

A Meta-analysis on Timing of Bowel Preparation in Colonoscopy: Same-day versus Evening before

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INTRODUCTION

Bowel preparation is a fundamental part in colonoscopy in achieving a quality and optimal result both in screening and clinical cases. However, despite advances in technology and better skills of endoscopists, the facilitation and patient compliance in bowel preparation has been a long time ordeal in colonoscopy. The factors that affect patient compliance leading to poor prep are several days diet restriction, unpalatable and large volume of purgatives/cathartics. Duration of colonoscopy, decreased cecal intubation leading to increased risk of missed lesion and adenoma detection rate, as well as, patient discomfort are some if not most effects of poor preparation.

Split-dose method is a clinically proven regimen and has been the standard of care in bowel preparation based on the evidence of better colonic cleanliness and most especially adenoma detection rate. Since preparations are traditionally given the evening before the procedure disturbance in sleep among patients may also lead potentially to loss of working hours. With this, there are various guidelines that recommended same-day bowel preparation. Worldwide, there is no standard guideline regarding timing of bowel preparation prior to colonoscopy. Some studies that compare same-day versus evening before show superiority of same-day over evening before. However, some studies as well say otherwise and showed no significant difference between the 2 timings. The aim of this study is to compare and clarify issues regarding timing of bowel preparation by measuring the cecal intubation, adenoma detection rate, bowel preparation quality (Ottawa, Boston or Arichnok) and patient satisfaction. Superiority of either schedule using quality of bowel preparation was the primary end point of the study.

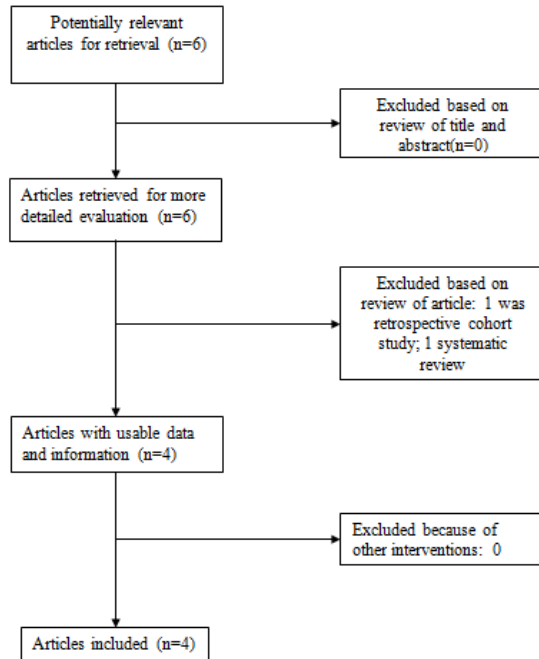


Figure 1 Articles reviewed, included and excluded in the meta-analysis.

METHODS

Criteria for considering studies for this review

All randomized controlled trials comparing the effects same-day bowel preparation to evening before on adult patients undergoing colonoscopy were included in the study. There was no restriction regarding the date of publication or language. Studies were excluded if they were observational studies, non-randomized experimental studies, opinion articles, or abstracts without adequate data. Unpublished studies, local studies, and ongoing trials were also not included.

Outcomes

Primary outcome analyzed is the quality of bowel preparation. Secondary outcomes examined in this study are incidence of cecal intubation rate, patient satisfaction, and adenoma detection rate.

Search strategy

A systematic computerized search using free text and MeSH terms, with the key words *colonoscopy, bowel preparation, same-day and evening* was done using PubMed. Free text search using the same key words was also done using Cochrane, clinicaltrials.gov and Google Scholar.

Selection of studies

All the authors reviewed abstracts independently and identified articles meeting the study's inclusion criteria. Study eligibility was determined by consensus among the authors, based on the determined inclusion criteria.

Data extraction and management

Eligible studies were reviewed independently by the authors and data were extracted based on the Cochrane Data Extraction Template (EPOC). The following information were extracted from each eligible study: total number of included and excluded participants, total number of participants observed and those that are lost to follow-up and the reasons for loss to follow-up. Trial characteristics were also abstracted such as type of study, inclusion and exclusion criteria, method of allocation generation and concealment, blinding, follow-up rate, intention to treat analysis, trial intervention and control. As for the outcomes, primary (quality of bowel preparation) and secondary outcomes (cecal intubation rate, patient satisfaction, and adenoma detection rate) were recorded.

