Clinical Trial/Experimental Study

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Ward nurses-focused educational intervention improves the quality of bowel preparation in inpatients undergoing colonoscopy

A CONSORT-compliant randomized controlled trial

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Abstract

Background: Adequate bowel preparation is essential for the detection of pathological lesions during colonoscopy. However, it has been found to be inadequate in approximately 20% to 30% of colonoscopy examinations. Educational interventions focused on health staff, such as physicians and nurses, may improve the patients' understanding of the bowel preparation instructions, and consequently, increase the quality of bowel preparation.

Objectives: To investigate whether enhanced education of ward nurses could improve the bowel preparation quality in inpatients undergoing colonoscopy.

Design: This was a single-center randomized controlled study.

Methods: A total of 190 consecutive inpatients scheduled to undergo colonoscopy from March 2019 to March 2020 were randomized to the educated (nurses with enhanced education) or control group (nurses without enhanced education). We assessed the bowel preparation quality using the Boston bowel preparation scale.

Results: There were 89 patients in the educated group and 101 patients in the control group. The proportion of colonoscopies with adequate bowel preparation was 83.1% in the educated group and 69.3% in the control group. Patients' compliance with bowel preparation in the educated group was superior to that in the control group. Furthermore, significantly better sleep quality was found in the educated group. The multivariate logistic regression analysis identified the ward nurses-focused enhanced educational intervention as a risk factor for bowel preparation quality.

Conclusions: The ward nurses-focused educational intervention improved the bowel preparation quality and reduced the adverse event rates in inpatients undergoing colonoscopy.

Trial registration: This study was registered in the Chinese Clinical Trial Registry under number ChiCTR2000030366.

Abbreviation: BBPS = Boston bowel preparation scale.

Keywords: bowel preparation, colonoscopy, education, ward nurses

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AL, SY and HW contributed equally to this work.

AL, SY and HW are co-first authors.

The study was approved by the Ethics Committee of the Sixth Affiliated Hospital of Sun Yat-sen University and was performed in accordance with the ethical standards of the Declaration of Helsinki.

Informed consent was obtained from all individual participants included in the study.

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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1. Introduction

Colonoscopy is an important tool for the diagnosis and treatment of colorectal diseases.[1] Adequate bowel preparation is essential for the detection of pathological lesions during colonoscopy.[2] However, bowel preparation is a complex procedure and has been found to be inadequate in approximately 20% to 30% of colonoscopy examinations.[3] Several factors might influence the quality of bowel preparation, including the patient's age, purgative and protocol used, colonoscopy timing, and patient's compliance with the bowel preparation instructions.[2,4,5]

Previous studies have indicated that patient-focused educational interventions may improve their understanding of the bowel preparation instructions, and consequently, increase the quality of bowel preparation.[6,7] Compared to that in outpatients, the rate of adequate bowel preparation in inpatients remains unsatisfactory, while the overall adequate bowel preparation rate varies from 50% to 70%.[8–10] Hospitalized patients often misunderstand the complicated bowel preparation instructions, making it difficult for them to successfully complete their bowel preparation.[11,12]

Several studies demonstrated that educational interventions provided by physicians and nurses after the regular instructions might improve the patient's comprehension and compliance, ultimately improving the quality of bowel preparation.[13,14] It has also been suggested that ward nurses-focused educational interventions could enhance their ability to provide more effective clinical nurse care, leading to improved inpatients' clinical outcomes.[15–17] However, few studies have investigated whether ward nurses-focused educational interventions could increase the bowel preparation quality in inpatients scheduled for colonoscopy. Thus, we hypothesized that a ward nurses-focused educational intervention on the details of bowel preparation might enhance the effectiveness of the provided bowel preparation instructions for inpatients and increase the quality of bowel preparation.[18]

This randomized controlled trial was performed with the aim to investigate whether enhanced education of ward nurses could increase the bowel preparation quality.

2. Methods

2.1. Ethical considerations

This study was approved by the Ethics Committee of our institution and was performed in accordance with the tenets of the Declaration of Helsinki. All methods were performed following the relevant guidelines and regulations. All patients provided written informed consent for participation in the study before enrollment, as well as for colonoscopy before the examination. The study was registered at the Chinese Clinical Trial Registry under number ChiCTR2000030366.

