Pre-procedural Intravenous Lactated Ringer's Solution Preloading to Prevent Hypotension during Sedation for Elective Colonoscopy

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Objective: *Colonoscopy is a common procedure for diagnostic, therapeutic or surveillance purposes. Pre-procedural fasting and bowel preparation to facilitate the procedure may result in dehydration, which could lead to hypotension during colonoscopy under sedation. The goal of this study is to test the hypothesis that pre-procedural intravenous lactated Ringer's solution (LRS) preloading decreases the incidence of intra-procedural hypotension during sedation for elective colonoscopy.*

Material and Method: *Sixty ASA 1 to 2 Patients, aged 18 to 60 years presenting for elective colonoscopy were randomized into 2 groups, control (C group) or preloading group (L group). Before procedure, C group received intravenous LRS of 1 hour maintenance while L group received intravenous LRS 200 ml preloading in 15 minutes prior to colonoscopy. Sedation was achieved by intravenous fentanyl 25 mcg and propofol infusion using target-control infusor (TCI) with preset target of propofol blood level 3.5 to 6 mcg/ml. Primary outcome was the incidence of hypotension, defined as $\geq$25% decrease in systolic blood pressure from baseline during sedation. Secondary outcome were vasopressor use and post-procedural complications (nausea, vomiting and dizziness).*

Results: *Fifty-three patients, 28 in C group and 25 in L group, completed the study. The incidence of hypotension were 39.3% in C group and 40.0% in L group (p = 0.958). Vasopressor use and post-procedural complications were either not significantly different between groups.*

Conclusion: *Pre-procedural intravenous LRS 200 ml preloading cannot prevent hypotension during sedation for elective colonoscopy in ASA 1 to 2 patients.*

Keywords: *Intravenous fluid, Preloading, Hypotension, Colonoscopy, Elective colonoscopy*

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Colonoscopy is a common procedure for diagnostic, therapeutic or surveillance purposes. Its popularity necessitates appropriate choice of anesthesia to ensure patient safety and comfort[1]. In order to facilitate the procedure, bowel preparation is considerably instrumental. Pre-procedural fasting and bowel preparation may result in dehydration, or hypotension during colonoscopy under sedation[2]. British consensus guidelines on intravenous fluid therapy for adult surgical patients[3] suggest using Hartmann's or Ringer-lactate/acetate type for pre-procedural and intra-procedural fluid in patient who has undergone bowel preparation. Phongthara Vichitvejpaisal et al[4] studied the effect of alternative IV crystalloids on acid-base balance in patients undergoing colonoscopy. They found that lactated Ringer's solution (LRS) and acetate Ringer's solution (ARS) are preferable to normal saline solution for fluid replacement in patients with colonoscopy.

In a previous study, 1.5 ml/kg and 15 ml/kg of intravenous Hartmann's solution preloading to prevent hypotension were compared in patients undergoing elective colonoscopy[5]. However, Hartmann's solution is not available in our center. To date, there has been no study investigating LRS preloading to prevent hypotension in patients undergoing elective colonoscopy. The goal of the present study is to test the hypothesis that pre-procedural intravenous LRS preloading decreases the incidence of intra-operative hypotension during sedation for elective colonoscopy.

Material and Method

The study period was from September 2015 to July 2016. The project was funded by Strategic Wisdom

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and Research Institute, Srinakharinwirot University and approved by Institutional Review Board and was approved by The Ethical committee of Srinakharinwirot University (SWUEC/F-104/2558). Inclusion criteria included patients 18 to 60 years of age, in-patient undergoing elective colonoscopy requiring intravenous sedation, ASA physical status 1 to 2, with full bowel preparation and fasting. Exclusion criteria included patients who had contraindication to rapid intravenous infusion (e.g. cardiac failure or renal failure), known allergic history to egg, propofol or fentanyl, for those under 18 or over 60, and non-consent patients. Written informed consent was obtained before the procedure from each patient. Patients were randomized into 1 of 2 groups by block randomization, control (C) and preloading (L) group at the waiting room. Before the procedure the C group received intravenous LRS of 1 hour maintenance (4 ml/kg/hr for first 10 kg, 2 ml/kg/hr for the second 10 kg and 1 ml/kg/hr for every kg above 20) and the L group received intravenous LRS 200 ml for preloading in 15 minutes prior to colonoscopy. All patients were blinded to group assignment. The primary outcome was the incidence of hypotension, defined as $\geq$25% decrease in systolic blood pressure (SBP) from baseline during sedation for colonoscopy. Secondary outcomes were vasopressor use and post-procedural complications (nausea, vomiting, dizziness).

