Prolonged apneic oxygenation and ventilation with Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE) during high risk airway management scenarios: a case series.

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Introduction

• High flow nasal cannulae (HFNC) provide rapid insufflation of a heated, humidified, titratable oxygen-air mixture.
• With recommended flow rates of 2-5 L/kg/min (up to 70 L/min), HFNC results in continuous positive airway pressure of up to 6 cmH2O.
• Transnasal humidified rapid–insufflation ventilatory exchange (THRIVE) refers to apneic oxygenation and ventilation achieved with HFNC as a result of differences in CO2 excretion and O2 absorption, gaseous mixing, and flushing of deadspace.
• Previous studies have shown that THRIVE prolongs time to oxygen desaturation in apneic adults and children. Its effect on CO2 clearance has been less consistent.

Cases

Case 1: 3 year old former premature infant with laryngotracheal stenosis status post reconstruction presenting for direct laryngoscopy and bronchoscopy. HFNC was placed and the patient was deeply anesthetized with propofol boluses. ETCO2 measured via mask ventilation prior to emergence after successful procedure.

Case 2: 14 month old with dwarfism and Pierre Robin Sequence presenting for mandibular osteotomies and distraction. Following induction with sevoflurane and rocuronium, THRIVE was initiated. Despite multiple unsuccessful fiberoptic intubation attempts, SpO2 remained 100% before slowly dropping to 76% at 14 minutes. Mask ventilation was used to rescue, with ETCO2 measured at that time. The patient was eventually successfully intubated with a fiberoptic bronchoscope through a supraglottic airway.

Case 3: 16 year old with an anterior mediastinal mass presenting for biopsy. HFNC was placed and general anesthesia induced and maintained with fentanyl and propofol. ETCO2 measured with mask ventilation prior to cessation of propofol infusion after successful procedure.

Case 4: 15 year old with scleroderma, ankylosis of the mandible with a 1.5cm mouth opening, and interstitial lung disease presenting for laparoscopic gastrostomy tube placement. Patient expressed desire to avoid intubation due to concern for potential prolonged intubation and postoperative ventilation. General anesthesia was induced and maintained with propofol and rocuronium. ETCO2 measured with mask ventilation prior to neuromuscular blockade reversal and cessation of propofol infusion after successful procedure.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Weight, kg</th>
<th>Flow, L/min</th>
<th>Apnea induction agent</th>
<th>Maintenance anesthetic</th>
<th>THRIVE time, min</th>
<th>SpO2 nadir</th>
<th>First ETCO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 yr</td>
<td>12</td>
<td>25</td>
<td>n/a</td>
<td>Propofol boluses (90mg total)</td>
<td>15</td>
<td>100</td>
<td>47</td>
</tr>
<tr>
<td>2</td>
<td>14 mo</td>
<td>8</td>
<td>15</td>
<td>7mg rocuronium</td>
<td>Sevoflurane</td>
<td>14</td>
<td>76</td>
<td>52</td>
</tr>
<tr>
<td>3</td>
<td>16 yr</td>
<td>53</td>
<td>30</td>
<td>200mcg fentanyl</td>
<td>Propofol</td>
<td>50</td>
<td>100</td>
<td>52</td>
</tr>
<tr>
<td>4</td>
<td>15 yr</td>
<td>31</td>
<td>40</td>
<td>40mg rocuronium</td>
<td>Propofol</td>
<td>42</td>
<td>100</td>
<td>58</td>
</tr>
</tbody>
</table>

Conclusion

• THRIVE may be used to prolong apneic time to oxygen desaturation during airway management.
• THRIVE may also be used as the primary oxygenation and ventilation method during procedures in which apnea is required, or placement of invasive airway devices is impossible or undesirable.
• Future studies are needed to characterize CO2 clearance during THRIVE, upper limits of safe THRIVE time, optimal monitoring during THRIVE, rescue techniques when adequate oxygenation or ventilation is not achieved, patients in whom THRIVE may not be effective, and types of operations which may benefit from this technique.

References