

Efficiency of bowel preparation for capsule endoscopy examination: A meta-analysis

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Abstract

Good preparation before endoscopic procedures is essential for successful visualization. The small bowel is difficult to evaluate because of its length and complex configuration. A meta-analysis was conducted of studies comparing small bowel visualization by capsule endoscopy with and without preparation. Medical data bases were searched for all studies investigating the preparation for capsule endoscopy of the small bowel up to July 31, 2007. Studies that scored bowel cleanness and measured gastric and small bowel transit time and rate of cecum visualization were included. The primary endpoint was the quality of bowel visualization. The secondary endpoints were transit times and proportion of examinations that demonstrated the cecum, with and without preparation. Meta-analysis was performed with StatDirect Statistical software, version 2.6.1 (<http://statsdirect.com>). Eight studies met the inclusion criteria. Bowel visualization was scored as "good" in 78% of the examinations performed with preparation and 49% performed without ($P < 0.0001$). There were no significant differences in transit times or in the proportion of examinations that demonstrated the cecum with and without preparation. Capsule endoscopy preparation improves the quality of small bowel visualization, but has no effect on transit times, or demonstration of the cecum.

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Key words: Capsule endoscopy; Bowel preparation; Transit time

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INTRODUCTION

Good preparation before endoscopic procedures is essential for successful visualization. It is also an important factor for patient safety, quality of care, and cost efficiency^[1,2]. The small bowel is difficult to evaluate because of its length and complex configuration. The recently developed Given Diagnostic Imaging System (PillCam, Given Imaging Ltd., Yoqneam, Israel) for evaluation of pathologies of the small bowel^[3-7] can identify lesions that cannot be detected by other techniques^[8,9]. The preparation recommended by the manufacturer is a 12-hour fast after 24-hour intake of clear liquids.

Studies of the effect of bowel preparation for capsule endoscopy on optimal visualization, gastric and small bowel transit times, and rate of cecum demonstration have sometimes reached different conclusions^[10-17]. Sood *et al*^[18], in MRI studies, found no significant difference in transit time between patients prepared with polyethylene glycol or standard methods. In our previous studies, the use of sodium phosphate preparation was not associated with a significant change over fasting in gastric or small bowel transit times, although it yielded a significantly better view of the mucosa^[10,11]. Others reported that both polyethylene glycol and sodium phosphate have a marked accelerating effect on small intestinal transit time^[19,20].

In the present study, we performed a meta-analysis of studies comparing preparation with no preparation before capsule endoscopy of the small bowel. The primary endpoint was the quality of small bowel visualization. The secondary endpoints were gastric and small bowel transit times and proportion of examinations demonstrating the cecum.

FORMULATION OF QUESTIONS

The primary question was: What is the contribution of bowel preparation to successful capsule endoscopy

examination? This raised the subsidiary question of a possible difference in the rates of excellent and good cleaning of the small bowel with and without preparation. In addition, we sought to determine the impact of preparation on gastric transit time, small bowel transit time, and arrival of the capsule to the cecum with the battery still functioning.

CRITERIA FOR CONSIDERING STUDIES FOR THIS META-ANALYSIS

Our study was based on controlled studies of the quality of small bowel capsule examination with and without prior preparation. Two studies of our group were included in the meta-analysis^[10,11]. There was no overlap between the patient populations in these two studies.

SEARCH STRATEGY FOR IDENTIFICATION OF STUDIES

We conducted a bibliographic search of the PubMed (MEDLINE), EMBASE, COCHRANE LIBRARY (Cochrane Database of Systemic Reviews and the Cochrane Controlled Trial Register), CINAHL, and AMED databases up to July 31, 2007 using the following keywords: "capsule endoscopy", "M2A" (mouth-to-anus), and "PillCam". The search was directed at English-language medical journals. All papers identified by the electronic database search were examined and additional references were identified from the references listed in each paper.

INCLUSION CRITERIA

Case-control studies investigating the preparation for capsule endoscopy of the small bowel which employed a scoring system for bowel cleanness and measured gastric and small bowel transit time and rate of cecum demonstration were included.

EXCLUSION CRITERIA

Studies that focused on esophageal or colonic examination, did not directly compare preparations, had no control, or did not measure transit times were excluded from the analysis.

