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ORIGINAL RESEARCH

Propofol sedation in colonoscopy: from satisfied patients to improved quality indicators

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Background: Propofol-mediated sedation is safe and clearly associated with increased patient satisfaction. However, whether it results in a favorable effect on colonoscopy outcomes and performance compared to standard sedation with benzodiazepines/opiates remains unclear.

Objectives: To determine the effect of propofol-mediated sedation on colonoscopy-quality measures compared to traditional sedation.

Methods: A large cohort of 44,794 patients who had undergone sedated colonoscopies were included. Colonoscopy-quality indicators were examined in benzodiazepine/opiate-sedated patients and compared with a propofol-mediated sedation group. Adjustment for potential confounders, such as age, sex, quality of bowel preparation, procedural setting, and indication was performed.

Results: Patients who received propofol-mediated sedation were more likely, and in a dose-dependent manner, to have an enhanced polyp-detection rate (22.8% vs 20.9%, $P<0.001$), cecal intubation rate (90.4% vs 87.3%, $P<0.001$), and terminal ileum-intubation rate (6.4% vs 1.6%, $P<0.001$). On multivariate analysis, these findings were maintained, as propofol-mediated sedation use was significantly associated with improved colonoscopy indicators.

Conclusion: Propofol-mediated sedation during colonoscopy is associated with better examination performance and improved outcomes. Further prospective or randomized trials to support these findings are warranted.

Keywords: cecal intubation rate, colonoscopy, polyp-detection rate, propofol-mediated sedation, quality indicators

Introduction

An adequate level of patient sedation allows for thorough and relaxed endoscopic procedures and is desirable for the successful performance of a safe and high-quality colonoscopy. Historically, sedation was induced and maintained mainly by a combination of a benzodiazepines and opioids (Bdz–O), which ensured a mild–moderate level of sedation; however, more recently propofol-mediated sedation has been introduced as a reasonable alternative for sedation, due to its pharmacokinetic and pharmacodynamic properties, which facilitate rapid onset of action and recovery, as well as its favorable safety profile.[1,2] Traditionally, propofol is administered by anesthesiologists, but due to its increasing use within endoscopy units, programs have been developed for nonanesthesia sedationists to use propofol sedation during endoscopy procedures, typically with the sedation being given by trained endoscopists or nurses.

Several studies have demonstrated that propofol-mediated sedation is well tolerated and associated with faster recovery and discharge times compared with Bdz–O

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sedation, without an increase in adverse events.[3–6] In addition, patient satisfaction appears to be greater for those undergoing a colonoscopy who receive propofol-mediated sedation,[7] and this finding may improve patient compliance and adherence to colorectal cancer-screening and -surveillance programs.

The level of sedation under propofol-mediated sedation increases in a dose-dependent manner, and patients are generally titrated to an adequate level of sedation as required during the procedure,[8] which may improve the efficiency and quality of the procedure by providing the endoscopist with optimal conditions for a thorough visualization, while eliminating any distraction due to an uncomfortable patient. This may be translated into an enhanced adenoma/polyp-detection rate, a premier colonoscopy-quality indicator. Moreover, the more comfortable and sedated a patient is, the higher the likelihood that cecal or terminal ileum intubations can be performed, especially in technically difficult cases.[9,10] An assessment of the effect of propofol-mediated sedation on the outcome of a procedure, namely colonoscopy-quality measures, may be of paramount importance in justifying its widespread use, as controversy remains regarding the limitations concerning the setting and personnel certified to provide propofol-mediated sedation.

Methods

We conducted a large retrospective cohort study that examined consecutive patients who had undergone a colonoscopy over a 15-year period within the Gastroenterology Department at the Hillel Yaffe Medical Center, a university-affiliated hospital in Israel. All patient data were collected from the department's electronic record system, and only patients who had undergone sedated colonoscopies and had a full data set, including demographic details (age, sex), procedural setting (inpatient/outpatient), indication for exam, type and dose of sedation, quality of bowel preparation, depth of examination, and endoscopic findings, were included in the final analysis. Patients under the age of 18 years and those who had undergone prior colon resection were excluded. All patients included in the study were unselectively offered propofol-mediated or standard sedation, based mainly on performer or patient preference/experience.

