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Comparison of In-Hospital and At-Home Administration of Bowel Preparation Agents Before Outpatient Colonoscopy in Elderly Patients

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ABSTRACT

Background: Most patients take bowel preparation agents at home before undergoing outpatient colonoscopy. However, some elderly patients undergo bowel preparation at the hospital. This study compared the outcomes of in-hospital (Group A) versus at-home (Group B) bowel preparation in elderly patients to clarify the usefulness of in-hospital bowel preparation.

Patients and Methods: From September 2022 to September 2023, 151 patients aged 70 years or older undergoing outpatient colonoscopy at Ureshino Medical Center were prospectively enrolled (51 in Group A and 100 in Group B). The primary endpoint was bowel preparation time. Secondary endpoints were the number of defecations, colonoscopy start time, and adverse events. Propensity score matching (PSM) was applied to account for baseline differences, and multivariate analysis was conducted to identify factors associated with bowel preparation time.

Results: After PSM, 26 matched pairs were analyzed. Group A had a significantly shorter bowel preparation time (192.1 ± 80.5 vs. 271.1 ± 57.9 min, $p < 0.001$), shorter time from preparation to colonoscopy (259.3 ± 70.2 vs. 341.4 ± 67.1 min, $p < 0.001$), and fewer defecations (8.5 ± 4.6 vs. 11.2 ± 4.1, $p < 0.001$) than Group B. There were no significant intergroup differences in adverse events or patient satisfaction. Multivariate analysis revealed that in-hospital preparation was strongly associated with shorter bowel preparation time (odds ratio 8.87, 95% CI 3.16–24.92, $p < 0.001$).

Conclusions: For elderly patients, in-hospital bowel preparation is beneficial because it significantly shortens preparation and colonoscopy start times and reduces defecations, while maintaining safety and satisfaction rates compared with at-home preparation.

Trial Registration: University Hospital Medical Information Network Clinical Trials Registry: UMIN000057045

Abbreviations: ASA-PS, American Society of Anesthesiologists physical status; BMI, body mass index; CONSORT, Consolidated Standards of Reporting Trials; CRC, colorectal cancer; CSP, cold snare polypectomy; EMR, endoscopic mucosal resection; PEG-Asc, polyethylene glycol solution combined with ascorbic acid; PSM, propensity score matching.

1 | Introduction

Colonoscopy is widely used for the early detection of colorectal cancer (CRC) [1–8]. In Japan, where the population is rapidly aging, the number of outpatient colonoscopies performed on elderly patients is increasing, and there is a growing demand for this examination [2, 9–11]. It is known that a successful colonoscopy depends on the quality of the bowel preparation, and that good bowel preparation contributes to the detection of CRC [2, 6]. Therefore, appropriate bowel preparation is also required for the elderly [12–16].

Many patients take the bowel preparation agents at home before coming to the hospital for the colonoscopy. However, elderly patients who require assistance with taking the bowel preparation agent, as well as those who live far from the hospital, often take the agent after arriving at the hospital before undergoing the colonoscopy [2, 17, 18].

Patients are usually asked to come to the hospital after completing the bowel preparation, and the presence or absence of adverse events is confirmed by telephone. When patients take the bowel preparation agents at the hospital, the nurse talks to the patient each time to check whether they are taking the agents properly, to ask details about their defecation, and to ask whether they are experiencing any adverse effects. The problem with taking the bowel preparation agents at home is that it is difficult to closely monitor the bowel movements. The problem with taking the bowel preparation agents at the hospital is that there are limited beds available and limited access to toilets. Therefore, it is necessary to find the best way for elderly patients to take the bowel preparation agents for outpatient colonoscopy. Although many reports have compared the types of bowel preparation agents used for outpatient colonoscopy, no report has compared the outcomes of taking the agents at the hospital compared with at home [11, 19–23].

This study hypothesized that in-hospital bowel preparation would lead to a shorter preparation time and comparable safety compared with at-home bowel preparation in elderly patients. We compared the safety and efficacy of taking bowel preparation agents at the hospital versus at home for elderly patients (aged 70 years or over) undergoing outpatient colonoscopy.

