O, resulting in prolonged safe apneic time.[1] Successful use of THRIVE for laryngeal surgeries has been reported.[2-4]

CASES

First patient was a 55-year-old male, chronic tobacco chewer, with no known comorbidities, presented with hoarseness and change in voice, gradual dysphagia, and rapid loss of weight over 1 month with no dyspnea or stridor. Airway assessment showed a mouth opening three finger breadths, Mallampati Class I with no restriction of neck movements. On 70° scopy, growth was extending from the right side of epiglottis to false vocal cords, true vocal cords, and right arytenoids with a very small glottis [Figure 1a]. Computed tomography (CT) of neck showed glottic and subglottic mass with narrowed tracheal lumen.

Second patient was 69-year-old male, a chronic tobacco chewer, controlled hypertensive, presented with hoarseness of voice and dysphagia. Upper airway assessment was normal. On 70° scopy, bilateral swollen arytenoid with a growth in the pyriform fossa and vocal cords was visualized [Figure 1b]. CT of neck showed a soft-tissue lesion involving left aryepiglottic fold and causing obliteration of the left vallecula and left pyriform sinus involving supraglottic larynx.

Both the patients were posted for direct rigid laryngoscopy guided biopsy. They were very difficult intubation due to growth involving glottis and narrowed trachea. Hence, tracheostomy was considered as the first option; however, the patients were reluctant for tracheostomy as first choice, however, consented for emergency tracheostomy if need

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arises. After a multidisciplinary discussion between the surgery and the anesthesia team, it was decided to avoid elective tracheostomy and small endotracheal tube (ETT) intubation in view of risk of tumor seeding, complications of very small ETT, and difficult extubation. Hence, the Plan A was to use apneic anesthesia using THRIVE keeping Plan B preparation for intubation with microlaryngeal ETT of small size (4 mm), tracheostomy, and Jet ventilation apparatus absolutely ready. Standard ASA monitoring and balanced anesthesia technique was used. THRIVE was attached to the patient with initial flows of 20 l/min. After titrated intravenous (iv) induction, mask ventilation was confirmed and succinylcholine was administered. THRIVE flows were increased to 70 L/min. The patient was maintained on intermittent doses of iv propofol and succinylcholine with continuous monitoring of heart rate, electrocardiogram, oxygen saturation (SPO_2), and arterial blood gases (ABG). In the absence of a cuffed ETT, the risk of aspiration of blood and laryngeal contents was prevented by supine positioning with a 15-° head low tilt, frequent suctioning of airway secretions, and blood and meticulous hemostasis with adrenaline-soaked gauze pads. Procedure was done under apneic anesthesia with THRIVE for 15 and 13 min in patient 1 and 2, respectively [Figure 2]. The ABG at 10 min and immediate post apnea showed a $PaCo_2$ of 52–55 mmHg, rest ABG parameters being normal. Throughout the procedure, hemodynamic parameters were within normal limits with SPO_2 100%. At the end of procedure after confirming optimum hemostasis, mask ventilation was resumed till

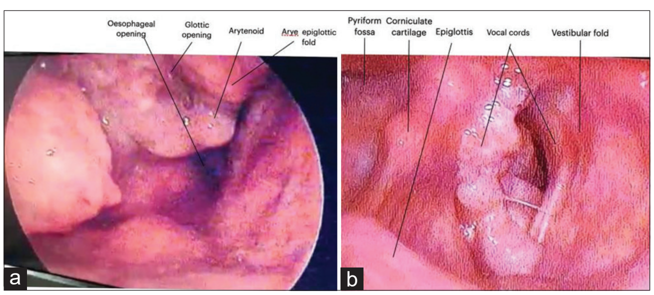

Figure 1: (a and b) Glottis view of two different patients by 70° scopy

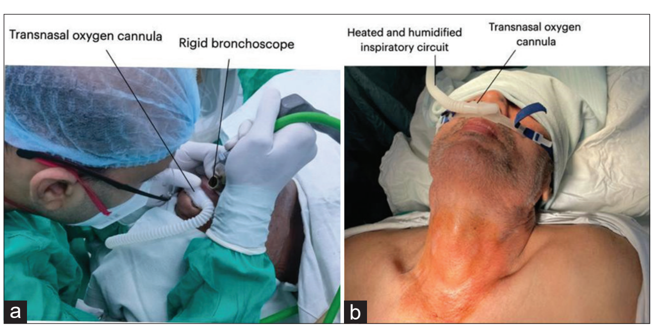

Figure 2: (a) Surgeon performing rigid bronchoscopy with THRIVE *in situ* (b) patient positioned for surgery with neck prepared for emergency tracheotomy

resumption of adequate spontaneous respiration and the $EtCO_2$ noted on capnography at beginning of mask ventilation was 50–52 which came to normal range within 2 min with normal ABG parameters. Both the patients had very smooth emergence with adequate spontaneous breathing and were shifted to post anesthesia care unit for observation for 2 h and then shifted to ward.

DISCUSSION

THRIVE consists of air-oxygen gas blender or a high flow venturi system which provides delivery of FiO_2 between 0.2 and 1, humidifying and heating system with sterile water reservoir which provides warm and humidified oxygen, heat insulated non-condensing circuit and an operating interface with wide-bore nasal prongs. During apneic oxygenation, alveolar oxygen uptake occurs due to concentration gradient of oxygen between alveoli and pulmonary capillaries. The oxygen extraction rate on an average in apneic adult is 250 ml/min and 10 ml/min of CO_2 diffused back into alveoli. The sub atmospheric pressure in alveoli causes flow of gas to alveoli allowing maintenance of oxygen saturation during prolonged periods of apnea (up to 65 min) without desaturation.[2] The high flows (20–70 L/min) in THRIVE and cardiogenic oscillations improve the clearance of CO_2 0.15 kPa/min.[3] Patel *et al*. showed safe apnea time of 14 min without arterial desaturation and the rate of increase in end-tidal carbon dioxide was 0.15 kPa.min.[3] In our both the patients, THRIVE enabled the procedure smoothly by providing a safe apnea time of 15 and 13 min, respectively, with permissible increase in $PaCo_2$ levels with normal hemodynamic parameters and SPO_2. A review of THRIVE for laryngeal surgeries by Lucy Huang *et al*. showed a mean apnea time between 13 and 27 min and To K *et al*. found a median safe apnea time of 18 min without significant complications.[4,5] THRIVE avoids the need for intubation in airway surgeries and associated complications of small ETT and post extubation airway edema and stridor.[6] Many authors have mentioned about the effectiveness of THRIVE for perioperative use.[7-9] It also eliminates the risk of detachment of parts of laryngeal mass during intubation and its seeding and provides a tubeless surgical field in a shared airway. In our patients, tracheostomy and its immediate and long-term complications could be averted, and short laryngeal procedure was conducted safely using THRIVE contributing to enhanced patient recovery. However, it is essential to have point of care ABG monitoring and needs a meticulous planning, correct patient selection, team approach, and vigilance. Large studies are warranted for generalized use of THRIVE in laryngeal procedures. Thus, to conclude, THRIVE enabled the short laryngeal procedures by providing a safe apnea time of 13–15 min with permissible increase in

$PaCO_2$ levels, no desaturation with normal hemodynamic parameters and smooth emergence. It also avoided the invasive tracheostomy with enhanced patient recovery. THRIVE has unique applications for optimum outcome and quality care anesthesia in shared airway surgeries.

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