
ORIGINAL ARTICLE

Comparison of Propofol–Lidocaine and Propofol–Fentanyl for Total Intravenous Anesthesia during Day–Case Colonoscopy: A Randomized Controlled Trial**Kanittha Nakkarin, M.D., Niyada Paiklai, R.N., Poodis Keawsiri, R.N.**

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ABSTRACT

BACKGROUND: Colonoscopy is generally considered an uncomfortable procedure.**OBJECTIVES:** To compare recovery time, intraoperative adverse events, and total propofol consumption between propofol-lidocaine and propofol-fentanyl regimens for day-case colonoscopy.**METHODS:** This randomized, double-blind, controlled study was conducted in 60 patients with American Society of Anesthesiologists (ASA) physical status I–II, aged 18–64 years and of either sex. Thirty patients were randomly assigned to each group. The propofol-fentanyl (PF) group received fentanyl 1 µg/kg, whereas the propofol-lidocaine (PL) group received lidocaine 1.5 mg/kg intravenously, followed by induction with propofol 1 mg/kg. Hemodynamic parameters, intraoperative adverse events, total propofol consumption, and recovery time were assessed.**RESULTS:** The PL group had a longer recovery time (4.2 (2.5–7.5) vs. 2.4 (2.1–4.4) min; $p=0.027$), greater total propofol consumption (170 (130–200) vs. (130 (90–180) mg; $p=0.005$), and longer induction time (67 (54–94) sec vs. 47 (37–66) sec; $p=0.002$) than the PF group. Adverse events were comparable. The reduction in mean arterial pressure from baseline during the first 7.5 min after induction was significantly less pronounced in the PL group.**CONCLUSIONS:** Propofol-lidocaine TIVA was associated with longer induction and recovery times and greater total propofol consumption than propofol-fentanyl, while intraoperative adverse events were comparable between groups. Lidocaine attenuated the severity of hypotension during early induction.**KEYWORDS:** lidocaine, propofol-lidocaine, propofol-fentanyl, colonoscopy, recovery time

INTRODUCTION

Colonoscopy is a painful and uncomfortable procedure resulting in anxiety and fear associated with reduced completion rates¹. The pain during colonoscopy primarily results from the stimulation of visceral pain receptors when the colon wall, ligaments, and peritoneum are stretched¹. Sedation administration is recommended for patients undergoing colonoscopy to relieve patient anxiety and discomfort, improve the outcome of the procedure, and prevent traumatic memories². Propofol is a potent sedative-hypnotic agent commonly used for TIVA during colonoscopy due to its rapid onset and recovery; however, it lacks analgesic effects and may cause cardiovascular complications and respiratory depression³. Although fentanyl, a strong opioid with rapid onset and short duration of action⁴, reduces propofol requirements and enhances analgesia when co-administered with propofol, this combination may increase the risk of bradycardia, hypoxia, and apnea⁵. Dexmedetomidine and ketamine are reported to be used as adjuncts to propofol for reducing respiratory and cardiovascular complications. Nevertheless, dexmedetomidine increases the incidence of hypotension and bradycardia, while ketamine causes hallucinations after the procedure and prolongs the recovery time^{4,6}.

Lidocaine is a local anesthetic agent. Intravenous administration of 1.5 mg/kg as a loading dose followed by 2 mg/kg/h intraoperative infusion in patients undergoing abdominal surgery can reduce the duration of ileus and provide better postoperative pain control compared with placebo without local anesthetic systemic toxicity⁷. Several studies have demonstrated that lidocaine results in a significant reduction in propofol requirements during colonoscopy and gastroscopy^{3,5,8-10}. Although lidocaine has been studied as an adjunct to propofol-fentanyl or ketamine

regimens, propofol-lidocaine alone has not been evaluated for colonoscopy.

The primary objective of this study was to compare the recovery time of the propofol-lidocaine regimen with that of the propofol-fentanyl regimen. The secondary objective was to evaluate intraoperative adverse events, i.e., hypotension, oxygen desaturation, bradycardia, and propofol consumption.