2 | Patients and Methods

2.1 | Patients and Ethical Issues

This prospective study enrolled outpatients scheduled for elective colonoscopies at the National Hospital Organization Ureshino Medical Center from September 2022 to September 2023. The patients took the bowel preparation agents before the colonoscopy at the hospital or at home. The study participants were outpatients aged 70 years or older who had consented to participate in the study and were undergoing a colonoscopy. Patients aged 69 years or younger, those unable to take the bowel preparation agents themselves, those who did not understand how to take the bowel preparation agents, and those unable to undergo the colonoscopy on the same day as they took the bowel preparation agents were excluded. In addition, patients with serious complications (heart failure, renal failure, hepatic failure, respiratory failure), pregnant women, lactating women, and patients with a history of allergy to the study drug were excluded.

When making an outpatient appointment for colonoscopy, the patient was assigned to either a group that would take the bowel preparation agents at the hospital (Group A) or a group that would take the agents at home (Group B), depending on their condition in consultation with their physician. Group allocation was determined based on the clinical assessment by the physician in consultation with the patient, taking into account physical ability, cognitive status, social support, and distance from the hospital.

This study was conducted in accordance with the tenets of the Declaration of Helsinki and the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines for observational studies. The study protocol and the consent procedure were approved by the Ethics Review Committee of the National Hospital Organization Ureshino Medical Center (approval number 22-12, approved on August 30, 2022).

2.2 | Bowel Preparation for Colonoscopy

The patients were instructed to follow a restricted diet for 3 days before the colonoscopy. On the day before the colonoscopy, patients in both groups consumed 20 mL of sodium picosulfate (Sodium Picosulfate Hydrate; Pfizer Japan Inc., Tokyo, Japan) with 100 mL of water at 9:00 p.m. On the day of the colonoscopy, patients in both groups started taking 1 L of polyethylene glycol solution combined with ascorbic acid (PEG-Asc) solution (Moviprep; EA Pharma Co. Ltd., Tokyo, Japan) with 500 mL of water. Patients were instructed to take the PEG-Asc solution and water alternately at a rate of 500 mL every 30 min. Patients in Group A arrived at the hospital at 9:00 a.m. and began taking the bowel preparation agents. Patients in Group B started at 8:00 a.m.; a nurse called between 9:30 and 10:00 to review effluent. On arrival (> 11:00 a.m.), two nurses reassessed stool clarity and, if not clear, instructed an additional 500 mL PEG-Asc with 250 mL water. Bowel preparation time was defined uniformly as the interval from first PEG-Asc ingestion to the last bowel movement confirmed by nursing staff; in Group B, the time was self-reported at check-in and verified by two nurses. If the bowel movement is clear by the time of arrival, the patient's self-reported time was also accepted.

Before colonoscopy, nursing staff used a 4-grade effluent clarity scale to decide whether to proceed: 1 = opaque/solid; 2 = brown liquid with visible particulate; 3 = yellow liquid with small particulate; 4 = clear/yellow transparent without particulate. "Clear" was defined as Grade 4. Two nurses assessed the effluent together and reached a consensus before proceeding. If clarity was < 4, patients received an additional 500 mL PEG-Asc with 250 mL water, followed by reassessment. Patients were instructed to complete the administration of the lavage solution at least 1 h before the colonoscopy.

2.3 | Colonoscopy and Post-Colonoscopy Questionnaire Survey

In Groups A and B, after two nurses confirmed that the stool condition was clear, the colonoscopy was performed

by an endoscopist who was blinded to the group allocation. Colonoscopy was performed by one of nine endoscopists (five specialists and four trainees). Specialists were defined as endoscopists who were board-certified fellows of the Japan Gastroenterological Endoscopy Society.

Bowel preparation time was defined as the time from the first ingestion of the PEG-Asc solution to the time when a nurse confirmed the last bowel movement. In Group A, this was recorded directly by nursing staff. In Group B, the patient self-reported the time during the hospital visit and was confirmed by a nurse.

