

Research Progress of Bowel Preparation for Colonoscopy

Yongquan Huang^{1,2}, Xiaoping Tan^{1*}

¹Medical College of Yangtze University, Jingzhou, China

²Department of Gastroenterology, Zhuhai Fifth People's Hospital, Zhuhai, China

Email: *651389023@qq.com

How to cite this paper: Huang, Y.Q. and Tan, X.P. (2024) Research Progress of Bowel Preparation for Colonoscopy. *Journal of Biosciences and Medicines*, 12, 10-18. <https://doi.org/10.4236/jbm.2024.125002>

Received: March 9, 2024

Accepted: May 5, 2024

Published: May 8, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Colorectal cancer ranks third in the global cancer data in 2020. Colorectal scope is the most effective method to diagnose colorectal diseases such as benign and malignant colorectal tumors. The poor quality of intestinal preparation causes an increased rate of missed diagnosis of colorectal tumors, reduces the rate of cecal intubation for colorectal examination, increases the discomfort, and reduces the compliance of re-examination. Therefore, we should try our best to improve the quality of intestinal preparation. This study reviewed the latest advances related to the preoperative preparation for colonoscopy. Recent research shows that smartphone apps can provide more detailed education and guidance on bowel preparation; Pre-packaged foods are more suitable as a way to eat before colonoscopy. The use of smaller doses, better taste of cathartic agents, and some auxiliary measures, combined with the patient's situation to provide personalized intestinal preparation measures to improve the quality of intestinal preparation. Starting from the quality of colonoscopy bowel preparation, continuous improvement of patients' tolerance to bowel preparation, continuous improvement of bowel preparation plan based on individual factors' needs, and better communication with examined subjects by using existing scientific information technology, may be the hot spot of colonoscopy bowel preparation research in the next few years.

Keywords

Colonoscopy, Bowel Preparation, Preoperative Education, Quality of Bowel Preparation, Polyethylene Glycol

*Corresponding author.

1. Introduction

Colorectal scope is the gold standard for the diagnosis of various colorectal diseases, such as colorectal tumors, inflammatory bowel disease, ischemic enteritis, etc. At the same time, it can also treat some colorectal diseases. However, the key to the successful diagnosis of colorectal diseases is the quality of intestinal preparation [1] [2]. Numerous studies have shown that the rate of polyp detection on colonoscopy is significantly higher in patients with good-quality bowel preparation than in those with inadequate bowel preparation, especially if the morphology is flat polyps. When subjects had a good or excellent standard of bowel cleansing, the percentage of adenomas detected on colonoscopy significantly exceeded that of those with inadequate bowel cleansing. In addition, if their bowel preparation was not thorough enough, it may have cost the surgeon more time in performing the procedure, making it more difficult, increasing patient discomfort and incurring additional health care costs, as well as resulting in the needless consumption of significant health care resources [3]. The main objective of this paper is to discuss strategies to improve the effectiveness of bowel cleansing before colonoscopy worldwide and to propose an improved method to improve the effectiveness of bowel cleansing.

2. Preoperative Education and Bowel Preparation

Pre-operative education before bowel preparation is often the key to coordinating patients with a colonoscopy, which mainly includes the importance of bowel preparation in colonoscopy, dietary management, and the administration of laxatives. Traditional preoperative education is mainly based on verbal information, as well as text, pictures, videos, etc. Liu found that the quality of bowel preparation for colonoscopy increased from 69.3% to 83.1% with nurse-centered preoperative education based on verbal, text, picture and video [4]. With the development of science and technology, social media apps and public websites have also become a way to educate patients about bowel preparation. zander Team independently developed a smartphone application, patients can run the application on android or ios equipment, the application provides information and conventional hospital education content is very similar, but the way of information is more intuitive, namely according to the patient appointment colonoscopy time customization, provide patients need to achieve intestinal cleaning degree of low residue food image, laxative intake method and image, provide personalized intestinal preparation steps, the results showed that the quality of gut preparation was significantly better in the smartphone app population compared to the control group [5]. Guan Y Team uses WeChat, a smart Chinese instant messaging and social media application, let colonoscopy or their families in booking time scan or codes WeChat group, the medical staff WeChat group with text, pictures, videos telling the importance of intestinal preparation, dietary requirements, and diarrhea drug medication instructions, etc., the results show that using WeChat group, can improve the quality of intestinal preparation and

increase the adenoma detection rate, shorten the total time of colonoscopy, and reduce the discomfort in intestinal preparation [6]. In clinical work, the workload of clinical medical staff is heavy, and the simple propaganda and education efficiency is low. Patients are affected by speech communication and other aspects. In the future, it is necessary to improve the theoretical knowledge of propaganda and education of specialized medical staff and make full use of electronic information products to provide patients with simple and easy-to-understand intestinal steps to improve the quality of bowel preparation.

