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ARTICLE

Optimizing Bowel Preparation for Capsule Endoscopy and Colonoscopy: A Patient-Centered Protocol Revision and Application

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Abstract

Objective: This study aimed to evaluate the effectiveness of a modified patient experience-based bowel preparation protocol for capsule endoscopy combined with colonoscopy. **Methods:** A total of 262 patients who underwent capsule endoscopy combined with colonoscopy in a tertiary hospital in Zhuhai city from July to December 2021 were enrolled in this study. They were divided into the control group (n=141) and the experimental group (n=121) using the random number method. The experimental group used the modified bowel preparation protocol while the control group used the conventional preparation protocol. Post-examination indicators, including sleep quality, gastrointestinal discomfort, nausea, vomiting, abdominal pain, and satisfaction, were compared between the two groups. **Results:** The data showed that the experimental group's preparation medication had a better taste and was effective in improving patient symptoms, such as gastrointestinal discomfort, nausea and vomiting, abdominal pain, and sleep quality, compared to the control group. Moreover, both patients and nurses reported greater satisfaction with the experimental group's bowel preparation time compared to the control group, with statistically significant differences observed ($P<0.05$). **Conclusions:** The modified bowel preparation protocol could improve patient sleep quality, reduce adverse reactions, and increase patient comfort and satisfaction.

Keywords: Capsule endoscopy; Colonoscopy; Bowel preparation protocol; Patient experience.

INTRODUCTION

Bowel preparation, or bowel cleansing, is a crucial procedure for various medical examinations and surgeries, including colonoscopy, capsule endoscopy, and imaging examinations. Colonoscopy, in particular, is widely used for the diagnosis and screening of colorectal lesions [1]. Meanwhile, capsule endoscopy is a relatively new technology used primarily for small bowel examination, offering a high sensitivity and specificity in detecting small bowel polyps, intestinal cancers, and inflammatory bowel disease [2]. However, its effectiveness is limited due to the large surface area of the rectum, making it crucial to combine capsule endoscopy with colonoscopy to achieve accurate and safe treatment outcomes.

The quality of bowel preparation plays a crucial role in ensuring accurate diagnoses and treatment outcomes. Currently, research on bowel preparation mainly focuses on colonoscopy, with limited attention paid to capsule endoscopy preparation. Moreover, there is no clear recommendation for capsule endoscopy preparation in clinical practice, and research on the impact of patients' well-being is lacking.

Current research shows that patients' experiences with bowel preparation could significantly affect their subjective experiences. Studies also indicate that 9% to 67% of patients who underwent full intestinal examinations believed that bowel preparation could cause adverse reactions such as nausea, abdominal pain, and poor sleep quality, leading to unsatisfactory subjective experiences [3-4].

This study aimed to improve the bowel preparation protocol for capsule endoscopy combined with colonoscopy, guided by patients' experiences, to achieve better outcomes. A total of 262 patients who underwent capsule endoscopy combined with colonoscopy in a tertiary hospital were enrolled. The patients were randomly divided into control and experimental groups, with the experimental group receiving a modified patient experience-based bowel preparation protocol and the control group receiving a conventional preparation protocol. The post-examination indicators, including sleep quality, gastrointestinal discomfort, nausea, vomiting, abdominal pain, and satisfaction, were compared between the two groups.

MATERIALS AND METHODS

Research participants

This study included 262 patients who had capsule endoscopy combined with colonoscopy examination in the Endoscopy Center of a tertiary grade A hospital in Zhuhai, China from July 2021 to December 2021. According to the random number method, 141 patients were included in the control group and 121 patients were included in the experimental group. Inclusion criteria were as follows: (1) aged 18 years or older; (2) able to comply with the medication and water intake during the intestinal preparation period; (3) able to communicate with the researchers and understand the requirements for intestinal preparation. Exclusion criteria were as follows: (1) patients with severe cardiorespiratory diseases; (2) patients with intestinal obstruction; (3) patients with (suspected) gastrointestinal bleeding; (4) patients with liver or kidney dysfunction. This study was reviewed by the hospital's ethics committee, and the participants were fully informed of the nature and risks of the study. Prior to receiving the study medication, they signed an informed consent form, and the ethics approval number was ZY [2019] No. (21).

