



Successful use of high flow nasal cannula in an obese patient with hypoxemia during endoscopic retrograde cholangiopancreatography: a case report

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ABSTRACT

A 42-year-old obese woman with a body mass index of 37.8 kilograms per square meter, diabetes, epilepsy, and heavy smoking developed hypoxemia during endoscopic retrograde cholangiopancreatography despite maximal oxygen delivery through a conventional nasal cannula at 12 liters per minute. During sedation with propofol and sufentanil, peripheral oxygen saturation decreased to 76 percent. Switching to high flow nasal cannula oxygen therapy at a flow of 45 liters per minute and a fraction of inspired oxygen of 0.50 rapidly improved oxygenation to 93 to 95 percent within minutes, allowing the procedure to be completed safely. This case illustrates how high flow nasal cannula oxygen therapy can rapidly reverse severe hypoxemia and enable safe completion of endoscopic retrograde cholangiopancreatography in a high-risk obese patient.

KEYWORDS

Oxygen inhalation therapy; endoscopic retrograde cholangiopancreatography; obesity; hypoxemia; sedation

INTRODUCTION

Hypoxemia is among the most frequent complications during endoscopic retrograde cholangiopancreatography (ERCP), particularly in obese patients or those with reduced pulmonary reserve and multiple comorbidities⁽¹⁾. Sedation decreases upper airway tone, increases the risk of hypoventilation and alveolar collapse, and can lead to desaturation. The conventional nasal cannula (CNC) has long been used for supplemental oxygen delivery during sedated procedures, although its effectiveness may be limited in patients with high oxygen demand or obesity⁽²⁾. In obese patients, conventional flow rates of 6-12 L/min often fail to maintain adequate oxygenation⁽³⁾ (Figure 1).

The high flow nasal cannula (HFNC) delivers heated and humidified gas at flows up to 60 L/min, generating mild positive airway pressure (2-5 cmH₂O), washing out anatomical dead space, and improving ventilation-perfusion matching. Although this system is more expensive and technically demanding, it can prevent hypoxemia and reduce the need for airway intervention in high-risk patients⁽⁴⁾.

This case demonstrates how timely switching from conventional nasal cannula to high flow nasal cannula oxygen therapy during endoscopic retrograde cholangiopancreatography ensured adequate oxygenation and procedural safety, illustrating the rationale for its use in selected high-risk patients despite greater system cost and complexity.

