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World Journal of Gastrointestinal Endoscopy
Baishideng Publishing Group Inc
8226 Regency Drive, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
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Retrospective Study

Does deep sedation with propofol affect adenoma detection rates in average risk screening colonoscopy exams?

Selvi Thirumurthi, Gottumukkala S Raju, Mala Pande, Joseph Ruiz, Richard Carlson, Katherine B Hagan, Jeffrey H Lee, William A Ross

Selvi Thirumurthi, Gottumukkala S Raju, Mala Pande, Jeffrey H Lee, William A Ross, Department of Gastroenterology, Hepatology and Nutrition, University of Texas MD Anderson Cancer Center, Houston, TX 77030, United States

Joseph Ruiz, Richard Carlson, Katherine B Hagan, Department of Anesthesiology and Peri Operative Medicine, University of Texas MD Anderson Cancer Center, Houston, TX 77030, United States

Author contributions: Thirumurthi S performed the research and wrote the paper; Raju GS and Lee JH provided clinical advice and reviewed the manuscript; Pande M performed the statistical analysis; Ruiz J, Carlson R and Hagan KB reviewed the manuscript; Ross WA designed the study, performed the research, reviewed and edited the manuscript.

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Correspondence to: William Ross, MD, Professor, Department of Gastroenterology, Hepatology and Nutrition, University of Texas MD Anderson Cancer Center, 1515 Holcombe Boulevard Unit 1466, Houston, TX 77030, United States. wross@mdanderson.org
Telephone: +1-713-7944073
Fax: +1-713-7944421

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Abstract

AIM

To determine the effect of sedation with propofol on adenoma detection rate (ADR) and cecal intubation rates (CIR) in average risk screening colonoscopies compared to moderate sedation.

METHODS

We conducted a retrospective chart review of 2604 first-time average risk screening colonoscopies performed at MD Anderson Cancer Center from 2010-2013. ADR and CIR were calculated in each sedation group. Multivariable regression analysis was performed to adjust for potential confounders of age and body mass index (BMI).

RESULTS

One-third of the exams were done with propofol ($n = 874$). Overall ADR in the propofol group was significantly higher than moderate sedation (46.3% vs 41.2%, $P =$

0.01). After adjustment for age and BMI differences, ADR was similar between the groups. CIR was 99% for all exams. The mean cecal insertion time was shorter among propofol patients (6.9 min *vs* 8.2 min; $P < 0.0001$).

CONCLUSION

Deep sedation with propofol for screening colonoscopy did not significantly improve ADR or CIR in our population of average risk patients. While propofol may allow for safer sedation in certain patients (*e.g.*, with sleep apnea), the overall effect on colonoscopy quality metrics is not significant. Given its increased cost, propofol should be used judiciously and without the implicit expectation of a higher quality screening exam.

Key words: Sedation; Propofol; Adenoma detection rate; Cecal intubation rate; Colonoscopy; Quality metrics

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Core tip: This is a retrospective study to evaluate the effect of propofol deep sedation *vs* opioid/benzodiazepine moderate sedation on adenoma detection rate (ADR) and cecal intubation rate (CIR) colonoscopy quality metrics. After adjusting for confounding variables of age, gender and body mass index, there was no difference seen in ADR or CIR between the two groups.

Thirumurthi S, Raju GS, Pande M, Ruiz J, Carlson R, Hagan KB, Lee JH, Ross WA. Does deep sedation with propofol affect adenoma detection rates in average risk screening colonoscopy exams? *World J Gastrointest Endosc* 2017; 9(4): 177-182 Available from: URL: <http://www.wjgnet.com/1948-5190/full/v9/i4/177.htm> DOI: <http://dx.doi.org/10.4253/wjge.v9.i4.177>

INTRODUCTION

In the United States endoscopic procedures routinely utilize sedation to minimize patient discomfort. Today, moderate sedation is widely used, with a combination of opioid and benzodiazepine for amnestic and analgesic effects^[1]. In recent years endoscopists have increasingly turned to deep sedation provided by anesthesiologists using propofol although significant regional differences in utilization exist^[2]. Between 2008 and 2011, one third of colonoscopies were performed using anesthesia services^[3]. Propofol provides sedative, amnestic and hypnotic effects but does not have analgesic properties.