STATISTICAL ANALYSIS

For each study, the following variables were extracted and entered into an Excel data sheet: author, journal, year of publication, number of participants, type of preparations, proportion of good bowel visualization, gastric transit time, small bowel transit time, and proportion of cecum demonstration. The meta-analysis was performed with the StatDirect Statistical software, version 2.6.1 (<http://statsdirect.com>). Heterogeneity was checked using χ^2 test (Q-statistics) with significance of $P < 0.05$. With the assumption that the studies are a random sample from a population of studies, we choose to use a random

Table 1 List of 5 case-control studies, comparing proportions of "good scoring" of bowel visualization, fulfilling the inclusion/exclusion criteria ($n = 237$)

Author	Ref.	Preparation	No. with	No. without	"good scoring" with prep.	"good scoring" without prep.
Niv Y, 2004	10	Na-P	22	10	19	3
Viazis N, 2004 ¹	17	PEG 2L	40	40	36	24
Albert J, 2004	12	Simethicone	18	18	14	5
Niv Y, 2005	11	Na-P	23	23	18	12
Ben-Soussan E, 2005	13	PEG 2L	26	16	15	10
Total			130	107	102	54
Proportion ^a					0.78	0.49

^a $P < 0.0001$. Na-P: Sodium-phosphate; Prep.: Preparation; PEG: Polyethylene glycol. ¹Randomized controlled trial.

effects model. Forest plots were constructed for visual presentation of the individual studies proportions and the pooled proportion^[21].

RESULTS

Our search yielded 550 studies of capsule endoscopy, of which 8 investigated the preparation for small bowel capsule endoscopy and otherwise met the inclusion criteria^[10-17].

Five out of these studies compared the proportion of "good" scores between the groups^[10-13,17]. The findings are shown in Table 1. A total of 237 patients were included, 130 with and 107 without preparation.

Seven out of these studies included a comparison of gastric and small bowel transit times and in proportion to examinations of cecum demonstration^[10,11,13-17]. The findings are shown in Table 2. A total of 401 patients were included, 221 with and 180 without preparation.

A "good" score was similarly defined in the five papers found suitable for comparison of preparations. In our two papers^[10,11] we used a score of 3 grades, where "good" was defined as a good mucosal visualization in more than 80% of the small bowel transit time. Albert and coworkers^[12] used a score of 4 grades, and we used their scores 0 and 1 as "good", when there was no limitation for interpretation. Viazis and coworkers used the term adequate when more than 90% of the small bowel transit time and the mucosa was clear^[17], and Ben-Soussan and colleagues, using a score of 4 grades, defined "good or excellent" when visibility was good in more than 75% of the small bowel transit time^[13]. A "good" score was documented for 78% of the patients with preparation (95% CI, 65%-88%) compared to 49% of the patients without preparation (95% CI, 35%-62%; $P < 0.0001$; Figure 1).

The capsule reached and visualized the cecum in 76% of the patients with preparation and 68% without. This difference did not reach statistical significance (Figure 2).

There was no statistically significant difference between the endoscopies performed with or without preparation in gastric transit time (pooled effect size, -0.054; 95% CI, -0.418 to 0.308) or small bowel transit time (pooled effect size, -0.327; 95% CI, -1.419 to -0.765; Figure 3A and B).

Table 2 List of 7 case-control studies, comparing transit times and proportions of cecum demonstration, fulfilling the inclusion/exclusion criteria (*n* = 401)

Author	Ref.	Prep.	No. with	No. without	GTT with (min)	GTT without (min)	SBTT with (min)	SBTT without (min)	Cecum reached with	Cecum reached without
Niv Y, 2004	10	Na-P	22	10	25.0	18.0	300	333	16	5
Viazis N, 2004 ²	17	PEG 2L	40	40	36.2	44.1	291.8	304.6	32	26
Niv Y, 2005	11	Na-P	23	23	25.0	40.0	341	241	18	18
Ben-Soussan E, 2005	13	PEG 2L	26	16	45.7	25.5	288	271	24	16
Fireman Z, 2005	14	PEG 1L or Na-P or Erythro	55 ¹	40 ¹	39.7	45.5	228	218	NM	NM
Dai N, 2005	16	PEG 4L	33	28	13.0	14.0	213	253	32	22
Caddy GR, 2006	15	Erythro	22	23	50.5	38.4	304.4	302.6	7	5
Total			166	140					129	92
Average ± SD					33.5 ± 13.2	32.2 ± 12.8	280.8 ± 44.9	274.7 ± 40.6		
Proportion									0.76	0.68
<i>P</i>					0.296		0.155		0.38	

With: With preparation; Without: Without preparation; GTT: Gastric transit time; SBTT: Small bowel transit time; Na-P: Sodium-phosphate; Prep.: Preparation; PEG: Polyethylene glycol; NM: Not mentioned. ¹Not included; ²Randomized controlled trial.