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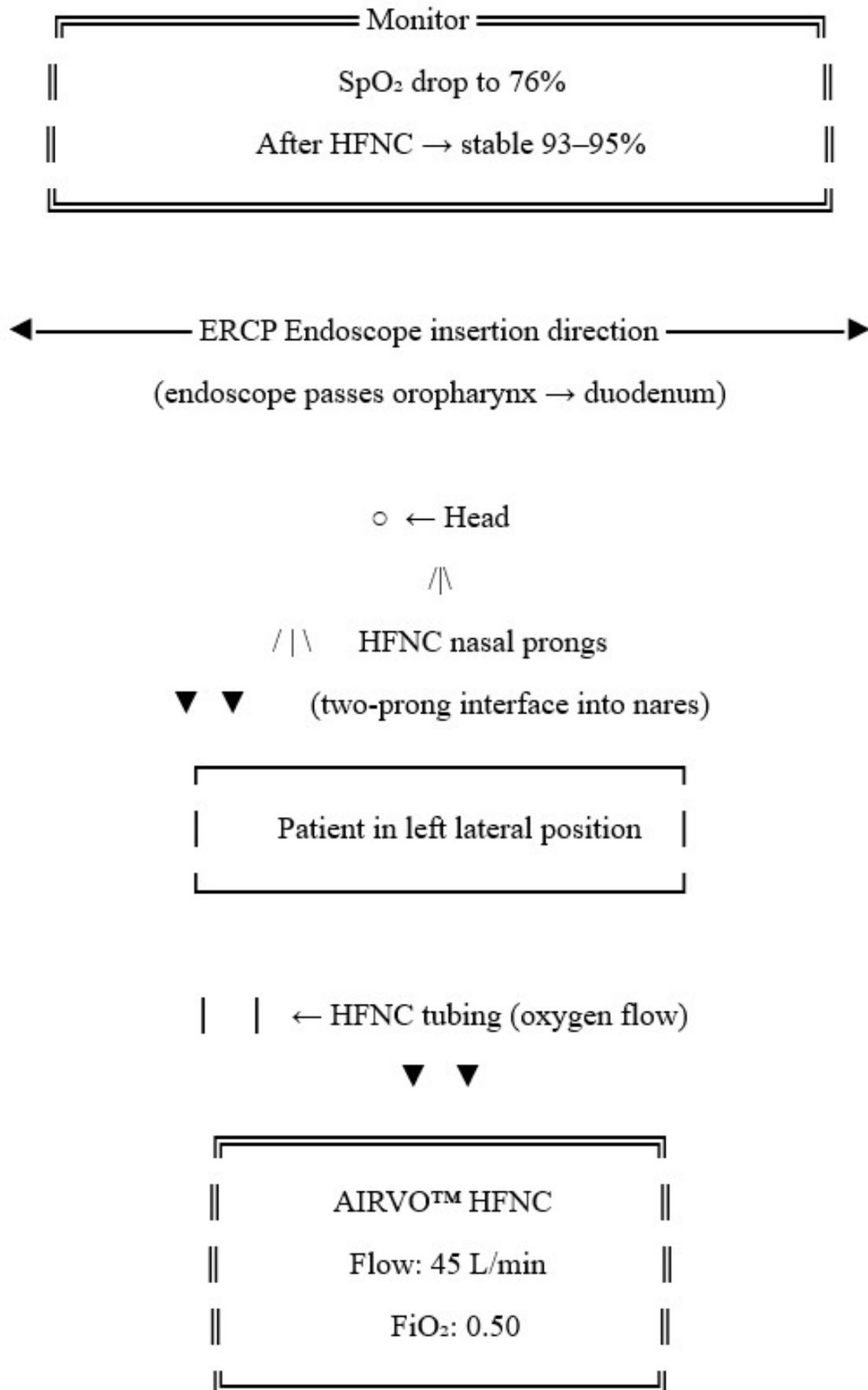


Figure 1. Representation of high-flow nasal cannula support during ERCP. The illustration demonstrates patient positioning in left lateral decubitus, placement of HFNC nasal prongs connected to the AIRVO™ system (45 L/min; FiO₂ 0.50), endoscope route to duodenum, and desaturation–recovery trend. HFNC was introduced as rescue oxygenation when SpO₂ decreased to 76%, resulting in stabilization to 93-95%.

CASE REPORT

A 42-year-old woman classified as American Society of Anesthesiologists physical status II (ASA II, BMI 37.8 kg/m²) with type 2 diabetes mellitus, epilepsy, and chronic tobacco use (~45 cigarettes/day) was admitted for endoscopic retrograde cholangiopancreatography due to choledocholithiasis confirmed by magnetic resonance cholangiopancreatography. Pre-procedure laboratory tests, ECG, and chest X-ray were unremarkable.

Continuous monitoring included oxygen saturation (SpO₂) (Table 1), end-tidal carbon dioxide (ETCO₂), noninvasive blood pressure, heart rate, and bispectral index (BIS 60-80). Sedation was achieved with total intravenous anesthesia using propofol (520 mg) and sufentanil (10 µg). Oxygen was initially delivered via a conventional nasal cannula at 6 L/min and increased stepwise to 12 L/min as desaturation developed. Despite maximal flow, SpO₂ progressively dropped from 96% to 76%. The procedure was performed in the left lateral position, which is standard for endoscopic retrograde cholangiopancreatography but may compromise diaphragmatic excursion and functional residual capacity in obese patients. Sedation-related reduction of upper airway tone, combined with endoscope insertion, increases the risk of hypoventilation and desaturation, making oxygenation management a key anesthetic challenge.