Assessment of risk of bias in included studies

Study quality was appraised independently by two authors using the Cochrane Assessment of Risk of Bias Tool. Each study was rated as low, unclear or high risk for bias based on the six domains (sequence generation, allocation concealment, blinding of participants, personnel and outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias. Any discrepancies were resolved by consensus. Based on the tool, low risk of bias is when majority of the domains are rated low and bias is unlikely to seriously alter the results. Unclear risk indicates unclear risk for at least one domain

and infers that there may be bias that raises some doubts about the results. Studies are rated high risk of bias when at least one domain is rated high and infers that the bias seriously weakens the confidence in the results.

Statistical analysis

Data were combined and analyzed using Review Manager 5.3 software (RevMan). Dichotomous outcomes were combined using risk ratios (RR). Heterogeneity was assessed using the I-squared statistic. Less than 25% was assessed as minimal heterogeneity, 25-50% was moderate and >50% was substantial heterogeneity. Chi² test was also used to test for significant heterogeneity ($P > 0.10$).

RESULTS

Description of Studies

A total of 6 articles were identified from literature search, all of which were eligible studies based on the inclusion criteria [see Figure 1]. Of the 6 articles, 2 were excluded, 1 trial was excluded because it was a retrospective cohort studies (Wen 2017), and one was a systematic review (Cheng 2017).

The characteristics of the three articles analyzed are summarized in Table 1. (Varughese, Gupta, Al, Tao). All the studies used quality of bowel preparation as their primary outcomes. All articles reported cecal intubation rate as their secondary outcomes but only, 3 articles (Varughese, Gupta, Al) included patient satisfaction and only 1 article included adenoma detection rate (Varughese). The selected trials included a total of 620 adult patients who underwent colonoscopy: 308 randomized to same-day bowel preparation, and 312 received standard evening preparation.

Risk of Bias in Included Studies

The quality of the studies included was assessed using the Cochrane Risk of Bias Tool [Figure 2]. All studies were rated overall as having low risk of bias. However, it is important to note that one study, Buxbaum *et al.*, had unclear risk of bias because of failure to indicate if blinding of participants, personnel, and outcome assessors were done.

Primary Outcome: Quality of Bowel Preparation

The results are summarized in Figure 3. There was no significant difference between same-day bowel preparation and evening before bowel preparation since it touches the line of no effect; however CI is narrow. [Relative risk (RR) [1.05]; 95% confidence interval (CI) 0.96 – 1.15] Although there were trends that favor same-day bowel preparation more than in evening before. The studies included in the quality of bowel preparation were heterogenous and with significant heterogeneity ($I^2= 89\%$).

Secondary Outcome: Patient Satisfaction

Figure 4 summarizes the effect of same-day bowel preparation on patient satisfaction rate. The studies significantly favors same-day bowel preparation more than evening-before bowel preparation with a narrow CI [Relative risk (RR) [0.39]; 95% confidence interval (CI) 0.29 – 0.54] significantly low and might not be important. ($I^2= 0\%$). However, less patient satisfaction occurs in same-day bowel preparation since the diamond lies to the right of the line of no effect.

Secondary Outcome: Cecal Intubation Rate

A summary of the effect of same-day bowel preparation on cecal intubation rate using a random effects model can be seen in Figure 5. The overall effect of the estimate crosses the line of no effect which means that the treatment effect no significant difference between same-day bowel preparation and evening-before bowel preparation. Although there were trends that favor same-day bowel preparation more than in evening before. Heterogeneity among the four studies is significantly low and might not be important and has no effect ($I^2=0\%$).

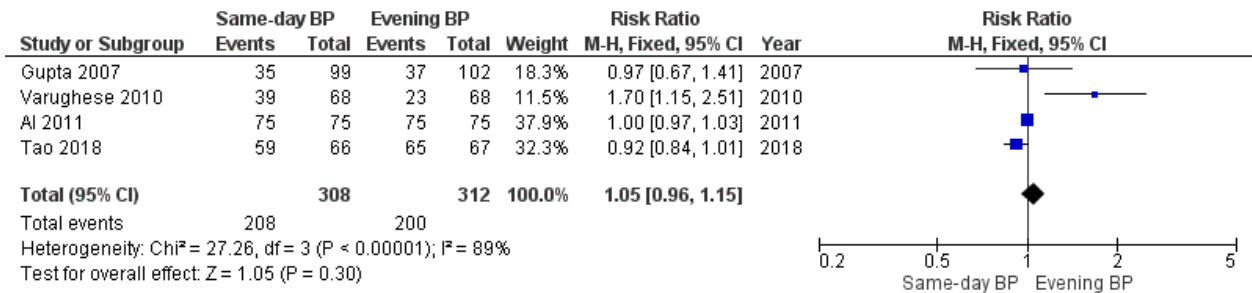


Figure 3. Effect of same-day bowel preparation on Quality of Bowel Preparation using a random effects model.