3. Dietary Management and Bowel Preparation

Dietary management is very important in bowel preparation, e.g., fasting for 24 hours before colonoscopy, a low-fiber semifluid diet, and a clear liquid diet can reduce the amount of feces in the bowel and increase the quality of the bowel preparation, however, fasting alone without additional intravenous glucose supplementation may present a risk of hypoglycemia [7]. After Meta-analyzing the results of a study containing twenty articles, Zhang found that there were no significant differences in the degree of cleanliness (Boston score) and the number of colonic adenomatous polyps detected, the probability of successful cecum insertion, and patient comfort whether Low-fiber diet or clear liquid diet were used as a bowel cleansing method, however, patients consuming Low-fiber diet, as compared to those on the clear liquid diet, however, patients who consumed a low-fiber diet experienced hunger pangs and nausea and vomiting much less frequently than those on a clear liquid diet, and were more likely to be accepted by patients [8]. Consumption of foods colored red, orange, blue, and purple may affect colonoscopy results [9].

A pre-packaged diet for bowel preparation is a unified diet before bowel preparation. Zhang found that the pre-packaged diet has a more balanced nutrient composition, less risk of hunger and hypoglycemia, is convenient to consume, is easy to accept by the patients, and can significantly improve the quality of bowel preparation. However, the pre-packaged diet has not been fully promoted because the standardized diet does not meet the taste of patients, the process of adoption is cumbersome, and further research is needed [10].

According to Lee's research results, the combination of 1L PEG electrolyte solution and ascorbic acid as prepackaged food is not inferior to the combination of 2L PEG electrolyte solution and ascorbic acid-based low-fiber food, but the former can improve the comfort of patients and reduce the use of PEG [11].

4. The Choice of Bowel Preparation Programs

European guidelines recommend PEG (polyethylene glycol) electrolyte powder for bowel preparation, PEG adds water to form an isotonic solution to be taken, in the human body is not absorbed, not metabolized, the intestinal absorption and secretion function has no obvious effect, and is not easy to cause water-electrolyte disorders, It can combine with water molecules to form stable hydro-

gen bonds, so that the water in the intestinal contents will not be over-absorbed by the colon, thus playing a role in lubricating the intestinal tract, softening the feces, increasing the volume of intestinal contents and promoting intestinal motility. According to the newly released “Expert Consensus Opinion on Bowel Preparation for Colonoscopy” in China, there are two recommended methods: the first method is to take 1 L of PEG 10 to 12 h before colonoscopy, and 2 L of PEG 4 to 6 h before colonoscopy; in addition, a second set of methods is to take 2 L PEG 4 to 6 h before colonoscopy, and take within 2 h [12].

PEG is salty and bitter, and some patients may experience nausea and vomiting when taking it, resulting in failure of intestinal preparation. To improve the taste, Wang compared vitamin C beverage + warm water (ratio of 1:1) with dissolved PEG, and found that patients with the former regimen had better taste and were again willing to do a colonoscopy with higher compliance, and the adverse reactions such as nausea and abdominal distension were less [13]. Wang studied the 3L PEG regimen and 2L PEG regimen, take 3 L PEG program need to start the night before, so repeated defecation will affect the quality of sleep, found that the bowel preparation in the night before colonoscopy patients sleep loss rate of 30.8%, in the day of the examination patients sleep loss rate of 16.4%, night defecation will affect patients sleep quality [14]. Another study conducted by Li compared the time-divided bowel preparation based on the appointment time of patients with the traditional bowel preparation, the former significantly improved the quality of intestinal preparation and reduced the time of colonoscopy. This segmented medication method requires collaboration between medical staff in wards outpatients and endoscopy staff [15].