Intervention methods for the experimental group

Establishing a research team

First, a research group consisting of a multidisciplinary research team led by the director of the Endoscopy Center and the head nurse was established to conduct the project. The team includes three doctors, five nurses, and one pharmacist, all of whom have undergraduate or higher education qualifications, including two doctoral students and three students (including one nursing student) with master degrees and two senior professional title holders. All members participated in literature retrieval and protocol development, with the head nurse responsible for coordinating the work, the pharmacist responsible for selecting drugs and assessing drug side effects, the doctors responsible for providing professional guidance on intestinal preparation protocols, and the nurses responsible for implementing the protocols, patient assessment, and data collection.

Modifying the bowel preparation protocol for capsule endoscopy combined with colonoscopy

Literature review: Relevant articles, guidelines, expert consensus, evidence summaries, and randomized controlled trials published in the past 5 years were retrieved from databases such as China National Knowledge Infrastructure, Wanfang, JBI Evidence-Based Nursing Database, and PubMed, using keywords such as "capsule endoscopy", "colonoscopy", "bowel preparation protocol". "patient experience", and "gastrointestinal reactions". The research team screened and evaluated the evidence items based on feasibility, suitability, clinical significance, and effectiveness, and formulated the preliminary "First Edition of the Bowel Preparation Protocol for Capsule Endoscopy Combined with Colonoscopy (hereafter referred to as the Protocol)".

Clinical pre-survey: Based on the literature review, the "Patient Experience Survey on Bowel Preparation for Capsule Endoscopy Combined with Colonoscopy" (hereafter referred to as the "Experience Survey Questionnaire") was developed. Specific observation indicators included: (1) bowel preparation conditions, including preparation time and effectiveness, with bowel preparation effectiveness evaluated using the Boston Bowel Preparation Scale; (2) patient comfort evaluation, including adverse reactions such as nausea, vomiting, stomach pain, abdominal distension, and sleep quality; (3) other aspects such as physician and nurse satisfaction and patient satisfaction. The pre-survey results showed that gastrointestinal reactions such as nausea, vomiting, and abdominal pain were common among patients, and sleep time (nighttime) and satisfaction were both affected. Based on the clinical survey results, the "Second Edition of the Protocol" was modified.

Expert review: Five clinical experts, including two chief physicians, two deputy chief nurses, and one deputy chief pharmacist, with over 15 years of specialty experience, were selected. The experts had an average familiarity level (Cs) of 0.94, an average judgment basis (Ca) of 0.82, and an average authority coefficient of 0.88 > 0.70. The review group deliberated on various aspects, such as medication regimen for bowel preparation, health education, clinical observation, and determined the "modified Protocol" as shown in Table 1.

Implementation of a modified protocol for bowel preparation before capsule endoscopy combined with colonoscopy

Prior to intervention implementation, a modified health education manual for bowel preparation before endoscopic examination was synchronized, and ward and endoscopy center medical staff were trained. The training included examination pre-assessment, medication for bowel preparation, patient preparation, emergency handling of adverse reactions, and nurse standardized education content. At the same time, a uniform doctor's order mode was established, and a doctor's order set was set up in the health information system (HIS) to ensure accurate prescription. After training, theoretical assessments and spot checks were carried out to ensure that medical staff were aware of the bowel preparation process. The specific process includes: (1) the doctor assesses the patient's condition, determines whether capsule endoscopy combined with colonoscopy is needed, informs the patient of the situation and obtains consent; (2) the nurse assesses the patient's daily life, diet, activity, bowel movements, etc., and develops a bowel preparation diet plan for the patient, mainly consisting of a list of easily digestible foods; (3) the nurse instructs the patient in bowel preparation [5], including medication time, method, dosage, activity during medication, and possible adverse reactions. During the patient's bowel preparation process, the nurse should pay attention to whether the patient experiences adverse reactions such as nausea, vomiting, abdominal pain, insomnia, and bowel movements, and record them in the "Patient Bowel Preparation Record Form"; (4) after the endoscopic examination, the nurse evaluates the patient's experience using the "Experience Survey Questionnaire".

