

## Clinical utility of trans-nasal humidified rapid insufflation ventilatory exchange (THRIVE) during awake craniotomy

Sir,

Awake craniotomy (AC) is indicated for neurosurgical pathologies involving eloquent cortex. Airway management during AC is performed electively for an asleep-awake-asleep technique or for emergency (airway obstruction, desaturation, hypercapnia, brain swelling or seizure).<sup>[1]</sup> Trans-nasal Humidified Rapid Insufflation Ventilatory Exchange (THRIVE) is an oxygenation technique that provides heated and humidified oxygen using high-flow nasal cannula. We report utility of THRIVE technique in preventing adverse airway events during AC.

Our first patient was 50-year-old lady with insular lesion close to motor and speech areas and ipsilateral cortico-spinal tract. Considering potential risk of damage to these eloquent areas during surgery, AC was planned. Preoperative airway, neurological, cardio-respiratory and laboratory parameters were unremarkable. After attaching monitors (electrocardiogram, non-invasive blood pressure, pulse-oximeter, and end-tidal carbon-dioxide [ETCO<sub>2</sub>]), dexmedetomidine infusion was started at 1 µg/kg/h. Dose was titrated between 0.25-1 µg/kg/h to achieve modified Observer's Assessment of Alertness/Sedation Scale (OAASS) between 5 (responds readily to words spoken in normal tone) during awake period and 2 (responds only after mild prodding or shaking) during asleep phase of surgery. THRIVE was used to provide 10-30 L/min of humidified 100% oxygen during 4.5 h of surgery. [Figure 1] At OAASS = 2, scalp block with bupivacaine was performed and neuromonitoring electrodes, and urinary and arterial catheters were placed. After craniotomy, speech and motor areas were identified and tumor resection was performed under continuous motor evoked potential (MEP) monitoring. Intraoperative seizure was observed during MEP stimulation which was terminated with midazolam 2 mg and cold saline flooding at surgical site. Although patient was drowsy (OAASS = 0) and apnoeic transiently, oxygen saturation remained ≥98%. Rest of the surgery was uneventful.

The second patient was a 57-year-old male who presented with headache, right-sided weakness and slurring of



**Figure 1:** Application of THRIVE to the patient during awake craniotomy

speech due to a left frontal lesion. He was diagnosed to be at high-risk (6/8) of obstructive sleep apnea (OSA) on STOPBANG score {body mass index (BMI)- 35.2 kg/m<sup>2</sup>, neck circumference- 43 cm, snoring and hypertension}. In view of neurological symptoms and lesion close to speech and motor areas, AC was considered. To mitigate potential airway compromise, desaturation and need for emergent airway during sedation for surgery, oxygen was administered at 30 L/min using THRIVE. Emergency airway cart was kept ready. After attaching similar monitors as in first case, sedation was provided with dexmedetomidine 0.2-1 µg/kg/h depending on stage of surgery. Scalp block was used for analgesia and motor, speech and subcortical assessment was performed during 3.5 h surgery, which was uneventful.

Intraoperative seizures during AC require immediate administration of benzodiazepines or anaesthetics which can compromise oxygenation and ventilation. Similarly, patients with OSA are vulnerable to respiratory complications during asleep-phase of AC. Adverse respiratory events during AC can result in brain bulge, increased bleeding, seizures, prolonged surgery, and adverse outcome. It also necessitates emergent airway management under challenging circumstances during surgery. Use of THRIVE preempts potential airway and respiratory harms such as apnoea, desaturation, airway obstruction, and hypercarbia and contributes to patient safety in these situations.

THRIVE is used in anaesthesia practice during management of difficult airway.<sup>[2]</sup> THRIVE provides upto 70 L/min of oxygen and is well tolerated because of humidification. It improves oxygenation and provides continuous positive airway pressure effect<sup>[3]</sup> which overcomes airway obstruction and increases safety

margin during sedation. Similarly, CO<sub>2</sub> accumulation can occur during AC when breathing spontaneously under the drapes due to rebreathing with low gas-flows or from excessive sedation. This can lead to hypertension and tense brain, complicates surgery and invites additional interventions. THRIVE enhances CO<sub>2</sub> clearance during apnoea by flow-dependent, non-rhythmic ventilatory exchange, hence, may be beneficial in this setting including in obese patients.<sup>[2]</sup> Seizure or surgical manipulation during AC can also cause apnoea.<sup>[4]</sup> THRIVE prevented airway obstruction and desaturation in our patients during seizure and sedation which is not possible with simple nasal or facemask oxygenation. During emergency, THRIVE would provide safety window by prolonging apnoea time before airway could be secured.<sup>[5]</sup> During spontaneous breathing, CO<sub>2</sub> accumulation is significantly less than during apnoea.<sup>[6]</sup> Both our spontaneously breathing patients did not demonstrate hypercarbia on arterial blood gas analysis performed during surgery. While advantages of THRIVE are several (simple, portable, patient and user friendliness, respiratory benefits), its disadvantages (increased oxygen consumption, inaccurate ETCO<sub>2</sub> values during high flows) should be noted.

To conclude, THRIVE is a useful technique to prevent adverse respiratory events and consequent emergent airway management during AC.

### **Balaji Vaithialingam, Kamath Sriganesh**

Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India

#### **Address for correspondence:**

Dr. Kamath Sriganesh,  
Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India.

E-mail: drsri23@gmail.com

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