Patients were divided into two groups, with all those who had been sedated using Bdz–O (midazolam/fentanyl) alone or in combination (directed by the endoscopist), representing the control group, and those who underwent propofol-mediated sedation (propofol alone or in combination with Bdz, directed either by the anesthesiologist or the endoscopist) constituting the study (propofol) group.

Polyp-detection rate, cecal intubation rate, and terminal ileum-intubation rate were examined and compared between the sedation groups and also for a subgroup analysis of patients with adequate bowel preparation only. In the propofol-sedation group, an assessment was made of the correlation between dose and examination outcome. In the same group, examination outcomes for anesthesiologist-administered propofol-mediated sedated colonoscopies were compared to endoscopist-guided propofol-mediated sedation procedures. Moreover, we compared examination outcomes for propofol-only sedation with balanced propofol sedation (use of propofol in addition to Bdz–O). A multivariate analysis was performed to adjust for the potential confounders of age, sex, quality of bowel preparation, procedural setting (outpatient/inpatient), and indications. This study was approved by the Hillel Yaffe Medical Center's local ethics committee.

Statistical analysis

Descriptive statistics in terms of means ± SD and percentages are presented for the different parameters examined. Differences between the two groups (propofol group vs control group) were compared using Fisher's exact test for categorical parameters and *t*-tests for quantitative parameters. ORs and 95% CIs were also used to analyze the differences between the two groups. Several multivariate logistic regression models were employed to determine the effect of the independent parameters associated with the polyp-detection rate, as well as terminal ileum- and cecal intubation rates. SPSS version 25 was used for the statistical analysis, and $P<0.05$ was considered significant.

Results

The records of 44,794 patients who had undergone a sedated colonoscopy at our hospital over a 15-year period (2003–2018) were examined. Colonoscopies were performed using propofol-mediated sedation in 16,992 patients (37.9%), and these patients were classified as the propofol group. In total, 15,474 (91%) of these patients received endoscopist-directed propofol-mediated sedation, 3,012 (17.6%) patients propofol-monotherapy sedation, and in 12,462 (73.4%) patients propofol combination with Bdz–O, while in 1,518 patients (9%) propofol was administered by an anesthesiology provider. The control group consisted of 27,802 patients (62.1%) who received Bdz–OP-mediated, endoscopist-directed sedation during their colonoscopy.

Baseline characteristics of both groups are summarized in Table 1. The mean age was 58.5±14.3 and 59.0±14.5 years in the control and propofol groups, respectively, and there was a

slight but insignificant predominance of males in both groups (50.9% in the control group and 51.8% in the propofol group, *P*=0.06). In both groups, the vast majority of procedures (85.1%) were performed in the outpatient setting. Overall, the most common indications for colonoscopy in both groups were abdominal pain and diarrhea (24.2%), rectal bleeding (15.3%), anemia (11.3%), and constipation (11.0%). However, although there was no prominent difference in procedure indications between the groups, a statistically significant difference was noted for several colonoscopy indications, with a greater number of procedures in the propofol group being performed for a personal history of polyps (8.6% vs 6.7%, *P*<0.01), positive fecal occult blood test (8.6% vs 6.6%, *P*<0.01), and screening (5% vs 2.4%,*P*<0.01), but fewer for rectal bleeding (12.9% vs 16.9%,*P*<0.01), family history of colorectal cancer (8.6% vs 10%, *P*<0.001) and constipation (7.3% vs 13.3%, *P*<0.001).

In terms of bowel preparation, there was a small but significant difference between groups, as patients in the control group were less adequately prepared compared to the propofol group (67.4% vs 69%, *P*<0.001). Patients who received propofol-mediated sedation were more likely to have an enhanced polyp-detection rate (22.8% vs 20.9%, *P*<0.001), cecal intubation rate (90.4% vs 87.3%, *P*<0.001), and terminal ileum-intubation rate (6.4% vs 1.6%, *P*<0.001), and this trend remained in the subgroup analysis of patients with adequate bowel preparation (Table 2). In a multivariate analysis propofol-mediated sedation was found to be significantly associated with polyp-detection rate (OR 1.08, 95% CI 1.03–1.13; *P*=0.029), cecal intubation rate (OR 1.33, 95%