Eligible patients presenting for elective colonoscopy were required to fast at least 8 hours before the procedure. Intravenous fluid was infused after fasting. Patients received oral bowel preparation solution the evening before colonoscopy. Type of intravenous fluid administration after fasting and oral solution for bowel preparation was of endoscopist's preference. No anxiolytic drug was given in all patients.

At waiting room, non-invasive blood pressure (NIBP) was measured twice 5 minutes apart, mean blood pressure was calculated for baseline blood pressure. After randomization, the patient received intravenous as allocated for C or L group. Patients were then transferred to the operating room. The rate of Lactated Ringer's solution infusion was then set to maintenance rate for all patients.

NIBP, heart rate, EKG and oxygen saturation were monitored before sedation. Patients were placed in left lateral decubitus during colonoscopy and blood pressure (BP) cuff was placed on left arm. BP was measured every 1 minute for 5 minutes, then every 3 minutes until the end of the procedure. Sedation was started with fentanyl 25 μg IV, followed by propofol administration using target controlled infusor (TCI Fresenius®), calculated by Schnider model, with plasma concentration setting at 3.5 to 6 μg/ml to maintain deep sedation. Adjustment of plasma concentration during the procedure was allowed according to sedation level, patient's movement and the anesthesiologist's discretion. Propofol was discontinued 5 minutes before the end of procedure. Supplemental oxygen 2 L/min was administered via oxygen cannula during sedation. Patients were then transferred to postanesthesia care unit (PACU) after colonoscopy.

Baseline data including age, sex, body mass index (BMI), ASA physical status classification, type of bowel preparation, amount and type of intravenous fluid after fasting and premedication were recorded. Intra-procedural data including intra-operative hypotension, propofol and fentanyl dose, vasopressor drugs use, duration of sedation and amount of total intravenous LRS during the procedure were also recorded. At PACU, hypotension, nausea, vomiting, dizziness and other complications were recorded before discharge.

Statistical analysis

Statistical analysis was performed using IBM SPSS statistic 19. The sample size was calculated for a power of 0.8 and $\alpha = 0.05$. Twenty-six patients were required in each group. A total of 60 patients were recruited in the study to compensate possible dropouts.

Continuous data were tested for normality using Kolmogorov Smirnov test; normally distributed data were summarized using mean $\pm$ SD and skewed data were summarized using median [interquartile range (IQR)]. Categorical data were summarized using number (percent).

The categorical data were compared using Chi-square test while continuous data were compared using independent t-test and Mann-Whitney U test. The $p<0.05$ was considered statistically significant.

Results

Patients were recruited from September 2015 to July 2016. Fifty-three patients completed the study. Two patients in C group and 5 patients in L group were excluded from the analysis because the procedure had been changed from colonoscopy to esophagogastroduodenoscopy (EGD) combined with colonoscopy (Fig. 1).

Baseline characteristics were similar between C and L group (Table 1). No patient took anxiolytic drug as premedication. Amount of

intravenous fluid administration after fasting was not different between C and L group (604 ml vs. 598 ml respectively; $p = 0.940$). One patient in preloading group did not receive intravenous fluid after fasting.

The outcomes during the procedure were compared between groups (Table 2). The incidence of hypotension was 39.3% in C group and 40.0% in L group ($p = 0.958$). Propofol and ephedrine dose were not different. Duration of sedation and total intra-procedural LRS infusion were not significantly different either between groups. No post-procedural complications including hypotension, nausea, vomiting, dizziness were found in either group. No vasopressor drug was used at PACU.

Discussion

Fasting and bowel preparation before colonoscopy cause a large amount of fluid loss resulting