5. Adjuvant Measures and Bowel Preparation

There are many ways to assist bowel preparation in clinical practice, such as exercising after taking PEG, chewing gum, and taking lactulose the day before taking PEG. Chewing gum promotes the secretion of digestive juices, promotes intestinal motility, and also reduces the incidence of nausea and vomiting. A meta-analysis of 10 RCTs with a total of 2002 patients showed that chewing gum during bowel preparation not only improves bowel cleansing and reduces adverse effects such as bloating, nausea, and vomiting, but also improves patient satisfaction and compliance with re-examination [16]. In a study by Wang, on the effects of chewing gum at different times in bowel preparation, the results showed that chewing gum on the day of the examination reduced adverse reactions such as bloating and nausea, and that chewing gum 2 days before the examination shortened the time of bowel preparation [17].

Exercise promotes bowel motility. The results of a meta-analysis involving more than 2000 patients showed that the addition of quantitative exercise to routine bowel preparation not only increased the quality of bowel preparation, but also reduced adverse effects in patients [18]. Jiang studied the effects of different exercise intensities on intestinal preparation, and found that the first de-

fecation time of the moderate-intensity exercise group and high-intensity exercise group was shorter than that of the low-intensity exercise group, and the total defecation was more and the intestinal tract was higher. The adverse reactions such as abdominal pain and nausea in the moderate-intensity exercise group were lower than those in the high-intensity exercise group and the low-intensity exercise group [19]. Another study of chewing gum and exercise based on oral PEG could improve the quality of intestinal preparation and reduce the occurrence of digestive tract adverse reactions compared to the single PEG group [20].

Lactulose is a permeable laxative that can promote intestinal peristalsis and stool. Song's study found that in overweight and obese patients, taking lactulose before intestinal preparation could reduce the dose of PEG, reduce the adverse reactions of the digestive tract, and increase the willingness of patients to re-examine [21]. Huang's study on the effect of taking lactulose at different times on intestinal preparation, found that the intestinal preparation quality of lactulose 2 days before colonoscopy was higher than that in patients taking lactulose before 1 day, and the intestinal preparation time was significantly shortened, which could also reduce the amount of PEG [22]. A study involving 14 RCT studies on PEG combined with mosapride and PEG alone as an intestinal regimen showed that the intestinal tract of mosapride combined with PEG was better than that of PEG alone [23]. There are many intestinal auxiliary measures in clinical practice, but there is a lack of big data multicenter research, and the effect of the combined use of various auxiliary measures needs further study.

6. The Use of Defoaming Agent

In clinical practice, commonly used defoaming agents include dimethyl silicone oil, simethicone oil, etc. After a large number of studies, it has been proved that the defoaming agent can reduce the bubble tension, and promote bubbles to break and discharge through intestinal peristalsis, thus reducing the formation of intestinal bubbles, improving the bowel preparation quality, increasing the detection rate of colorectal adenoma, and reduce the possible adverse reactions such as abdominal distension after colonoscopy [24]. Zhang study shows that PEG solution as intestinal cleaner and oral simethicone oil can improve intestinal preparation quality without causing additional adverse reactions and patient compliance, shorten cecal insertion time, and improve the detection rate of colorectal adenoma [25]. At present, there is still no consensus on the dosage and timing of the defoaming agent. Li found that increasing the dose of defoaming agent could not improve the quality of intestinal preparation [26].

7. Intestinal Tract Preparation for Special Populations

Most hospitals have a uniform plan for bowel preparation for patients, but some patients have decreased intestinal motility, such as chronic constipation, diabetes, and other patients, these patients with intestinal preparation unqualified rate can reach more than 60%, how to improve the quality of this part of patients with

intestinal preparation, is the hot topic of intestinal preparation [27]. Fang found that nearly 30% of colonoscopy patients have chronic constipation [28]. A study by Xi on the effect of PEG combined with olive oil on bowel preparation in constipation patients found that PEG combined with olive oil could shorten the time of first defecation increase the number of bowel movements, and improve the quality of bowel preparation [29]. In another study by Chen Jing and others, lactulose and mosapride combined with PEG, compared with PEG alone, can significantly increase the detection rate of intestinal and small polyps in the intestines of constipation patients [30]. Qi added linaclotide to PEG, improved the quality of intestinal preparation, reduced adverse reactions, and reduced the dose of PEG compared to the PEG regimen alone [31].