Figure 4. Effect of same-day bowel preparation on patient satisfaction rate using a random effects model.

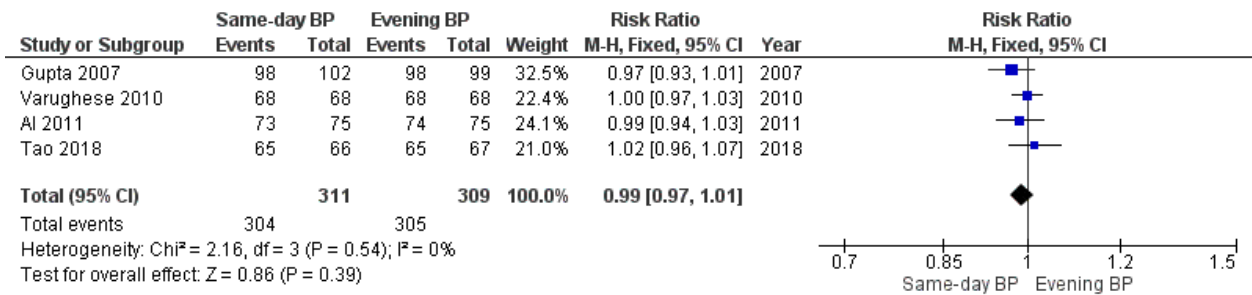


Figure 5. Effect of same-day bowel preparation on cecal intubation rate using a random effects model.

Table 2. Summary of Findings

Same-day bowel preparation compared to evening before bowel preparation undergoing colonoscopy

Patient or population: patient undergoing colonoscopy
Intervention: Same-day bowel preparation
Comparison: Evening before bowel preparation

Outcomes	Relative effect (95% CI)	No of Participants (studies)
Quality of Bowel preparation	RR [1.05] (0.96 – 1.15)	620 patients (4 RCTs)
Patient Satisfaction	RR [0.39] (0.29 – 0.54)	487 patients (3 RCTs)
Cecal Intubation Rate	RR [0.99] (0.97 – 1.01)	620 patients (4 RCTs)

CI: Confidence interval; RR: Risk Ratio

DISCUSSION

Afternoon colonoscopies, according to studies have showed higher rates of inadequate or poor bowel preparation and higher failure rates (1,2). Some studies as well recommend to avoid afternoon procedures and perform all colonoscopies in the morning so as to avoid repetition of the same procedure and to relieve patient's from complications. As of date, there no standard recommendations or guidelines regarding timing of bowel preparations for afternoon colonoscopies. One study elaborated that the timing of bowel preparation is one of the predictors of inadequate bowel cleansing, which may lead to lower cecal intubation and most importantly, lower adenoma detection rate. (3). A number studies have shown as well that PEG bowel solution administration in the morning of afternoon colonoscopy may help to improve the quality of the preparation (3, 4, 5)

Several studies used factors like, cecal intubation rate, adenoma detection rate and withdrawal time and patient satisfaction as predictors that may allow determination of the quality of colonoscopy and may therefore be an important determinant of the quality of the colonoscopy. In our pooled studies, cecal intubation rate did not show significant differences however trend seems to favor the same-day over evening before. (3, 6, 7, 8).

A number of studies compared the amount of PEG solution to be given on same-day or evening before (9,10) The study by Chiu *et al.* (9) randomized 120 patients. The polyps detected on a screening colonoscopy received either 2L PEG in the morning or the night before, which showed significantly better bowel cleansing and adenoma detection rates among the patients who received laxative in the morning. Another study by Church (10) wherein all patients underwent afternoon colonoscopies were randomized to receive 4L PEG the night before or at 8 AM on the day of the examination. All patients in his study had a clear liquid diet the day before the colonoscopy, whereas we allowed those consuming PEG in the morning to have a regular breakfast the day before the procedure. In this study Church demonstrated better quality of preparation in those assigned to receive PEG the morning. However, the limitation in this study showed 25% of the patients had bowel resection requiring less amount of PEG to achieve a better quality.