METHODS

This prospective, randomized, double-blind, controlled study was registered with the Thai Clinical Trials Registry (TCTR20260121002) and conducted in accordance with the Declaration of Helsinki and the International Council for Harmonisation – Good Clinical Practice (ICH-GCP) at Kumphawapi Hospital, Udon Thani, Thailand, from May 2025 to July 2025. Following approval by the Institutional Ethics Committee (KPEC 22/2025), all patients were informed about the study and provided written consent to participate.

Study Population

Sixty patients with American Society of Anesthesiologists (ASA) physical status I–II, aged 18–64 years and of either sex, who underwent day-case colonoscopy were enrolled in the study. Exclusion criteria were patients who refused to participate or could not communicate with the researcher; contraindication to any study drugs; pregnancy or lactation; cardiovascular disease such as ischemic heart disease, hypertension, or arrhythmia; body mass index (BMI) >30 kg/m²; obstructive sleep apnea (OSA); chronic obstructive pulmonary disease (COPD); history of epilepsy or seizure disorder; use of hypnotic drugs; glomerular filtration rate (GFR) <45 mL/min/1.73 m²; cirrhosis Child-Pugh B–C, and family history of suspected malignant hyperthermia.

Randomization and Interventions

The 60 patients who met the inclusion and

exclusion criteria were randomly allocated to two equal groups using a block-of-four randomization method generated by a computer (<https://www.sealedenvelope.com/simple-randomiser/v1/lists>) and concealed using sealed envelopes. The propofol-lidocaine group (PL) received lidocaine 1.5 mg/kg (preservative-free), while the propofol-fentanyl group (PF) received fentanyl 1 µg/kg intravenously. The study drugs were prepared in 10-mL syringes and diluted to 10 mL by a research assistant who was not involved in patient care. The patients, endoscopists, and anesthesiologists were blinded to the group allocation and drug preparation. Prior to anesthesia induction, all patients received 5 mL/kg of Ringer's acetate infusion within 15 minutes. Standard monitoring, including electrocardiogram (EKG), non-invasive blood pressure (NIBP), and peripheral oxygen saturation (SpO₂), was applied to all patients. Then, 3 L/min of oxygen was continuously inhaled via nasal cannula. The study drug was administered as a slow bolus over 2 minutes according to randomization as a single dose. Two minutes later, anesthesia was induced with propofol 1 mg/kg (Propofol®-Lipuro; B. Braun, Melsungen, Germany) injected over 20 sec and titrated until the patient lost consciousness (inability to respond to verbal commands and loss of eyelash reflex); thereafter, propofol was administered as a bolus. The level of sedation was assessed every 5 minutes using the Ramsay Sedation Scale¹¹ (RSS 1–6); it was maintained at a deep sedation depth (RSS 5–6).

If heart rate (HR) increased by more than 20 bpm, mean arterial pressure (MAP) increased by at least 10 mmHg, the patient moved, or RSS was less than 5, a 10–30 mg IV bolus of propofol was administered and could be repeated every 1 minute. If hypotension (MAP decrease >20% from baseline or <65 mmHg) occurred, 6 mg of ephedrine was

administered if HR was less than 60 bpm, or 4 µg of norepinephrine was administered if HR was more than 60 bpm. If bradycardia (HR <50 bpm) occurred, 0.6 mg of atropine was administered. Oxygen desaturation (SpO₂ <95%) was treated with a jaw thrust or oropharyngeal airway. If SpO₂ fell below 90%, an oxygen mask with a bag was applied. If the apneic time was longer than 10 sec, facemask ventilation with a fraction of inspired oxygen of 1.0 was applied until oxygen saturation was more than 95%. Patients were excluded from the study when malignant arrhythmia occurred, the operative time exceeded 45 min, procedural complications occurred (i.e., perforation or uncontrolled bleeding), or the anesthetic technique was changed to general anesthesia.

