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LETTER TO THE EDITOR

Separate circuit nasal cannulae for end-tidal CO_2 monitoring may lead to hypoxia in patients with unilateral nasal airway obstruction

Dear Editor,

Monitored anesthetic care in the form of moderate or deep sedation is ubiquitous in anesthesia practice. Given that most sedative agents affect respiration, hypopnea and apnea (secondary to airway obstruction and/or central nervous system depression) is of constant concern, as it may lead to significant hypoxia and potentially respiratory or cardiovascular collapse. In this setting, nasal cannulae are commonly used to provide low-flow supplemental oxygen to patients undergoing procedural sedation. The utilization of capnography monitoring has been shown to decrease the incidence of hypoxia compared to supplemental oxygen alone, likely due to earlier detection of ventilatory inadequacy allowing prompt intervention prior to the development of critical hypoxia.[1,2] Therefore, capnography monitoring is deemed mandatory for all patients undergoing general anesthesia or procedural sedation by many renowned anesthesiology societies worldwide.[3-6] Hence, nasal cannulae with combined side-stream sampling ports for waveform capnography monitoring are commonly used by anesthesiologists.

Differences in nasal cannula design, however, can influence their ability to deliver O_2 while concurrently and accurately sampling end-tidal CO_2 ($EtCO_2$). For instance, expired CO_2 can be washed out by high oxygen flows within standard nasal cannulae where oxygen is delivered into both nares through bilateral prongs (Fig. 1A). Conversely, a “separate circuit” design – whereby oxygen is delivered through one (single) nare and CO_2 is sampled from the other/contralateral nare (Fig. 1B) – can be more effective in such instances.

Indeed, this “independent/separate circuit” cannula design is particularly beneficial when higher oxygen flows are required as it prevents the expired gas mixture from being washed out by the oxygen flow, thereby significantly improving accuracy of waveform capnography monitoring. However, delivering oxygen to a single nare is not ideal and can, in some cases, present a safety risk. For instance, patients with acute and/or chronic unilateral nasal obstruction may become hypoxic if oxygen is delivered to the obstructed nare. Additionally, increasing oxygen flow rate is unlikely to improve the hypoxemia in such instances. Notably, (unilateral) nasal airway obstruction is a common symptom and can occur due to a variety of processes, including sinonasal mass, acute sinusitis following upper respiratory tract infection, chronic sinusitis, allergic rhinitis, nasal polyps, and septal deviation.[7]

Anesthesiologists should be aware of the specific type of $EtCO_2$-monitoring nasal cannulae used at their institution, while also being aware of potential new equipment they may be faced with minimal or no forewarning due to product shortages commonly seen in this post-pandemic era. Consideration should be given to assessing patients for nasal patency prior to using nasal cannulae, particularly when independent/separate circuit cannulae are the only option available. In such instances, if a patient with unilateral nasal obstruction becomes hypoxic, the cannula can be turned 180 degrees thus delivering oxygen to the opposite (patent) nare which may improve oxygenation. Finally, in patients with known nasal airway obstruction, consideration should be given to utilizing a facemask for oxygen delivery. Notably, $EtCO_2$ monitoring can also be adapted to a facemask to allow for both adequate oxygen delivery and capnography monitoring (Fig. 1C).

Both supplemental oxygen delivery and capnography monitoring are essential for patient safety and should, therefore, be routinely incorporated into monitored anesthetic care. Given the current paucity of data surrounding safety and efficacy of different capnography-monitoring devices commonly used in procedural sedation, future research is needed to ensure that devices can accurately measure $EtCO_2$ without compromising oxygen delivery (i.e., regardless of the adopted [higher] oxygen flows). This, however, may become increasingly difficult with new oxygen delivery devices, such as high-flow nasal cannulae. Nevertheless, familiarity with the various options for capnography-monitoring devices and their respective potential limitations is advisable for practicing anesthesiologists.

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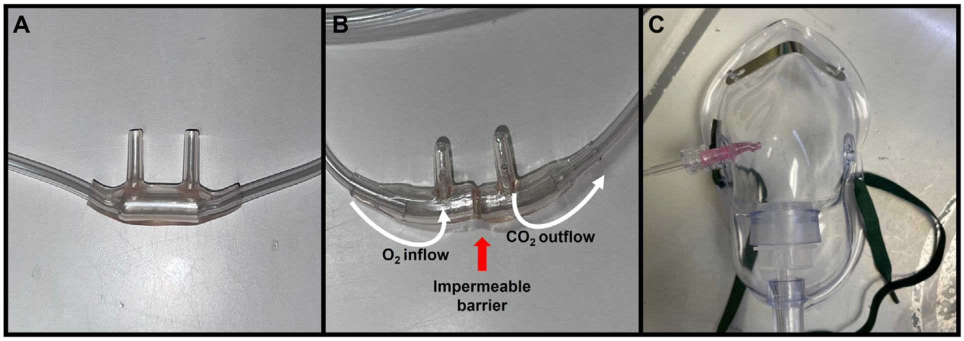

Figure 1 Alternatives to provide supplemental oxygen while concurrently monitoring end-tidal CO_2 ($EtCO_2$) during procedural sedation. (A) Standard nasal cannula. (B) $EtCO_2$-measuring nasal cannula with independent/separate circuits for oxygen delivery and $EtCO_2$ sampling. The impermeable barrier between circuits at the level of the nasal prongs is denoted with a red arrow. Note the one-way oxygen inflow and CO_2 outflow (white arrows) through the independent/separate circuits. (C) Facemask with adapted $EtCO_2$ sampling tubing using an intravenous cannula.

Conflicts of interest

The authors declare no conflicts of interest.

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