



Case report

Use of high-flow nasal cannula in obese patients receiving colonoscopy under intravenous propofol sedation: A case series

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ABSTRACT

Intravenous sedation during colonoscopy has become the standard practice in the United States given its higher patient satisfaction and procedural quality. This practice is not free of side effects as a significant proportion of patients undergoing this procedure tend to have respiratory depression and desaturation events. Obesity, as it relates to higher levels of body mass index (BMI) has a positive correlation with the incidence of hypoxemia. During colonoscopy High flow nasal cannula (HFNC) may potentially improve oxygen performance in patients receiving colonoscopy under intravenous sedation. Here we present 3 cases of patients undergoing adjunctive oxygen therapy with HFNC during colonoscopy with intravenous sedation. We found patients to have lower number of desaturation events and were satisfied with their experience.

1. Introduction

Intravenous sedation during colonoscopy has become the standard practice in the United States given its higher patient satisfaction [1] and procedural quality [2]. The most common used short-acting sedative agent is propofol. Although possessing safe and rapidly reversible pharmacokinetic properties, propofol intravenous infusion can lead to respiratory depression and desaturation in 20% of patients while receiving colonoscopies [3]. Obesity is one of the identified risk factors in association with hypoxemia, since patients with higher body mass index (BMI) are prone to experience airway collapse during sedation.

High flow nasal cannula (HFNC) is a new generation of oxygen therapy. It provides constant high flow oxygen delivery with heated and humidified air. Moreover, its high velocity of airflow can create the effect of “positive end expiratory pressure” (PEEP) and consequently assist in ventilation and work of breathing [4–7].

HFNC may potentially improve oxygen performance in patients receiving colonoscopy under intravenous sedation. It has been utilized in patients undergoing bronchoscopy [8] or dental procedures [9]. To our knowledge, currently, there are no published studies or case reports of using HFNC during gastrointestinal endoscopy or colonoscopy. Here we present 3 cases of patients undergoing adjunctive oxygen therapy with HFNC during colonoscopy with intravenous sedation.

2. Case presentations

2.1. Patient 1

An 85-year-old female patient was brought to the hospital after passing dark stools. She was hemodynamically stable without evidence of active gastrointestinal bleeding. Her BMI was 32 and rectal examination revealed no abnormalities. Fecal occult blood testing was negative. Her admission hemoglobin was 7.7 g/dL, decreased from a prior baseline of 11.2 g/dL. Patient had been on rivaroxaban for 4 months due to a diagnosis of pulmonary embolism. Gastroenterology service was consulted. Patient underwent an upper endoscopy, which failed to reveal the source of bleeding. Patient subsequently received colonoscopy to evaluate for a possible lower gastrointestinal source of bleeding. During her first colonoscopy, bowel preparation was sub-optimal, thus she underwent a second colonoscopy one day later.

2.2. Patient 2

A 30 year-old-male patient was admitted for rectal bleeding. Patient had a history of Crohn's disease, and presented with rectal ulcers and involvement of the terminal ileum. He had stopped taking his medications a week prior to this admission. His BMI was 34. He passed bright red blood per rectum on examination however remained hemodynamically stable. His hemoglobin was 10.9 g/dL, down from 12 g/dL previously, hematocrit 30%, down from 35%, and CRP was 2.5 mg/dL. Gastroenterology service was consulted and the patient was started

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Table 1
Baseline characteristic of 3 patients receiving HFNC oxygen therapy during colonoscopy.

	Age	Gender	BMI	ASA Classification	Indication for colonoscopy
Patient 1	85	Female	32	II	Melena
Patient 2	30	Male	34	II	Rectal bleeding
Patient 3	71	Female	37	III	Abdominal pain Rectal bleeding

BMI: body mass index.

ASA: American Society of Anesthesiologists physical status classification system.

on IV steroids, mesalamine, and scheduled for colonoscopy.