Arterial blood gases before the procedure revealed PaO₂ 77 mmHg and PaCO₂ 41 mmHg; post-procedure analysis showed PaO₂ 80 mmHg, PaCO₂ 53 mmHg, and SaO₂ 94.3%. The mild increase in PaCO₂ was clinically acceptable and is likely attributed to hypoventilation associated with deep propofol sedation rather than oxygenation failure. This degree of CO₂ retention is common in obese patients with reduced chest wall compliance and was not accompanied by hemodynamic instability or prolonged recovery. Possible causes of desaturation – including bronchospasm, micro-aspiration, or sedative overdose – were considered, but the rapid oxygenation recovery

following high flow nasal cannula oxygen therapy initiation confirmed a ventilatory mechanism.

High flow nasal cannula oxygen therapy (AIRVO™ 2 system, Fisher & Paykel Healthcare, Auckland, New Zealand) was applied at 45 L/min and a fraction of inspired oxygen (FiO₂) of 0.50. SpO₂ rose to 91% within one minute and stabilized at 93-95% after five minutes. The procedure lasted 20 minutes and was completed without interruption or airway manipulation. This setting was selected as the standard initial protocol in our institution for rescue oxygenation in obese or high-risk patients. FiO₂ was not titrated during the intervention because the priority was rapid reversal of severe hypoxemia rather than stepwise adjustment. The chosen flow of 45 L/min was sufficient to generate mild PEEP while ensuring patient comfort and maintaining airway patency.

In the recovery unit, the patient remained hemodynamically stable with sustained SpO₂ (94-96%). She reported no dyspnea or discomfort and was discharged the next day in good general condition.

DISCUSSION

Endoscopic retrograde cholangiopancreatography is among the endoscopic procedures with the highest risk of respiratory complications, particularly in obese individuals with reduced pulmonary reserve and multiple comorbidities⁽⁵⁻⁷⁾. In such patients, a conventional nasal cannula may fail to maintain adequate oxygenation due to flow limitations, delivery of dry non-humidified gas, variable FiO₂, and increased upper airway dead space.

Over the past decade, high flow nasal cannula oxygen therapy has become a preferred method in various clinical settings, including procedural sedation. It delivers warmed and humidified gas at high flow rates (up to 60 L/min) with precise FiO₂ control and generates a mild

Table 1. Clinical course of oxygen saturation (SpO₂) during ERCP

Time (min)	Oxygen delivery	Flow (L/min)	SpO ₂ (%)	Comment
0	CNC	6	96	Start of procedure
5	CNC	8	90	Mild desaturation
10	CNC	10	82	Moderate hypoxemia
15	CNC	12	76	Severe desaturation
20	HFNC	45	93	5 min after HFNC initiation
25+	HFNC	45	94-95	Stable oxygenation

Legend: CNC = conventional nasal cannula; HFNC = high-flow nasal cannula; SpO₂ = peripheral oxygen saturation; ERCP = endoscopic retrograde cholangiopancreatography. Oxygen flow was gradually increased until HFNC was initiated at minute 15 due to persistent hypoxemia despite maximal CNC flow.

positive airway pressure. This mechanism enhances alveolar ventilation, reduces CO₂ rebreathing, and maintains more stable oxygenation compared with conventional oxygen systems.

This system continuously flushes nasopharyngeal dead space, improves CO₂ washout and increases alveolar ventilation, while the constant flow generates low-level PEEP (2-5 cmH₂O). This promotes alveolar recruitment and better ventilation-perfusion matching. These physiologic mechanisms have been described in detail by Nishimura⁽⁸⁾.

A meta-analysis by Thiruvengatarajan et al.⁽⁹⁾ demonstrated that the use of high flow nasal cannula during procedural sedation significantly reduces the incidence of hypoxemia, airway intervention requirements, and procedure interruptions compared with conventional oxygenation. Similarly, previous systematic reviews have confirmed that this therapy reduces the need for intubation and escalation of oxygen therapy in patients at risk of respiratory compromise, while Leeies et al.⁽¹⁰⁾ reported good safety and physiological tolerance of high flow nasal cannula oxygen therapy and fewer ventilation-related complications compared with noninvasive ventilation. Collectively, these findings support high flow nasal cannula oxygen therapy as an effective, safe, and patient-friendly oxygenation strategy, particularly in high-risk obese patients.

