

Comparison of Four Different Colonic Preps in 3595 Patients at A University Center: A Real Life Experience

Tilak R Baba, James H. Lewis

Tilak R Baba, Department of Internal Medicine, Georgetown University Medical Center, Washington DC, the United States
James H. Lewis, Division of Gastroenterology, Department of Medicine, Georgetown University Medical Center, Washington DC, the United States

Correspondence to: Tilak R Baba, MD, Department of Internal Medicine, Pasquerilla Healthcare Center, 5th Floor 3800 Reservoir Road, N.W., Washington D.C. 20007, the United States.

Email: tilak.r.baba@gunet.georgetown.edu

Telephone: +1-919-475-7172

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ABSTRACT

AIM: Several bowel preps are currently used for colonoscopy but only limited data are available comparing the different products.

METHODS: We retrospectively reviewed all colonoscopies performed at Georgetown U. Hospital from May 2013 to May 2014. A 9-point modified Boston Bowel Preparation Scale (BBPS) was utilized (best score = 9) by experienced endoscopists. Colonoscopies without a BBPS score were excluded.

RESULTS: Four preps and their percentage usage were 4-L PEG solutions (Golytely® or Colyte®) (50%), PEG with bisacodyl tablets (Miralax®) (17%), PEG with ascorbic acid (Moviprep®) (8%), sodium picosulfate (Prepopik®) (25%), with the following overall BBPS scores respectively: 7.45, 7.45, 7.40, 7.55. Statistical superiority of split-dose to day-prior dose was seen for Golytely®/Colyte®, Miralax®, and Moviprep® with a trend seen for Prepopik®. Comparison of each prep by split and prior day dosing showed a significantly higher score only for Golytely®/Colyte® and Prepopik® vs Moviprep® given prior day dosing. A higher BBPS score was seen for women vs men overall for both split-dose and day-prior dose preps (with the exception of Moviprep® in PD preps). Higher

scores were seen for a.m. procedures but were not significant. All preps had lower scores in the right colon, regardless of being split-dose or day-prior dose.

CONCLUSIONS: This real world experience in nearly 3600 patients confirms that split dosing is superior to day-prior dosing. We found women had higher BBPS scores than men but no differences were seen between morning and afternoon procedures. All preps were relatively comparable, however differences in price may be an important decision-maker.

Key words: Colonoscopy; Colon preparations; BBPS; Polyethylene Glycol; Miralax; Ascorbic Acid; Sodium Picosulfate

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INTRODUCTION

Inadequate bowel preparation is related to lower adenoma detection rates, longer procedural times and an increase in costs and need for repeat exams^[1-5]. Various bowel regimens are commercially available for pre-colonoscopy preparations^[6] and each has been studied for its efficacy and tolerability. Bowel regimens are generally categorized based on their ingredients such as, PEG-based, sodium phosphate, and sodium picosulfate solutions^[6]. Several studies have compared two bowel regimens within each class^[7-9]. However, there are limited data comparing multiple regimens across different classes of bowel preparations. The timing of the bowel preparation has also been shown to play an important role in increasing effectiveness^[10,11]. Six organizations have issued guidelines that endorse split-dose (SD) over day-prior dose (DPD) regimen^[6,12-16]. Patient satisfaction and

compliance have also been shown to be superior with SD compared to DPD preparations^[10,17,18].

The aim of this study was to evaluate the effectiveness of the four most commonly used bowel preparations in our tertiary center endoscopy unit to determine whether any differences exist between the preps and whether there was a correlation between split dosing or day-prior dosing and the effectiveness of the bowel preparation in a non-study setting.