2.3. Patient 3

A 71 year-old-male patient was admitted to the hospital for several weeks of intermittent severe epigastric abdominal pain along with rectal bleeding. Patient had a significant history of internal hemorrhoids status post banding, peptic ulcer disease and esophagitis status post cautery through upper endoscopy 4 years prior to this admission. He was compliant with outpatient gastrointestinal therapeutics. He was hemodynamically stable without evidence of active bleeding. His BMI was 37. Fecal occult blood test was positive. His hemoglobin was 10.8 g/dL; decreased from a baseline of 12–13 g/dL. Gastroenterology service was consulted and patient underwent colonoscopic evaluation.

After explaining risks and benefits of using HFNC, we asked the patients to give consent. Patients' baseline characteristics were described in Table 1. Patients in both HFNC and conventional nasal cannula groups received intravenous propofol sedation under the direct supervision of an anesthesiologist as part of the standard of care. By protocol, at our institution, the standard propofol dosing consists of an initial bolus of 0.5 mg/kg, with downward adjustment for patients older than 80 years old (0.25 mg/kg). This initial bolus is followed by propofol boluses of 10–20 mg (5–10 mg in patients older than 80 years old) as needed to maintain an adequate level of sedation.

During colonoscopies, the anesthesiologist used the Richmond Agitation-Sedation Scale (RASS) to a sedation target of −2 to 0 to determine the need for subsequent propofol boluses after the initial bolus.

Patients' oxygen performance was recorded in Table 2. Table 3 recorded patients' data of end-tidal CO₂, respiratory rate, total propofol dose and procedure duration. After the colonoscopy, we asked patients to fill out a patient satisfaction questionnaire, which assessed comfort level, dryness and stomach bloating (Table 4).

3. Discussion

Performing colonoscopy with moderate conscious sedation has become the standard practice in the United States. It is estimated that 98% of patients in the United States receive sedative agents while

undergoing gastrointestinal endoscopy [10]. Sedation in colonoscopy reduces procedure related pain and improves patient satisfaction [11,12]. It may also lead to an increase in cecum intubation rates [2]. Although the best sedative agent is still debatable, propofol is increasingly used for sedation during colonoscopy. In a systematic review of 22 randomized trials, in comparison with conventional anesthetic agents, propofol resulted in shorter recovery times and higher patient satisfaction levels [1].

On the other hand, propofol can potentially create adverse effects on hemodynamic and respiratory performance. In a cross sectional study, propofol use during endoscopic procedures lead to desaturation events, defined by an SpO₂ less than 90%, in 3.6% of patients using the American Society of Anesthesiologists (ASA) physical status classification system III and IV [13]. Beitz et al. conducted a large prospective randomized trial focusing on patients receiving colonoscopy and 19.8% of them experienced a SpO₂ less than 90% under propofol sedation [3].

Obesity is one of the well-known risk factors associated with desaturation events during sedation. A prospective study conducted by Wani et al. showed that obese patients had two times the risk of sedation-related complications and need for airway maneuver while undergoing advanced endoscopic procedures [4]. Berzin et al. prospectively assessed patients receiving endoscopic retrograde cholangiopancreatography (ERCP) under monitored anesthesia care and found higher BMI was strongly associated with adverse respiratory events [14].

Propofol can potentially precipitate hypoxemia via various mechanisms including hypoventilation, airway collapse, aspiration, and carbon dioxide (CO₂) retention.

Several studies revealed that capnographic monitoring of respiratory activity can reduce the incidence of oxygen desaturation during procedural sedation through early identification of hypoventilation [3,15,16]. Non-invasive ventilation like bilevel positive airway pressure (BiPAP) was widely used to augment ventilation and CO₂ washout in the setting of respiratory failure. However, anesthesiologists seldom applied it to patients who underwent gastrointestinal endoscopy in fear of aspiration and abdominal distention.

HFNC use in procedural sedation has gained interest, due to its ability to provide steady FiO₂ with high airflow rates and minimal interference with endoscopic devices inserted through the oral route. Studies have also shown that HFNC could create positive end expiratory pressure (PEEP) by impeding expiratory flow [17,18], which can range as high as 5–7.5 cm H₂O. Lucangelo et al. discovered patients who received HFNC had higher ratio of arterial partial pressures of oxygen (PaO₂)/FiO₂ than those who received venturi mask while undergoing bronchoscopy with conscious sedation [19]. Sago et al. utilized HFNC in dental procedures and disclosed that patients who received it had better PaO₂ compared to those who received oxygen at 5L/min through conventional nasal cannula [20].