Table 1 Baseline characteristics of the propofol and control sedation groups

	Control group (n=27,802)	Propofol group (n=16,992)	*P*-value
Age	58.5±14.3	59.0±14.5	
Sex (female)	13,646 (49.1%)	8,193 (48.2%)	
Setting (outpatient)	23,742 (85.4%)	14,374 (84.6%)	
Indication			
Unknown	676 (2.4%)	475 (2.8%)	0.019
Personal history of polyps	1,867 (6.7%)	1,469 (8.6%)	<0.0001
Abdominal pain/diarrhea	7,147 (25.7%)	3,690 (21.7%)	<0.0001
IBD follow-up	442 (1.6%)	306 (1.8%)	0.094
Past colonic surgery	543 (2.0%)	211 (1.2%)	<0.0001
Anemia	3,190 (11.5%)	1,872 (11.0%)	0.14
Positive FOBT	1,823 (6.6%)	1,462 (8.6%)	<0.0001
Rectal bleed	4,685 (16.9%)	2,191 (12.9%)	<0.0001
Family history of CRC	2,767 (10.0%)	1,463 (8.6%)	<0.0001
Screening	668 (2.4%)	842 (5.0%)	<0.0001
Constipation	3,704 (13.3%)	1,236 (7.3%)	<0.0001
Imaging findings	1,285 (4.6%)	617 (3.6	<0.0001
Weight loss	801 (2.9%)	465 (2.7%)	0.38

Abbreviations: CRC, colorectal cancer; FOBT, fecal occult blood test; IBD, inflammatory bowel disease.

Table 2 Endoscopic findings in both sedation groups

	Control group	Propofol group	*P*-value
Cecal intubation rate			
Overall	24,273 (87.3%)	15,368 (90.4%)	<0.0001
Adequate-preparation subgroup	17,548 (94.5%)	11,418 (97.8%)	<0.0001
Polyp-detection rate			
Overall	5,814 (20.9%)	3,879 (22.8%)	<0.0001
Adequate-preparation subgroup	3,885 (20.9%)	2,577 (22.1%)	0.016
Terminal ileum-intubation rate			
Overall	446 (1.6%)	1,085 (6.4%)	<0.0001
Adequate-preparation subgroup	321 (1.7%)	816 (7.0%)	<0.0001
Quality of bowel preparation			
Adequate	18,574 (67.4%)	11,670 (69.0%)	<0.0001
Inadequate	9,001 (32.6%)	5,233 (31.0%)	<0.0001

CI 1.25–1.42; *P*<0.001), and terminal ileum intubation rate (OR 4.72, 95% CI 4.19–5.31; *P*<0.0001).

In the propofol group, anesthesiology provider–administered propofol-mediated sedation was associated with an increased polyp-detection rate (26.3% vs 22.5%, *P*<0.01), but not with an improved cecal intubation rate (84.1% vs 91%, *P*<0.01) or terminal ileum-intubation rate (6.6% vs 3.8%, *P*<0.01). Utilizing propofol as a monosedative agent compared to propofol combined with Bdz was associated with an increased polyp-detection rate (25.7% vs 21.7%, *P*<0.01), cecal intubation rate (95% vs 91.7%, *P*<0.01), and terminal ileum-intubation rate (11.7% vs 5.4%, *P*<0.01). In addition, propofol-monotherapy sedation demonstrated a straightforward dose-dependent correlation with polyp-detection, cecal intubation, and terminal ileum-intubation rates (Figure 1).

Discussion

Cecal intubation and polyp-detection rates are considered among the most important quality indicators of colonoscopy and key measures of a quality procedure.[11] Together with terminal ileum-intubation rates, these indicators can reliably predict an examination's outcome and an endoscopist's performance. In the current study, a large cohort of patients were included who had undergone colonoscopy procedures after being sedated with propofol-mediated sedation or Bdz–O, in order to compare the sedation-related influence on procedure outcome and performance. As these quality indicators could be affected by patient demographics, bowel-preparation quality, procedure timing (inpatient/outpatient), and indication, these parameters were noted and a multivariate analysis performed to neutralize their possible effect as confounders.

The current study demonstrated a potential positive effect of propofol-mediated sedation on quality indicators and enhanced endoscopist performance compared to standard sedation. Propofol-mediated sedation was significantly associated with an enhanced polyp-detection rate, increased cecal intubation rate, and was associated with the performance of a greater number of terminal ileum intubations. To the best of our knowledge, this is the first study to demonstrate such a positive association between propofol-mediated sedation and colonoscopy outcomes.