Propofol is gaining popularity among United States endoscopists in part due to its rapid onset of action and faster patient recovery^[4]. In a nationwide survey, physicians under age 65 used propofol in their practice more frequently and were more satisfied with propofol over moderate sedation compared to older physicians^[5]. Half of the physicians in this survey favored propofol sedation for their own endoscopy as they felt that this

would improve the quality of the exam^[5]. However, the data on patient satisfaction compared with conscious sedation are mixed with a recent meta-analysis showing no difference^[6].

Adenoma detection rate (ADR) is the premier quality indicator in screening colonoscopy and is inversely related to the risk of interval colorectal cancer development and death^[7,8]. Since some gastroenterologists perceive that propofol sedation improves the quality of the exam, investigators have evaluated the effect of sedation on ADR. While multiple studies have compared varying levels of sedation to no sedation and found conflicting results in terms of exam quality^[9,10] other studies have compared different levels of sedation to each other. However, these studies either did not utilize propofol^[11], did not describe the level sedation achieved with various agents^[12], or gave conflicting results^[13]. Thus the question of whether deep sedation with propofol improves ADR when compared to moderate sedation with benzodiazepines/opioids remains unresolved.

Adenoma detection depends on the entire colon being examined, therefore cecal intubation rate (CIR) is another quality parameter in screening colonoscopy. The more comfortable the patient is, the higher likelihood that the cecum will be reached especially in technically difficult cases. In general, the use of any level of sedation has improved the rates of cecal intubation over unsedated exams^[9,10]. In one study using propofol for sedation, CIR was 98% and incomplete exams were associated with patient history of constipation and poor bowel prep^[14].

Given the recent trend toward increased anesthesia involvement in endoscopy and the added cost, the current emphasis on value in health care services makes it worthwhile to evaluate the relationship between deep sedation and colonoscopy quality metrics. Our primary outcome was to determine the effect of deep sedation with propofol (total intravenous anesthesia, TIVA) compared to moderate sedation on ADR in a population of average-risk patients presenting for their index screening colonoscopy. Our secondary aim was to determine any differences in cecal intubation rates between these two sedation groups.

MATERIALS AND METHODS

We performed a retrospective chart review of all average risk patients aged 50 to 75 undergoing initial screening colonoscopy between July 2010 and May 2013 at the University of Texas MD Anderson Cancer Center. Patients who have had prior exams often cannot recall the pertinent details (whether adenomas were removed, if the exam was complete, preparation quality, *etc.*) in addition the risk of adenomas increases with patient age. Therefore based on chart review, we excluded patients who had undergone a prior colonoscopy to get a homogenous group of patients to determine ADR. High-risk patients (*i.e.*, with a family history of colon cancer or genetic syndromes), diagnostic exams (done

for evaluation of symptoms) and patients who had undergone prior colon resection were excluded. Patients with a personal history of non-gastrointestinal cancers were included. In our group practice, the endoscopy time assigned to TIVA or moderate sedation use can vary between physicians. Endoscopists who performed less than 20 exams in either sedation group during the study period were excluded from analysis. This was done to evaluate a group of physicians who had contributed to both sedation groups to minimize bias and obtain accurate ADRs^[15]. Full time faculty with endoscopic experience ranging from one year to 25 years post fellowship training performed all exams. All patients received a standard split dose bowel to optimize the quality of bowel prep^[16]. Our Institutional Review Board approved this study. Informed consent was not required for this retrospective study, data was collected in a de-identified manner and in the course of usual patient management.

Patients are referred to our endoscopy unit for screening exams after being evaluated in a cancer prevention center, gastroenterology clinic, or by other MD Anderson clinics. These referrals are reviewed within our department and the patients are scheduled with moderate sedation or TIVA based on uniform criteria. Our criteria for TIVA mirror those of the American Society for Gastrointestinal Endoscopy and fall into three categories: (1) pulmonary (e.g., increased risk of airway obstruction or aspiration, documented sleep apnea with use of continuous positive airway pressure device); (2) co-morbid conditions (e.g., BMI \geq 35, cardiac disease such as arrhythmia, pacemaker, decompensated heart failure, myocardial infarction within 6 mo, etc.); or (3) anticipated intolerance of moderate sedation (e.g., scheduled use of narcotics or benzodiazepines or patient preference)^[4]. Moderate sedation consisted of intravenous midazolam and either meperidine or fentanyl under the direction of the endoscopist with routine monitoring. Deep sedation was the target for TIVA patients. In addition to routine monitoring of blood pressure, EKG, and use of nasal cannula oxygen, TIVA patients were also monitored with end-tidal capnography.