2.2. Study design and patients

This was a single-center randomized controlled study that included consecutive inpatients aged between 18 and 75 years who were scheduled for colonoscopy at the Department of gastrointestinal surgery of our hospital from May 2019 to March 2020. The exclusion criteria were as follows: colorectal cancer with obvious obstruction, history of gastrointestinal surgery, gastrointestinal hemorrhagic diseases, suspected intestinal obstruction or perforation, emergency colonoscopy, and refusal to participate.

2.3. Randomization and blinding

After signing the written informed consent form, patients were randomly assigned to be under the care of ward nurses with enhanced education (educated group) or ward nurses without enhanced education (control group) by an independent nurse (LPF) with an allocation ratio 1:1. The allocation sequence was generated using a random number table. Ward nurses were also randomly allocated into the educated or control group. The ward nurses knew the patients' group assignment, while the patients, investigators, and colonoscopists were blinded to the patients' group assignment during the study period.

2.4. Intervention

In the educated group, patients received directions from ward nurses who underwent enhanced education on bowel preparation. In the control group, patients received directions from ward nurses who did not undergo enhanced education on bowel preparation. Patients were allowed to ask the nurses whenever they had questions about the bowel preparation.

2.4.1. Educational intervention. Nurses in the educated group underwent enhanced education via lessons and leaflets. The enhanced education included lessons on the rationale of the purgative, bowel preparation instructions, the Boston bowel preparation scale (BBPS; pictures of the scale were provided on a leaflet), and the possible adverse events during bowel preparation. There were also lessons on precolonoscopy diet, including its rationale and a guide on choosing the food according to the patient's preferences (a meal list with pictures was provided). The lessons were taught by an experienced colonoscopist in the meeting room of the ward for 1 hour, once a week, for 4 weeks. Nurses were allowed to ask any questions during the lessons. No additional education was provided to the nurses who were assigned to the control group.

2.5. Bowel preparation and colonoscopy

The bowel preparation regimens were 3-L split-dose of polyethylene glycol for morning colonoscopies and a same-day 3-L polyethylene glycol regimen for afternoon colonoscopies. All patients received instructions on bowel preparation after colonoscopy was scheduled. Patients in the educated group could ask questions about the bowel preparation and were provided detailed explanations about the colonoscopy procedure, bowel preparation protocol, precolonoscopy diet, purgative intake time, and how to intake purgative based on the instructions for bowel preparation from the educated nurses. Patients in the control group received the standard explanations based on the instruction for bowel preparation from nurses who had received no enhanced education. All colonoscopies were performed by experienced colonoscopists with more than 1000 procedures of experience (YL and WJZ). Successful endoscopy was defined as terminal ileum intubation confirmed by photography.

2.6. Definition of primary and secondary endpoints

The primary endpoint was the quality of bowel preparation, as assessed by the BBPS score.[19,20] The assessment was performed using a 4-point scoring system, from 0 to 3 (3: excellent, 2: good, 1: poor, or 0: inadequate) for the 3 broad regions of the colon: the

right colon (including the cecum and ascending colon), the transverse colon (including the hepatic flexures, transverse colon, and splenic flexures), and the left colon (including the descending colon, sigmoid colon, and rectum). The total BBPS score was calculated as the sum of the 3 segmental scores and ranged from 0 to 9.[20] Inadequate preparation was defined as a total BBPS score of less than 6 points or a score in any segment of less than 2 points.[21]

The secondary endpoints included the rate of sleeping disturbance, adverse events, and compliance with the instructions during the preparation. Sleeping disturbance included complaints of staying awake or difficulty falling asleep and poor sleep quality. Adverse events included nausea, vomiting, abdominal pain, and abdominal bloating during bowel preparation. Failing to follow the dietary restrictions or consumption of less than 75% of the assigned preparation volume was considered non-compliance. Factors affecting inadequate bowel preparation, as assessed by the proportion of inadequate bowel preparation, were also identified.

2.7. Sample size calculation

The sample size was calculated to achieve an 80% power at a 2-sided type I error of 0.05 to detect an estimation of 20% difference in the rate of good colonic preparation. The calculated minimal sample size required was 186 patients.

