Original Article

Comparison of the effect of 1-day and 2-day low residue diets on the quality of bowel preparation before colonoscopy

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Abstract

Background/Aim: Low residue diet (LRD) has a similar quality of bowel preparation with clear liquid diet before colonoscopy, but improved patient tolerance. However, the optimal LRD duration is still controversial. In this study, we have compared the effect of a 1-day LRD and 2-day LRD on the quality of bowel preparation and patient tolerance.

Patients and Methods: Our prospective, randomized, single-blind trial, single-blind, trial compared two dietary regimens administered the day before colonoscopy. All patients were administered PEG-ES and simethicone for bowel preparation. The primary outcome measure was bowel preparation quality. The secondary outcome measures were insertion time, withdrawal time, polyp detection rate, patient tolerance, and willingness to use the same diet for bowel preparation again. Bowel preparation quality was evaluated using the Boston bowel preparation scale (BBPS). Patient tolerance was evaluated using a hunger-comfort scale.

Results: There was no significant difference in bowel preparation quality between the 2 groups. The 1-day LRD group had a BBPS score of 6.48 ± 1.59 points, while the 2-day LRD group had a score of 6.42 ± 1.06 points ($P > 0.05$). The groups reported similar colonoscope insertion times, withdrawal times, polyp detection rates and patient tolerance scores (hunger-comfort scores). The numbers of patients who reported that compliance as easy or very easy were 126 (78.2%) in the 1-day group versus 88 (55.0%) in the 2 day group ($P < 0.05$) and the numbers who were willing to use the diet again in the future were 154 (95.7%) in the 1-day group versus 131 (81.9%) in the 2 day group ($P < 0.05$).

Conclusion: LRD duration (1 day or 2 days) had no significant effect on bowel preparation quality. Patients in the 1-day LRD group had higher tolerance and satisfaction levels than patients in the 2-day LRD group. However, overall satisfaction was higher with the 1-day LRD group than with the 2-day LRD group.

Keywords: Bowel preparation, cleanliness, colonoscopy, duration, low residue diet

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INTRODUCTION

Colonoscopy is the gold standard for colorectal cancer screening and prevention. Most colorectal cancers are transformed adenomas. Timely detection and removal of adenomas can effectively reduce the incidence of colorectal cancers.[1] Adequate bowel preparation is key to ensuring

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clear observation of the mucosa by colonoscopy. Current studies have shown that adequate bowel preparation is related to the following factors: type of diet and laxatives, time between taking the last laxative dose and the colonoscopy, ability to comply or tolerate bowel preparation, and non-split dose or split dose of laxatives.[2-5] Limiting the type of diet can reduce the amount of stool in the intestines. Previously, it was a common practice to limit patients to a clear liquid diet (CLD) for 1 day before colonoscopy, but this practice significantly increased the hunger sensation of patients, greatly reduced patient compliance and comfort, and even caused hypoglycaemia. Many recent studies compared the effect of a CLD and a low residue diet (LRD) on bowel preparation and found that the 2 diets had comparable quality regarding bowel preparation, but the LRD had a higher patient compliance and tolerance than the CLD.[6,7] The European Society of Gastrointestinal Endoscopy (ESGE) and the American Society of Gastrointestinal Endoscopy (ASGE) also recommended the use of an LRD for colonoscopy.[3,8] LRD duration is still controversial. Some scholars recommend an LRD for 2 days prior to colonoscopy, while some others recommend an LRD for 1 day. ESGE guidelines recommend, based on experience, 1-day LRD for bowel preparation, without any strong data from evidence-based studies. This study aims to determine whether a 2-day LRD has higher bowel preparation quality than a 1-day LRD and to explore the difference in patient compliance and tolerance between these 2 diets.

PATIENTS AND METHODS

Study design

This study was a randomized, controlled, single-blinded prospective trial, comparing two dietary regimens prior to colonoscopy: a 1-day low-residue diet (LRD) vs. a 2-day LRD the day before colonoscopy. The study protocol was approved by the Ethics Committee and was conducted at the outpatient Endoscopy Unit at our Hospital. The trial is registered at Chinese Clinical Trial Registry (ChiCTR1900025843).

Participants

Patients undergoing colonoscopy in our hospital, including outpatients and inpatients, between May 2018 and March 2019 were selected. All included patients signed informed consent forms. After approval by the ethics committee, all enrolled subjects were formally included in the study, and the research work was formally started.