Vital signs were measured and recorded before anesthesia induction and at 2.5-min intervals throughout the procedure. Intraoperative events: hypotension, hypertension, bradycardia, oxygen desaturation, the amount of propofol, vasopressor and IV fluid, and induction time (time from the start of propofol induction until loss of consciousness) were evaluated and recorded. After the procedure, recovery time and time to spontaneous eye opening were assessed and recorded. Recovery time was defined as the time between the end of the colonoscopy and awakening with an RSS score of 2. Patients were transferred to the post-anesthesia care unit (PACU). Vital signs were monitored and recorded every 5 minutes for 60 minutes using the Modified Aldrete Score. Patients were discharged when the Modified Aldrete Score was ≥9¹¹. Postoperative nausea and vomiting, dizziness, post-colonoscopy pain scores (assessed using a 0–10 numeric rating scale), and both patient and endoscopist satisfaction scores (rated on 1–10 scale) were assessed and recorded. Postoperative

complications within 24 hours were evaluated by telephone.

Instruments

The case record form was designed to collect data consisting of three parts:

Part I: Demographic data and baseline hemodynamic parameters.

Part II: Intraoperative data: induction time, vital signs at 2.5-min intervals, SpO₂, total propofol consumption, vasopressor and fluid administration, episodes of hypotension, procedural details.

Part III: Postoperative data: time to spontaneous eye opening, recovery time, postoperative pain score, nausea/vomiting, dizziness and other complications, Modified Aldrete Score every 5 min, endoscopist and patient satisfaction.

The Ramsay Sedation Scale (RSS) was used to assess sedation depth; 1=Patient is anxious and agitated or restless, or both; 2=Patient is cooperative, oriented, and calm; 3=Patient responds to commands only; 4=Patient exhibits a brisk response to light glabellar tap or loud auditory stimulus; 5=Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus; 6=Patient exhibits no response.

Statistical Analysis

The sample size was calculated based on a previous study,⁸ which reported that the time to

regain consciousness after the procedure in the propofol-fentanyl group was 65.1±63.6 seconds and 18.5±19.7 seconds in the propofol-lidocaine group ($p<0.001$). Type I error (α) was set at 0.05 and Type II error (β) at 0.1 (90% power). The calculated sample size was 22 per group. To account for potential attrition, this was increased to 30 per group (total $n=60$).

The normality of data distribution was assessed using the Shapiro-Wilk test. Categorical variables were expressed as frequencies and percentages. To compare proportions, the Chi-square test and Fisher's exact test were applied. The unpaired t-test or Wilcoxon rank-sum test was used to compare continuous variables between groups, depending on the normality of the data distribution. Continuous variables were expressed as the mean±standard deviation (SD) or median (IQR). Repeated measures of hemodynamic parameters were analyzed using a linear mixed-effect model, followed by post hoc analysis with Bonferroni correction for multiple comparisons. Results are reported as beta coefficients (β) with 95% confidence intervals (CIs). A p -value<0.05 was considered statistically significant. All statistical analysis were performed using Stata version 13 (StataCorp, College Station, TX, USA).