In a study by Wang et al,[12] which compared mild–moderate sedation with Bdz–O to deeper sedation levels with propofol, it was reported that it was 25% more likely to detect an advanced lesion with propofol-mediated sedation. However, Thirumurthi et al[13] demonstrated that deep sedation achieved via propofol did not significantly improve the polyp-detection or cecal intubation rate in initial average risk-screening colonoscopies compared to moderate sedation. Other studies

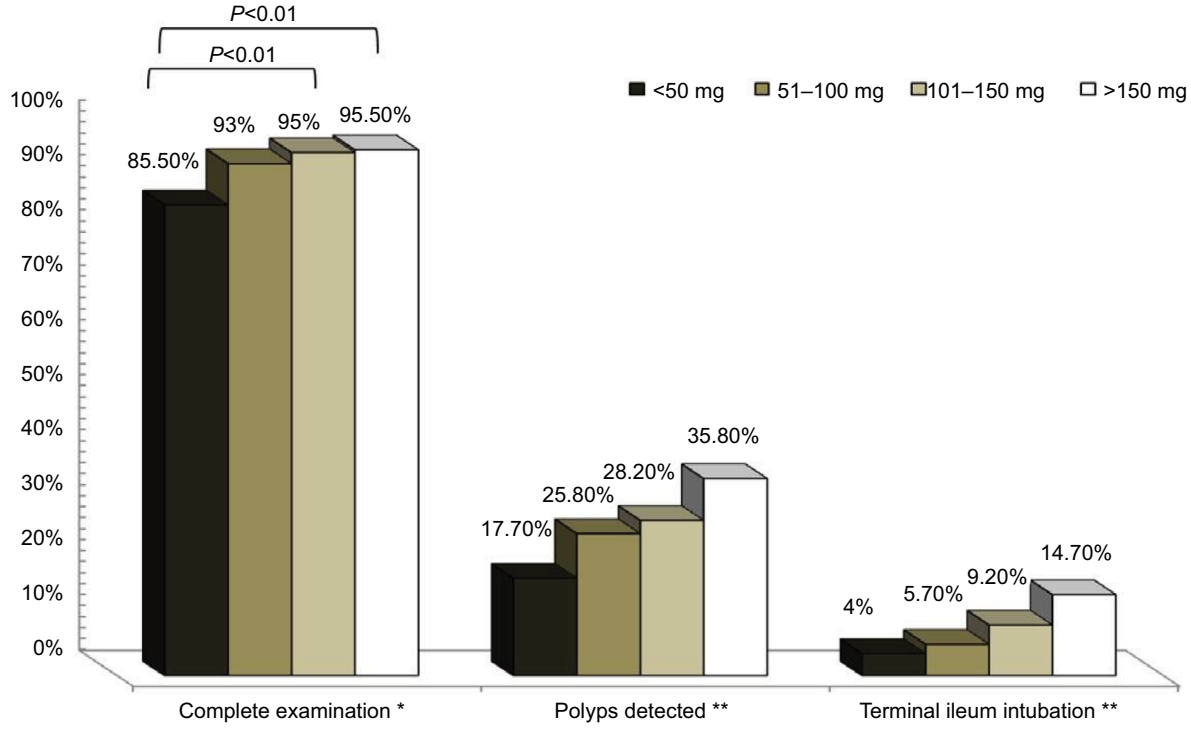

Figure 1 Correlations between propofol dose and colonoscopy-quality indicators.
Notes: Propofol monotherapy improved colonoscopy-quality indicators in a dose-dependent manner. *P<0.01; **P<0.01.

have similarly provided conflicting results, mainly reporting no apparent difference in the overall polyp-detection rate or cecal intubation rate.[14–16]

In recent years, endoscopist-directed propofol-mediated sedation has been practiced safely and widely, and there is a growing body of evidence that demonstrates this practice to be safe, with no statistically significant increases in adverse events compared to other sedation regimens.[17] Moreover, propofol-mediated sedation may boost surveillance and screening programs, as it has been found to be clearly associated with improved patient satisfaction.[18] However, despite these advantages, the recent trend toward increased anesthesia involvement in endoscopic procedures, the increased cost, the numerous constraints issued by several gastroenterology and anesthesiology societies, and regional regulations on propofol-mediated sedation utilization during colonoscopies may limit the use of propofol. The American Society of Anesthesiologists and other anesthesiology societies continue to maintain that propofol-mediated sedation should be managed only by anesthesia providers,[19–21] yet according to the recent guidelines issued by the American Society for Gastrointestinal Endoscopy on sedation and anesthesia during a gastrointestinal endoscopy, endoscopist use of propofol-based sedation is recommended when it is expected to improve a patient's safety and comfort and procedural efficiency.[22]