Recent randomized studies in obese patients further confirm the clinical effectiveness of high flow nasal cannula oxygen therapy during endoscopic procedures under sedation. Wang et al.⁽¹¹⁾ demonstrated that in patients with a body mass index (BMI) ≥ 28 kg/m², the incidence of hypoxemia was significantly lower in the high flow nasal cannula group (2.0%) compared with the conventional nasal cannula group (21.2%), representing a statistically significant difference (-19.14%, 95% CI -23.09 to -15.36; $p < 0.001$) Likewise, an earlier case series by Lee et al.⁽¹²⁾ reported that in patients with BMI values ranging from 32 to 37 kg/m², high flow nasal cannula oxygen therapy during colonoscopy under intravenous sedation resulted in fewer desaturation episodes compared with conventional oxygenation.

Although this system requires more costly equipment, additional staff training, and logistical resources, its selective use in high-risk patients (e.g., BMI >30 kg/m², comorbidities, ASA IIIII) may be both clinically and economically justified. In the presented case, a timely transition from conventional nasal cannula oxygen delivery to high flow nasal cannula oxygen therapy allowed for adequate oxygenation and completion of endoscopic retrograde cholangiopancreatography without interruption or the need for invasive airway management.

These findings emphasize the importance of individualized oxygen support and continuous respiratory monitoring

during sedation, particularly in patients with elevated BMI and limited pulmonary reserve. A prompt decision to initiate high flow nasal cannula oxygen therapy in such cases may prevent severe hypoxemia and reduce the risk of respiratory complications, highlighting its role as a safe and cost-effective strategy for high-risk patients undergoing endoscopic retrograde cholangiopancreatography.

Alternative oxygenation strategies during endoscopic retrograde cholangiopancreatography include the use of supraglottic airways designed to permit endoscope passage while maintaining ventilatory support, as well as deeper anesthesia with endotracheal intubation or general anesthesia. Supraglottic devices may provide more stable ventilation in selected patients, but require equipment availability and an experienced anesthesiologist, and may still pose challenges in obese individuals with limited airway reserve. In this case, the team opted to begin with conventional nasal cannula oxygen delivery due to patient cooperation, procedural simplicity, and the desire to avoid more invasive airway management. High flow nasal cannula oxygen therapy was available as a rescue strategy and provided an effective means of reversing hypoxemia without escalating to instrumentation of the airway.

Clinical implications and limitations

This case highlights the clinical relevance of high flow nasal cannula oxygen therapy as an effective rescue strategy for severe hypoxemia during endoscopic retrograde cholangiopancreatography in an obese patient. Its use allowed for the rapid reversal of desaturation and safe procedure completion without the need for escalation to invasive airway management. However, this report describes a single patient and therefore its findings cannot be generalized or used to conclude the overall efficacy or safety of high flow nasal cannula oxygen therapy compared with other techniques. Alternative airway strategies such as supraglottic devices may also provide adequate oxygenation during endoscopy and should be considered in selected high-risk patients.

The key clinical message is the importance of structured respiratory planning during endoscopic retrograde cholangiopancreatography in obese patients, while high flow nasal cannula oxygen therapy may be a rapid and efficient rescue therapy when conventional nasal cannula oxygen delivery is insufficient.

CONCLUSION

High flow nasal cannula oxygen therapy may represent a valuable rescue strategy when conventional oxygen therapy fails during endoscopic retrograde cholangiopancreatography in obese patients. However, conclusions regarding general safety and clinical advantage require further research. As a single

patient case, these observations should be interpreted cautiously and validated in controlled trials.

Patient perspective

At the beginning of the procedure, I received oxygen through a standard nasal cannula, but the air felt cold and dry, causing discomfort and a mild burning sensation in my nostrils. Soon after, I began to drift into sleep and do not remember anything further. When I woke up, the team explained that there had been some breathing difficulties during the procedure, which were promptly resolved. I felt tired but also deeply relieved to hear that everything had gone well and without any complications.

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This study was carried out at the Sestre Milosrdnice University Hospital Center, Zagreb, Croatia.

Authors' contributions: Valentina Ješić performed all roles.

Ethics statement: This study was approved by the Institutional Ethics Committee of the Sestre milosrdnice University Hospital Center, Zagreb, Croatia (Class: 003-06/23-03/003; Reg. No.: 251-29-11-23-04). Written informed consent for publication was obtained from the patient.

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