

# Oxygen Supplementation for Propofol-based Deep Sedation in Colonoscopic Procedure: A Comparison between Nasal Cannula and Face Mask

Somchai Amornyotin, Wiyada Chalayonnawin, Siriporn Kongphlay

*Department of Anesthesiology and Siriraj GI Endoscopy Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

## ABSTRACT

**Background:** The type of airway tool for oxygen supplementation has been under much debate. The aim of the study was to evaluate and compare the complication rate of propofol-based deep sedation (PBDS) for colonoscopic procedure in patients with oxygen supplement through nasal cannula and face mask during the procedure. **Materials and Methods:** A total of 2052 patients underwent colonoscopic procedures using PBDS in Siriraj Hospital. The primary outcome variable of the study was the complication rate during and immediately after procedure. The secondary outcome variables were sedation-related complications during and immediately after procedure. **Results:** After matching age, weight, body mass index, ASA physical status, and the indications of procedure, there were 98 colonoscopic procedures in nasal cannula group (N) and 104 procedures in face mask group (M). All sedation was given by residents or anesthetic nurses directly supervised by staff anesthesiologist in the endoscopy room. There were no significant differences in patients' characteristics, sedation time, indications of procedure, overall complication rate, and sedation-related complications as well as the sedative agents used between the two groups. **Conclusion:** The complication rate during oxygen supplementation with nasal cannula or face mask for PBDS in colonoscopic procedure was comparable. Although, the complication rate in both groups was relatively high, all complications were easily treated, with no adverse sequelae.

**Key words:** Colonoscopy, deep sedation, face mask, nasal cannula, oxygen supplementation, propofol

## INTRODUCTION

Colonoscopy is the most common diagnostic and therapeutic tool for colorectal abnormalities. Intravenous sedation is generally utilized for this procedure. Although, sedation is regarded as a relatively safe technique, it causes significant morbidity and rarely mortality. The most common complication of sedation is the deterioration of cardiorespiratory function.<sup>[1-3]</sup> Oxygen supplementation during sedation could prevent this complication. To date, there have been different clinical practices in regard to the use of oxygen supplementation.

In general, propofol is used for sedation in colonoscopy. A combination of propofol and other sedoanalgesic drugs

is usually utilized for this technique.<sup>[4]</sup> Propofol-based sedation usually tends to deepen the sedation level and produce some forms of complications.<sup>[5]</sup> There have no studies directly comparing the complication rate of nasal cannula and face mask used during propofol-based deep sedation (PBDS) for colonoscopy in the adult patients. In our practice, most colonoscopic procedures are performed in the endoscopy room. The type of oxygen supplementation is decided according to the patient's medical condition and the anesthesiologist's preference.

We conducted a retrospective study to evaluate whether there was a difference in the incidence of complication rate between the patients who received PBDS and oxygen supplemented

### Address for correspondence:

Somchai Amornyotin, Department of Anesthesiology and Siriraj GI Endoscopy Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok - 10700, Thailand.

© 2020 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

with nasal cannula or face mask for colonoscopic procedures in an endoscopy unit outside the operating room.

## PATIENTS AND METHODS

### Patients

The patients from Siriraj Hospital, Bangkok, Thailand, underwent colonoscopic procedures from September 2008 to August 2009 were eligible for the study. Inclusion criteria were age  $\geq 18$  and  $< 65$  years, and colonoscopic procedures performed using PBDS technique. Exclusion criteria were the patients who had respiratory disease or severe systemic disease, procedures performed in the intensive care units, procedures performed without PBDS, or procedures performed under monitored anesthesia care, and general anesthesia.

### Study design

This study is a retrospective study. The patients were sedated by well-trained anesthetic personnel directly supervised by a staff anesthesiologist in the endoscopy room. Anesthetic personnel included residents in anesthesiology and anesthetic nurses who were well trained in the use of sedation technique and airway management. All patients were sedated in deep sedation level, according to guideline of the American Society of Anesthesiologists.<sup>[6]</sup> Cardiovascular monitoring, including blood pressure measurements, electrocardiogram, heart rate, and oxygen saturation ( $SpO_2$ ), was performed. No pre-medications were used before the procedure.

All patients were classified into two groups according to the device of oxygen supplementation during the procedure. In Group N, oxygen supplementation was done using nasal cannula 3 L/min. In Group M, colonoscopic procedure was performed with oxygen face mask 6 L/min. The primary outcome variable of the study was the incidence of complication rate during and immediately after procedure. The secondary outcome variables were sedation-related complications during and immediately after procedure.