Many endoscopists believe that patient satisfaction regarding the use of propofol is not sufficient to justify its routine use in endoscopic procedures without an established effect on the procedure's outcomes and efficiency. Therefore, our study's findings suggesting a possible favorable effect on colonoscopy performance and outcome are of paramount importance and should be taken into account when determining the policy for sedation during colonoscopies. Given the favorable safety profile and patient satisfaction, our findings may support the adoption of propofol-mediated sedation as the sedation of choice during colonoscopy procedures, and this may help ease the regulations and constraints limiting its use. However, prospective and randomized trials are needed to support and confirm these findings.

In the current study, a subgroup analysis of the propofol-mediated sedation group focusing on propofol monotherapy demonstrated a direct dose-dependent association with endoscopic findings and performance (Figure 1). Therefore, dose limitation is not advisable, and monitoring the level of consciousness and patient discomfort should be performed continuously throughout the procedure, with the dose titrated accordingly to maintain the level of sedation. Moreover, a further subgroup analysis showed that balanced propofol sedation (use of propofol in addition to Bdz–O) did not improve quality indicators compared to propofol monotherapy. While balanced propofol sedation is preferred, as it reduces the risk of oversedation according to some reports,[22,23] in our experience propofol monotherapy is easily handled, less associated with respiratory depression, and enables predictable and rapid recovery.

In this study, we have demonstrated that propofol-mediated sedation administered by an anesthesia provider was associated with a significantly enhanced polyp-detection rate, but was associated with lower cecal intubation and terminal ileum-intubation rates compared to endoscopist-directed propofol-mediated sedation. Potential advantages of anesthesia provider–administered sedation may include improved monitoring and decreased distractions for endoscopists. However, anesthesiology-service involvement increases the cost of a procedure and may not be warranted in low-risk patients and procedures, as several studies have demonstrated that there is no added safety benefit.[24,25]

Limitations

This study has limitations inherent in its retrospective nature. Other confounders influencing the quality indicators, such as endoscopists' experience and withdrawal times, were not included, and these may have affected the results. Moreover, the size of polyps and their histological data were not considered. Although the adenoma-detection rate is judged to be more reliable and has been widely studied, we preferred to use the polyp-detection rate, as it is easily utilized and was readily available from the colonoscopy reports, obviating the need for incorporating endoscopy and pathology reports. The current study was not designed to address safety issues associated with propofol-mediated sedation, as this has been studied extensively and validated in previous studies, as discussed earlier.[17]

Conclusion

Our study demonstrates that propofol-mediated sedation use is associated with enhanced colonoscopy-quality indicators. However, large prospective or randomized control trials are warranted to confirm these findings.