The bowel preparation time, number of defecations, total time from the start of taking the bowel preparation agents to the start of the colonoscopy (colonoscopy start time), and amount of bowel preparation agent taken were measured. The endoscopist assessed the degree of bowel preparation using a 5-point scale based on the Modified Aronchick Scale [24]. The recorded information comprised the content of the endoscopic procedure (colonoscopy, cold snare polypectomy [CSP], endoscopic mucosal resection [EMR]), use of sedatives and analgesic agents, and procedure time. A questionnaire survey was conducted to determine the presence or absence of adverse events such as nausea, vomiting, abdominal pain, abdominal distention, fatigue, and disorientation before and after the colonoscopy. After the colonoscopy, the patients completed a 10-point satisfaction survey. The patients were also asked their preferred location for taking the bowel preparation agents for their next colonoscopy.

2.4 | Study Outcomes

As long-term bowel preparation is physically demanding for the elderly, the primary endpoint of this study was the bowel preparation time. The secondary endpoints were the amount of bowel preparation agents taken, number of defecations, colonoscopy start time, procedure time, and adverse events before and after the colonoscopy.

2.5 | Data Collection

The following patient demographic data were collected by reviewing the electronic clinical records: age, sex, administration of laxative agents, body mass index (BMI), American Society of Anesthesiologists physical status (ASA-PS) classification, family history of CRC, indication for colonoscopy, and comorbidities (including the Charlson comorbidity index score). A chart review was performed to obtain the endoscopy-related data, namely the content of the endoscopic procedure (colonoscopy, CSP, EMR), use of sedatives and analgesic agents, procedure time, endoscopist specialty, and peri-procedural adverse events (unstable vital signs indicated by ≥ 20% decrease from the baseline values).

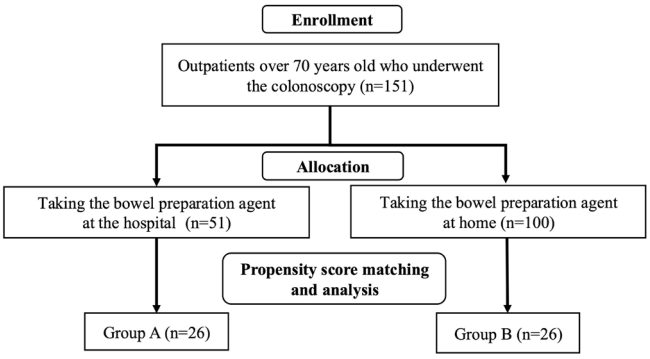

FIGURE 1 | Study flowchart. Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.

2.6 | Statistical Analysis

The sample size was not estimated because this was a prospective, observational study using regular medical record

TABLE 1 | Baseline characteristics of the participants.

	Group A	Group B	*p*
Number of patients (*N*)	51	100	
Age (years)	82.6 ± 5.3	75.6 ± 3.8	< 0.001
Sex, males	28 (54.9%)	71 (71.0%)	0.069
BMI	22.7 ± 2.7	22.9 ± 3.4	0.709
ASA-PS, I	43 (84.3%)	98 (98.0%)	0.003
ASA-PS, II	7 (13.7%)	2 (2.0%)	
ASA-PS, III	1 (2.0%)	0 (0.0%)	
Family history of CRC	4 (7.8%)	8 (8.0%)	1.000
Taking laxative agents	12 (23.5%)	16 (16.0%)	0.271
Comorbidity			
Hypertension	33 (64.7%)	53 (53.0%)	1.000
Malignant diseases	13 (25.5%)	38 (38.0%)	0.147
Diabetes mellitus	12 (23.5%)	17 (17.0%)	0.384
Cardiovascular diseases	15 (29.4%)	21 (21.0%)	0.313
Chronic kidney diseases	2 (3.9%)	9 (9.0%)	0.335
Cerebrovascular diseases	5 (9.8%)	8 (8.0%)	0.763
Chronic liver diseases	1 (2.0%)	8 (8.0%)	0.279
Indication for colonoscopy			
FIT positive	17 (33.3%)	23 (23.0%)	0.179
Detailed examination	15 (29.4%)	41 (41.0%)	0.213
Polyp surveillance	6 (11.7%)	21 (21.0%)	0.185
Any abdominal symptoms	9 (17.7%)	13 (13.0%)	0.471
Others	4 (7.8%)	2 (2.0%)	0.180

Note: Results are presented as the number of patients or mean ± standard deviation.
Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.
Abbreviations: ASA-PS, American Society of Anesthesiologists physical status; BMI, body mass index; CRC, colorectal cancer; FIT, fecal immunochemical test.

information. However, based on the frequency of patient visits, it was anticipated that 50 patients in the hospital group (taking the bowel preparation agent at the hospital) could feasibly be targeted for this study in approximately 1 year. Another home group (taking the bowel preparation agent at home) consisted of 100 patients, approximately twice as many as the hospital group.