METHODS

We conducted a retrospective cross-sectional review of all inpatient and outpatient colonoscopies performed at Georgetown University Hospital from May 2013 to May 2014. Data were collected for patients ≥ 18 years of age, with the only exclusion being if no bowel preparation score was recorded in our electronic endoscopic database (EndoPro®, Pentax Corporation, New Jersey). The bowel preparation was chosen at the discretion of the endoscopist. Based on our standard information for patients about prepping for colonoscopy, patients were instructed to take the first half of a SD regimen starting in the evening prior to the procedure and the second half of the prep was taken 6-9 hours prior to the colonoscopy. For DPD dosing, patients were instructed to take the whole prep during the late afternoon or evening prior to their procedure. All patients were instructed to drink only clear liquids the entire day before the procedure. The 9-point modified Boston Bowel Prep Scale (BBPS)^[19], as recorded in our electronic endoscopy database, was used to evaluate effectiveness in each part of the colon (left, transverse, right) using a scale of 1 to 3 as follows: 1 = residual stool/mucosa not well seen; 2 = stool fragments but mucosa well seen; 3 = no stool present (maximum score = 9). A score of zero in the original BBPS was considered equivalent to one. Scores were based on the mucosal appearance prior to any washing or aspiration maneuvers. Additionally, the following data were collected: age, sex, race, split-dose versus day-prior dose prep, morning (AM) versus afternoon (PM) procedure times. The primary end point was total BBPS score. Secondary end point was BBPS score according to each part of the colon. Statistical significance was calculated using an unpaired *t*-test. All calculations were made using Microsoft Excel®. The study was approved by the Institutional Review Board of Georgetown University Medical Center.

RESULTS

The total number of colonoscopies performed in this one year period was 4046 with 451 colonoscopies (11.1%) excluded as no bowel prep name or BBPS score was recorded. Table 1 shows the baseline patient characteristics of the four most commonly used bowel preparations at our institution: 4-L polyethylene glycol-electrolyte lavage solution (PEG-ELS) (either GoLYTELY® [Braintree Laboratories, Braintree MA] or CoLyte® [MedaPharma, Somerset NJ]), 2-L PEG solution with bisacodyl delayed release tablets (PEG) (MiraLAX®, Germany), 2-L PEG with ascorbic acid (PEG-A) (MoviPrep®, Salix Pharmaceuticals, Raleigh, NC), and sodium picosulfate based solution (PICO) (Prepopik®, Parsippany NJ). Bowel preparations other than the ones listed above were rarely used and not included in this analysis. For the purposes of this analysis, the results of GoLYTELY® and CoLyte® were combined as one class. MiraLAX was instructed to take with Gatorade 64oz or an equal amount of water (2 liters) at the patient's discretion.

The mean age of patients for each group was over 50. The racial makeup reflected the patient population at our medical center.

Overall, approximately 55% of the procedures were done in the morning (prior to 12 noon). Table 2 lists the individual BBPS scores for each of the four preparations studied. The majority of subjects, both overall and within each preparation group, had BBPS scores of 7 or above. The overall BBPS scores of the individual bowel preps were as follows: PEG-ELS (7.45), PEG (7.45), PEG-A (7.40), PICO (7.55) (*p*-value 0.351).

Table 3 compares pre-cleaning BBPS scores between each of the preps by split-dose and day-prior dosing. All of the BBPS scores were comparable with no statistically significant difference except for PEG-A, which had a numerically lower score than the other three preps for day-prior dosing. However, this difference was not seen for the split-dose regimen for PEG-A.

When comparing split vs day-prior dosing for each preparation, SD was significantly better than DPD, except for PICO, which had similar scores for both split and day-prior dosing as illustrated graphically in Figure 1.

The timing of the colonoscopy (AM or PM) did not appear to be an important factor in achieving an adequate bowel preparation for any of the regimens, except PEG-ELS, which had a lower score for PM procedures in patients given day-prior dosing (6.95 vs 7.23, *p*-value 0.025) (Figure 2).

Figure 3 illustrates the differences in BBPS scores comparing women to men based on each preparation. Women had a better bowel prep score than men for all regimens except for PEG, which showed a trend toward a better BBPS score for women, but was not statistically significant.

Table 1 General Patient Characteristics in Each Preparation Group.

	Overall (N = 3595)	PEG-ELS (N = 1805)	PEG (N = 597)	PEG-A (N = 284)	PICO (N = 909)
Mean Age	55.3	58.7	50.3	59.5	50.7
Years Sex (%)					
Female	54.3	50.5	56.3	54.3	56.4
Race (%)					
White	50.5	47.7	51.4	46.8	57.4
African Am	24.3	27.9	23.7	32.7	16.3
Asian	1.9	2.3	1.5	0.3	1.8
Other	9.4	9.4	9.6	9.1	10.3
Unknown	13.1	12.8	13.3	10.9	14.3
Timing of colonoscopy					
AM (%)	55.4	1012 (56.1)	312 (52.4)	163 (57.4)	514 (56.5)
PM (%)	44.6	790 (43.9)	283 (47.6)	121 (42.6)	396 (43.5)
Split Preparations (%)	74.2	59.7	83.6	83.8	93.9

Table 2 Total Score Stratified by Preparation, N(percentage).