Inclusion criteria

All patients aged between 18 and 80 years who underwent colonoscopy were enrolled, including patients receiving colorectal cancer screening or patients with non-specific gastrointestinal symptoms.

Exclusion criteria

(1) Patients who were not cooperative during the examination; (2) patients who had digestive tract surgery; (3) patients with severe heart, brain, kidney, liver and other diseases and who could not tolerate colonoscopy; (4) patients with contraindications for colonoscopy, including digestive tract obstruction or perforation, severe intestinal infection or toxic megacolon, impaired consciousness and unstable vital signs; (5) failure to reach the caecum due to non-bowel-preparation issues (e.g., malignant lumen narrowing); (6) pregnant and lactating women; (7) stroke or dementia patients; (8) patients suffering from anxiety or depression; and (9) patients allergic to polyethylene glycol (PEG).

Grouping

A total of 344 patients were enrolled. After signing the informed consent form, patients who met the inclusion criteria were divided into 2 groups, 1-day LRD and 2-day LRD, using the random number table from computer-generated numbers prepared by an independent researcher. LRD guidance was provided to all included patients for bowel preparation. Low residue foods refer to foods that have a low fiber content, including rice porridge, noodles, taro, bread, tofu, Chinese steamed eggs, chicken, some peeled and cored fruits, and cooked vegetables (such as apples and carrots).[3] Patients were told to avoid eating vegetables, fruits, and whole grains.

Bowel preparation method

(1) According to the grouping, patients began the LRD 1 day or 2 days before the colonoscopy and started fasting (food and water) at 10:00 pm the day before the examination. The patients were not allowed to discuss the grouping with the colonoscopist and only contacted the reception nurse when there was a problem
(2) Administration of laxatives: Patients in both groups were orally administered 3 L of PEG-ES from 9:00 am to 11:00 am on the day of the examination, followed by 30 mL of simethicone. Colonoscopy was performed between 3 pm and 6 pm on the examination day.

Colonoscopy

An Olympus CF H-290 colonoscopy system was used for endoscopic diagnosis and treatment. All participating physicians had performed more than 1000 endoscopy examinations prior to this study.

Observation indicators:

(1) General conditions: patient age, sex, weight, education

level, history of constipation, history of colonoscopy, indications for colonoscopy, etc.

(2) Colonoscopy: rate of reaching the caecum, insertion time, withdrawal time, and polyp detection rate. Insertion time and withdrawal time were recorded by a nurse who was blinded to the grouping

(3) Colon cleanliness score: Colon cleanliness was evaluated and scored by a physician, who was blinded to the grouping, using the Boston bowel preparation scale (BBPS).[9] The BBPS divides the colon into the right colon (caecum and ascending colon), transverse colon (including hepatic flexure and splenic flexure) and left colon (descending colon, sigmoid colon and rectum) and uses a 4-point scoring system: 3 points (excellent), entire mucosa clearly observed in all segments, without observable residual staining; 2 points (good), entire mucosa seen well, with a minor amount of residual staining, stool and/or opaque liquid; 1 point (fair), part of the mucosa not well seen due to residual staining, stool and/or opaque liquid; and 0 points (poor), unprepared colon with mucosa not seen due to large amounts of solid stool. The 3 colon segments were individually evaluated and scored. The total score of the 3 segments was used to grade the overall bowel preparation quality in 5 grades: excellent (8-9 points), good (6-7 points), medium (4-5 points), poor (2-3 points), and extremely poor (0-1 point), of which "excellent", "good" and "medium" were considered meeting bowel preparation requirements[10]

(4) Patient tolerance and satisfaction: On the day of the colonoscopy, questionnaires were administered before the examination. (1) A hunger-comfort scale,[11] referencing the numerical simulation scale, was designed by the research team. Using the pain scale as a reference and comfort level as an index value, the hunger-comfort conditions of the patients were evaluated and scored: 1 point was comfortable, 10 points was hungry. (2) Compliance of patients to the LRD was classified into 5 grades: very easy to comply to, easy to comply to, tolerable, difficult to comply to and unacceptable.[11] (3) Willingness of patients to use an LRD again was assessed.[12] (4) Any adverse reactions such as nausea, vomiting, bloating and abdominal discomfort were recorded.