Ethical approval

The study protocol conformed with the ethical guidelines of the 1980 Declaration of Helsinki and was approved by the Hillel Yaffe Medical Center Ethics Committee (0013-18HYMC). The committee waived the need to obtain consent for the collection, analysis, and publication of the retrospectively obtained and anonymized data for this noninterventional study.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Smith I, White PF, Nathanson M, Gouldson R. Propofol. An update on its clinical use. *Anesthesiology*. 1994;81(4):1005.
2. Shafer SL. Advances in propofol pharmacokinetics and pharmacodynamics. *J Clin Anesth*. 1993;5(6):14–21.
3. Ulmer BJ, Hansen JJ, Overley CA, et al. Propofol versus midazolam/fentanyl for outpatient colonoscopy: administration by nurses supervised by endoscopists. *Clin Gastroenterol Hepatol*. 2003;1(6):425–432.
4. Sipe BW, Scheidler M, Baluyut A, Wright B. A prospective safety study of a low-dose propofol sedation protocol for colonoscopy. *Clin Gastroenterol Hepatol*. 2007;5(5):563–566.
5. Singh H, Poluha W, Cheung M, et al. Propofol for sedation during colonoscopy. *Cochrane Database Syst Rev*. 2008;(4):CD006268.
6. Wang D, Chen C, Chen J, et al. The use of propofol as a sedative agent in gastrointestinal endoscopy: a meta-analysis. *PLoS One*. 2013;8(1):e53311.
7. Padmanabhan A, Frangopoulos C, Shaffer LET. Patient satisfaction with propofol for outpatient colonoscopy: a prospective, randomized, double-blind study. *Dis Colon Rectum*. 2017;60(10):1102.
8. Ramsay MAE, Newman KB, Jacobson RM, et al. Sedation levels during propofol administration for outpatient colonoscopies. *Proc*. 2014;27(1):12–15.
9. Bannert C, Reinhart K, Dunkler D, et al. Sedation in screening colonoscopy: impact on quality indicators and complications. *Am J Gastroenterol*. 2012;107(12):1837–1848.
10. Radaelli F, Meucci G, Sgroi G, Minoli G, Italian Association of Hospital Gastroenterologists (AIGO). Technical performance of colonoscopy: the key role of sedation/analgesia and other quality indicators. *Am J Gastroenterol*. 2008;103(5):1122–1130.
11. Rex DK, Schoenfeld PS, Cohen J, et al. Quality indicators for colonoscopy. *Gastrointest Endosc*. 2015;81(1):31–53.
12. Wang A, Hoda KM, Holub JL, Eisen GM. Does level of sedation impact detection of advanced neoplasia? *Dig Dis Sci*. 2010;55(8):2337–2343.
13. Thirumurthi S, Raju GS, Pande M, et al. Does deep sedation with propofol affect adenoma detection rates in average risk screening colonoscopy exams? *World J Gastrointest Endosc*. 2017;9(4):177–182.
14. Paspatis GA, Tribonias G, Manolaraki MM, et al. Deep sedation compared with moderate sedation in polyp detection during colonoscopy: a randomized controlled trial. *Colorectal Dis*. 2011;13(6):e137–e144.
15. Nakshabendi R, Berry AC, Munoz JC, John BK. Choice of sedation and its impact on adenoma detection rate in screening colonoscopies. *Ann Gastroenterol*. 2016;29(1):50–55.
16. Metwally M, Agresti N, Hale WB, et al. Conscious or unconscious: the impact of sedation choice on colon adenoma detection. *World J Gastroenterol*. 2011;17(34):3912–3915.
17. Wang D, Chen C, Chen J, et al. The use of propofol as a sedative agent in gastrointestinal endoscopy: a meta-analysis. *PLoS One*. 2013;8(1):e53311.
18. Singh H, Poluha W, Cheung M, et al. Propofol for sedation during colonoscopy. *Cochrane Database Syst Rev*. 2008;(4):CD006268.
19. Vargo JJ, Cohen LB, Rex DK, Kwo PY. Position statement: nonanesthesiologist administration of propofol for Gi endoscopy. *Am J Gastroenterol*. 2009;104(12):2886–2892.
20. Perel A. Non-anaesthesiologists should not be allowed to administer propofol for procedural sedation: a consensus statement of 21 European national societies of anaesthesia. *Eur J Anaesthesiol*. 2011;28(8):580–584.
21. Pelosi P. Retraction of endorsement: European Society of Gastrointestinal Endoscopy, European Society of Gastroenterology and Endoscopy Nurses and Associates, and the European Society of Anaesthesiology guideline: non-anesthesiologist administration of propofol for Gi endoscopy. *Endoscopy*. 2012;44(3):302.
22. Early DS, Lightdale JR, Vargo JJ, et al. Guidelines for sedation and anesthesia in GI endoscopy. *Gastrointest Endosc*. 2018;87(2):327–337.
23. Cohen LB, Hightower CD, Wood DA, Miller KM, Aisenberg J. Moderate level sedation during endoscopy: a prospective study using low-dose propofol, meperidine/fentanyl, and midazolam. *Gastrointest Endosc*. 2004;59(7):795–803.
24. Cooper GS, Kou TD, Rex DK. Complications following colonoscopy with anesthesia assistance: a population-based analysis. *JAMA Intern Med*. 2013;173(7):551–556.
25. Wernli KJ, Brenner AT, Rutter CM, Inadomi JM. Risks associated with anesthesia services during colonoscopy. *Gastroenterology*. 2016;150(4):888–894.