



# Methodological Insight to the High-Flow Nasal Cannula Oxygenation in Elderly Undergoing Endoscopic Retrograde Cholangiopancreatography

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## Abbreviations

ERCP Endoscopic retrograde cholangiopancreatography  
HFNC High-flow nasal cannula  
CPAP Continuous positive airway pressure  
CO<sub>2</sub> Carbon-di-oxide

## To the Editor:

Lee and colleague's study is intriguing to analyze the benefits of high flow nasal cannula (HFNC) oxygenation in the endoscopic retrograde cholangiopancreatography (ERCP) procedure in elderly patients [1]. We applaud the work as the study contributes towards a significant advancement in the control of oxygenation during ERCP and opens new possibilities. However, we believe some physiological, pharmacological, and methodological aspects pertinent to the procedure employed are worth discussion for conscious acceptance of the method in clinical practice.

Continuous positive airway pressure (CPAP) like effects of HFNC is vital to have the maximal benefit of it [2, 3].

the authors accept that using HFNC with an open mouth can limit some of the beneficial effects of CPAP or positive end-expiratory pressure, which helps prevent a decrease in lung capacity. Furthermore, the efficacy of HFNC oxygenation with postural changes like left-lateral or prone position, especially with the decreased diaphragm function, for example, in elderly under sedation, is not well known. The contentious ventilatory effect of HFNC further complicates the scenario. As the procedure time extends, the patient usually retains carbon-di-oxide (CO<sub>2</sub>), which might significantly impact the oxygenation benefit, ultimately leading to dilutional hypoxia. The authors have noticed a few hypoxias even in the HFNC group. It would be prudent to know the characteristic of those patients, especially whether they were oxygen-dependent in the preoperative period; what was the duration of the ERCP procedure?

The effect of sedation using Propofol or Midazolam on upper airway muscle tone is a critical factor to be considered both from airway protection and the possible impact of resistance to the flows through the nasopharyngeal route, thereby on ventilation and work of breathing. Further, the airway protection ability decreases with advancing age [4]. Nevertheless, normal oxygenation does not exclude the possibility of micro- aspiration. The sedation level maintained in the authors' study was 'deep sedation' as per the American Society of Anesthesiologists' practice advisory. Further, Midazolam was added to Propofol to achieve the target conscious level. While deep sedation does not mean an unconscious patient, the conscious level is unpredictable and exaggerated, especially with the combination [5].

Furthermore, deep sedation, endoscopy, and air insufflation for ERCP might jeopardize the patients' airway-related safety. Therefore, targeted sedation management using electro-encephalography-based indices or sedative agents has a low or negligible effect on respiratory depression and airway reflexes like Dexmedetomidine, which is well-known to

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provide awake sedation, even in combination with Propofol, might be a better alternative [6]. Again, it is vital to know the sedation level in those hypoxic patients at that time-point.

We again thank the authors for bringing out this new horizon to HFNC. The authors rightly point out the limitations, especially not having the arterial gas analysis. We also consider that future more extensive studies using objective assessment of sedation, analysis of the acid–base status, postoperative follow-up for aspiration-related complications, along with the respiratory gases, will establish a definitive use of HFNC in this procedure.

## Reply

We thank Dr. Habib Md Reazaul Karim for giving the consideration and opportunity to discuss to our study [1]. Our randomized trial suggested that high flow nasal cannula (HFNC) oxygenation in the endoscopic retrograde cholangiopancreatography (ERCP) under sedation can maintain oxygen saturation and prevent unexpected hypoxia events [1]. The protective effect of HFNC originated mainly from several physiologic factors, including continuous positive airway pressure and warm humidification. However, we need to consider carefully several circumferential and situational aspects in patients who underwent ERCP under sedation.

First, we need to discuss the effect of HFNC according to changes in posture during ERCP procedure, such as lateral or prone positioning. Awake prone positioning in patients with acute hypoxemic respiratory failure due to COVID-19 treated with HFNC improved oxygen profiles and had preventable effect on the tracheal intubation or treatment failure [7, 8]. Prone position may reduce ventilation to perfusion

mismatch and intrapulmonary shunt and decrease respiratory rate. Thus, respiratory drive and transpulmonary pressure gradient may be reduced in prone position, which probably improves oxygenation. In addition, prone position with deep sedation during endoscopic procedure did not affect maintenance of oxygen saturation and end tidal carbon dioxide level [1, 9]. Therefore, prone and lateral position during ERCP can be feasible to prevent desaturation.

Second, level of sedation and monitoring are challenging issue for patient safety and completion of the procedure. Although propofol and dexmedetomidine are widely used sedatives, propofol showed better satisfaction especially in endoscopy as compared with dexmedetomidine, and there were no differences in hypoxia and cardiopulmonary complications [10]. In our study, ERCP was performed under deep sedation as described in the American Society of Anesthesiologist, which can be response following repeated or painful stimulation. However, none of patients who experienced hypoxia during procedure received midazolam. [Table 1] When hypoxia occurred, the procedure and sedation were temporarily interrupted to secure the airway and resumed after restoration to complete the procedure. Therefore, propofol sedation during ERCP may be tolerated for safety and desirable for patient satisfaction.

Our data from subgroups of patients with hypoxia during ERCP are presented in Table 1. There were no differences in peri-procedural and sedation-related parameters in patients between HFNC and conventional nasal cannula. There was no patient with significant respiratory failure or oxygen dependence, because patients who received intubation or home oxygen were excluded from the study protocol. Although our study and recent data have shown feasibility and usefulness of HFNC in sedation ERCP, large-scale

**Table 1** Comparison patients between HFNC and nasal cannula

	HFNC oxygenation (n = 4)	Nasal cannula oxygenation (n = 12)	p-value
Age, years	75	79	0.379
BMI	24	23.4	0.521
ASA grade $\geq$ 3	1	2	0.607
Procedure time, minutes	19	17	0.770
Dose of propofol, mg per kg	1.92	0.94	0.316
Use of midazolam	0	0	N/A
SpO <sub>2</sub> before procedure	98	98	0.770
Any oxygen supplement before procedure	1	3	0.728
Dose of oxygen before procedure			
Subject 1	5 L	3 L	
Subject 2	N/A	2 L	
Subject 3	N/A	3 L	
The lowest SpO <sub>2</sub> during the procedure, %	87	84	0.212

Continuous variables presented as median and Mann–Whitney u test was used for analysis. Categorical variables presented as the number of patients and Pearson’s chi-square or Fisher’s exact tests were used for analysis.

studies are needed to investigate arterial blood gas analysis for carbon dioxide concentration, electro-encephalography indicators for sedation level, and comparison at the same oxygen fraction.

In conclusion, HFNC support during ERCP under propofol-based sedation can provide adequate oxygenation. However, studies focused on physiology are needed to investigate these potential mechanisms.

Physiological aspects of High-Flow Nasal Cannula Oxygenation in Patients Who Undergone Endoscopic Retrograde Cholangiopancreatography under Propofol Sedation.

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#### Declarations

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