### Assessment of complication rate

All serious and minor complications were recorded. Serious complication was defined as severe hypoxia  $SpO_2 < 90\%$ ,  $\geq 20$  s. Minor complications were defined as follows: Transient desaturation ( $SpO_2 < 95\%$ ); airway obstruction; hypertension or hypotension (increase or decrease in blood pressure by 25% from baseline); tachycardia or bradycardia (increase or decrease in heart rate by 25% from baseline); and any cardiac arrhythmias. Airway intervention was defined as airway management (head tilt, chin lift, and jaw thrust) or utilization of airway device (oropharyngeal or nasopharyngeal airway). After colonoscopic procedure, all patients were observed in the recovery room at least 2 h before discharged to ward or home.

### Statistical analysis

Results were expressed as mean  $\pm$  SD or percentage (%), when appropriate. Comparisons between Groups C and M were compared using with Chi-square tests (for categorical variables), Chi-square tests for trend (for ordinal variables), and two-sample independent *t*-test (for continuous variables). The statistical software package SPSS for Window Version 17 (SPSS Inc., Chicago, IL) was used to analyze the data. All statistical comparisons were made at the two-sided 5% level of significance.

## RESULTS

There were 2840 consecutive patients underwent colonoscopic procedures during the study period. Of these, 2052 patients underwent colonoscopic procedures using PBDS. After matching age, weight, body mass index, American Society of Anesthesiologists (ASA) physical status, and the indications of procedure, there were 202 patients: 98 colonoscopic procedures in Group N and 104 colonoscopic procedures in Group M.

All cases were concluded with the satisfactory completion of the procedure. Table 1 showed the characteristics of patients, duration of sedation, and indications of procedure. There were no statistically significant differences in age, gender, weight, height, body mass index, ASA physical status, sedation time, and indications of the procedure between the two groups.

Table 2 demonstrated overall complication rate and sedation-related complications. There were no significant differences in overall complication rate and sedation-related complication between the two groups. One patient in both groups developed severe hypoxia ( $P = 0.966$ ). Overall, eight patients (8.2%) in Group N and 11 patients (10.6%) in Group M, experienced respiratory related complications ( $P = 0.557$ ). Airway interventions were not significantly different between the two groups ( $P = 0.661$ ). Cardiovascular-related complications occurred in 27.6% and 25.0% of patients in Groups N and M, respectively. No procedures were aborted as a result of insufficient sedation or complications of sedation.

Table 3 showed the sedative agents used in both groups. Propofol, fentanyl and midazolam were used in both groups. There was no significant difference in the mean dose of propofol, fentanyl, and midazolam between the two groups.

## DISCUSSION

Colonoscopy is a painful and unpleasant procedure. To date, deep sedation is commonly used for this procedure. Opioids, benzodiazepines, and propofol in several combinations are usually administered for deep sedation.<sup>[3,4]</sup> However, deep sedation could create some complications. One of

**Table 1:** Characteristics of patients, duration of sedation, and indication of procedure

	Group N (n=98)	Group M (n=104)	P-value
Age (years)	51.1±9.1	51.7±9.1	0.706
Gender <i>n</i> (%)			0.449
Male <i>n</i> (%)	38 (38.8)	35 (33.7)	
Female <i>n</i> (%)	60 (61.2)	69 (66.3)	
Weight (kg)	60.5±11.5	58.3±9.9	0.833
Height (cm)	160.6±8.2	159.3±6.9	0.215
Body mass index (kg/m <sup>2</sup> )	23.4±3.8	22.9±3.4	0.927
ASA physical status			0.692
I <i>n</i> (%)	54 (55.1)	55 (52.9)	
II <i>n</i> (%)	36 (36.7)	43 (41.3)	
III <i>n</i> (%)	8 (8.2)	6 (5.8)	
Duration of sedation (min)	31.8±14.8	28.1±14.2	0.672
Indications			0.785
Colorectal cancer <i>n</i> (%)	33 (33.7)	29 (27.9)	
Bowel habit change <i>n</i> (%)	12 (12.2)	15 (14.4)	
Surveillance <i>n</i> (%)	11 (11.2)	11 (10.6)	
Lower gastrointestinal hemorrhage <i>n</i> (%)	10 (10.2)	14 (13.5)	
Colonic polyp <i>n</i> (%)	9 (9.2)	8 (7.7)	
Others <i>n</i> (%)	19 (19.4)	27 (26.0)	