2.8. Statistical analysis

IBM SPSS Statistics software (Version. 22.0; IBM Corporation, Armonk, NY) was used for statistical analysis. Chi-square test or Fisher exact test was used to analyze the categorical variables. Continuous variables were analyzed using Student *t*-test. Univariate analysis and multiple logistic regression models were

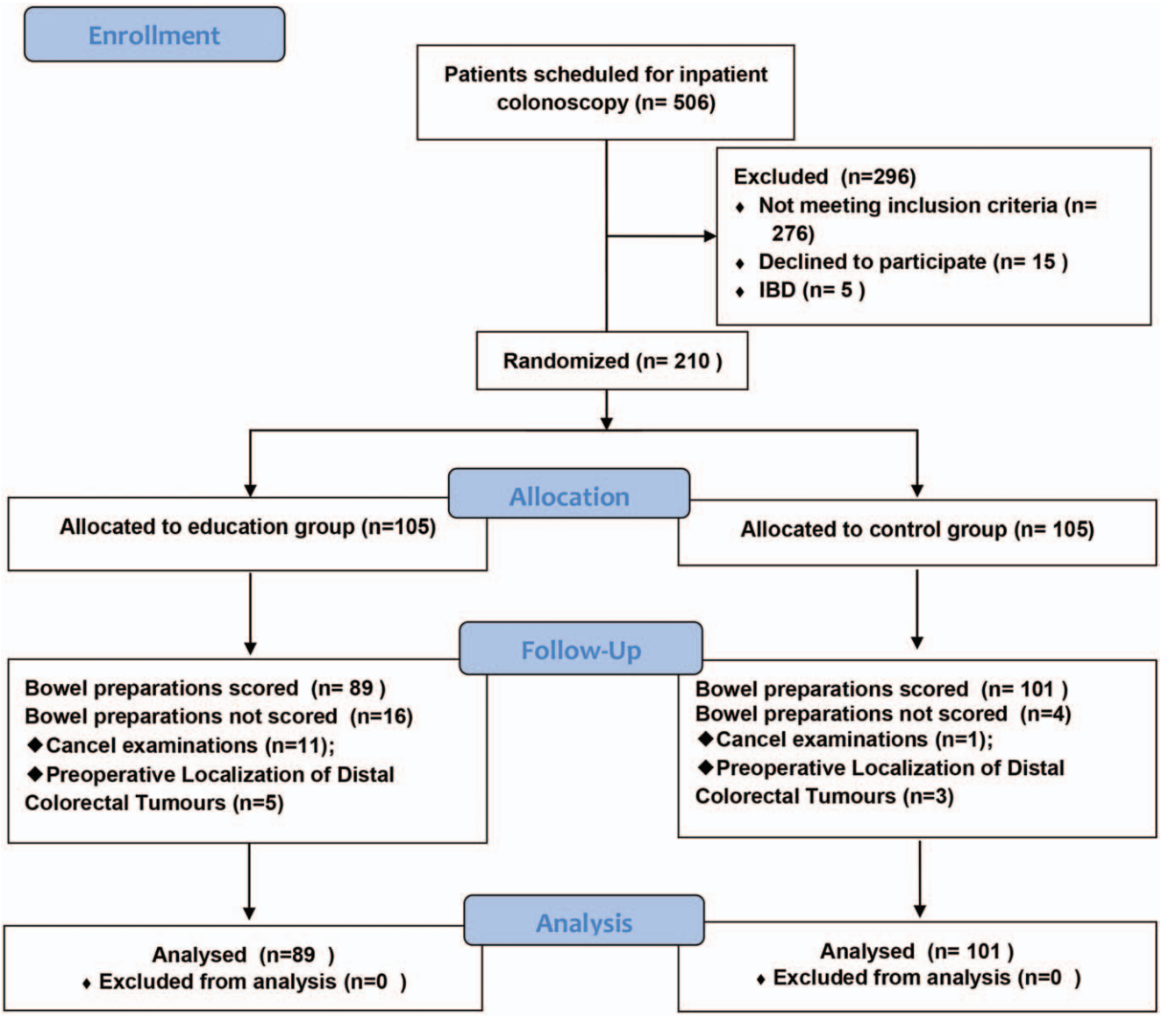

Figure 1. Study flowchart.