CONCLUSION

In summary, preparations in same-day and evening-before preparation in terms of cecal intubation rate and quality of bowel preparation did not show any significant difference. Patient satisfaction is more apparent among patients under same-day bowel preparation. Therefore, same-day bowel preparation can be used for afternoon colonoscopies, which favors patients' comfort that may affect compliance as well.

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Conflict of interest statement

Hashamiya M. Babaran, M.D.; Lariza Marie Canseco, M.D.; Carlos Rolando Cuaño, M.D.; Julius Christian Sunglao, M.D.; Angela D. Salvaña, M.D. have no conflicts of interest or financial disclosures to declare.

Table 1. Characteristics of randomized trials include

Authors, Year [Ref.]	N (total)	Population		Same-day Bowel preparation	Evening-before preparation	Outcomes	
		Inclusion criteria	Exclusion criteria			Primary	Secondary
Varughese 2010	136	All adult patients aged > 19 years evaluated at the ambulatory gastroenterology clinic at Cleveland Clinic Florida and scheduled for an elective colonoscopy in the afternoon (1 PM onward)	Only those patients who had a previous history of colon resection or a suspicion of bowel obstruction were excluded from participation in the study.	Morning group: same bowel preparation between 6 AM and 10 AM on the day of colonoscopy	Evening group: 1 gallon of PEG between 5 PM and 9 PM on the day before colonoscopy	Ottawa scale mean scores compared between the two groups. Other outcome measures included the Ottawa scale divided into good and poor preparation, patient, questionnaire data, and the number of polyps detected.	- Patient satisfaction using a patient questionnaire that measured hours of sleep loss, side effects, ease of following dietary restrictions, - Overall satisfaction of the bowel preparation.
Gupta 2007	201	Any patient between 18 and 80 years who needed colonoscopy was included in the study.	Patients with Background and aims: Evening preparation for colonoscopy is often unsatisfactory and inconvenient. We performed this study to compare the efficacy of bowel preparation at two different timings: previous evening and same morning and to compare the loss of working hours and sleep between	Morning group: patients received this solution at 0600 hours on the day of the colonoscopy	Evening group: sodium phosphate-based preparatory fluid (Exelyte; USV limited, India; 90 mL with 300 mL of lemonade) on the evening prior to colonoscopy (at 1700 hours)	Bowel preparation was independently rated by them, using the Ottawa Bowel Preparation Quality Scale usage guide [10] and the Aronchick Scale [11]. The Ottawa Scale assesses cleanliness in the right colon (cecum, ascending), mid colon (transverse, descending), and rectosigmoid separately, and al-	Loss of working hours and sleep disturbance

			<p>these groups.</p> <p>Patients and methods: In this prospective, investigator blinded, randomized trial, 201 patients were enrolled from February to June 2005. Patients aged between 18 to 80 years needing colonoscopy were included. Patients with prior bowel surgery, suspected bowel obstruction or contraindications to phosphate preparation were excluded. Patients received a phosphate based preparation on the previous evening or morning of the procedure. The endoscopist and an observer scored bowel preparation using the Ottawa and Aronchick scales. Using the Ottawa scale right, middle and left colon were separately assessed. Loss of sleep</p>			<p>allows the observer to globally rate the volume of colonic fluid. A summary score is then obtained from the individual parameters [10] (Table 1). The Aronchick scale on the other hand, allows descriptions of percentage of fluid and stool coverage, and rates the colon as a whole using these two criteria</p>	
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			<p>and working hours were noted.</p> <p>Results: One hundred and two patients received morning preparation and 99 patients received preparation on the previous evening. There was no significant difference in bowel preparation in both the groups using the Ottawa (P = 0.87) or Aronchick (P = 0.22) scales. Bowel preparation for right colon was significantly better in the morning group (P = 0.008). More working hours were lost in the evening group (7.99 vs 10.17, P < 0.001). Sleep was disturbed in 15 patients in morning group and in 42 patients in evening group (P < 0.001).</p> <p>Conclusion: Both preparations had similar efficacy. Right side preparation</p>			
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			<p>was significantly better in the morning group. Evening preparation was associated with loss of more working hours and sleep.</p> <p>Gupta T et al. Comparison of two bowel preparation schedules¼ Endoscopy 2007; 39: 706±709</p> <p>Downloaded by: Chinese University of Hong Kong. Copyrighted material.</p> <p>prior bowel surgery, suspected bowel obstruction, or any contra-indication to phosphate preparation (cardiovascular or renal insufficiency) were excluded from the study. Patients who were inconvenienced by the timing of bowel preparation were also excluded.</p>				
Al 2011	150	Outpatients aged between 18 and 80 years who were scheduled for elective colonoscopy at Al Kindy	Exclusion criteria involves prior bowel surgery and suspected bowel obstruction and known allergy to polyethylene	Regimen: PEGELS (Alfares Pharm., Syria; {59 g polyethylene glycol, 5.68 g Na2SO4, 1.68 g NaHCO3, 1.46 g NaCl, and 0.75 g KCl} per sachet)	Regimen: PEGELS (Alfares Pharm., Syria; {59 g polyethylene glycol, 5.68 g Na2SO4, 1.68 g NaHCO3, 1.46 g NaCl, and 0.75	Bowel preparation was independently rated, using the Ottawa Bowel Preparation Quality Scale usage guide (9)	- Cecal intubation rate - Sleep disturbance