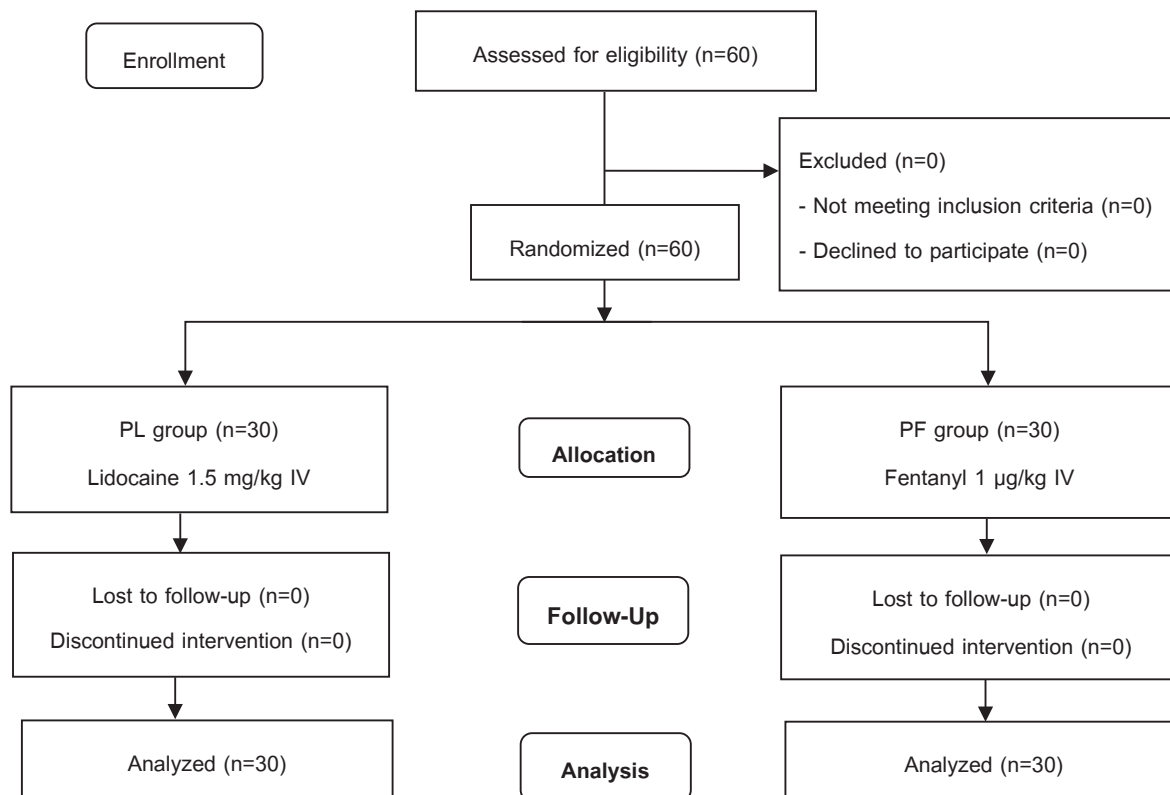


Figure 1 CONSORT Flow Diagram

Sixty patients were included in this study from May 2025 to July 2025. No significant differences were observed in demographic data, baseline hemodynamic parameters, procedural details, and intravenous fluid administration between groups (Table 1).

Table 1 Demographic Data and Procedural Details

	Propofol-fentanyl (PF group) (n=30)	Propofol-lidocaine (PL group) (n=30)	p-value
Age (yr), median (IQR)	57.0 (56–60)	58.5 (54–62)	0.67
Gender, n (%)			1.00
Male/Female	14 (46.7) / 16 (53.3)	14 (46.7) / 16 (53.3)	
Weight (kg), mean±SD	61.2±10.2	58.8±8.1	0.32
Height (cm), mean±SD	159.4±7.3	157.9±7.0	0.41
BMI (kg/m ²), mean±SD	24.0±3.4	23.7±2.7	0.72
ASA physical status, n (%)			0.60
I/II	14 (46.7)/ 16 (53.3)	12 (40.0)/ 18 (60)	
SBP (mmHg), mean±SD	143.3±16.3	136.8±15.8	0.11
DBP (mmHg), mean±SD	78.0±10.9	73.2±9.9	0.08
MAP (mmHg), mean±SD	98.9±11.8	95.2±9.1	0.18
HR (bpm), mean±SD	73.8±15.5	72.0±15.3	0.66

Table 1 Demographic Data and Procedural Details (Continue)

	Propofol-fentanyl (PF group) (n=30)	Propofol-lidocaine (PL group) (n=30)	p-value
Polypectomy, n (%)	4 (13.3)	10 (33.3)	0.07
Biopsy, n (%)	3 (10)	1 (3.3)	0.30
Procedural time (min), median (IQR)	11.8 (8.3–16.3)	11.7 (8.1–16.4)	0.83
Intravenous fluid (mL), median (IQR)	500 (450–560)	500 (450–550)	0.99