Score (Total %)	PEG-ELS	PEG	PEG-A	PICO
9 (36.2)	673 (37.3)	192 (32.3)	95 (33.4)	341 (37.5)
8 (19.86)	345 (19.1)	127 (21.3)	58 (20.4)	184 (20.2)
7 (12.4)	189 (10.5)	105 (17.6)	41 (14.4)	111 (12.2)
6 (23.9)	438 (24.3)	135 (22.7)	67 (23.6)	219 (24.1)
5 (3.9)	82 (4.5)	18 (3.0)	9 (3.2)	31 (3.4)
4 (1.67)	31 (1.7)	12 (2.0)	8 (2.8)	9 (1.0)
3 (1.6)	33 (1.8)	6 (1.0)	4 (1.4)	14 (1.5)
Mean Score	7.45	7.45	7.40	7.55

Table 3 *p*-value Comparing Different Preparations Based on Prior Day (PD) vs Split Dosing (SD).

	Day-Prior (BBPS Score)				Day-Prior (BBPS Score)			
	PEG-ELS	PEG	PEG-A	PICO	PEG-ELS	PEG	PEG-A	PICO
	7.16	7.10	6.50	7.36	7.64	7.54	7.57	7.56
PEG-ELS	0.779	0.012	0.380		0.193	0.481	0.209	
PEG		0.062	0.355			0.807	0.845	
PEG-A			0.009				0.922	

Statistical significance was defined as *p*-value less than 0.05.

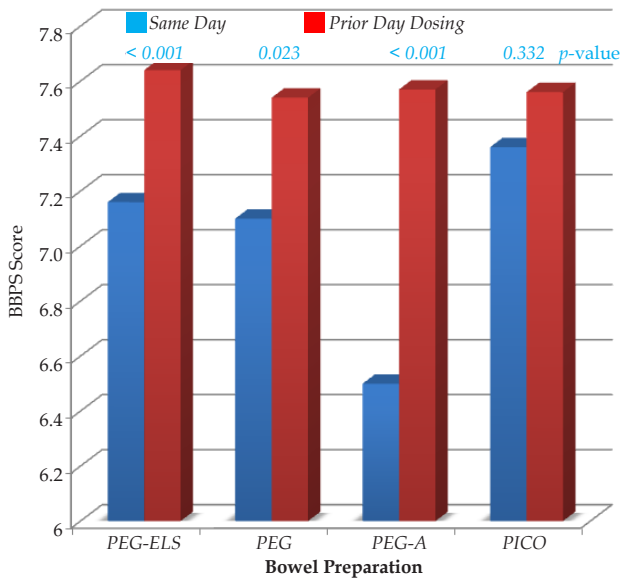


Figure 1 BBPS score for each prep based on split dosing (SD) vs prior day dosing (PD). *p*-value represents statistical significance comparing SD vs PD for each individual bowel preparation.

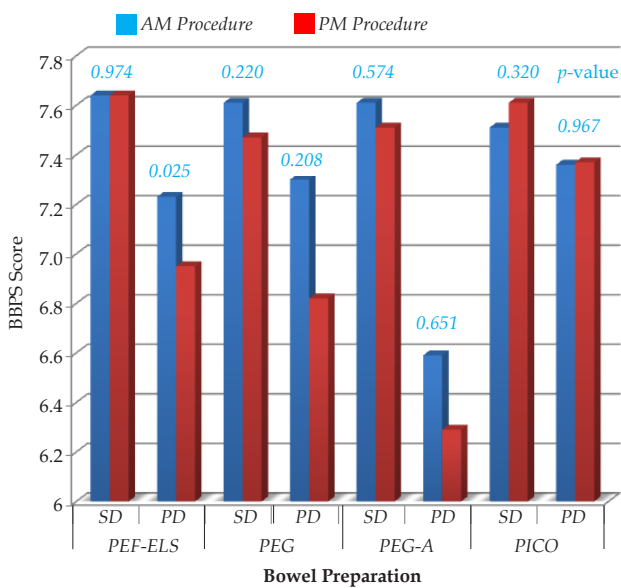


Figure 2 BBPS score based on whether colonoscopy in morning (AM) vs afternoon (PM) procedure and further stratified by split (SD) and prior day (PD) dosing for each bowel preparation.