		teaching Hospital, Baghdad, Iraq, between March 2010 and August 2011 were enrolled in a consecutive manner.	glycol.	as the preparation agent. Morning Regimen Three sachets were ingested on the morning of the day of colonoscopy, starting at 05:00 hour, which should be completed before 8:00.	g KCl} per sachet) as the preparation agent. Evening Regime: Four sachets were ingested the day prior to the procedure starting at 15.00 hour, which should be completed before bed time.	,which assesses cleanliness in the right colon (cecum, ascending), mid colon (transverse, descending), and left colon(rectosigmoid) separately, and allows the observer to globally rate the volume of colonic fluid. A summary score is then obtained from the individual parameters (9)	
Tao 2018	133	One hundred and thirty-three consecutive patients who underwent elective colonoscopy	Exclusion criteria included symptomatic congestive heart failure (CHF), myocardial infarction, serum creatinine levels greater than 1.5mg/dL, abnormal liver function defined as glutamic-oxaloacetic transaminase (GOT) and glutamic-pyruvic transaminase (GPT) each greater than 120U/L, ascites, electrolyte abnormalities, gastrointestinal obstructions,	90ml at 6:00-7:00AM in the same morning of the colonoscopy (AM).	One group was assigned to take one 90 ml sodium phosphate solution (Fleet®) for bowel preparation, diluted with a cold clear liquid or water, at 6:00-7:00PM in the evening before the day of the colonoscopy (PM)	Colonic cleansing was evaluated based on the amount of stool (none, small, moderate, or large), consistency of stool (none, clear lavage, liquid stool, particulate stool, semi-solid stool, and solid stool), and the estimated percentage of the bowel wall visualized (<49%, 50-74%, 75-89%, and >90%) at various segments of the colon, as well as the overall assessment of the preparation rated by the colonoscopist (small volume	A self-administered questionnaire was completed by the patients to assess the tolerance and acceptability of the bowel preparation.

			<p>gastric retention, bowel perforations, toxic colitis, toxic megacolon, ileus, known hypomotility syndrome, uncontrolled hypertension, unstable angina pectoris, clinical evidence of dehydration, or severe chronic constipation. Further exclusion criteria included women who were pregnant or breastfeeding, those using investigational drugs, those unable to communicate to the study personnel or unable to understand bowel preparation instructions, One group was assigned to take one 90 ml sodium phosphate solution (Fleet®) for bowel preparation, diluted with a cold clear liquid or water, at 6:00-7:00PM in the evening before the day</p>			<p>of clear liquid, large volume of clear liquid, some semi-solid stool that could be suctioned or washed away, and semi-solid stool that could not be suctioned or washed away).</p>	
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			of the colonoscopy (PM) inability to take oral hydration adequately, or patients with known allergies to the medications used in this study.				
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	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Al 2011	+	+	+	+	+	+	+
Gupta 2007	+	+	+	+	+	+	+
Tao 2018	+	+	+	+	+	+	+
Varughese 2010	+	+	+	+	+	+	+

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.