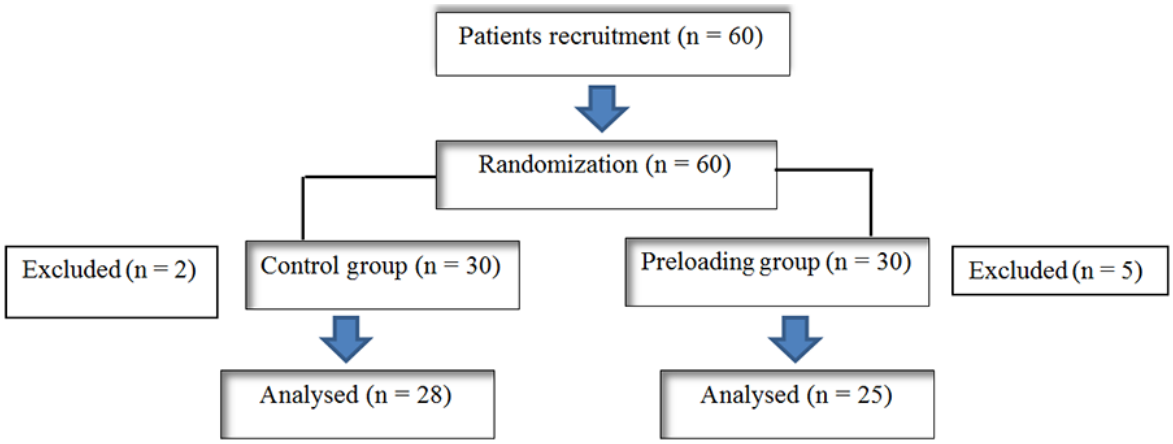

Fig. 1 Study flow diagram.

Table 1. Baseline characteristics

Characteristic	Control group (n = 28)	Preloading group (n = 25)	*p*-value
Age (year), median (interquartile range)	57.5 (48,68)	55 (41,60)	0.354
Sex, n (%)			0.276
Male	10 (35.7)	13 (52)	
Female	18 (64.3)	12 (48)	
Body mass index (kg m^{-2}), mean ± SD	23.30±4.17	22.37±4.42	0.431
ASA physical status, n (%)			0.276
1	11 (39.3)	14 (56)	
2	17 (60.7)	11 (44)	
Bowel preparation solution, n (%)			0.140
Sodium phosphate	22 (78.6)	22 (88)	
Niflec	1 (3.6)	3 (12)	
Polyethylene glycol	4 (14.3)	0	
Sodium chloride	1 (3.6)	0	
Antihypertensive drug as premedication, n (%)	2 (7.1)	1 (4)	
Type of intravenous fluid administration, n (%)			0.500
5% DN/2	22 (78.6)	22 (88)	
LRS	4 (14.3)	2 (8)	
NSS	2 (7.1)	1 (4)	
Amount of intravenous fluid administration (ml), mean ± SD	604±300	598±341	

ASA = American Society of Anesthesiologists; LRS = Lactated Ringer's solution; NSS = Normal saline solution

Table 2. Study outcome

	Control group (n = 28)	Loading group (n = 25)	*p*-value
Hypotension, n (%)	11 (39.3%)	10 (40.0%)	0.958
Propofol dose (mg), median (interquartile range)	249 (194, 376)	284 (203, 361)	0.643
Duration of sedation (min), median (interquartile range)	21 (14, 34)	26 (20, 33.5)	0.380
Vasopressor drug used (mg)			
Ephedrine, median (interquartile range)	0 (0, 6)	0 (0, 6)	0.794
Intravenous LRS intra-procedure (ml), median (interquartile range)	100 (62.5, 350)	200 (100, 300)	0.378

in dehydration[2] which can precipitate hypotension during colonoscopy. Fluid replacement during fasting and bowel preparation is crucial in ambulatory and in-patient setting. Those who have self-administered bowel preparation for ambulatory setting can replenish fluids by oral intake. While in-patients are usually infused with intravenous fluid during fasting period.

In the present study, LRS 200 ml was infused within 15 minutes in L group, as per British consensus guideline on intravenous fluid therapy for adult surgical patient[3]. The guideline recommends that 200 ml of colloid or crystalloid be infused to hypovolemic patient as a test for fluid responsiveness.

The present study showed that intravenous preloading of LRS 200 ml in 15 minutes did not prevent hypotension during sedation for colonoscopy. The incidence of hypotension was 39.3% (11/28) and 40% (10/25) in C and L group, respectively. Vasopressor drug used and postoperative complications such as postoperative hypotension, nausea, vomiting, dizziness were similar in both groups. These results were consistent with the finding of previous studies, comparing 2 ml/kg and 20 ml/kg of Plasmalyte® preloading[6,7]. Another study which compared 1.5 ml/kg and 15 ml/kg of Hartmann's solution infused before elective colonoscopy showed that incidence of hypotension during sedation were not different between groups[5].