The median recovery time in the PL group was 4.2 (2.5–7.5) min vs. 2.4 (2.1–4.4) min ($p=0.027$) in the PF group; the difference between groups was significant. This was the same for spontaneous eye opening after the procedure. The incidence of hypotension and episodes of hypotension were slightly higher in the PF group than in the PL group (86.7% vs. 70.0%, $p=0.11$). Similarly, the incidence of desaturation and bradycardia was also slightly higher in the PF group than in the PL group (23.3% vs. 16.7%, $p=0.37$ and 10% vs. 6.7%, $p=0.64$). These differences were not significant. However, the median induction time was significantly longer in the PL group than in the PF group (67 (54–94) sec vs. 47 (37–66) sec, $p=0.002$) (Table 2).

No significant differences were observed between groups in post-colonoscopy pain score, Modified Aldrete Score, patient or endoscopist satisfaction, or the incidence of postoperative nausea, vomiting, and dizziness (Table 2). Two patients in the PF group continued to experience hypotension in the PACU. No cases of cardiac arrhythmias or local anesthetic systemic toxicity were observed. The median total dose of propofol administration was significantly higher in the PL group than in the PF group (170 (130–200) mg vs. 130 (90–180) mg, $p=0.005$). The median dose of propofol (in mg/kg/min) was also significantly higher in the PL group than in the PF group (0.26 (0.19–0.30) vs. 0.2 (0.16–0.21), $p<0.001$) (Table 3).

Table 2 Perioperative Outcomes and Satisfaction

	PF group (n=30)	PL group (n=30)	p-value
Desaturation, n (%)	7 (23.3)	5 (16.7)	0.37
SpO ₂ <90%, n (%)	3 (10.0)	1 (3.3)	0.31
SpO ₂ <95%, n (%)	4 (13.3)	4 (13.3)	1.00
Hypotension, n (%)	26 (86.7)	21 (70.0)	0.11
1 episode	10 (38.5)	7 (33.3)	0.24
2 episodes	6 (23.1)	10 (47.6)	
3 episodes	5 (19.2)	3 (14.3)	
4 episodes	5 (19.2)	1 (4.8)	
Bradycardia, n (%)	3 (10.0)	2 (6.7)	0.64
Time to spontaneous eye opening after the procedure (min), median (IQR)	2.1 (1.3–3.2)	3.7 (2.3–6.1)	0.007
Recovery time (min), median (IQR)	2.4 (2.1–4.4)	4.2 (2.5–7.5)	0.027
Induction time (sec), median (IQR)	47 (37–66)	67 (54–94)	0.002
Mean Modified Aldrete Score (0-10), median (IQR)	10 (10–10)	10 (9.9–10)	0.12
Nausea and vomiting, n (%)	1 (3.3)	0 (0.0)	0.31

Table 2 Perioperative Outcomes and Satisfaction (Continue)

	PF group (n=30)	PL group (n=30)	p-value
Dizziness, n (%)	0	0	
Pain score (NRS 0–10), median (IQR)	0 (0–0)	0 (0–0)	0.63
Patient satisfaction (1–10), median (IQR)	10 (10–10)	10 (10–10)	0.55
Endoscopist satisfaction (1–10), median (IQR)	10 (10–10)	10 (10–10)	0.62

Table 3 Drugs and Dosage Administered

	PF group (n=30)	PL group (n=30)	p-value
Total propofol (mg), median (IQR)	130 (90–180)	170 (130–200)	0.005
Propofol (mg/kg/min), median (IQR)	0.2 (0.16–0.21)	0.26 (0.19–0.30)	<0.001
Ephedrine (mg), median (IQR)	12 (6–12)	6 (6–12)	0.11
Norepinephrine (μg), mean±SD	10.2±4.1	7.4±3.2	0.82

The reduction in MAP from baseline was significantly less in the PL group than in the PF group during the first 7.5 min after induction. There was no statistically significant difference in heart rate at any time point after induction between groups (Table 4).