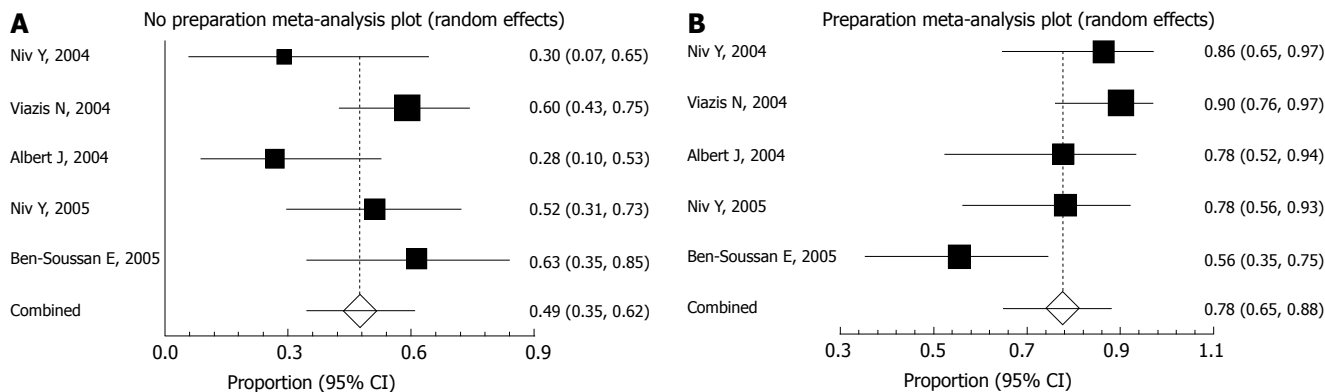


Figure 1 Proportion of a “good scoring” in small bowel visualization with (B) and without (A) preparation, a meta-analysis of 5 papers and 237 patients. Data were sufficiently homogenous, and statistically significant difference that favored preparation for good visualization is demonstrated. The statistical significance of results did not differ between fixed and random mode.

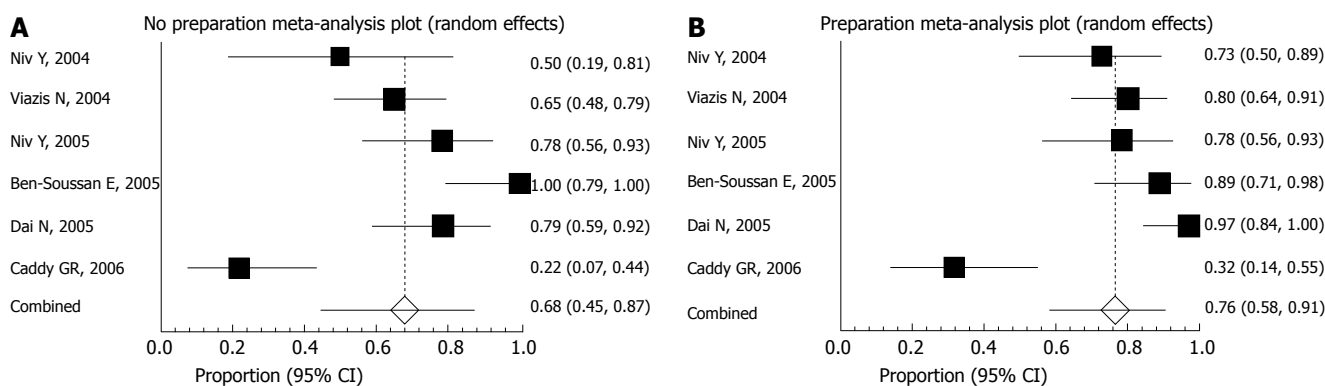


Figure 2 Proportion of cecum demonstration with (B) and without (A) preparation, a meta-analysis of 7 papers and 401 patients.

CONCLUSION

Capsule endoscopy is a new technology, and there is still no consensus regarding the proper preparation. The manufacturer recommends only a 12-h fast after 24-h intake of clear liquids. It may be in the interest of the manufacturer to recommend such a simple preparation, so that the procedure will be easy to perform. However,

since the procedure is costly, time consuming, and not usually repeated, it is critical to optimize the quality of visualization, which may be impaired by secretions, bubbles or coating of the capsule with intestinal residue.