Intervention methods for the control group

The control group intervention method involved the responsibility nurse assessing the patient's basic condition on the day of admission, distributing a health education manual to the patient, and explaining the contents of the education in detail. The health education manual consisted of relevant knowledge about the disease, including clinical symptoms, examination and treatment, diet, medication, bowel movements, gastrointestinal reactions, and other related information. The control group follows the routine nursing procedures for colonoscopy bowel preparation according to the established protocol.

Data collection and evaluation indicators

The data collection and evaluation indicators involved standardized and homogenized training for nurses, guiding or assisting patients to complete the "Experience Survey Questionnaire". The research team collected and input questionnaire data on a weekly basis, while also conducting data quality control procedures.

Statistical analysis

The statistical analysis was performed using SPSS 13.0 software and the results were considered statistically significant when $P < 0.05$. Frequency and rate description were used to analyze general data, and the chi-square test was applied. Descriptive statistical analysis was utilized for metric data, with two independent samples t-test or analysis of variance (ANOVA) being employed. The chi-square test was utilized for count data.

Table 1. Modified protocol for bowel preparation prior to capsule endoscopy and colonoscopy.

Days	Timing	Prep Instructions
2 days before the examination	Whole day	Low-fiber diet
1 day before the examination	Whole day	Low-residue diet
	19:00	Mosapride 5mg/tablet
	after 20:00	Fasting
	20:00-21:30	2L polyethylene glycol electrolyte solution (200-300ml every 10-15 minutes, finish within 1.5 hours)
On the day of examination	8:30-10:00	2L polyethylene glycol electrolyte solution + 30ml simethicone oil (200-300ml every 10-15 minutes, finish within 1.5 hours)
	14:00	Putting on the examination gown. Registering patient information in the system.
	14:10	Instruct the patient to swallow the capsule. The doctor and nurse should watch the capsule enter the stomach in real time.
	14:10-14:30	Instruct the patient to walk back and forth and climb stairs.
	14:30	Observe whether the capsule enters the small intestine; if it does not enter the small intestine, instruct the patient to continue walking back and forth for 30 minutes.
	15:00	The patient will be sent to the endoscopy room for colonoscopy. If the capsule does not enter the small intestine, it will be pushed to the descending duodenum under gastroscopy.
		If polyps are found by gastroenteroscopy, polypectomy can be performed at the same time.
	16:00	Escorting the patient back to the ward after completing the gastroenteroscopy.
	Back to the ward	Continue to observe the movement of the capsule in the small intestine. The capsule can travel in the small intestine for 6-8 hours. Observe if it reaches the large intestine.
End of examination	Capsule entering the bowel	Battery power is depleted or the capsule is expelled from the body.

RESULT

Baseline characteristics of the two groups

This study involved a total of 262 participants, with 141 in the control group and 121 in the experimental group. Baseline characteristics of the patients in the control and experimental groups were compared. As shown in Table 2, parameters including gender, age, education levels, previous medical histology, defecation habits, and frequency of defecation were comparable between the two groups.

Comparison of implementation outcomes between the two groups

As shown in Table 3, the comparison of outcomes between the two groups showed that the experimental group's medication had a better taste than the control group, and the experimental group was able to improve the patient's discomfort in the stomach, nausea and vomiting, abdominal pain, and sleep quality, with statistically significant differences.

Table 2. Comparison of the general information between the two groups.