Propensity score matching (PSM) analysis was used to assess the efficacy and safety of bowel preparation agents taken in hospital versus at home. This method was used to adjust for significant differences in the patients' baseline characteristics and to minimize the influence of possible confounding factors [25]. The two groups were matched in a 1:1 ratio (26 patients in each group) with adjustment for five covariates (age, sex, BMI, ASA-PS classification, family history of CRC) to minimize inherent bias (Figure 1). These five covariates were selected based on the opinions of expert endoscopists (D.Y., Y.T., N.H., K.A., and S.T.). This model yielded a C statistic of 0.858, indicating that the model had a good ability to control confounding factors in the comparison between groups A and B. The caliper width of the PSM was 0.20.

Categorical data were expressed as frequency and percentage and were compared between the two groups using the χ^2 test. Normally distributed numerical data were expressed as mean ± standard deviation and were compared between the two groups using the Student's *t* test. Numerical data with a skewed distribution were expressed as median (interquartile range) and were compared between the groups using the Mann–Whitney *U* test. Levels of significance for all comparisons were reported, regardless of statistical significance, as *p* values or confidence intervals. $p < 0.05$ was considered statistically significant for each test.

Univariate and multivariate logistic regression analyses were performed to identify factors associated with a shorter bowel preparation time, with the explanatory variables of bowel preparation method, age, sex, BMI, ASA-PS, family history of CRC, dosage of bowel preparation agent, number of defecations, type of endoscopy, and Modified Aronchick Scale. In the process used for the determination of variables associated with bowel preparation time, 10 variables were suggested by five expert endoscopists. The variables were sequentially refined by removing variables that did not meet the prespecified *P* value for statistical significance.

All statistical analyses were performed with JMP, version 17.0.0 (SAS Institute Inc., Cary, NC, USA).

TABLE 2 | Details of bowel preparation and pre-colonoscopy adverse events.

	Group A	Group B	*p*
Dosage of bowel preparation agent (L)	1.4 ± 0.3	1.3 ± 0.3	0.227
Number of defecations	8.7 ± 3.7	10.9 ± 3.6	< 0.001
Bowel preparation time (min)	203.9 ± 73.8	270.3 ± 61.5	< 0.001
Colonoscopy start time (min)	276.9 ± 76.9	341.4 ± 68.5	< 0.001
Pre-colonoscopy adverse events			
Nausea	5 (9.8%)	6 (6.0%)	0.510
Vomiting	0 (0.0%)	0 (0.0%)	1.000
Abdominal pain	1 (5.8%)	2 (2.0%)	0.336
Abdominal distention	8 (15.9%)	12 (12.0%)	0.613
Fatigue	2 (3.9%)	4 (4.0%)	1.000
Disorientation	3 (5.8%)	4 (4.0%)	0.689

Note: Results are presented as the number of patients or mean ± standard deviation.
Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.

TABLE 3 | Colonoscopy outcomes and post-colonoscopy adverse events.

	Group A	Group B	*p*
Procedure time (min)	29.3 ± 13.7	29.1 ± 12.4	0.943
Type of endoscopy			
Colonoscopy	33 (64.7%)	59 (59.0%)	0.597
CSP	14 (27.5%)	34 (34.0%)	0.464
EMR	4 (7.8%)	7 (7.0%)	1.000
Using sedative agent	5 (9.8%)	10 (10.0%)	1.000
Using analgesic agent	1 (2.0%)	1 (1.0%)	1.000
Modified Aronchick Scale			
Excellent	34 (66.7%)	75 (75.0%)	0.338
Good	13 (25.5%)	19 (19.0%)	0.402
Fair	4 (7.8%)	6 (6.0%)	0.734
Poor/inadequate	0 (0.0%)	0 (0.0%)	1.000
Post-colonoscopy adverse events			
Nausea	2 (3.9%)	1 (1.0%)	0.264
Vomiting	0 (0.0%)	0 (0.0%)	1.000
Abdominal pain	1 (2.0%)	9 (9.0%)	0.165
Abdominal distention	2 (3.9%)	11 (11.0%)	0.220
Fatigue	2 (3.9%)	2 (2.0%)	0.604
Disorientation	7 (13.7%)	10 (10.0%)	0.587
Satisfaction (10-point scale)	6.8 ± 2.6	7.0 ± 2.8	0.738
Desire for next same colonoscopy	43 (84.3%)	89 (89.0%)	0.443