Few studies have compared different preparation strategies, using different approaches, designs, and methods. Two controlled studies by our group found that the sodium phosphate method provided better

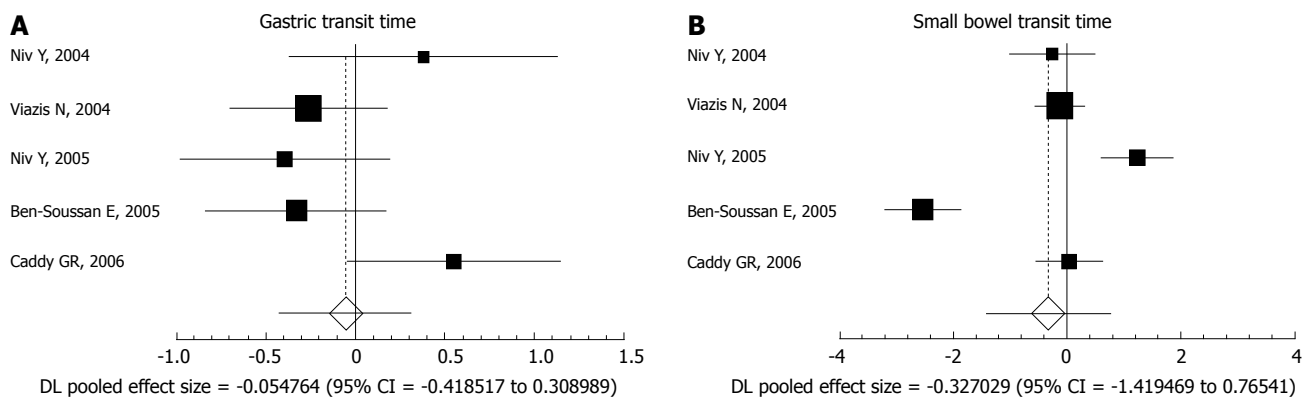


Figure 3 Differences in transit times in patients underwent preparation before the capsule examination and those who underwent the procedure without prior preparation, a meta-analysis of 7 papers and 401 patients. **A** = difference in gastric transit time, **B** = difference in small bowel transit time.

visualization than the standard method, with significantly less and later-appearing turbid fluid in the small bowel lumen, which could block the visual field of the capsule^[10,11]. Our results were in agreement with the prospective, randomized, controlled trial of Viazis *et al*^[17], which demonstrated a significant advantage of preparation with polyethylene glycol over fasting alone. The findings in our control group were also similar to the control findings of Viazis *et al*^[17] in terms of transit times, percentage of procedures in which the cecum was reached, and diagnostic yield (secondary endpoint). Taken together, the data from our nonrandomized comparison case-control studies^[10,11] and the randomized study of Viazis *et al*^[17] indicate that bowel preparation with either sodium phosphate or polyethylene glycol is superior to simple fasting for capsule endoscopy. Albert and colleagues used simethicone for bubble absorption and improved the visibility of the small bowel mucosa^[12]. Thus their paper was added to this meta-analysis even though simethicone is not a classic preparation drug and may not be considered equivalent to polyethylene glycol or to sodium phosphate^[12].

Only 3 papers looked at the diagnostic yields as a secondary endpoint, since it would be much more useful to compare more definite outcomes such as number and type of lesions visualized in attempting to compare the effect of preparation and no preparation^[11,13,17]. Ben-Soussan and colleagues found no association between preparation and diagnostic yield of the capsule examination^[13], while we and Viazis found a significant advantage of preparation for findings more lesions^[11,17]. Thus, this point is still controversial.

The main weakness of the study is in the different preparation regimens, and different scores used by the individual centers, sometimes addressed to evaluate different aspects of the small bowel cleansing: amount of intraluminal fluid, gas or air bubbles, and percentage of "free" mucosal surface.

Our search yielded 8 studies comparing preparation with sodium phosphate, polyethylene glycol or simethicone in one group of patients with simple fasting in another group, before capsule endoscopy of the small bowel. The results of the meta-analysis clearly demonstrated that although preparation improves the quality of small bowel visualization, it has no significant effect on gastric transit

time, small bowel transit time, or cecum demonstration. The main limitation of our meta-analysis is the diversity of the methods used by the different trials. All the studies were controlled, but only one of them was randomized^[17]. Two studies compared different strategies used by different centers, and 5 studies compared 2 different periods with changed strategies. Nonetheless, the study groups in every study were very similar in their demographic and clinical data. Most of the patients were referred for the capsule examination to evaluate occult gastrointestinal bleeding. Co-morbidity was also similar between the groups, and no significant alterations in transit times were anticipated. Thus, further studies are needed to definitively establish the association among motility factors, battery life-time, good visualization of the bowel, and completeness of the examination.

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