Group N: Nasal cannula, Group M: Face mask

**Table 2:** Overall complication rate and sedation-related complications

	Group N (n=98)	Group M (n=104)	P-value
Overall complication rate <i>n</i> (%)	35 (35.7)		0.984
Sedation-related complications	8 (8.2)	37 (35.6)	0.557
Respiratory system <i>n</i> (%)	1 (1.0)	11 (10.6)	0.966
Hypoxia <i>n</i> (%)	3 (3.1)	1 (1.0)	0.760
Transient desaturation <i>n</i> (%)	4 (4.1)	4 (3.8)	0.581
Upper airway obstruction <i>n</i> (%)	6 (6.1)	6 (5.8)	0.661
Airway intervention <i>n</i> (%)	27 (27.6)	8 (7.7)	0.680
Cardiovascular system <i>n</i> (%)	25 (25.5)	26 (25.0)	0.571
Hypotension <i>n</i> (%)	1 (1.0)	23 (22.1)	0.966
Hypertension <i>n</i> (%)	1 (1.0)	1 (1.0)	0.596
Bradycardia <i>n</i> (%)		2 (1.9)	

Group N: Nasal cannula, Group M: Face mask

**Table 3:** Sedative agents used in both groups

	Group N (n=98)	Group M (n=104)	P-value
Propofol			
mg/kg	4.04±1.71	3.64±1.68	0.903
mg/kg/h	8.32±3.51	8.52±3.46	0.906
Fentanyl			
mg/kg	0.001±0.000	0.001±0.000	0.330
mg/kg/h	0.002±0.001	0.002±0.001	0.360
Midazolam			
mg/kg	0.03±0.01	0.03±0.00	0.703
mg/kg/h	0.06±0.03	0.07±0.04	0.979

Group N: Nasal cannula, Group M: Face mask

the most common complications during colonoscopy is cardiorespiratory-related complications including hypotension, bradycardia, hypoventilation, upper airway obstruction, apnea, and hypoxia. To prevent and manage these, oxygen supplemented therapy is recommended by the ASA<sup>[6]</sup> and the American Society of Gastrointestinal Endoscopy.<sup>[7]</sup> However, there is no recommendation about the device to be used for oxygenation. In colonoscopy, oxygen supplementation during the procedure could be augmented by nasal cannula or face mask. We hypothesized that oxygen supplementation by the use of face mask would offer no better than nasal cannula.

The primary objective of the study was to evaluate and to compare the complication rate of PBDS for colonoscopy in

patients who oxygen supplemented between nasal cannula and face mask. Our study demonstrated that the complication rate during oxygen supplementation with nasal cannula or face mask for PBDS in colonoscopic procedure was not significantly different. In addition, there were no significant differences in the sedation-related complications between the two groups. We applied standard oxygenation in these two groups.

Several previous studies showed that the use of high-flow nasal cannula could reduce the number and degree of respiratory-related adverse events.<sup>[8-10]</sup> Nasal high-flow system has been described to provide effective oxygenation in the patients with obstructive sleep apnea. Moreover, this system could prevent hypoxia in sedated patients.<sup>[11]</sup> However, high-flow nasal cannula was not significantly different from standard nasal cannula for prevention of arterial oxygen desaturation in the morbidly obese patients undergoing propofol sedation for colonoscopy.<sup>[12]</sup> To the best of our knowledge, this is the first trial performed comparing nasal cannula and face mask in adult patients under deep sedation for colonoscopy. The result of our study confirmed that the complication rate would be associated with deep sedation. According to the complication rate, oxygen supplementation by the use of face mask would offer no better than nasal cannula.

The present study used only standard monitoring, including an assessment of blood pressure, pulse rate, respiratory rate and pulse oximetry, as well as electrocardiogram. We detected a relatively high overall complication rate in both groups. This rate is relatively high, and there might be several explanations. We used these criteria in defining adverse events: Hypo/hypertension and brady/tachycardia measured as the alterations of blood pressure and heart rate of more than 25% of base line values. Hypoxia was defined as SpO<sub>2</sub> <90%. Interestingly, we found that cardiovascular-related complications commonly occurred in the two groups.

This present study did not evaluate the procedure-related complications. However, the data from our previous study demonstrated that colonoscopy under PBDS technique did not increase the perforation rate.<sup>[1]</sup> The use of sedation was the major determinant of patient and endoscopist satisfaction. Consequently, sedation could be performed safely and effectively with a lower complication rate.<sup>[13]</sup> Several guidelines had been recommended that oxygen supplementation needed to be done in deep sedation. In clinical practice, our center routinely used nasal cannula or face mask for oxygen supplementation in sedation for colonoscopic procedure.<sup>[14,15]</sup> This present study also confirms the benefit of nasal cannula and face mask for oxygen supplementation in PBDS technique.

Limitations of this study exist. First, inaccurate and incomplete documentation of certain measures, as occurs

with many chart reviews, also occurred in this study. Second, the population of this study was age <65 years. The elderly patients did not include in the study. A complication rate could not be confirmed in elderly patients. Third, our study performed only basic monitoring, which does not include the use of end-tidal carbon dioxide. Thus, respiratory-related complications might have been undervalued. Overall, in spite of these limitations, we are assured that the findings are generalizable to the practice of PBDS in colonoscopic procedure.