Calculation of the sample size

The main outcome of this study was the efficacy of bowel preparation measured by the BBPS, which ranges from 0 to 9. A previous study demonstrated that the values were well spread across the 10-point scale with a mean of 8.1 points and standard deviation (SD) of 1.1 points.[13] We considered a 1-point average difference between groups to be minimally clinically important and therefore a 1-point margin of equivalence to test the non-inferiority of the 1-LRD group. With a SD of 1.1 and 21 patients per arm, an independent *t*-test would provide 80% power to detect a difference between groups of 1 point at a two-sided α of 0.05. Assuming a dropout rate of 20%, we thus aimed at enrolling 25 subjects in each arm to achieve an effective sample size of at least 21 per group.

Blinding

All involved physicians and nursing staff were blinded to the study participants' group assignments.

Statistical methods

SPSS 19.0 software (SPSS Inc., Chicago, Illinois, USA) was used for statistical analyses. Measurement data are expressed as mean ± standard deviation. Homogeneity of variance was analyzed. If the variance was homogeneous, pair-wise comparison was performed using an independent samples *t* test; otherwise, the Kruskal-Wallis test was performed. $P<0.05$ was considered statistically significant. Count data were analysed using the χ^2 test, and $P < 0.05$ was considered statistically significant.

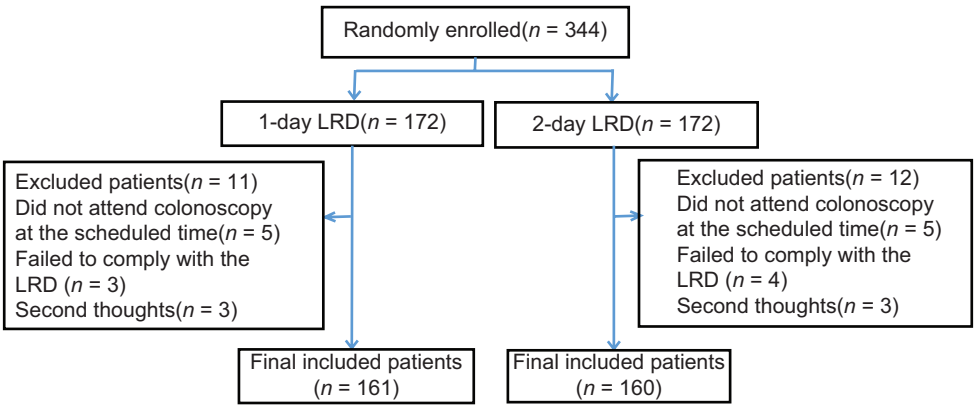

Figure 1: Study patient flowchart

Table 1: General clinical data of patients in the 2 groups

Patient characteristics	1 day LRD (*n*=161)	2 day LRD (*n*=160)	*P*
Age	48.17±15.44	47.03±13.79	0.49
Body weight	61.26±10.82	62.66±10.96	0.28
Sex (male)	56 (34.78)	70 (43.75)	0.10
Education level (high school and above)[#2]	112 (69.57)	97 (60.63)	0.09
History of constipation	28 (17.39)	38 (23.75)	0.16
Gastrointestinal symptoms (Abdominal pain, bloating, altered bowel habit, bloody stool, etc.)	112 (69.57)	101 (63.13)	0.22
History of colonoscopy	23 (14.29)	36 (22.5)	0.06

The results showed that there were no statistically significant differences between the 2 groups for age, body weight, sex, education level, constipation history, abdominal symptoms and colonoscopy history

RESULTS

Clinical data

A total of 344 outpatients and inpatients were enrolled in this study. Among them, 11 patients in the 1-day LRD group and 12 patients in the 2-day LRD group were excluded due to reasons such as not attending the colonoscopy at the scheduled time, not complying with the LRD and having second thoughts about the study, as shown in Figure 1. Finally, a total of 321 patients were included in this study: 161 in the 1-day group and 160 in the 2-day group. As shown in Table 1, there were no statistically significant differences between the 2 groups regarding general clinical data ($P > 0.05$). The 2 groups were comparable.