Parameters		Control group (n=141)	Experimental group (n=121)	χ^2	P value
Gender	Male	66 (46.8)	43 (35.5)	1.842	0.066
	Female	75 (53.2)	78 (64.5)		
Age (Years)	18-35	21 (14.9)	16 (13.2)	1.769	0.077
	36-50	57 (40.4)	32 (26.4)		
	51-60	46 (32.6)	60 (49.6)		
	61-70	17 (12.1)	11 (9.1)		
	>70	0 (0.0)	2 (1.7)		
Education	Elementary school and below	29 (20.6)	15 (12.4)	1.568	0.117
	Junior college or high school	42 (29.8)	68 (56.2)		
	College, undergraduate and above	70 (49.6)	38 (31.4)		
Previously medical history	Yes	59 (41.8)	45 (37.2)	0.766	0.444
	No	82 (58.2)	76 (62.8)		
Defecation habits	Normal	73 (51.8)	49 (40.5)	1.821	0.069
	Abnormal	68 (48.2)	72 (59.5)		
Frequency of defecation	Once every 2~3 days	3 (2.1)	7 (5.8)	0.728	0.467
	Once a day	90 (63.8)	70 (57.9)		
	2～3 times/day	38 (27.0)	19 (15.7)		
	4~5times/day	10 (7.1)	21 (17.4)		
	>5 times/day	0 (0.0)	4 (3.3)		

Note: The data were presented as mean (standard deviation).

Comparison of endoscopy results and satisfaction between the two groups

The comparison of endoscopic examination results and satisfaction between the two groups showed no differences in the endoscopic examination results. However, the satisfaction with the endoscopic examination time in the experimental group was better than that in the control group, with statistically significant differences (Table 4).

DISCUSSION

The modified bowel preparation protocol could reduce adverse reactions in patients

Studies have shown that some patients experience adverse reactions such as bloating, diarrhea, abdominal pain, nausea, vomiting, and hypoglycemia due to the long fasting time, sudden large amounts of water and medication intake during bowel preparation [6]. The use of the "Patient Bowel Preparation Record" reminds nurses to timely evaluate adverse reactions to bowel preparation, take preventive measures in advance, and reduce adverse reactions such as abdominal pain, bloating, and nausea, thereby improving patient compliance.

Table 3. Comparison of the implementation outcomes between the two groups.

Parameters	Categories	Control group (n=141)	Experimental group (n=121)	χ^2	P value
Finishing the medication on time	Yes	120 (85.1)	109 (90.1)	1.208	0.227
	No	21 (14.9)	12 (9.9)		
Whether the taste of the medication is acceptable	Yes	53 (37.6)	74 (61.2)	3.826	<0.0001
	Partially	80 (56.7)	44 (31.3)		
	No	8 (5.7)	3 (2.5)		
Stomach discomfort	Yes	92 (65.2)	57 (47.1)	2.950	0.003
	No	49 (34.8)	64 (52.9)		
Abdominal pain	Yes	65 (46.1)	72 (59.5)	2.162	0.031
	No	76 (53.9)	49 (40.5)		
Nauseous and vomiting	Yes	122 (86.5)	86 (71.1)	3.076	0.002
	No	19 (13.5)	35 (28.9)		
Sleep disorder afterwards	Yes	141 (100.0)	70 (57.9)	8.574	<0.0001
	No	0 (0.0)	51 (42.1)		

Note: The data were presented as mean (standard deviation).

Table 4. Comparison of the bowel cleanliness and satisfaction results between the two groups.

Parameters	Categories	Control group (n=141)	Experimental group (n=121)	χ^2	P value
Bowel cleanliness	Clean	120 (85.1)	112 (92.6)	1.886	0.059
	Not clean	21 (14.9)	9 (7.4)		
Bowel cleanliness score	High	128 (90.8)	106 (87.6)	0.828	0.408
	Low	13 (9.2)	15 (12.4)		
Patient satisfaction with examination time	Satisfied	96 (68.1)	113 (93.4)	3.003	0.003
	Not satisfied	45 (31.9)	8 (6.6)		
Nurse satisfaction with examination time	Satisfied	112 (79.4)	112 (92.6)	5.073	<0.0001
	Not satisfied	29 (20.6)	9 (7.4)		

Note: The data were presented as mean (standard deviation).