Intestinal need to control diet and take laxatives before colonoscopy, adverse reactions such as hypoglycemia may occur, especially in diabetic patients, it is particularly important to reduce the risk of hypoglycemia during bowel preparation [32]. Studies by Chen Lijuan and others found that fasting blood sugar in diabetic patients should be controlled at 6 - 10 mmol/L before colonoscopy. If the patient's blood sugar is below 6 mmol/L, it is recommended to infuse glucose to raise blood sugar to 6 mmol/L, and then a colonoscopy can reduce the adverse reactions such as hypoglycemia [33]. Zhang Hongliang's study suggested that oral hypoglycemic drugs should be discontinued on the day of colonoscopy; If patients use insulin, reduce the basal insulin to 50% of the original dose the night before, and stop using short-acting insulin on the day of examination, adverse reactions such as hypoglycemia may reduce [34]. He Kai *et al.* found that chewing gum and lactulose combined with PEG 24 hours before the examination compared with the other three schemes (chewing gum and PEG, lactulose combined with PEG, single PEG) could improve the quality of intestinal preparation and the detection rate of polyps, and reduce the occurrence of adverse reactions [35]. The bowel preparation of different patients needs to be given a personalized bowel preparation regimen in combination with the specific situation of the patient. Moreover, more specific evaluation methods for the patient and a more personalized bowel preparation regimen are also needed in the future.

8. Conclusion

In conclusion, colonoscopy is an effective method for the diagnosis and treatment of many colorectal diseases, the quality of intestinal preparation affects the effect of colonoscopy, and optimizing colonoscopy for intestinal preparation needs to be carried out from many aspects. The choice of intestinal cleaning program needs to be more humanized, more formulated based on individual patient factors and tolerance, to minimize the intake of fluid, increase patient comfort, and improve compliance and the acceptance of re-examination. Pre-packaged diet, in the future, it is also possible to develop individualized diet plans for each colonoscopy person. More supplements like defoaming agents are needed

to improve the quality of bowel preparation without affecting the safety of examination and the tolerance of patients. However, there is still a lack of big data and multi-center research on the joint auxiliary measures, and further research is needed in the future. The best strategy is to make a full evaluation of each colonoscopy examiner, understand the patient's disease situation, and individually design the most suitable intestinal preparation scheme, but this significantly increases the workload of medical staff, and a simpler evaluation method needs to be developed in the future. With the development of science and technology, AI may be used in providing bowel preparation solutions for examiners to help solve these problems. In addition, a variety of ways to do preoperative education, especially combined with modern electronic information equipment, such as WeChat, smartphone apps, etc., to implement simple and easy personalized preoperative education. As modern electronic information technology is limited by patients' cultural level, mobile phone model, and Internet traffic, and increases the workload of medical staff, a more advanced communication platform is needed to solve the problem in the future. However, the mechanism of abdominal pain, nausea, abdominal distension, and other symptoms is less studied, so more research is needed to reveal the production mechanism of these symptoms to reduce the discomfort and improve the acceptance of colonoscopy.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Hassan, C., *et al.* (2019) Bowel Preparation for Colonoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Guideline—Update 2019. *Endoscopy*, **51**, 775-794. <https://doi.org/10.1055/a-0959-0505>
- [2] Yi, S., *et al.* (2022) A Summary of the Best Evidence for Bowel Preparation before Colonoscopy. *Nurse Training Journal*, **37**, 216-222.
- [3] Guo, X., *et al.* (2017) Enhanced Instructions Improve the Quality of Bowel Preparation for Colonoscopy: A Meta-Analysis of Randomized Controlled Trials. *Gastrointestinal Endoscopy*, **85**, 90-97. E6. <https://doi.org/10.1016/j.gie.2016.05.012>
- [4] Liu, A., *et al.* (2020) Ward Nurses-Focused Educational Intervention Improves the Quality of Bowel Preparation in Inpatients Undergoing Colonoscopy: A CONSORT-Compliant Randomized Controlled trial. *Medicine*, **99**, e20976. <https://doi.org/10.1097/MD.00000000000020976>
- [5] van der Zander, Q.E.W., *et al.* (2021) Effects of a Personalized Smartphone App on Bowel Preparation Quality: Randomized Controlled Trial. *JMIR mHealth and uHealth*, **9**, e26703. <https://doi.org/10.2196/26703>
- [6] Guan, Y., Song, Y., Li, X., Zhang, A. and Li, R. (2023) Impact of WeChat Guidance on Bowel Preparation for Colonoscopy: A Quasi-Experiment Study. *Scientific Reports*, **13**, Article No. 11553. <https://doi.org/10.1038/s41598-023-37435-z>
- [7] Chen, H. (2023) Analysis of the Factors Influencing the Quality of Bowel Preparation before Colonoscopy and the Improvement Study. Youjiang Medical College for