Bowel preparation quality

Bowel preparation quality of the entire colon and each segment was evaluated using the BBPS score [Table 2]. The 1-day LRD group had a left colon score of 2.26 ± 0.68, a transverse colon score of 2.00 ± 0.59, a right colon score of 2.22 ± 0.59, and a total score of 6.48 ± 1.59. The 2-day LRD group had a left colon score of 2.24 ± 0.61, a transverse colon score of 1.98 ± 0.66, a right colon score of 2.21 ± 0.66, and a total score of 6.42 ± 1.06. The differences between these 2 groups were not statistically significant ($P > 0.05$). In the 1-day LRD group, 140 patients (87%) achieved adequate bowel preparation (BBPS total score ≥6), while in the 2-day LRD group, 129 cases (81%) achieved adequate bowel preparation. The proportion of patients having adequate bowel preparation was slightly higher in the 1-day group than in the 2-day group.

Colonoscopy examination

As shown in Table 3, the average insertion times for the 1-day group and the 2-day LRD group were 10.05 ± 2.33 min and 10.04 ± 2.15 min, respectively, and the difference between the 2 groups was not statistically significant ($P > 0.05$). The average withdrawal times for the 1-day group and the 2-day LRD group were 9.74 ± 2.43 min and 9.27 ± 1.96 min, respectively, showing no statistically significant between-group difference ($P > 0.05$). The polyp detection rate of the 1-day and 2-day LRD groups were 17.39% and 25%, respectively, and the difference was not statistically significant ($P > 0.05$). Both groups had successful insertion and complete colonoscopy.

Table 2: Boston bowel preparation scale score

Rating	1-dayLRD group (*n*=161)	2-day LRD group (*n*=160)	*P*
Left colon	2.26±0.68	2.24±0.61	0.75
Right colon	2.22±0.59	2.21±0.66	0.94
Transverse colon	2.00±0.59	1.98±0.66	0.72
Total score	6.48±1.59	6.42±1.06	0.69

Comparison of patient tolerance and adverse reactions

The hunger-comfort score of the 1-day LRD group was 2.7 ± 1.881, and that of the 2-day LRD group was 2.96 ± 2.50, with no statistically significant difference between the 2 groups ($P > 0.05$). In the 1-day group, 126 patients reported that complying to the diet was very easy or easy, while in the 2-day group, 88 patients reported the same; the difference between the 2 groups was statistically significant ($P < 0.05$). In the 1-day group, 154 patients (95.7%) claimed that they were willing to use this diet again, while in the 2-day group, 131 patients (81.9%) were willing to use the diet again in the future; there was a statistically significant difference between the 2 groups. These results indicate that patients had better acceptance towards the 1-day LRD. Approximately 1/4 of the patients in each group experienced adverse reactions such as nausea, vomiting, bloating, abdominal pain, and dizziness. Specifically, adverse reactions were reported by 42 patients (26.1%) and 38 patients (23.1%) in the 1-day and 2-day LRD groups, respectively; the difference between the 2 groups was not statistically significant ($P > 0.05$) [Table 4].

DISCUSSION

Adequate bowel preparation is critically important for colonoscopy, because it can avoid missed adenomas,

Table 3: Comparison of colonoscopy indicators between groups

Colonoscopy indicators	1-day LRD group (*n*=161)	2-day LRD group (*n*=160)	*P*
Insertion time (min)	10.05±2.33	10.04±2.15	0.98
Withdrawal time (min)	9.74±2.43	9.27±1.96	0.06
Polyps detection rate (%)	28 (17.39)	40 (25)	0.10

Table 4: Comparison of patient tolerance and adverse reactions

Tolerance indicators and Incidence of adverse reactions	1-day LRD group (*n*=161)	2-day LRD group (*n*=160)	*P*
Hunger-Comfort score	2.7±1.881	2.96±2.50	0.28
Compliance -very easy or easy (%)	126 (78.3)	88 (55)	<0.001
Willing to use this diet again for bowel preparation (%)	154 (95.7)	131 (81.9)	<0.001
Adverse reactions (%)	42 (26.1)	38 (23.8)	0.63