Two investigators (WR and ST) performed data collection from the electronic medical record to identify patients for inclusion. Demographic information including age, gender, race and BMI were recorded for each patient. Transcribed clinic notes were reviewed to determine family history, presence of symptoms at the time of colonoscopy and reports of prior colonoscopy exams. Procedure notes and the endoscopy reporting software database (Endoworks Olympus Inc. Center Valley, PA, United States) were examined to determine method of sedation, insertion time to the cecum and scope withdrawal time (which are marked by the endoscopy technician during the procedure) as well as the number of polyps removed. The software system default for bowel prep quality is set to good/adequate and the physician must make the effort to change it.

Since there is variability among our endoscopists in doing this, we did not specifically collect this data point. We used CIR as a surrogate marker for adequacy of bowel prep. Pathology reports were reviewed to record polyp histology (hyperplastic, adenoma, sessile serrated adenoma, or adenocarcinoma).

ADR was calculated for male and female patients by method of sedation. Statistical analysis was performed using the chi-square test for categorical variables and *t* test for continuous variables. Multivariable logistic regression analysis was performed to determine the effect of TIVA vs moderate sedation on ADR for male and female patients. The analyses were adjusted for potential confounders, namely BMI and age^[17,18]. The relationship between the depths of sedation and CIR, as well as scope insertion times was evaluated. Pearson's correlation coefficient was calculated to assess for any relationship between ADR and the proportion of TIVA procedures performed by each endoscopist. We did not perform any additional provider-level analyses (such as ADR by years in clinical practice) because of unequal sub-group distribution of physicians in our practice.

RESULTS

A total of 2604 first-time screening colonoscopies were performed during the study period. The majority were done under moderate sedation ($n = 1730$, 66.4%; TIVA: $n = 874$, 33.6%). Female patients outnumbered male patients ($n = 1681$ and $n = 926$ respectively) and most patients were non-Hispanic whites (Table 1). Patients in the TIVA group had a significantly higher BMI and were older than the moderate sedation group as expected based on our allocation criteria. Adenomas were detected in 1118 exams while 1486 patients had negative exams. Of these, approximately 9% of patients had advanced adenomas and 6% had sessile serrated adenomas.

The overall ADR was higher in the TIVA group than the moderate sedation group (46.3% vs 41.2% $P = 0.01$). The ADR was significantly higher among female patients undergoing exams with TIVA compared to moderate sedation (42.4% vs 36.4% $P = 0.03$). There was no significant difference in ADR in male patients between the TIVA and moderate sedation groups (53.7% vs 50.4% $P = \text{NS}$). Detection of sessile serrated adenomas and advanced adenomas was similar between the two groups. Multivariate analysis was performed to adjust for potential confounders (i.e., age and BMI)^[17]. There was no significant difference in ADR in either male or female patients between the study groups after multivariable analysis (Table 2).

Cecal intubation rates were evaluated for the study group. CIR was 99.0% overall and similar between sedation groups (98.8% moderate sedation, 99.4% TIVA, $P = 0.15$). Failure to reach the cecum was more common among female patients ($n = 15$ of 19 incomplete exams). The most common reason for an incomplete colonoscopy was poor bowel prep,

Table 1 Patient characteristics by type of sedation

	Moderate sedation, n (%)	Propofol sedation, n (%)	P value
Total	1730 (66.4)	874 (33.6)	
Gender			0.16
Female	1133 (67.4)	548 (32.6)	
Male	597 (64.7)	326 (35.3)	
Race			< 0.0001
Non-Hispanic White	1190 (66.2)	607 (33.8)	
African American	166 (55.7)	132 (44.3)	
Hispanic	186 (65.5)	98 (34.5)	
Asian	172 (83.9)	33 (16.1)	
Unknown	16 (80.0)	4 (20.0)	
BMI			< 0.0001
< 25	617 (81.8)	137 (18.2)	
25-30	645 (76.0)	204 (24.0)	
> 30	451 (45.8)	533 (54.2)	
Missing	17 (100)	0 (0)	
Mean age (SD)	55.4 (5.3)	56.7 (5.9)	< 0.0001
Adenoma			0.01
No	1017 (58.8)	469 (53.7)	
Yes	713 (41.2)	405 (46.3)	
Mean insertion time, min (SD)	8.2 (6.5)	6.9 (4.7)	< 0.0001
Mean scope withdrawal time, min (SD)	12.8 (6.3)	12.6 (6.6)	0.75
Advanced adenoma detection rate (SD)	134 (7.8)	95 (10.4)	0.065
Sessile serrated adenoma detection rate (SD)	106 (6.1)	54 (5.9)	0.52