The present study had some limitations. First, this study was single-blinded. The anesthesiologist was probably aware of the allocated group because they could know the group from the amount of remaining LRS in the bottle. Second, duration of fasting and fluid loss during full bowel preparation was not recorded, both of which might have inpact on patient's volume status. Third, we measured baseline blood pressure (BP) in supine position (at waiting room); however we had to measure BP at left arm when patients were in left lateral decubitus during colonoscopy. This might affect the reading. Fourth, the sample size of preloading group was smaller than the calculated value. This might affect the result of this study. It is noted that although the outcomes between groups were not statistically different, the L group received total fluids more than the C group. Increasing the sample size may or may not change the outcomes since the incidence of hypotension between groups are almost equal.

Conclusion

Pre-procedural intravenous LRS 200 ml preloading cannot prevent hypotension during sedation for elective colonoscopy in ASA 1 to 2 patients.

What is already known on this topic?

Fasting and bowel preparation before colonoscopy cause a large amount of fluid loss resulting in dehydration which can precipitate hypotension.

What this study adds?

LRS 200 ml was infused within 15 minutes before colonoscopic procedure; it did not prevent hypotension during sedation.

Acknowledgements

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Potential conflicts of interest

None.

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การให้สารน้ำแลคเตทริงเกอร์อย่างรวดเร็วก่อนทำหัตถการเพื่อป้องกันภาวะความดันโลหิตต่ำในผู้ป่วยที่เข้ารับการส่องกล้องระบบทางเดินอาหารส่วนล่าง

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วัตถุประสงค์: การส่องกล้องระบบทางเดินอาหารส่วนล่างเป็นหัตถการที่ทำเพื่อการวินิจฉัยและการรักษา หลังจากการงดน้ำ งดอาหารและการเตรียมลำไส้ก่อนการทำหัตถการส่งผลให้ผู้ป่วยเกิดภาวะพร่องน้ำได้ และเมื่อผู้ป่วยได้รับการระงับความรู้สึกอาจส่งผลให้เกิดภาวะความดันโลหิตต่ำได้ วัตถุประสงค์ของการศึกษาครั้งนี้เพื่อศึกษาว่าการให้สารน้ำอย่างรวดเร็วก่อนทำหัตถการ สามารถป้องกันภาวะความดันโลหิตต่ำในผู้ป่วยที่เข้ารับการส่องกล้องระบบทางเดินอาหารส่วนล่าง

วัสดุและวิธีการ: กลุ่มตัวอย่างอายุระหว่าง 18 ถึง 60 ปี จำนวน 60 ราย มารับการระงับความรู้สึกเพื่อทำหัตถการ ส่องกล้องระบบทางเดินอาหารส่วนล่าง โดยแบ่งเป็น 2 กลุ่มคือกลุ่มควบคุม (C group) และกลุ่มที่ได้สารน้ำ (L group) ชนิด Lactated Ringer's solution (LRS) ปริมาณ 200 มิลลิลิตร ในเวลา 15 นาทีก่อนระงับความรู้สึก ผู้ป่วยทุกราย ได้รับการระงับความรู้สึกด้วย fentanyl 25 ไมโครกรัม และ propofol ด้วย target-control infusor (TCI) โดยตั้งค่าความเข้มข้นในกระแสเลือดที่ 3.5 ถึง 6 mcg/ml โดยเปรียบเทียบอัตราการเกิดภาวะความดัน systolic blood pressure ลดลงจากเดิม ≥25% และเปรียบเทียบปริมาณการใช้ยากระตุ้นหัวใจและหลอดเลือดรวมถึงภาวะแทรกซ้อนต่าง ๆ ได้แก่ คลื่นไส้อาเจียน ภาวะเวียนศีรษะหรือมึนศีรษะเป็นต้น

ผลการศึกษา: ผู้ป่วย 53 รายแบ่งเป็นกลุ่มควบคุม (C group) 28 ราย และกลุ่มได้สารน้ำ (L group) 25 ราย พบว่าผู้ป่วย C group มีอัตราการเกิดภาวะความดันโลหิตต่ำที่ร้อยละ 39.3 และผู้ป่วย L group มีอัตราการเกิดภาวะความดันโลหิตต่ำร้อยละ 40.0 ซึ่งไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p = 0.958$) อัตราการใช้ยากระตุ้นหัวใจและหลอดเลือด การเกิดภาวะคลื่นไส้ อาเจียนและมึนงงไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติทั้ง 2 กลุ่ม

สรุป: การให้สารน้ำอย่างรวดเร็วก่อนทำหัตถการไม่สามารถป้องกันภาวะความดันโลหิตต่ำขณะให้ยาระงับความรู้สึกในผู้ป่วยที่เข้ารับการส่องกล้องระบบทางเดินอาหารส่วนล่างได้