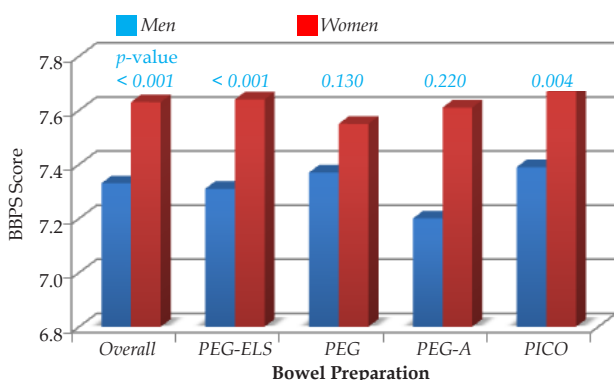


Figure 3 BBPS score for each prep stratified by gender.

DISCUSSION

Various bowel regimens are currently available for colonoscopy preparation. Our retrospective review of the four most widely used bowel preparation regimens in our endoscopy unit revealed that there were no significant differences between the preps based on our modified BBPS score. All physicians were trained in using the score, which is part of the endoscopy report. Since the scoring was not part of the study, responses were not controlled but reflect real-life results. While there have been studies comparing two different preps, there are limited data comparing PEG, PEG-ELS, PEG-A and PICO to one another. Both GoLYTELY[®] and CoLyte[®] are 4-L PEG solution whereas MiraLAX[®] and MoviPrep[®] are low-volume 2-L regimens. Prior randomized controlled trials have shown comparable results between 4-L PEG based solutions and the 2-L PEG solution with ascorbic acid (PEG-A)^[7-9]. While these studies used different 4-L PEG-electrolyte solutions, they were similar to the PEG-ELS preparations used in our study. These studies also used different bowel cleansing visualization scales (inverted Ottawa Scale, independent rating scale, Residual Stool Score). However the BBPS records similar data. Our results with the BBPS show a statistically significantly lower preparation score with PEG-A when compared to each of the other three preparations given as DPD. However, this difference was not seen for the SD regimen of PEG-A and the clinical relevance of a slightly lower score is lessened given that the endoscopist can deal with residual stool at the time of the procedure.

Prior studies also have compared 4-L PEG solutions (PEG-ELS) with 2-L PEG solutions and bisacodyl tablets (PEG) and found no significant differences in bowel preparation effectiveness using the BBPS scale^[20,21]. However, one randomized trial, and a recent meta-analysis of PEG bowel preparations, demonstrated statistically significantly fewer satisfactory bowel preparation scores as compared to PEG-ELS solutions using either the BBPS or Ottawa Preparation Scale (OPS)^[22,23]. This difference was not evident in our analysis, as PEG was comparable to not only PEG-ELS but also to PEG-A and PICO.

Several studies, including a recent meta-analysis, have shown SD is better than DPD regimen^[7,10,11,24] and current colonoscopy guidelines recommend the split dosing regimen^[13-15]. Our data reflect those findings, as SD was superior across all preparations except for PICO. This particular finding however, was in contrast to information reported in the recently published USMSTF guidelines^[16]. However, our results for PICO could be confounded because of the relatively small sample size of the DPD regimen (6% of all PICO preparations). Prior studies on PICO have shown non-inferiority to PEG based solutions (HalfLyte[®], colonLyte[®]) and/or sodium sulfate with DPD^[25-27]. However, a single-blinded randomized controlled trial suggested a split dose regimen is better than the traditional prior day dosing of sodium picosulfate (Pico-Salax[®])^[28]. These conflicting results warrant further evaluation of the optimal dosing regimen for PICO.

While our results suggested no important difference in overall BBPS scores between the preps studied, we did not collect data on patient satisfaction or compliance with each of the regimens. Previous studies have demonstrated differences in patient preference for one preparation over another (e.g. PEG over PEG-ELS)^[22,29,30]. However, there is not enough data to draw such conclusions regarding sodium picosulfate based preparations (such as PICO). Nevertheless, several studies have indicated a patient preference for the reduced (2-liter) volume PEG solutions (PEG, PEG-A) over traditional 4-liter PEG

solutions (PEG-ELS)^[8,9].