followed by technical difficulty (adhesions, fixed angulations, redundant colon). Three patients in the moderate sedation group had an incomplete exam due to inadequate sedation (pain during the procedure, paradoxical reaction to medication). In these cases, examination of the colon was completed by CT colonography or repeat colonoscopy with TIVA.

The mean scope insertion time to the cecum was calculated for complete exams and was significantly shorter among patients in the TIVA group compared to moderate sedation (6.9 min vs 8.2 min; $P < 0.0001$). Within the TIVA group, mean insertion times were longer for female patients compared to male patients (7.3 min vs 6.3 min; $P = 0.003$). Use of TIVA was associated with a significantly shorter scope insertion time to cecum among both females (OR = 0.96, 95%CI: 0.94-0.97, $P < 0.001$) and males (OR = 0.96, 95%CI: 0.60-0.99, $P = 0.02$) and remained significant even after adjusting for age and BMI (Table 2). Scope withdrawal times were similar for the TIVA and moderate sedation groups for exams done without polypectomy ($P = 0.919$, mean 12.6 min vs 12.8 min respectively, $P = 0.75$). The proportion of TIVA procedures performed by each endoscopist had no correlation with the ADR the physician achieved ($R = 0.11$).

DISCUSSION

Our group aimed to evaluate the effect of deep sedation with propofol compared to moderate sedation on ADR and CIR in our clinical setting. The overall ADR for our

group was 40.9% for moderate sedation and 46.1% for TIVA cases, higher than commonly reported rates and higher than the recently modified national society performance targets of 20% ADR for women and 30% for men^[8]. Although our reported ADR is higher than generally expected, comparable rates are seen in high performers^[19]. Our initial analysis found a significantly higher ADR among female patients having exams with TIVA but no difference among male patients. After adjusting for age and BMI, there was no difference in ADR among male or female patients regardless of the type of sedation. CIR was 99% in both sedation groups.

Although previous investigators have studied the effect of sedation on colonoscopy quality metrics, there are several important distinctions in our study^[9-11]. One of our strengths is that we specifically compare propofol for deep sedation vs an opioid/benzodiazepine combination to achieve moderate sedation and is reflective of clinical practice. The depth of sedation achieved with this cocktail can be variable while propofol reliably induces deep sedation. Another strength is our homogenous patient population best suited to evaluate ADR among average-risk patients undergoing their first screening colonoscopy. Other studies were performed among higher risk patients presenting for colonoscopy by virtue of positive symptoms, prior adenoma, older age, positive family history, etc. which influence adenoma prevalence^[10-12]. Our group had more female than male patients presenting for screening colonoscopy which supports existing literature^[20].

The decision to perform colonoscopy with moderate vs deep sedation is often left to a practitioner's clinical judgment and this variability can affect study outcomes. We consistently applied our department's criteria in selecting patients for exams with TIVA, to ensure uniform patient selection for the sedation groups. While we recognize that our specific criteria are not used universally, we feel that they are fairly generalizable (age, comorbidity, BMI) and done with the patients' safety in mind. While random assignment is ideal, it does not reflect clinical practice.