Note: Results are presented as the number of patients or mean ± standard deviation.
Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.
Abbreviations: CSP, cold snare polypectomy; EMR, endoscopic mucosal resection.

3 | Results

3.1 | Patient Background and Characteristics

The study cohort comprised 151 outpatients: 51 in Group A and 100 in Group B. The basic patient background data and indications for colonoscopy are shown in Table 1. When comparing the baseline characteristics of the two groups, there were significant differences between Groups A and B in age and ASA-PS classification. There were no significant differences between the two groups regarding comorbidities or indications for colonoscopy.

Table 2 shows the details of bowel preparation and adverse events before colonoscopy. There was no significant difference between the two groups in the amount of bowel preparation agent taken. However, compared with Group B, Group A had a significantly shorter bowel preparation time, a significantly shorter time from preparation to colonoscopy, and significantly fewer defecations.

Table 3 shows the details of the colonoscopy and the post-colonoscopy adverse events. Both groups had a similar procedure time for the colonoscopy, similar prevalences of normal colonoscopy, CSP, and EMR, and a similar degree of bowel preparation using the Modified Aronchick Scale. There were no significant differences between the two groups in post-colonoscopy adverse events and patient satisfaction.

3.2 | Propensity Score Matched Pairs and Study Endpoints

Because Group A was older and had a lower ASA-PS than Group B, PSM was performed to match the patient background characteristics. PSM created 26 matched pairs. After PSM, there were no differences between Group A and Group B in the five selected covariates (Table 4).

Bowel preparation and colonoscopy outcomes after PSM are described in Table 5. The primary endpoint, bowel preparation time, was significantly shorter in Group A than in Group B (192.1 ± 80.5 vs. 271.1 ± 57.9 min, $p < 0.001$). Furthermore, compared with Group B, Group A had a significantly shorter time from preparation to colonoscopy (259.3 ± 70.2 vs. 341.4 ± 67.1 min, $p < 0.001$) and a significantly lower number of defecations (8.5 ± 4.6 vs. 11.2 ± 4.1, $p < 0.001$).

Modified Aronchick Scale scores and the incidence of adverse events were equivalent between the two groups. In addition, there were no significant differences between the two groups regarding the amount of bowel preparation agents taken, procedure time, type of endoscopy, patient satisfaction, or desire for another colonoscopy.

3.3 | Univariate and Multivariate Analyses for the Factors Associated With a Shorter Bowel Preparation Time

Table 6 shows the results of univariate and multivariate analyses to identify the factors associated with a shorter bowel preparation time (< 240 min). In the univariate analysis, bowel preparation at the hospital, an age over 80 years, and a bowel preparation agent dosage of less than 1.5 L were significantly associated with shorter bowel preparation time. In the multivariate analysis, bowel preparation at the hospital and a bowel preparation agent dosage of less than 1.5 L were associated with shorter bowel preparation time, with bowel preparation at the hospital being

TABLE 4 | Patient characteristics before and after propensity score matching.