Our results also indicated that the BBPS scores did not differ significantly based on the timing of the procedure (morning vs afternoon) with the exception of PEG-ELS given as day-prior dosing. A recent prospective study of 300 outpatient colonoscopies found that the timing of colonoscopies did not have a significant impact on the quality of the bowel preparation^[31]. However, that study did suggest a better quality of the bowel preparation was found in patients with a shorter time between finishing the bowel prep and the start of colonoscopy. Similar results were found in another prospective study of 378 patients^[32], but these investigators did not use a validated scale to assess the quality of bowel preparation. Nevertheless, it appears that a shorter “runway” time between finishing the prep and undergoing colonoscopy is associated with a better quality preparation^[33]. This conclusion was also drawn in a study that suggested same day preparation for afternoon colonoscopy have better results than prior-day preparation^[34].

Finally, our analyses demonstrate that women had statistically significantly higher BBPS scores than men across all preps except for PEG. No prior studies have specifically evaluated this potential gender-specific finding. It is possible that women have higher adherence rates to preparation instructions, which, if confirmed, would suggest the need for increased patient education geared towards men.

Our study had a number of potential limitations. It was a retrospective review of colonoscopies, and the fact that bowel preparations were selected at the discretion of the endoscopists, resulted in uneven sample sizes among the different groups. The lack of patient satisfaction data limits our ability to assess compliance, which may have contributed to the effectiveness of each of the bowel preparations^[10,17,35-37]. Nevertheless, this real-world experience of bowel preps for colonoscopy in nearly 3,600 patients confirms that split dosing is superior to prior day dosing. While we found that women had higher BBPS scores than men, no differences were seen between the qualities of the preps when morning procedures were compared to those performed in the afternoon.

Importantly, the retail prices for the bowel preps analyzed based on the cost in our outpatient hospital pharmacy were as follows: GoLYTELY® \$20; CoLyte® unflavored \$36, MiraLAX® \$4 per 17 g, MoviPrep® \$74, and Prepopik® \$79. These differences in price with relative comparable effectiveness of the different preps suggest that cost may play an important role in prescribing one preparation over another.

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CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

REFERENCES

- Harewood GC, Sharma VK, de Garmo P. Impact of colonoscopy preparation quality on detection of suspected colonic neoplasia. *Gastrointest Endosc* 2003; **58**: 76-79.
- Rex DK, Imperiale TF, Latinovich DR, Bratcher LL. Impact of bowel preparation on efficiency and cost of colonoscopy. *Am J Gastroenterol* 2002; **97**: 1696-1700.
- Froehlich F, Wietlisbach V, Gonvers JJ, John-Paul Vader. Impact of colonic cleansing on quality and diagnostic yield of colonoscopy: the European Panel of Appropriateness of Gastrointestinal Endoscopy European multicenter study. *Gastrointest Endosc* 2005; **61**: 378-384.
- Sherer EA, Imler TD, Imperiale TF. The effect of colonoscopy preparation quality on adenoma detection rates. *Gastrointest Endosc* 2012; **75**: 545-553.
- Lebwohl B, Kastrinos F, Glick M, Rosenbaum AJ, Wang T, Neugut AI. The impact of suboptimal bowel preparation on adenoma miss rates and the factors associated with early repeat colonoscopy. *Gastrointest Endosc* 2011; **73**: 1207-1214.
- Johnson DA, Barkun AN, Cohen LB, Dominitz JA, Kaltenbach T, Martel M, Robertson DJ, Boland CR, Giardello FM, Lieberman DA, Levin TR, Rex DK. Optimizing Adequacy of Bowel Cleansing for Colonoscopy: Recommendations From the US Multi-Society Task Force on Colorectal Cancer. *Am J Gastroenterol* 2014; **109**: 1528-1545.
- Marmo R, Rotondano G, Riccio G, Cipolletta L. Effective bowel cleansing before colonoscopy: a randomized study of split-dosage versus non-split dosage regimens of high-volume versus low-volume polyethylene glycol solutions. *Gastrointest Endosc* 2010; **72**: 313-320.
- Ell C, Fischbach W, Bronisch HJ, Dertinger S, Layer P, Runzi M, Schneider T, Kachel G, Gruger J, Kollinger M, Nagell W, Goerg KJ, Wanitschke R, Gruss HJ. Randomized Trial of Low-Volume PEG Solution Versus Standard PEG + Electrolytes for Bowel Cleansing Before Colonoscopy. *Am J Gastroenterol* 2008; **103**: 883-893.
- Stefano Pontone, Rita Angelini, Monica Standoli, Gregorio Patrizi, Franco Culasso, Paolo Pontone, Adriano Redler. Low-volume plus ascorbic acid vs high-volume plus simethicone bowel preparation before colonoscopy. *World J Gastroenterol* 2011; **17**(42): 4689-4695.
- Kilgore TW, Abdinoor AA, Szary NM, Schowengerdt SW, Yust JB, Choudhary A, Matteson ML, Puli SR, Marshall JB, Bechtold ML. Bowel preparation with split-dose polyethylene glycol before colonoscopy: a meta-analysis of randomized controlled trials. *Gastrointest Endosc* 2011; **73**: 1240-1245.
- Cohen LB. Split dosing of bowel preparations for colonoscopy: an analysis of its efficacy, safety, and tolerability. *Gastrointest Endosc* 2010; **72**: 406-412.
- Lieberman DA, Rex DK, Winawer SJ, Giardiello FM, Johnson DA, Levin TR. Guidelines for colonoscopy surveillance after screening and polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology* 2012; **143**: 844-857.
- Wexner SD, Beck DE, Baron TH, Fanelli RD, Hyman N, Shen B, Wasco KE. A consensus document on bowel preparation before colonoscopy: prepared by a task force from the American Society of Colon and Rectal Surgeons (ASCRS), the American Society for Gastrointestinal Endoscopy (ASGE), and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). *Gastrointest Endosc* 2006; **63**: 894-909.
- Rex DK, Johnson DA, Anderson JC, Inadomi JM. American College of Gastroenterology guidelines for colorectal cancer screening 2008. *Am J Gastroenterol* 2009; **104**: 739-750.

