Airway management: High flow nasal oxygenation

The Editor,

Emergency and difficult tracheal intubation can be associated with a high incidence of airway trauma due to multiple attempts at laryngoscopy; hypoxia, carbon dioxide retention due to sedation and procedural complications resulting in a cannot intubate cannot ventilate like situation.[1] Awake fiber‑optic intubation is a standard technique for anticipated difficult tracheal intubation but may still be accompanied by desaturation. Multiple attempts and dwindling saturation levels lead to panic situation during an unsafe apneic period.

We present a case in which high flow nasal cannula (HFNC) was used to increase the safe apneic period while securing the airway with an awake fiberoptic bronchoscope (FOB). Coronary artery bypass grafting, repair of the left ventricular aneurysm, and removal of the left ventricular clot was performed on a 72‑year‑old male, with body surface area of 1.5 m^2 and left ventricular ejection fraction of 20%.

He had restricted mouth opening of two finger breadth due to submucous fibrosis resulting from tobacco chewing. His pulmonary function test was within normal limits. At the time of surgery, the patient's airway was secured with FOB under sedation. Surgery was uneventful, and the patient was shifted to the Intensive Care Unit. On postoperative day one, the patient developed intraventricular hemorrhage with right‑sided hemiparesis. Although he was conscious, he had plantar reflex down going on the right side and weakness 3/5 in all the limbs, which improved by day 2 when he was extubated.

Over the next two days, the patient had poor cough response, developed fever, increased total white count, and opacity on chest radiograph due to poor pulmonary toileting. Minitracheostomy for effective pulmonary toilet was performed on day 5. However, he maintained a saturation of 94%, PaO_2 of 64 mmHg and respiratory rate of 35–40 on ventimask. He was advised HFNC oxygenation with a peak inspiratory flow of 50 L/min and FiO_2 of 60% initially by device (AIRVO 2® Fisher Packel, Auckland, New Zealand). Initially, the patient showed improved saturation to 100% with a respiratory rate of 23/min.

On day 10, the patient became unresponsive saturation was still 97%, but his venous blood gas showed pH of 7.0 and $PaCO_2$ of 95 mmHg. He had shallow respiratory efforts with hardly any breath sounds on auscultation. Despite assisted mask ventilation for 30 min neither his neurological state nor his $PaCO_2$ improved. He required intermittent positive pressure ventilation and due to his restricted mouth opening awake fiber‑optic intubation was planned. The airway was prepared with lignocaine 4% nebulization. By that time, the patient developed nonpurposeful movements for which he was sedated with titrated dose of midazolam without using any relaxant which led to desaturation. HFNC was applied which raised the saturation to 100%. FOB was easily passed by the side of the nasal cannula.

Airway was secured on the third attempt while the entire procedure took 14 min. Nasal prongs (Optiflow®) remained inserted [Figure 1a], and he was being oxygenated with HFNC oxygenation system AIRVO 2®. The monitor displayed a saturation of 100% throughout the procedure. HFNC corrected and maintained oxygen saturation during a prolonged duration of difficult intubation establishing its role as one method of continuous oxygenation throughout the procedure of awake FOB intubation.

The HFNC system includes cannula, turbine, and a respiratory gas humidifier [Figure 1b]. It generates 2–60 L/min of flow with oxygen

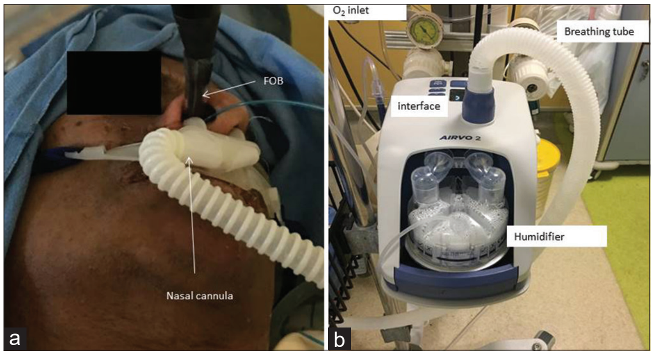

Figure 1: (a) Patient being intubated with fiberoptic bronchoscope and Optiflow® nasal cannula *in situ* providing 50 L of flow. (b) AIRVO 2® high flow oxygenation system with humidifier, interface, and inlet and outlet port

concentration of 21–100%, capable of matching or exceeding the patient's peak inspiratory flow, preventing room air entrainment. A quiet motor draws in room air and oxygen through a filter. Blended breathing gas is passed through a water chamber to be humidified and breathing tube heated to minimize condensation. Heated pass over humidifier atomizes the water molecule, unlike the nebulizers which produce water droplets which cause infection. Humidified air with atomized water molecule is passed through soft nasal cannulae of different sizes while the whole system is integrated into a mobile stand for convenient bedside positioning.

It has following mechanisms of action:

- Matches peak inspiratory flow and prevent room air entrainment[2]
- Nasopharyngeal dead space is washed out with oxygen rich gas and acts as reservoir[2]
- It delivers 100% oxygen and end-expiratory pressure of 6 mmHg at flow rate of 60 L/min[3]
- Humidified gas and soft nasal cannulae provide greater patient comfort.[4]

Proposed mechanisms are a washout of nasopharyngeal dead space by the high flow, a reduction in the work of breathing, and the provision of a degree of positive airway pressure.[5]

It has been shown to increase oxygen saturation, arterial oxygen partial pressure, prevent hypercarbia, and decrease the frequency of breathing in emergency department[6] and intensive care[7] settings, to treat acute respiratory failure,[8] prevent postoperative atelectasis,[9] alleviate dyspnea in acute heart failure[10] and is now being tried to increase the apneic window during tracheal intubation.[11]

Low-flow devices, i.e., nasal cannula can supply FiO_2 of 0.36 and also do not match the peak inspiratory flow rates of the patient and ambient air is entrained to dilute the inspired oxygen.

The use of nasal cannula adapted to nare size to deliver heated and humidified gas at high flow rate has been associated with improvement in washout of nasopharyngeal dead space.[2] It creates passive pharyngeal pressure to reduce the work of breathing, which positions the device the middle between classical oxygen delivery options, i.e., facemask and continuous positive airway pressure.[5] The end expiratory pressure is determined not only by flow but also the ratio of the prong/nostril fit and whether mouth is closed. It supports the inspiratory effort when patient flow is limited.

The greatest disadvantage of the HFNC is that recourse to more invasive management may be delayed in cases of respiratory decompensation which may actually increase mortality/morbidity. HFNC has been increasingly used in neonates though there are reports of pneumothorax in some pediatric patients.[1]

During awake FOB intubation in our high-risk case, HFNC allowed continuous oxygenation and concomitant passage of the fiberscope and tracheal tube, extended the safe apnea time, and reduced operator stress allowing optimal conditions for difficult tracheal intubation.

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Conflicts of interest

There are no conflicts of interest.

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