	Group A (%)	Group B (%)	*p*	Standardized difference
Before propensity score matching				
Number of patients (*N*)	51	100		
Age (years)	82.6 ± 5.3	75.6 ± 3.8	< 0.001	1.52
Sex, males	28 (54.9%)	71 (71.0%)	0.069	0.33
BMI	22.7 ± 2.7	22.9 ± 3.4	0.709	0.07
ASA-PS, I	43 (84.3%)	98 (98.0%)	0.003	0.50
Family history of CRC	4 (7.8%)	8 (8.0%)	1.000	0.00
After propensity score matching				
Number of patients (*N*)	26	26		
Age (years)	78.8 ± 4.1	79.0 ± 4.1	0.920	0.05
Sex, males	16 (61.5%)	18 (69.2%)	0.771	0.16
BMI	22.7 ± 2.6	22.8 ± 3.3	0.838	0.03
ASA-PS, I	24 (92.3%)	24 (92.3%)	1.000	0.00
Family history of CRC	2 (7.7%)	2 (7.7%)	1.000	0.00

Note: Results are presented as the number of patients or mean ± standard deviation.
Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.
Abbreviations: ASA-PS, American Society of Anesthesiologists physical status; BMI, body mass index; CRC, colorectal cancer.

TABLE 5 | Bowel preparation and colonoscopy outcomes after propensity score matching.

	Group A	Group B	*p*
Number of patients (*N*)	26	26	
Dosage of bowel preparation agent (L)	1.4 ± 0.4	1.4 ± 0.4	0.751
Number of defecations	8.5 ± 4.6	11.2 ± 4.1	0.028
Bowel preparation time (min)	192.1 ± 80.5	271.1 ± 57.9	< 0.001
Colonoscopy start time	259.3 ± 70.2	341.4 ± 67.1	< 0.001
Procedure time (min)	32.1 ± 13.7	29.4 ± 13.1	0.473
Type of endoscopy			
Colonoscopy	18 (69.3%)	16 (61.6%)	0.771
CSP	6 (23.0%)	9 (34.6%)	0.541
EMR	2 (7.7%)	1 (3.8%)	1.000
Modified Aronchick Scale			
Excellent	17 (65.4%)	20 (76.9%)	0.541
Good	7 (26.9%)	5 (19.2%)	0.743
Fair	2 (7.7%)	1 (3.8%)	1.000
Post-colonoscopy adverse events			
Nausea	2 (7.7%)	0 (0.0%)	0.490
Abdominal pain	1 (3.9%)	2 (7.7%)	1.000
Abdominal distention	1 (3.9%)	2 (7.7%)	1.000
Fatigue	2 (7.7%)	0 (0.0%)	0.490
Disorientation	5 (19.2%)	2 (7.7%)	0.419
Satisfaction (10-point scale)	6.6 ± 1.9	7.4 ± 2.3	0.204
Desire for next same colonoscopy	23 (88.4%)	21 (80.8%)	0.703

Note: Results are presented as the number of patients or mean ± standard deviation.
Group A: patients who took the bowel preparation agents at the hospital. Group B: patients who took the bowel preparation agents at home.
Abbreviations: CSP, cold snare polypectomy; EMR, endoscopic mucosal resection.

TABLE 6 | Results of univariate and multivariate analyses performed to identify the factors associated with a shorter bowel preparation time.

Variables	Odds ratio	95% CI		*p*
Univariate analysis				
Bowel preparation method, in-hospital	5.87	2.8	12.33	< 0.001
Age, > 80	2.34	1.17	4.69	0.021
Sex, male	1.95	0.99	3.86	0.059
BMI, > 25 kg/m^2	1.83	0.81	4.14	0.151
ASA-PS, I	2.08	0.56	7.72	0.329
Family history of CRC	0.94	0.28	3.11	1.000
Dosage of bowel preparation agent, < 1.5 L	2.20	1.13	4.27	0.022
Number of defecations, > 10	0.99	0.51	1.92	1.000
Type of endoscopy, colonoscopy	1.31	0.68	2.56	0.501
Modified Aronchick Scale, Excellent and Good	0.74	0.21	2.67	0.746
Multivariate analysis				
Bowel preparation method, in-hospital	8.87	3.16	24.92	< 0.001
Dosage of bowel preparation agent, < 1.5 L	2.95	1.34	6.52	0.007

Abbreviations: ASA-PS, American Society of Anesthesiologists physical status; BMI, body mass index; CI, confidence interval; CRC, colorectal cancer.

the most significant factor (odds ratio 8.87, 95% CI 3.16–24.92; $p < 0.001$).

