Case report

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

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ARTICLE INFO

Keywords:
High BMI (body mass index)
HFNC (high-flow nasal cannula)
Colonoscopy
Intravenous sedation
Obesity

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 [5] 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 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 rivotruxaban 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.

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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 |
|------|--------|-----|--------------------|---------------------------|
| 85   | Female | 32  | II                 | Melena                    |
| 30   | Male   | 34  | II                 | Rectal bleeding           |
| 71   | Female | 37  | III                | Abdominal pain            |
| 71   | Female | 37  | III                | Rectal bleeding           |

BMI: body mass index.  
ASA: American Society of Anesthesiologists physical status classification system.

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 cauterity 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 hypventilation, 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 inspiratory 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.

| Patient | Time             | Baseline SpO2 before sedation (under room air) | Minimum SpO2 during procedure | Number of desaturation | Oxygen flow rate (L/min) and FiO2 |
|---------|------------------|-----------------------------------------------|-------------------------------|------------------------|-----------------------------------|
| 1       | First time procedure | 98-100%                                      | 88%                           | 1                      | Rate:50 FiO2:40%                  |
| 1       | Second time procedure | 96%                                           | 90%                           | 1                      | Rate:50 FiO2:45%                  |
| 2       |                  | 100%                                         | 98%                           | 0                      | Rate:50 FiO2:40-45%               |
| 3       |                  | 95%                                          | 91%                           | 0                      | Rate:50 FiO2:40-45%               |

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

* Number of desaturation: SpO2 < 90% for 5 minutes or SpO2 drop more than 5% from baseline for 5 minutes.
Respiratory rate. EtCO2: end tidal carbon dioxide.

of the procedures and the patients’ individuality. varied from 70 mg to 450 mg, which was likely attributed to the length

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poventilation. However, it is worth mentioning that EtCO2 readings

Hg, which would indicate signi

anesthesiologist. None of patients had an EtCO2 of more than 50 mm

saturation during the

Table 4

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

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 the last 2 years.

References

[1] H. Singh, W. Poluba, M. Cheung, N. Chopra, K.J. Baron, S.P. Taback, Propofol for sedation during colonoscopy, Cochrane Database Syst. Rev. (4) (2008) CD006268.

[2] C. Bannert, K. Reinhart, D. Dunkler, M. Trauner, F. Renner, P. Knoflach, et al., Sedation in screening colonoscopy: impact on quality indicators and complications, Am. J. Gastroenterol. 107 (12) (2012) 183748.

[3] A. Beitz, A. Riphaus, A. Meining, T. Krennhofer, C. Geist, S. Wagenpfel, et al., Capnographic monitoring reduces the incidence of arterial oxygen desaturation and hypoxemia during propofol sedation for colonoscopy: a randomized, controlled study (ColoCap Study), Am. J. Gastroenterol. 107 (8) (2012) 120512.

[4] S. Wani, R. Azar, C.E. Hovis, R.M. Hovis, G.A. Cote, M. Hall, et al., Obesity as a risk factor for sedation related complications during propofol mediated sedation for advanced endoscopic procedures, Gastrointest. Endosc. 74 (6) (2011) 123847.

[5] N. Groves, A. Tobin, High flow nasal oxygen generates positive airway pressure in adult volunteers, Aust. Crit. Care 20 (4) (2007) 12631.

[6] K. Dysart, T.L. Miller, M.R. Wolson, T.H. Shaffer, Research in high flow therapy: mechanisms of action, Respir. Med. 103 (10) (2009) 14005.

[7] G. Spoleini, M. Alotaibi, F. Blasi, N.S. Hill, Heated humidified high flow nasal oxygen in adults: mechanisms of action and clinical implications, Chest 148 (1) (2015) 25361.

[8] R. Parke, S. McGuinness, M. Eccleston, Nasal high flow therapy delivers low level positive airway pressure, Br. J. Anaesth. 103 (6) (2009) 886–890 aep286.

[9] C. Lomas, O. Roca, A. Álvarez, J.R. Mascle, Fibroscopy in patients with hypoxemic respiratory insufficiency: utility of the highflow nasal cannula, Respir. Med. CME 2 (3) (2009) 1214.

[10] J.K. Triantafillidis, E. Merikan, D. Nikolakis, A.E. Papalois, et al., Sedation in gastroenterological endoscopy: current issues, World J. Gastroenterol. 19 (4) (2013) 463–481.

[11] J.L. Petrini, J.V. Egan, W.V. Hahn, Unsedated colonoscopy: patient characteristics and satisfaction in a community-based endoscopy unit, Gastrointest. Endosc. 69 (3 Pt 1) (2009) 567–572.

[12] D.K. Rex, T.F. Imperiale, V. Portish, Patients willing to try colonoscopy without sedation: associated clinical factors and results of a randomized controlled trial, Gastrointest. Endosc. 49 (1999) 554–559.

[13] Ludwig T. Heuss, et al., Safety of propofol for conscious sedation during endoscopic procedures in high-risk patients–a prospective, controlled study, Am. J. Gastroenterol. 98.8 (2003) 1751–1757.

[14] M. Tyler, S. Sirish, R. Shelah, A prospective assessment of sedation-related adverse
events and patient and endoscopist satisfaction in ERCP with anesthesiologist-administered sedation, Gastrointest. Endosc. 73.4 (2011) 710–717.

[15] J.R. Lightdale, D.A. Goldman, H.A. Feldman, A.R. Newburg, J.A. DiNardo, V.L. Fox, Microstream capnography improves patient monitoring during moderate sedation: a randomized, controlled trial, Pediatrics 117.6 (2006) e1170–e1178.

[16] M.A. Qadeer, J.J. Vargo, J.A. Dumot, R. Lopez, P.A. Trolli, T. Stevens, et al., Capnographic monitoring of respiratory activity improves safety of sedation for endoscopic cholangiopancreatography and ultrasonography, Gastroenterology 136.5 (2009) 1568–1576.

[17] J.E. Ritchie, A.B. Williams, C. Gerard, H. Hockey, Evaluation of a humidified nasal high-flow oxygen system, using oxygraphy, capnography and measurement of upper airway pressures, Anaesth. Intensive Care 39.6 (2011) 1103.

[18] Nicole Groves, Antony Tobin, High flow nasal oxygen generates positive airway pressure in adult volunteers, Aust. Crit. Care 20.4 (2007) 126–131.

[19] U. Lucangelo, F.G. Vassallo, E. Marras, M. Ferluga, E. Bezza, L. Comuzzi, et al., High-flow nasal interface improves oxygenation in patients undergoing bronchoscopy, Critical Care Res. Pract. 2012 (2012).

[20] Teppei Sago, N. Harano, Y. Chogyoji, M. Nunomaki, S. Shiiba, S. Watanabe, A nasal high-flow system prevents hypoxia in dental patients under intravenous sedation, J. Oral Maxillofac. Surg. 73.6 (2015) 1058–1064.