Table 1

Characteristics of patients (n = 190).

Characteristics	Educated group (n = 89)	Control group (n = 101)	*P*
Age (yr)	51.1 ± 13.2	50.8 ± 13.7	.877
Gender (male/female)	60/29	68/33	.990
Grade of education			.462
Primary school or lower	18	26	
Higher than primary school	71	75	
Timing of colonoscopy			.942
Morning session	48	55	
Afternoon session	41	46	
Previous colonoscopy	31	37	.796

Table 3

Comparison of patient's subjective feelings and compliance during bowel preparation.

Characteristics	Educated group (n = 89)	Control group (n = 101)	*P*-value
Sleep disturbance, No. (%)	17 (19.1)	32 (31.7)	.048
Nausea, No. (%)	16 (18.0)	21 (20.8)	.625
Vomiting No. (%)	10 (11.2)	9 (8.9)	.594
Abdominal pain, No. (%)	13 (14.6)	17 (15.8)	.675
Abdominal bloating, No. (%)	20 (22.5)	29 (27.1)	.456
Compliance to bowel preparation, No. (%)	79 (88.8)	68 (67.3)	<.001

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used to analyze the factors associated with inadequate bowel preparation. The level of significance was set at $P < .05$.

3. Results

3.1. Patients' characteristics

A total of 190 patients who were admitted at the Department of gastrointestinal surgery for scheduled colonoscopy were finally included in this study. Of these, 89 patients were allocated to the educated group and 101 patients were allocated to the control group. Figure 1 shows the study flow chart of patient enrollment. As shown in Table 1, the patients' baseline characteristics were similar between the 2 groups.

3.2. Primary endpoint

The average overall BBPS scores and the cleanliness scores for the left and transverse colon were higher in the educated group ($P < .05$). The proportion of patients with adequate bowel preparation (BBPS score ≥6) was significantly higher in the educated group than in the control group (83.1% vs 69.3%, $P = .026$). These results suggested that the nurses' enhanced education could improve the bowel preparation quality (Table 2).

3.3. Secondary endpoints

Patients in the educated group had significantly less sleep disturbances than did patients in the control group ($P = .048$). The rates of nausea and abdominal discomfort were lower in the educated than in the control group, but without a significant difference (all $P > .05$). The rate of vomiting was slightly higher in the educated group; however, there was no significant difference between the groups ($P > .05$). The rate of patients' compliance during bowel preparation was significantly higher in the educated than in control group ($P < .001$; Table 3).

Table 2

Comparison of bowel preparation quality (n = 190).

Characteristics	Educated group (n = 89)	Control group (n = 101)	*P*-value
Boston Bowel Preparation Scale scores (mean ± SD)	6.61 ± 1.23	6.01 ± 1.32	.002
Total			
Left colon	2.15 ± 0.51	1.89 ± 0.63	.003
Trans-colon	2.14 ± 0.50	1.95 ± 0.57	.014
Right colon	1.91 ± 0.41	2.03 ± 0.60	.089
Adequate bowel preparation, No. (%)	74 (83.1)	70 (69.3)	.026

3.4. Risk factors associated with poor bowel preparation

Among the 190 patients who were enrolled in this study, inadequate bowel preparation was identified in 45 patients. In the univariate analysis, the ward nurses' education and timing of colonoscopy were found to be risk factors for inadequate bowel preparation ($P < .001$). However, the multivariate analysis indicated that the ward nurses' education was the only independent risk factor related to the bowel preparation quality (odds ratio 2.103, 95% confidence interval, 1.038–4.261, $P = .039$; Table 4).

4. Discussion

In this study, we investigated whether a ward nurses-focused educational intervention could increase the bowel preparation quality in inpatients scheduled for colonoscopy. We found that inpatients under the care of nurses who underwent enhanced education on bowel preparation had a significantly better bowel preparation quality, lower rates of sleep disturbances, nausea, vomiting, and abdominal discomfort, and higher compliance rates than those in inpatients of the control group. In addition, the ward nurses' education was the only independent risk factor related to the bowel preparation quality.