4 | Discussion

To effectively perform a colonoscopy, it is important for the patient to have a clean bowel achieved through adequate bowel preparation. The bowel preparation should be achieved quickly and effectively. In Japan, a widely used bowel cleansing method is the administration of PEG-Asc and magnesium citrate on the day of the colonoscopy [2]. It is also common to use gastroprokinetic agents and sodium picosulfate hydrate on the day before the colonoscopy. These bowel cleansing methods are reportedly effective and considered acceptable by patients [26, 27]. Many studies have compared the degree of bowel preparation according to the type of bowel preparation agent used [11, 19–23, 28–31]. However, the present study is the first to compare the safety and efficacy of in-hospital versus at-home administration of bowel preparation agents. Furthermore, this study's novelty lies in its examination of the optimal bowel preparation method for colorectal endoscopy in the elderly population, which is increasing in Japan.

The main finding of the present study was that the bowel preparation time was significantly shorter for patients who took bowel preparation agents in hospital (Group A) compared with those who took bowel preparation agents at home (Group B). Furthermore, the total time from the start of bowel preparation to the start of colonoscopy was significantly shorter in Group

A than in Group B. The fact that the shorter preparation time and the number of defecations in Group A was low may be because the continuous support of the medical staff allowed the patients to take a large amount of bowel preparation agents in a short time, which could have encouraged them to defecate more at once. The results after PSM further support these findings by minimizing baseline differences between the groups. This approach strengthens the study's validity by eliminating intergroup differences in age and ASA-PS, and provides more robust evidence for differences in bowel preparation time and defecation frequency. These results emphasize the effectiveness of the bowel preparation and the effectiveness of performing the bowel preparation at the hospital, and suggest that the overall procedure time may be shortened by taking the bowel preparation agents at the hospital for elderly patients who have difficulty in self-management due to physical or cognitive limitations. Although in-hospital bowel preparation offers the advantage of continuous medical staff supervision and rapid escalation of care, its adoption must be balanced against limited ward capacity, nursing workload, and the availability of shared toilets. We therefore propose a triage to reserve hospital-based preparation for elderly outpatients at the highest risk of inadequate cleansing or adverse events.

In multivariate analysis, in-hospital bowel preparation was the factor most significantly associated with a shorter bowel preparation time. In elderly patients undergoing colonoscopy, in-hospital bowel preparation resulted in a shorter preparation time, but was as safe and satisfactory for patients as at-home bowel preparation. However, there are limitations to the space available in hospitals and the number of medical staff available to carry out these in-hospital bowel preparations in clinical practice. Therefore, in the real-world setting, clinicians should consider prioritizing in-hospital bowel preparation for elderly patients who are anxious about bowel preparation at home or for elderly patients who have difficulty obtaining the cooperation of their families.

The present study has several limitations. First, this study was conducted in a single center, which may limit the generalizability of the findings. Second, the group allocation was determined by physicians based on the patient's conditions, introducing potential selection bias, although PSM was used to address this issue. Third, as the study included only elderly patients aged 70 years or older, the results may not directly apply to younger populations. Fourth, this study is limited by reliance on self-reported at-home effluent without photographic verification and by telephone-based monitoring, which may introduce misclassification and communication/recall bias in an elderly cohort. However, two nurses reassessed effluent on arrival using a pragmatic 4-grade clarity scale with dual-nurse consensus and applied standardized add-on dosing to mitigate these issues. Lastly, the satisfaction survey and patient-reported adverse events might be subject to recall bias, especially in older adult patients. Therefore, this study should be interpreted as a pilot analysis that warrants further validation in a larger, multicenter, randomized controlled trial. Future studies should also investigate strategies to optimize at-home bowel preparation for elderly patients, such as remote monitoring or telemedicine-based support.

In conclusion, although hospital resources are limited, in-hospital administration of bowel preparation agents is preferable for elderly patients because it shortens bowel preparation time and reduces defecation. Therefore, in-hospital administration of bowel preparation agents should be recommended for elderly patients as necessary, considering their cognitive function, medical condition, and distance from hospital to home.

Ethics Statement

This study was conducted in accordance with the tenets of the Declaration of Helsinki and the guidelines of the Consolidated Standards of Reporting Trials (CONSORT). The study protocol and the consent procedure were approved by the Ethics Review Committee of the National Hospital Organization Ureshino Medical Center (approval number 22-12).

Consent

Informed consent was obtained from all study participants.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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