Table 2
Oxygen performance of patients receiving HFNC during colonoscopy.

	Baseline SpO ₂ before sedation (under room air)	Minimum SpO ₂ during procedure	^a Number of desaturation	Oxygen flow rate (L/min) and FiO ₂
Patient 1 First time procedure	98–100%	88%	1	Rate:50 FiO ₂ :40%
Patient 1 Second time procedure	96%	90%	1	Rate:50 FiO ₂ :45%
Patient 2	100%	98%	0	Rate:50 FiO ₂ :40–45%
Patient 3	95%	91%	0	Rate:50 FiO ₂ :40–45%

SpO₂: peripheral capillary oxygen saturation; FiO₂: fraction of inspired oxygen.

^a Number of desaturation: SpO₂ < 90% for 5 minutes or SpO₂ drop more than 5% from baseline for 5 minutes.

Table 3EtCO₂, RR, total propofol dose, and length of procedures of patients receiving HFNC during colonoscopy.

	Baseline EtCO ₂ (mmHg)	Frequency of EtCO ₂ more than 50 mmHg	RR before/after sedation	Total propofol dose during procedure (mg/kg/hr)	Length of procedures (min)
Patient 1, First time procedure	38	0	21/15	3.4	15
Patient 1, Second time procedure	28	0	18/15	1.8	40
Patient 2	36	0	14/13	6.0	40
Patient 3	36	0	17/16	3.7	35

EtCO₂: end tidal carbon dioxide.

RR: respiratory rate.

Table 4

Patient satisfaction questionnaire.

	Overall comfort level (Options included poor, fair, good and excellent)	Dryness of nose, mouth or throat (Options included not at all, slight, moderate, severe)	Stomach bloating (Options included not at all, slight, moderate, severe)
Patient 1, First time procedure	Excellent	Not at all	Not at all
Patient 1, Second time procedure	Good	Slight	Not at all
Patient 2	Excellent	Not at all	Not at all
Patient 3	Good	Not at all	Not at all

4. Summary

In our case series, the 3 patients tolerated colonoscopy well and no major adverse event occurred. Patient 1 developed one episode of desaturation during the first and second time of colonoscopy respectively, and they were reversed with the jaw thrust maneuver performed by the anesthesiologist. None of patients had an EtCO₂ of more than 50 mm Hg, which would indicate significant CO₂ retention secondary to hypoventilation. However, it is worth mentioning that EtCO₂ readings may not reflect the true PaCO₂ value because the high-velocity of air-flow could wash out CO₂ vigorously. Apparently, the respiratory rates of these 3 patients were stable after sedation. The total propofol doses varied from 70 mg to 450 mg, which was likely attributed to the length of the procedures and the patients' individuality.

In general, the patients were satisfied with their experience in terms of comfort level, mouth dryness and stomach distention.

5. Conclusion

HFNC is representative of the next generation oxygen device that carries unique advantages in augmenting respiratory function. It has great potential for utilization in procedural sedation. The objective of this case series was to report the successful use of HFNC in obese patients undergoing colonoscopies under sedation with propofol. To our knowledge, this is the first time that such a report has been generated. Further studies are needed to determine the specific population that will benefit from HFNC as an adjunctive therapy while receiving intravenous propofol sedation and in comparison with conventional oxygen therapy.

Conflicts of interest

The above authors declare that there are no conflicts of interest.

Author contribution

Chi Chan Lee, MD: Literature search, data collection, data analysis, manuscript preparation. No reportable industry relationships for the last 2 years.

Osman Perez, DO: Literature search, study design, manuscript preparation, manuscript review. No reportable industry relationships for

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Faryal I. Farooqi, MD: Study design, manuscript preparation, manuscript review. No reportable industry relationships for the last 2 years.

Trupti Akella, MD: Study design, data collection, manuscript preparation. No reportable industry relationships for the last 2 years.

Sameer Shaharyar, MD: Study design, literature search, manuscript review. No reportable industry relationships for the last 2 years.

Melissa Elizée, MD: Data collection, literature search, manuscript review.

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