The results showed that there was no significant difference in the hunger-comfort score between the 2 groups; there were significant differences between the 2 groups in the proportion of patients who considered the diet very easy or easy to comply to and were willing to use the diet again. There was no statistically significant difference in the incidence of adverse reactions

avoid long and difficult colonoscopy procedures and reduce the rate of incomplete colonoscopies. Ideal bowel preparation involves removing stool from the colon while ensuring patient tolerance and reducing the incidence of adverse reactions. Current studies have shown that LRD improves patient tolerance and comfort without affecting bowel preparation quality. By comparing indicators such as the BBPS scores of bowel preparation quality and patient tolerance to 1-day and 2-days LRD, we confirmed that 1-day and 2-day LRDs had similar bowel preparation quality and that patients considered the 1-day LRD easy to comply to and were willing to use the LRD for bowel preparation again. The reason why the bowel preparation quality of the 2-day LRD was not better than that for the 1-day LRD might be that the LRD reduced bowel movements and prolonged the time residue stayed in the intestines. This finding might also result from bias, as this was a single-centre study with a small sample size. Similar similar studies have been conducted to study the effects of LRD duration on the quality of bowel preparation. Antonio *et al*.[14] compared the quality of bowel preparations of outpatients using 1-day and 3-day LRDs and found that the 3-day LRD had a bowel preparation quality similar to that of the 1-day LRD.

Some studies have focused on investigating what types of LRDs are more convenient to use and thus achieve better bowel preparation quality. Matsumura *et al*.[15] compared a pre-packaged LRD and a conventional LRD and found that pre-packaged diets were more convenient for patients to use, resulting in higher BBPS scores, but the pre-packaged diets increased patient costs. Jeremy *et al*.[16] found that as an option for bowel preparation, white diets were high in calories, can be easily obtained and identified and were preferred by patients. In addition, white diets did not reduce bowel preparation quality. Butt *et al*.[17] also confirmed that as a novel type of diet, the white diet has double the calories of liquid food, which drastically reduces hunger and increases patient compliance. In this study, an LRD table listing acceptable daily food items was provided to patients so that they could easily select their diet of choice.

Because of advantages such as high safety, rapid onset, wide range of applications and short preparation time, PEG-ESs are widely recommended internationally.[18] However, a large volume of PEG-ES (2-4 L) is often needed for bowel preparation, which leads to poor tolerance and adverse reactions such as bloating, nausea and vomiting, causing bowel preparation failure. Currently, PEG is mostly administered in a split dose or in a small amount combined with other laxatives to ensure adequate bowel preparation. Matro *et al*.[19] found that for patients who underwent colonoscopy examination in the afternoon, oral administration of 2 L of PEG combined with ascorbic acid on the same day significantly improved patient tolerance and reduced abdominal discomfort when compared with a split dose of PEG one day before the colonoscopy. Park Previously, 2 single-blind RCTs.[20,21] showed that compared with 4 L of PEG, 2 L of PEG combined with magnesium citrate had a similar bowel preparation quality, increased patient satisfaction and boosted willingness to use the diet again. In this study, PEG combined with simethicone was used for bowel preparation. Simethicone, as a defoaming agent, can eliminate intestinal air bubbles, which is conducive to extending the colonoscopy observation field and reducing discomfort such as bloating. Simethicone functions in a mechanical fashion, does not enter the blood circulation and has high safety.[22] PEG-ES combined with simethicone, which was adopted in this study, can effectively reduce the symptoms of abdominal bloating, extend the observation field, and improve patient tolerance and satisfaction, which is more conducive to the completion of colonoscopy procedures.

Recent studies showed that the timing of PEG administration was more important than dietary restrictions.[23] In this study, the time between taking the last PEG dose and performing colonoscopy was 4–6 hours, which ensured adequate bowel preparation. Previous studies have shown that a total BBPS score of 8 points and above can be considered excellent and 6 points and above can be considered good and can provide excellent intestinal views.[24,25] In this study, in the 1-day and 2-day LRD groups, 87% and 81% of patients respectively, achieved "excellent" and "good" (BBPS ≥6) bowel preparations, percentages that were better or close to the 85% value recommended by some guidelines,[26] demonstrating the importance of timing management.

Our study has the following advantages. (1) To our knowledge, this study was the first to compare the effects of 1-day and 2-day LRDs on preparation quality before colonoscopy and patient tolerance. (2) This randomized controlled trial used the same bowel preparation method in the 1-day and 2-day LRD groups, which could reduce the bias caused by using different bowel preparation methods. (3) This study did not strictly limit the type of food, which enable patients to easily obtain their food of choice.