- 15 Hassan C, Bretthauer M, Kaminski MF, Jean-Marc Dumonceau. Bowel preparation for colonoscopy: European Society of Gastrointestinal Endoscopy (ESGE) guideline. *Endoscopy* 2013; **45**: 142-150.
- 16 David A. Johnsoncorrespondenceemail, Alan N. Barkun, Larry B. Cohen, Jason A. Dominitz, Tonya Kaltenbach, Myriam Martel, Douglas J. Robertson, C. Richard Boland, Frances M. Giardello, David A. Lieberman, Theodore R. Levin, Douglas K. Rex. Optimizing adequacy of bowel cleansing for colonoscopy: recommendations from the U.S. Multi-Society Task Force on Colorectal Cancer. *Gastrointest Endosc* 2014; **80**: 543-62.
- 17 Unger RZ, Amstutz SP, Seo da H, Huffman M, Rex DK. Willingness to undergo split-dose bowel preparation for colonoscopy and compliance with split-dose instructions. *Dig Dis Sci* 2010; **55**: 2030-2034.
- 18 Rex DK, Katz PO, Bertiger G, Vanner S, Hookey LC, Alderfer V, Joseph RE. Split-dose administration of a dual-action, low-volume bowel cleanser for colonoscopy: the SEE CLEAR I study. *Gastrointest Endosc* 2013; **78**: 132-41.
- 19 Lai EJ, Calderwood AH, Doros G, Jacobson BC. The Boston Bowel Preparation Scale: a valid and reliable instrument for colonoscopy-oriented research. *Gastrointest Endosc* 2009; **69**: 620-625.
- 20 McKenna T, Macgill A, Porat G, Friedenber FK. Colonoscopy preparation: polyethylene glycol with Gatorade is as safe and efficacious as four liters of polyethylene glycol with balanced electrolytes. *Dig Dis Sci* 2012; **57**: 3098-3105.
- 21 Samarasena JB, Muthusamy VR, Jamal MM. Split-dosed MiraLAX/Gatorade is an effective, safe, and tolerable option for bowel preparation in low-risk patients: a randomized controlled study. *Am J Gastroenterol* 2012; **107**: 1036-1042.
- 22 Siddique S, Lopez KT, Hinds AM, Ahmad DS, Nguyen DL, Matteson-Kome ML, Puli SR, Bechtold ML, Bechtold ML. Miralax With Gatorade for Bowel Preparation: A Meta-Analysis of Randomized Controlled Trials. *Am J Gastroenterol* 2014; **109**: 1566-1574.
- 23 Gerard DP, Holden JL, Foster DB, Raiser MW. Randomized trial of gatorade/polyethylene GLYCOL with or without bisacodyl and NuLYTELY for colonoscopy preparation. *Clin Transl Gastroenterol* 2012; **3**: e16.
- 24 Bucci C, Rotondano G, Hassan C, Rea M, Bianco MA, Cipolletta L, Ciacci C, Marmo R. Optimal bowel cleansing for colonoscopy: split the dose! A series of meta-analyses of controlled studies. *Gastrointest Endosc* 2014; **80**: 566-76
- 25 Katz PO, Rex DK, Epstein M, Grandhi NK, Vanner S, Hookey LC, Alderfer V, Joseph RE. A dual-action, low-volume bowel cleanser administered the day before colonoscopy: results from the SEE CLEAR II study. *Am J Gastroenterol* 2013; **108**: 401-409.