We realize that our study has limitations. This was a retrospective study with the limitations inherent in that design. While we are a tertiary care center, MD Anderson has a Cancer Prevention and Screening clinic. As a result, over half of our colon cancer screening practice consists of patients without a prior cancer history. While we included patients with a prior history of cancer, we excluded those with a prior gastrointestinal malignancy in order to reduce bias. We feel that survivors of non-gastrointestinal malignancies and are representative of the patients seen in general clinical practice. In addition, we have previously demonstrated that there was no difference in the ADR between patients without a cancer history and those with a history of non-gastrointestinal malignancy^[21]. There may be additional unmeasured confounders or selection bias present. Sedation may have an effect on detection of right sided vs left sided lesions but our database did not allow us to investigate

Table 2 Multivariable analysis: Association of type of sedation (propofol *vs* moderate) with adenoma detection rate and scope insertion time

Variable		Propofol, <i>n</i> (%)	Crude odds ratio (95%CI)	<i>P</i> value	Adjusted odds ratio ¹ (95%CI)	<i>P</i> value
Adenoma detection						
Gender	Female	548 (32.6)	1.27 (1.03-1.56)	0.03	1.07 (0.84-1.35)	0.60
	Male	326 (35.3)	1.14 (0.87-1.49)	0.34	1.16 (0.87-1.55)	0.32
Scope insertion time, mean (SD)						
Gender	Female	7.3 (5.0)	0.96 (0.94-0.97)	< 0.001	0.97 (0.95-0.99)	0.02
	Male	6.3 (4.2)	0.96 (0.60-0.99)	0.02	0.97 (0.93-1.00)	0.05

¹Adjusted for patient age and body mass index.

this further.

Ease of scope insertion to the cecum and performing a deliberate exam during scope withdrawal are important factors for a quality exam^[22]. In addition to overall CIR, we also evaluated mean scope insertion times and scope withdrawal times. The mean insertion time to the cecum was significantly shorter in our TIVA group. Investigators have shown that scope insertion to the cecum takes longer for female patients than male patients and this was confirmed in our study^[23-26]. Increasing patient age and BMI are other well-recognized factors that independently prolong scope insertion time^[23-26]. When adjusted for these factors, the scope insertion times were shorter with deep sedation compared to moderate sedation only in females. Our scope withdrawal times were similar between the two sedation groups for normal exams. One limitation is that polyp removal time was not separately recorded from insertion or withdrawal time. We assume that the endoscopist's preference of polypectomy during insertion or withdrawal would be performed consistently regardless of the method of sedation. Reaching the cecum more quickly could allow for additional time for inspection and increased polyp detection in the deep sedation group, but this was not seen. Apart from patient and procedure-related factors that affect ADR, the endoscopist themselves may have a greater impact on ADR than patient age or gender^[27]. Therefore we wanted to determine if there was a correlation between the proportion of TIVA procedures performed by an individual endoscopist and their ADR. No such correlation was seen in our study.

Although the majority of propofol sedation is done safely, some have reported increased complications with deep sedation^[3,28]. This may be a reflection of patient selection as regions of the country with more selective use of propofol show the highest complication rates compared to moderate sedation^[3]. In areas where propofol is used indiscriminantly, the complication rates are more modest. While the participation of anesthesiologists can expand the population that can undergo endoscopy safely, the use of propofol for routine procedures and, in some centers, without specific medical justification, contributes to escalating healthcare costs^[2]. We were not able to demonstrate an improvement in screening colonoscopy quality metrics with the use of propofol sedation. The additional expense of propofol may not be fully mitigated by enhanced

efficiency^[29]. In these times of heightened concern for value in health care expenditures, the effect of propofol use for endoscopic sedation on patient outcomes deserves further study.

COMMENTS

Background

Screening colonoscopy exams are being performed with deep sedation using propofol with increasing frequency in the United States. The authors aimed to determine if there was any effect of deep sedation (compared to moderate sedation) on colonoscopy quality metrics, specifically adenoma detection rates and cecal intubation rates.

Research frontiers

Although previous investigators have studied the effect of sedation on colonoscopy quality metrics, there are several important distinctions in this study. One of the strengths of this study is that we specifically compare propofol for deep sedation to opioid/benzodiazepine combination for moderate sedation which is reflective of clinical practice. This study inclusion criteria allowed us to identify average risk patients undergoing first-time screening colonoscopy, a homogenous group to evaluate adenoma detection rate.

Applications

Physicians using anesthesia services for propofol administration during elective screening colonoscopy should not have the expectation that this will improve the quality of their exam. Deep sedation with propofol did not affect adenoma detection rate in this retrospective study.

Peer-review

This is a retrospective study looking at a single institution's experience with colonoscopy using deep sedation with propofol or moderate sedation, and its impact on adenoma detection rate and other colonoscopy metrics such as completion rate, insertion time, and withdrawal time.

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