## CONCLUSION

We report the performance of the clinical efficacy of nasal cannula and face mask with PBDS technique for colonoscopic procedure in a unit outside OR from a tertiary-care teaching hospital in Thailand. The present study showed that the use of nasal cannula and face mask for oxygen supplementation during colonoscopy in deep sedated patients was effective and safe. The complication rate in these two groups was relatively high. However, serious complications are none. The use of face mask would offer no better than nasal cannula.

## DECLARATIONS

The authors declare that they have no competing interests.

## FUNDING

The authors have no sources of funding to declare for this manuscript.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES

1. Amornyotin S, Prakanrattana U, Chalayonnavin W, Kongphlay S, Kachintorn U. Propofol based sedation does not increase rate of perforation during colonoscopic procedure. *Gastroenterol Insights* 2010;2:13-6.
2. Amornyotin S, Kongphlay S. Complication rate of propofol-based deep sedation for colonoscopy in marked obesity patients. *J Gastroenterol Hepatol Res* 2015;4:1734-8.
3. Amornyotin S, Kongphlay S. Clinical efficacy of combination of propofol and ketamine (ketofol) for deep sedation in colonoscopic procedure. *J Gastroenterol Hepatol Res* 2015;4:1689-93.
4. Amornyotin S. Sedative and analgesic drugs for gastrointestinal endoscopic procedure. *J Gastroenterol Hepatol Res* 2014;3:1133-44.
5. Amornyotin S. Sedation-related complications in gastrointestinal endoscopy. *World J Gastrointest Endosc* 2013;5:527-33.
6. American Society of Anesthesiologists. Practice guidelines for sedation and analgesia by nonanesthesiologists. An update

- report by the ASA task force on sedation and analgesia by nonanesthesiologists. *Anesthesiology* 2002;96:1004-17.
7. Early DS, Lightdale JR, Vargo JJ, Acosta RD, Chandrasekhara V, Chathadi KV, *et al.* Guidelines for sedation and anesthesia in GI endoscopy. *Gastrointest Endosc* 2018;87:327-37.
  8. Teng WN, Ting CK, Wang YT, Hou MC, Chang WK, Tsou MY, *et al.* High-flow nasal cannula and mandibular advancement bite block decrease hypoxic events during sedative esophagogastroduodenoscopy: A randomized clinical trial. *BioMed Res Int* 2019;2019:4206795.
  9. Eugene A, Fromont L, Auvet A, Baert O, Mfam WS, Remerand F, *et al.* High-flow nasal oxygenation versus standard oxygenation for gastrointestinal endoscopy with sedation. The prospective multicenter randomized controlled ODEPHI study protocol. *BMJ Open* 2020;10:e034701.
  10. Lee CC, Perez O, Farooqi FI, Akella T, Shaharyar S, Elizee M. Use of high-flow nasal cannula in obese patients receiving colonoscopy under intravenous propofol sedation: A case series. *Respir Med Case Rep* 2018;23:118-21.
  11. Sago T, Harano N, Chogyoji Y, Nunomaki M, Shiiba S, Elizee M. A nasal high-flow system prevents hypoxia in dental patients under intravenous sedation. *J Oral Maxillofac Surg* 2015;73:1058-64.
  12. Riccio CA, Sarmiento S, Minhajuddin A, Nasir D, Fox AA. High-flow versus standard nasal cannula in morbidly obese patients during colonoscopy: A prospective, randomized clinical trial. *J Clin Anesth* 2019;54:19-24.
  13. Amornyotin S. Intravenous sedation techniques for gastrointestinal endoscopy. *J Gastroenterol Hepatol Res* 2016;5:2050-7.
  14. Amornyotin S, Pranootnarabhal T, Chalayonnavin W, Kongphlay S. Anesthesia for gastrointestinal endoscopy from 2005-2006 in Siriraj hospital: A prospective study. *Thai J Anesthesiol* 2007;33:93-101.
  15. Amornyotin S, Prakanrattana U, Chalayonnavin W, Kongphlay S. Anesthesia for gastrointestinal endoscopy in extremely elderly patients. *Thai J Anesthesiol* 2009;35:91-9.

**How to cite this article:** Amornyotin S, Chalayonnavin W, Kongphlay S. Oxygen Supplementation for Propofol-based Deep Sedation in Colonoscopic Procedure: A Comparison between Nasal Cannula and Face Mask. *J Clin Res Anesthesiol* 2020;3(2):1-5.