Our study has the following limitations. (1) Our study did not consider other diseases that may have a negative impact on bowel preparation quality, such as diabetes mellitus and chronic constipation.[27] In addition, our questionnaire did not include a detailed medication history[28]; patients taking medications that may cause constipation, such as opioids and tricyclic anti-depressants, might cause a small bias in the results. However, because this was a randomized study, we believe that these limitations did not affect the assessment of bowel preparation quality. (2) This study did not clearly specify the daily limit of total fiber intake for the LRD. Previous studies showed that total fiber intake should be limited to <10 g/d.[7,29] However, a specified limit in fiber intake might not be conducive to food administration to patients, and according to traditional Chinese diet characteristics, the total amount of daily fiber intake is usually less than 10 g.(3) This was a single-center trial with a relatively small sample size. The findings need to be further verified by multi-center studies.

In conclusion, our study confirmed that a 2-day LRD did not offer advantages over 1-day LRD in preparation for colonoscopy. In addition, a 1-day LRD is more easily accepted by patients and, thus, conducive to colorectal cancer screening.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Nishihara R, Wu K, Lochhead P, Morikawa T, Liao X, Qian ZR, *et al*. Long-term colorectal-cancer incidence and mortality after lower endoscopy. N Engl J Med 2013;369:1095-105.
2. Gimeno-García AZ, Baute JL, Hernandez G, Morales D, Gonzalez-Pérez CD, Nicolás-Pérez D, *et al*. Risk factors for inadequate bowel preparation: A validated predictive score. Endoscopy 2017;49:536-43.
3. Hassan C, East J, Radaelli F, Spada C, Benamouzig R, Bisschops R, *et al*. Bowel preparation for colonoscopy: European society of gastrointestinal endoscopy (ESGE) guideline-update 2019. Endoscopy 2019;51:775-94.
4. Perreault G, Goodman A, Larion S, Sen A, Quiles K, Poles M, *et al*. Split-versus single-dose preparation tolerability in a multiethnic population: Decreased side effects but greater social barriers. Ann Gastroenterol 2018;31:356-64.
5. Siddiqui AA, Yang K, Spechler SJ, Cryer B, Davila R, Cipher D, *et al*. Duration of the interval between the completion of bowel preparation and the start of colonoscopy predicts bowel- preparation quality. Gastrointest Endosc 2019;69:700-6.
6. Stolpman DR, Solem CA, Eastlick D, Adlis S, Shaw MJ. A randomized controlled trial comparing a low-residue diet versus clear liquids for colonoscopy preparation: Impact on tolerance, procedure time, and adenoma detection rate. J Clin Gastroenterol 2014;48:851-5.
7. Nguyen DL, Jamal MM, Nguyen ET, Puli SR, Bechtold ML. Low-residue versus clear liquid diet before colonoscopy: A meta-analysis of randomized, controlled trials. Gastrointest Endosc 2016;48:499-507.
8. ASGE Standards of Practice Committee, Saltzman JR, Cash BD, Pasha SF, Early DS, Muthusamy VR, Khashab MA, Bowel preparation before colonoscopy: The American Society for Gastrointestinal Endoscopy (ASGE) guideline-2015. Gastrointest Endosc 2015;81:781-94.
9. Yan Gao, Houde Zhang, Muxian Lin, Chun-sheng Cheng, Sheng-zhou Wu, Sui-song Zhu, *et al*. Reliability of the Boston bowel preparation scale. Chin J Dig Endosc 2012;29:78-80.
10. Lai EJ, Calderwood AH, Doros G, Fix OK, Jacobson BC. The Boston bowel preparation scale: A valid and reliable instrument for colonoscopy-oriented research. Gastrointest Endosc 2009;69:620-5.
11. Melicharkova A, Flemming J, Vanner S, Hookey L. A low-residue breakfast improves patient tolerance without impacting quality of low-volume colon cleansing prior to colonoscopy: A randomized trial. Am J Gastroenterol 2013;108:1551-5.
12. Jung YS, Seok HS, Park DI, Song CS, Kim SE, Lee SH, *et al*. A clear liquid diet is not mandatory for polyethylene glycol-based bowel preparation for afternoon colonoscopy in healthy outpatients. Gut Liver 2013;7:681-7.
13. Kim EJ, Park YI, Kim YS, Park WW, Kwon SO, Park KS, *et al*. A Korean experience of the use of Boston bowel preparation scale: A valid and reliable instrument for colonoscopy-oriented research. Saudi J Gastroenterol 2014;20:219-24.
14. Gimeno-García AZ, de la Barreda Heuser R, Reygosa C, Hernandez A, Mascareño I, Nicolás-Pérez D, *et al*. Impact of a 1-day versus 3-day low-residue diet on bowel cleansing quality before colonoscopy: A randomized controlled trial. Endoscopy 2019;51:628-36.
15. Matsumura T, Arai M, Ishigami H, Okimoto K, Saito K, Minemura S, *et al*. A randomized controlled trial comparing a prepackaged low-residue diet with a restricted diet for colonoscopy preparation: The impact on the results of colonoscopy in adenoma detection. Colorectal Dis 2015;18:37-42.
16. Dwyer JP, Tan JY, Paul E, Bunn C, Mangira D, Secomb R, *et al*. White diet with split-dose Picosalax is preferred, better tolerated, and non-inferior to day-before clear fluids with polyethylene glycol plus sodium picosulfate-magnesium citrate for morning colonoscopy: A randomized, non-inferiority trial. JGH Open 2017;1:38-43.