- 26 Lawrance IC, Willert RP, Murray K. Bowel cleansing for colonoscopy: prospective randomized assessment of efficacy and of induced mucosal abnormality with three preparation agents. *Endoscopy* 2011; **43**: 412-418.
- 27 Manes G, Amato A, Arena M, Pallotta S, Radaelli F, Masci E. Efficacy and acceptability of sodium picosulphate/magnesium citrate versus low-volume PEG-ascorbic acid for colon cleansing: a randomized controlled trial. *Colorectal Dis* 2013; **15**: 1145-1153.
- 28 Flemming JA, Vanner SJ, Hookey LC. Split-dose picosulfate, magnesium oxide, and citric acid solution markedly enhances colon cleansing before colonoscopy: a randomized, controlled trial. *Gastrointest Endosc* 2012; **75**: 537-544.
- 29 Samarasena JB, Muthusamy VR, Jamal MM. Split-dosed MiraLAX/Gatorade is an effective, safe, and tolerable option for bowel preparation in low-risk patients: a randomized controlled study. *Am J Gastroenterol* 2012; **107**: 1036-1042.
- 30 DiPalma JA, Wolff BG, Meagher A, Cleveland MB. Comparison of reduced volume versus four liters sulfate-free electrolyte lavage solutions for colonoscopy colon cleansing. *Am J Gastroenterol* 2003; **98**: 2187-2191.
- 31 Eun CS, Han DS, Hyun YS, Bae JH, Park HS, Kim TY, Jeon YC, Sohn JH. The timing of bowel preparation is more important than the timing of colonoscopy in determining the quality of bowel cleansing. *Dig Dis Sci* 2011; **56**: 539-544.
- 32 Siddiqui AA, Yang K, Spechler SJ, Cryer B, Davila R, Cipher D, Harford WV. Duration of the interval between the completion of bowel preparation and the start of colonoscopy predicts bowel-preparation quality. *Gastrointest Endosc* 2009; **69**: 700-706.
- 33 Aisenberg J. Bowel preparation for colonoscopy: shortening the "runway time". *Gastrointest Endosc* 2009; **69**: 707-709.
- 34 Gurudu SR, Ratuapli S, Heigh R, DiBaise J, Leighton J, Crowell M. Quality of bowel cleansing for afternoon colonoscopy is influenced by time of administration. *Am J Gastroenterol*. 2010; **105**: 2318-22.
- 35 Khan MA, Piotrowski Z, Brown MD. Patient acceptance, convenience, and efficacy of single-dose versus split-dose colonoscopy bowel preparation. *J Clin Gastroenterol* 2010; **44**: 310-311.
- 36 Katz PO, Rex DK, Epstein M, Grandhi NK, Vanner S, Hookey LC, Alderfer V, Joseph RE. A dual-action, low-volume bowel cleanser administered the day before colonoscopy: results from the SEE CLEAR II study. *Am J Gastroenterol*. 2013; **108**: 401-9.

Peer reviewers: Francis Seow-Choen, Professor, Director, Seow-Choen Colorectal Centre, 290 Orchard Road. Paragon #06-06 Singapore; Hirotsada Akiho, MD, PhD, Department of Gastroenterology, Kitakyushu Municipal Medical Center 2-1-1, Bashaku, kokurakita-ku, Kitakyushu-shi, Fukuoka 802-0077, Japan.