Nationalities, Baksak Si.

- [8] Zhang, X., *et al.* (2020) Low-Residual Diet versus Clear-Liquid Diet for Bowel Preparation before Colonoscopy: Meta-Analysis and Trial Sequential Analysis of Randomized Controlled Trials. *Gastrointestinal Endoscopy*, **92**, 508-518. E3.
- [9] Lu, Z. and Min, H. (2021) The Application of Diet Control in Intestinal Preparation for Colonoscopy. *Union Medical Journal*, **12**, 244-248.
- [10] Zhang, X., *et al.* (2020) A Randomized Controlled Study of the Effect of Pre-Packaged Slag-Free Liquid Food on the Effect of Intestinal Preparation in Patients with Colonoscopy. *Chinese Food and Nutrition*, **26**, 62-67.
- [11] Lee, J.W., *et al.* (2019) Favorable Outcomes of Prepackaged Low-Residue Diet on Bowel Preparation for Colonoscopy: Endoscopist-Blinded Randomized Controlled Trial. *Journal of Gastroenterology and Hepatology*, **34**, 864-869.
<https://doi.org/10.1111/jgh.14499>
- [12] Colorectal Group of Digestive Endoscopy Branch of Chinese Medical Association (2023) Expert Consensus Opinion of Colonoscopy Intestinal Preparation (2023, Guangzhou). *Chinese Journal of Digestive Endoscopy*, **40**, 421-430.
- [13] Wang, X., *et al.* (2022) Effect of Compound Polyethylene Glycol Electrolyte Powder in Vitamin Drinks on Medication Adherence and Adverse Reactions in Patients with Colonoscopy. *Qilu Nursing Journal*, **28**, 155-157.
- [14] Wang, J. and Yang, J. (2012) The Effect of Taking Compound Polyethylene Glycol Electrolyte in the Morning for Scattered Intestinal Preparation. *Journal of Medical Research*, **41**, 160-164.
- [15] Li, J., Fu, H. and Wang, C. (2024) Study on the Effect of Intestinal Preparation on Intestinal Cleaning Quality in Different Periods. *Nursing and Rehabilitation*, **23**, 30-32, 37.
- [16] Meng, Y., Zhu, Y., Ding, F., Wang, J., Ding, Y., Hu, M. and Luo, J. (2021) Meta-Analysis of the Effects of Chewing Gum on the Cleanliness and Safety of Bowel Preparation. *Modern Digestive and Interventional Diagnosis and Treatment*, **26**, 1424-1431.
- [17] Wang, C. (2019) Study on the Influence of Chewing Gum at Different Time Windows on Bowel Preparation Effect and Mood in Patients Undergoing Colonoscopy. Harbin Institute of Technology, Harbin.
- [18] Chai, Q., Qi, X. and Wei, L. (2019) Meta-Analysis to Quantify the Effect of Exercise Intervention on the Effect of Bowel Preparation for Colonoscopy. *The Chinese Journal of Modern Nursing*, **25**, 3755-3760.
- [19] Jiang, G., *et al.* (2021) Application of Individualized Walking Exercises with Different Intensities in Bowel Preparation of Patients Undergoing Colonoscopy. *Qilu Nursing Journal*, **27**, 174-176.
- [20] Jiang, L., *et al.* (2022) Effect of Chewing Gum Combined with Exercise Intervention in Patients with Polyethylene Glycol Electrolyte Loose Bowel Preparation. *Integrated Chinese and Western Medicine Nursing (Chinese and English)*, **8**, 97-99.
- [21] Song, R., *et al.* (2023) Effect of Lactulose Combined with Compound Polyethylene Glycol Electrolyte Powder in Intestinal Preparation for Overweight and Obese Colonoscopy. *The Journal of Clinical Digestive Diseases*, **35**, 474-477.
- [22] Huang, Y., *et al.* (2020) Effect of Oral Lactulose Intestinal Preparation at Different Times on Intestinal Cleaning Quality in Diabetic Patients. *Nursing Research*, **34**, 1261-1263.
- [23] Dai, Q., *et al.* (2020) Meta-Analysis of the Efficacy and Safety of Bowel Preparation