The modified bowel preparation protocol controls the time for bowel preparation and endoscopic examination within 24 hours, and adds prokinetic drugs such as mosapride and defoaming drugs such as simethicone to reduce gas bubbles. It also uses polyethylene glycol with good taste and less gastrointestinal irritation, instead of laxatives such as mannitol or magnesium sulfate which produce more gas. During medication administration, patients are encouraged to massage their abdomen to promote gastrointestinal motility and reduce symptoms such as intestinal colic pain and nausea, increasing patient comfort.

Literature research has shown that diet and bowel habits in the 2-3 days prior to endoscopic examination are crucial to the effectiveness of bowel preparation [7]. Therefore, upon admission, nurses evaluate patients' diets and bowel habits, and develop individualized diet plans to adjust patients' bowel movements, avoiding the need for second bowel preparation or even second endoscopic examination due to poor bowel preparation effectiveness.

The modified bowel preparation protocol improves patient sleep quality

According to research, poor sleep quality can lead to anxiety in patients. The adverse effects of multiple bowel preparations, such as diarrhea and abdominal pain, can significantly impact a patient's sleep quality and contribute to anxiety. The modified bowel preparation protocol, which is based on the timing of the endoscopy examination, takes into account the patient's bowel and defecation habits, thereby setting a schedule for taking laxatives to minimize the waiting time for the examination and reduce the amount of time patients need to spend preparing their bowel at night, thus improving their sleep quality.

Furthermore, patients undergoing bowel preparation often experience anxiety related to the effectiveness of the bowel preparation or the results of the endoscopy examination. Changes in light and sound during bowel preparation can also impact sleep quality, leading to anxiety. Therefore, patients who have endoscopy appointments at similar times are placed in the same ward to avoid disturbing each other's sleep. Additionally, during the laxative period, nurses increase monitoring, paying close attention to patients' behavior due to factors such as abdominal pain, bloating, nausea, and vomiting, providing guidance on abdominal massage, deep breathing, and other techniques to alleviate anxiety.

Nurses are more satisfied with the revised bowel preparation protocol than the traditional method

Nurses are the main instructors and supervisors of patients undergoing bowel preparation. This study shows that the modified bowel preparation protocol results in better bowel cleanliness and a lower probability of patients requiring a second endoscopy. The efficacy of bowel preparation is related to patient age, underlying disease, dietary habits, bowel habits, medication guidance, medication compliance, medication tolerance, and medication timing [8-10]. In the control group, nurses assessed and educated patients according to the conventional bowel preparation method, but neglected to track and evaluate patient education effectiveness. This caused patients to make mistakes in medication dosage and timing, increased the workload of nurses, and led to incomplete bowel preparation and prolonged hospitalization and increased examination costs. Therefore, the modified bowel preparation protocol has the following advantages: (1) adding patient assessment records to facilitate timely recording of patients' periodic conditions; (2) adding mosapride before taking the laxative to improve gastrointestinal motility and facilitate fecal excretion; and (3) combining capsule endoscopy and colonoscopy to shorten patient waiting time, reduce the number and duration of bowel preparations, enhance patient compliance, reduce nursing workload, and improve nursing and patient satisfaction [10]. Therefore, the modified bowel preparation protocol is beneficial for patients undergoing colonoscopy, and nurses are satisfied with the protocol.

CONCLUSION

In conclusion, the modified bowel preparation protocol can shorten the preparation time before capsule endoscopy in combination with colonoscopy, with a reduction in adverse reactions and an improvement in sleep quality, resulting in better outcomes. However, the high volume of water required for bowel preparation may be poorly tolerated by elderly

patients with poor bowel function. Therefore, there is a need for better drugs to assist with bowel preparation in the future.

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