Table 4 Change in MAP from Baseline at Each Post-Induction Time Point Between Groups

MAP at time point	PF group (n=30)		PL group (n=30)		p-value
	Mean±SD	β (95% CI)	Mean±SD	β (95% CI)	
Baseline	98.9±11.8	Reference	95.2±9.1	Reference	0.18
0 min	89.7±13.4	−9.17 (−13.97, −4.36)	90.1±11.3	−5.10 (−9.90, −0.30)	0.24
2.5 min	66.9±12.2	−32.00 (−36.80, −27.20)	73.1±10.9	−22.10 (−26.87, −17.26)	0.004
5 min	79.2±11.9	−19.63 (−24.44, −14.83)	79.2±10.1	−15.93 (−20.74, −11.13)	0.29
7.5 min	79.3±10.6	−19.57 (−24.37, −14.76)	82.8±14.1	−12.33 (−17.14, −7.53)	0.037

Abbreviations: β=beta coefficient; 0 min=immediately after induction

DISCUSSION

The primary finding of this study was that the recovery time in the PL group was significantly longer than in the PF group. This finding was likely attributable to higher propofol consumption in the PL group. In contrast, Chudziński et al.⁸ reported shorter recovery time with propofol-lidocaine than with propofol-fentanyl during colonoscopy for Crohn's disease, and Arun et al.¹⁰ also demonstrated reduced recovery time with lidocaine as an adjuvant to propofol during upper gastrointestinal endoscopy. The absence of premedication in the present study, unlike

in prior protocols including midazolam or fentanyl, may have affected lidocaine's propofol-sparing effect.

Regarding secondary outcomes, total propofol consumption and induction time were significantly higher and longer, respectively, in the PL group than in the PF group. Conversely, Li et al.³ reported that using lidocaine combined with propofol and sufentanil in elderly patients undergoing colonoscopy significantly reduced propofol consumption by 13.2% and shortened the time to achieve loss of consciousness compared with normal saline. Additionally, previous studies have shown that adding lidocaine to propofol

significantly reduced propofol requirements^{3,5,8,10,12,13}. Nevertheless, those studies administered lidocaine in combination with opioid-propofol or ketamine-propofol regimens rather than using propofol-lidocaine alone. This finding supports the hypothesis that the propofol-sparing effect of IV lidocaine is mediated predominantly through an antinociceptive rather than a hypnotic mechanism¹⁴. Without surgical stimulation during induction, a higher propofol dose was required to achieve loss of consciousness, indicating that lidocaine has a minimal hypnotic effect and potentially explaining the delayed induction time in the PL group. Intraoperative patient movement was more frequent in the PL group than in the PF group, necessitating additional propofol supplementation and leading to increased total propofol consumption and prolonged recovery time. Although the incidence of oxygen desaturation, bradycardia, and hypotension was similar between groups, the reduction in MAP was less pronounced in the PL group during the first 7.5 min after induction, whereas heart rate remained comparable at all time points. These findings are consistent with a previous study¹⁵ suggesting that lidocaine may attenuate hypotension during early induction. This may be attributable to less pronounced suppression of the sympathetic response with lidocaine compared with fentanyl, as well as the more potent synergistic effect of fentanyl¹⁶.

No additional adjuvant agents were included in the protocol; therefore, the propofol-sparing effect of lidocaine was not confounded, unlike in previous studies.

As the results suggest that lidocaine alone may not provide adequate sedative or analgesic

synergy with propofol in short endoscopic procedures, these findings may help guide drug-dosing strategies and optimize sedation protocols for colonoscopy and other procedures requiring propofol-based sedation. However, limitations include the use of RSS—a subjective observational tool that may result in variability in sedation depth assessment compared with objective measurements such as the bispectral index (BIS), electroencephalography (EEG), or target-controlled infusion (TCI), which were not available in our institution. In addition, the short procedural duration may have limited the detection of a propofol-sparing effect of lidocaine, as nociceptive stimulation was insufficient. Accordingly, further studies with larger sample sizes and longer procedures are warranted to better define the role of lidocaine as an adjunct to propofol in endoscopic sedation and to incorporate objective measurements for a more precise assessment of sedation depth.