17. Butt J, Bunn C, Paul E, Gibson PR, Brown G. The white diet is preferred, better tolerated and non-inferior to a clear-fluid diet for bowel preparation: A randomised controlled trial. J Gastroenterol Hepatol 2016;31:355-63.
18. Coghlan E, Laferrere L, Ayunta H, Martínez ML, Topor JJ, Nadales A, *et al*. Bowel preparation study using Boston bowel preparation scale. Acta Gastroenterol Latinoam 2012;42:186-92.
19. Matro R, Shnitser A, Spodik M, Daskalakis C, Katz L, Murtha A, *et al*. Efficacy of morning-only compared with split-dose polyethylene glycol electrolyte solution for afternoon colonoscopy: A randomized controlled single-blind study. Am J Gastroenterol 2010;105:1954-61.
20. Park SS, Sinn DH, Kim YH, Lim YJ, Sun Y, Lee JH, *et al*. Efficacy and tolerability of split-dose magnesium citrate: Low-volume (2 liters) polyethylene glycol vs. single-or split-dose polyethylene glycol bowel preparation for morning colonoscopy. Am J Gastroenterol 2010;105:1319-26.
21. Sharma VK, Chockalingham SK, Ugheoke EA, Kapur A, Ling PH, Vasudeva R, *et al*. Prospective, randomized, controlled comparison of the use of polyethylene glycolelectrolyte lavage solution in four-liter versus two-liter volumes and pretreatment with either magnesium citrate or bisacodyl for colonoscopy preparation. Gastrointest Endosc 1998;47:167-71.
22. Yu Bai, Yi-qi Du, Zhi-zheng Ge, Xue-gang Guo, Qiang Guo, Bo Jiang, *et al*. Bowel preparation for endoscopy: Chinese society of gastrointestinal endoscopy guideline-2013. Chin J Dig Endosc 2013;30:541-9.
23. Church JM. Effectiveness of polyethylene glycol antegrade gut lavage bowel preparation for colonoscopy—timing is the key! Dis Colon Rectum 1998;41:1223-5.
24. Brahmania M, Ou G, Bressler B, Ko HK, Lam E, Telford J, *et al*. 2 L versus 4 L of PEG3350+electrolytes for outpatient colonic preparation: A randomized, controlled trial. Gastrointest Endosc 2014;79:408-16.
25. Dik VK, Moons LM, Hüyük M, van der Schaar P, de Vos Tot Nederveen Cappel WH, Ter Borg PC, *et al*. Colonoscopy quality initiative. Predicting inadequate bowel preparation for colonoscopy in participants receiving split-dose bowel preparation: Development and validation of a prediction score. Gastrointest Endosc 2015;81:665-72.
26. Johnson DA, Barkun AN, Cohen LB, Dominitz JA, Kaltenbach T, Martel M, *et al*. Optimizing adequacy of bowel cleansing for colonoscopy: Recommendations from the US multi-society task force on colorectal cancer. Am J Gastroenterol 2014;109:1528-45.
27. Taylor C, Schubert ML. Decreased efficacy of polyethylene glycol lavage solution in the preparation of diabetic patients for outpatient colonoscopy: A prospective and blinded study. Am J Gastroenterol 2001;96:710-4.
28. Hale WE, Perkins LL, May FE, Marks RG, Stewart RB. Symptom prevalence in the elderly. An evaluation of age, sex, disease, and medication use. J Am Geriatr Soc 1986;34:333-40.
29. Avalos DJ, Sussman DA, Lara LF, Sarkis FS, Castro FJ. Effect of diet liberalization on bowel preparation. South Med J 2017;110:399-407.