Poor bowel preparation leads to missed adenomas, repeat examinations, patient discomfort, and higher healthcare cost.[22] Patient compliance is an important factor affecting the quality of colonoscopy.[23,24] Educational interventions significantly improve the patients' bowel preparation quality.[25] Previous studies have reported that physician- or nurse-focused education can improve the quality of bowel preparation.[9,14] However, the education level of healthcare staff, including physicians and nurses, may influence the efficacy of patient education.[26] A series of studies suggested that ward nurses play a useful role in the clinical care and follow-up.[27–29]

Bowel preparation is a complex procedure that requires active patient cooperation and a good understanding of the diet and purgative instructions.[6] Patient's compliance with the preparation instructions is important for patients to execute these instructions. Inpatients receive a face-to-face explanation and instructions from ward nurses and can ask them any questions,

Table 4

Analysis of factors associated with inadequate bowel preparation.

Characteristics	Univariate analysis, *P*			Multivariate analysis, *P*		
	OR	95% CI	*P*	OR	95% CI	*P*
Age ≥60 yr	0.842	0.417–1.702	.632	0.609	0.270–1.374	.232
Gender	0.735	0.332–1.518	.490			
Grade of education	0.827	0.421–1.626	.583			
Previous colonoscopy	0.619	0.313–1.224	.168			
Timing of colonoscopy	2,411	1.151–5.053	.020	0.505	0.230–1.408	.048
No enhanced education on Ward nurse	0.429	0.197–0.932	.032	2.103	1.038–4.261	.039

CI = confidence interval, OR = odds ratio.

which enables these patients to understand the instruction easily, resulting in increased compliance of inpatients during bowel preparation.[30] The enhanced education of the ward nurses by lectures and presentations on the importance of adequate bowel preparation and how to achieve the same resulted in better bowel preparation in the educated group compared with that in the control group. Furthermore, there were less complaints of sleep disturbance and discomfort in the educated group. Although the vomiting rate was slightly higher in the educated group, no significant difference was observed.

Previous studies have also indicated that nurses' education might improve the clinical outcomes and their knowledge might influence the patients' adherence to treatment.[31,32] In our study, the multiple logistic regression analysis showed that the ward nurses' enhanced education is a critical factor that might affect the quality of bowel preparation. The possible reason for this is that enhanced nurses' education could enhance the patients' understanding of the provided bowel preparation instructions and thereby decrease the rate of inadequate preparations.

This study had some limitations. First, this was a single-center study with a small sample size; hence, the generalizability of the results is debatable. A multi-center study with a larger sample is needed to confirm our results. Second, some factors, such as salary levels and body mass index, which can influence the quality of bowel preparation, were not reported. This may have introduced a bias between the 2 groups. Third, only 1 kind of purgative and bowel preparation regimen was used in this study. The efficacy of nurses' education on the bowel preparation quality using other purgatives and regimens should be analyzed.[33,34] Fourth, although several bowel preparation scales have been developed to access the quality of bowel preparation,[19,21,35,36] only the BBPS was used for this study. Other scales should be used in future studies to confirm our results. Finally, the educational level of nurses was not reported in this study. A previous study indicated that higher proportions of nurses educated at a baccalaureate level or higher might improve the patients' outcomes.[31] Hence, future studies should investigate the effect of the nurse educational level on the bowel preparation quality.

In conclusion, inpatients under the care of nurses who underwent enhanced education on bowel preparation had a significantly better bowel preparation quality, lower adverse event rates, and higher compliance rates than those in inpatients of the control group. Ward nurses' education was identified as an independent risk factor for bowel preparation quality.

5. Relevance to clinical practice

This study highlights the role of ward nurses during bowel preparation. Enhanced educational interventions focused on ward nurses could improve the quality of bowel preparation, increase patient satisfaction, and reduce the rate of adverse events.

6. What does this paper contribute to the wider global clinical community?

- This study highlights the role of ward nurses during bowel preparation.
- Enhanced educational interventions focused on ward nurses could improve the quality of bowel preparation, increase patient satisfaction, and reduce the rate of adverse events.

Author contributions

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