CONCLUSION

Propofol-lidocaine TIVA was associated with longer induction and recovery times and greater total propofol consumption than propofol-fentanyl in patients undergoing day-case colonoscopy, while intraoperative adverse events were comparable between groups. However, lidocaine attenuated the severity of hypotension during early induction without a significant difference in heart rate.

CONFLICTS OF INTEREST: None

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ORIGINAL ARTICLE

**การเปรียบเทียบ propofol-lidocaine และ propofol-fentanyl ในการระับความรู้สึกโดยการให้ยาทางหลอดเลือดดำ
ทั้งหมดสำหรับการส่องกล้องลำไส้ใหญ่แบบผู้ป่วยนอก: การศึกษาแบบสุ่มที่มีกลุ่มควบคุม**

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กลุ่มงานวิสัญญีวิทยา โรงพยาบาลกุมภวาปี

บทคัดย่อ

ที่มาของปัญหา: การส่องกล้องลำไส้ใหญ่เป็นหัตถการที่ก่อให้เกิดความไม่สบาย

วัตถุประสงค์: เพื่อเปรียบเทียบระยะเวลาฟื้นตัวจากการระับความรู้สึก ภาวะแทรกซ้อนระหว่างหัตถการ และปริมาณการใช้ propofol รวม ระหว่างการใช้ propofol-lidocaine และ propofol-fentanyl ในการระับความรู้สึกเพื่อการส่องกล้องลำไส้ใหญ่แบบผู้ป่วยนอก

วิธีการศึกษา: ศึกษาแบบสุ่มมีกลุ่มควบคุมและปกปิดสองทาง ในผู้ป่วย 60 ราย อายุ 18-64 ปี ASA physical status I-II แบ่งเป็นกลุ่มละ 30 ราย กลุ่ม propofol-fentanyl (PF) ได้รับ fentanyl 1 ไมโครกรัม/กิโลกรัม ส่วนกลุ่ม propofol-lidocaine (PL) ได้รับ lidocaine 1.5 มิลลิกรัม/กิโลกรัม ทางหลอดเลือดดำ ก่อนนำสลบด้วย propofol 1 มิลลิกรัม/กิโลกรัม ประเมินค่าทางระบบไหลเวียนโลหิต ภาวะแทรกซ้อน ปริมาณการใช้ propofol รวม และระยะเวลาฟื้นตัว

ผลการศึกษา: ระยะเวลาฟื้นตัวในกลุ่ม PL นานกว่ากลุ่ม PF (4.2 (2.5-7.5) เทียบกับ 2.4 (2.1-4.4) นาที; $p=0.027$) เช่นเดียวกับปริมาณ propofol ที่ใช้ (170 (130-200) เทียบกับ 130 (90-180) มิลลิกรัม; $p=0.005$) และระยะเวลานำสลบ 67 (54-94) เทียบกับ 47 (37-66) วินาที ($p=0.002$) ภาวะแทรกซ้อนไม่แตกต่างกัน ความดันโลหิตเฉลี่ยในกลุ่ม PL ลดลงจากค่าเริ่มต้นน้อยกว่าใน 7.5 นาทีแรกหลังนำสลบอย่างมีนัยสำคัญ

สรุป: การระับความรู้สึกโดยให้ยาทางหลอดเลือดดำด้วย propofol-lidocaine สัมพันธ์กับระยะเวลานำสลบและฟื้นตัวจากการระับความรู้สึกที่นานขึ้น และเพิ่มการใช้ propofol เมื่อเทียบกับ propofol-fentanyl ภาวะแทรกซ้อนไม่แตกต่างกัน lidocaine ลดความรุนแรงของภาวะความดันโลหิตต่ำในช่วงแรกของการนำสลบ

คำสำคัญ: ลิโดเคน, โปรโพรอล-ลิโดเคน, โปรโพรอล-เฟนทานิล, การส่องกล้องลำไส้ใหญ่, ระยะเวลาฟื้นตัวจากการระับความรู้สึก