- before Colonoscopy. *General Practice in China*, **23**, 1778-1784.
- [24] Moolla, M., *et al.* (2019) Simethicone Decreases Bloating and Improves Bowel Preparation Effectiveness: A Systematic Review and Meta-Analysis. *Surgical Endoscopy*, **33**, 3899-3909. <https://doi.org/10.1007/s00464-019-07066-5>
- [25] Zhang, S., *et al.* (2018) Simethicone Improves Bowel Cleansing with Low-Volume Polyethylene Glycol: A Multicenter Randomized Trial. *Endoscopy*, **50**, 412-422. <https://doi.org/10.1055/s-0043-121337>
- [26] Li, D.F., *et al.* (2020) Efficacy of Low-Dose versus High-Dose Simethicone with Polyethylene Glycol for Bowel Preparation: A Prospective Randomized Controlled Trial. *Journal of Gastroenterology and Hepatology*, **35**, 1488-1494. <https://doi.org/10.1111/jgh.15022>
- [27] Doykov, D. and Andonov, V. (2019) Risk Factors and Incidence of Poor Bowel Preparation in Elderly Patients: Prospective Study. *Folia Medica*, **61**, 370-376. <https://doi.org/10.3897/folmed.61.e39409>
- [28] Fang, J., Fu, H.Y., Ma, D., *et al.* (2016) Constipation, Fiber Intake and Non-Compliance Contribute to Inadequate Colonoscopy Bowel Preparation: A Prospective Cohort Study. *Journal of Digestive Diseases*, **17**, 458-463. <https://doi.org/10.1111/1751-2980.12376>
- [29] Xi, X., *et al.* (2022) Effect of Polyethylene Glycol Electrolyte Powder Combined with Olive Oil in Bowel Preparation in Patients with Different Degrees of Constipation. *Journal of Gastroenterology and Hepatology*, **31**, 1139-1143.
- [30] Chen, J., *et al.* (2020) Application of Lactulose with Mosapride in Bowel Preparation for Colonoscopy in Patients with Chronic Constipation. *Journal of Clinical Pharmacotherapy*, **18**, 57-61.
- [31] Qi, Z., *et al.* (2022) Clinical Application of Linalotide in Combination with Compound Polyethylene Glycol Electrolyte in Intestinal Preparation in Patients with Chronic Constipation. *Journal of Kunming Medical University*, **43**, 130-135.
- [32] Peng, L., Zhai, X. and Peng, H. (2023) Prevention of Hypoglycemia Intervention Combined with the Application of Endoscopy in Bowel Preparation before Endoscopy in Diabetic Patients. *Jiangxi Medicine*, **58**, 449-450, 463.
- [33] Chen, L.J., Feng, S.X., Huang, L.X., *et al.* (2021) Evaluation of the Impact of Cluster Care on Reducing the Incidence of Colonoscopy Hypoglycemia in Elderly Diabetic Patients. *Diabetes New World*, **24**, 177-180, 185.
- [34] Zhang, H., Liu, H., Zhao, H. and Li, Z. (2023) Blood Glucose Management during Bowel Preparation in Diabetic Patients by Colonoscopy. *World Lest Medical Information Abstract*, **23**, 77-81.
- [35] He, K. (2019) Evaluation of the Efficacy of Colonoscopy by Different Bowel Preparation Schemes in Diabetic Patients. *Shandong First Medical University*, Tai'an.