

Comparison of Two Bowel Preparations for Colonoscopy: Sodium Picosulphate With Magnesium Citrate *Versus* Sulphate-Free Polyethylene Glycol Lavage Solution

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Objectives: Adequate preparation of the bowel is essential for accurate colonoscopic examination. We compared colonic preparation with sodium picosulphate plus magnesium citrate (SPS-Mg) with sulphate-free polyethylene glycol electrolyte lavage (PEG-EL) solution before colonoscopy, for quality of bowel cleansing, patient discomfort, and side effects. **Methods:** Sixty-eight consecutive patients were randomly assigned to receive either 3 sachets of SPS-Mg (16.5 g each) ($n = 39$) or 3 L of PEG-EL ($n = 29$) on the day before colonoscopy. Shortly before the procedure each patient was interviewed to determine the degree of discomfort (1 = none or mild, 2 = moderate, 3 = severe) and side effects. The quality of bowel cleansing was graded by a gastroenterologist who was unaware of the method of preparation (from 1 = poor to 4 = excellent). **Results:** Of the 29 PEG-EL patients, four (14%) did not complete the preparation because of side effects. The degree of discomfort was significantly greater with PEG-EL (mean score, 2.3 ± 0.7) than with SPS-Mg (mean score, 1.4 ± 0.5 ; $p < 0.01$). Nausea and vomiting were significantly more common in the PEG-EL group (38% vs 13%; $p < 0.05$). Using intention-to-treat analysis, bowel cleansing proved to be significantly better with SPS-Mg than with PEG-EL (mean score \pm SD, 3.05 ± 0.9 and 2.57 ± 1.0 , respectively; $p = 0.036$). **Conclusions:** Colonic preparation with SPS-Mg is better tolerated, associated with significantly fewer side effects, and results in higher quality bowel cleansing than preparation with PEG-EL. (Am J Gastroenterol 1998;93:1478–1482. © 1998 by Am. Coll. of Gastroenterology)

monly used regimens for preparation for colonoscopy. Since being introduced in 1980 (1), PEG-EL solutions (GoLyte, Meroken Colopeg, Cololyt,) have become the most widely used laxatives for colonic lavage. Despite their proven efficacy, these large-volume laxatives are difficult for many patients to tolerate. This has led to the introduction of similar preparations designed to taste better through reduced sodium sulphate content (e.g., Golytely-RSS, Nulytely, New-Meroken) (2). The combination of sodium picosulphate, a stimulant cathartic, and magnesium citrate, an osmotic laxative (SPS-Mg) (Pico-salax), has been commonly used in Europe for colonic preparation since the early 1980's (3). This pharmaceutical composition is dissolved in a relatively small volume of water (a glass of water for each sachet, 2–3 sachets per preparation), and has been demonstrated to be well tolerated and effective for bowel preparation for barium enema examination and colonoscopy (4–11).

One of the main advantages of PEG-EL is its minimal effect on intravascular volume and serum electrolyte balance (1, 2). This issue may be a problem in small-volume preparations. Several studies using small-volume sodium-phosphate-based laxatives found them in most cases to be as effective as or superior to PEG-EL, usually with better tolerability (12–16). However they were found to cause significant alterations in serum electrolytes (16). Such alterations have not been demonstrated in studies using SPS-Mg (7, 9).

In this prospective, randomized, controlled study we compared the efficacy and tolerability of SPS-Mg (Pico-salax) with that of sulphate-free PEG-EL solution (New-Meroken) in colonic preparation for colonoscopy.

INTRODUCTION

Polyethylene glycol-electrolyte lavage (PEG-EL) solutions and sodium picosulphate preparations are both com-

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MATERIALS AND METHODS

Study design

Ambulatory patients scheduled for elective colonoscopy participated in the study if they did not meet any of the exclusion criteria: known renal insufficiency (serum creatinine > 2.0 mg/dl), symptomatic congestive heart failure, or

recent myocardial infarction. After informed consent, patients were randomly assigned to preparation with either 3 sachets of SPS-Mg (Pico-salax, Ferring AB, Malmo, Sweden) or 3 L of sulphate-free PEG-EL solution (New-Meroken, Taro, Israel). Each patient was given appropriate written preparation instructions.

The study was prospective, randomized, and single-blinded in design, so that the endoscopist performing the examination and rating the quality of the preparation was unaware of the preparation regimen used by the patient. Randomization was performed according to the patients' identity number. Patients with even numbers were assigned to preparation with SPS-Mg and patients with odd numbers were assigned to PEG-EL. The study was reviewed and approved by the Institutional Review Board of Rabin Medical Center. The investigators had no relationship with the manufacturer of either laxative used in this study. No funding for the study was solicited or accepted.

Preparation instructions

Each sachet of SPS-Mg contains 5.0 g sodium picosulphate, 3.5 g magnesium oxide, and 12.0 g citric acid. Each bottle of PEG-EL contains 315.00 g polyethylene glycol, 4.28 g sodium bicarbonate, 8.42 g sodium chloride, and 1.12 g potassium chloride. Patients receiving SPS-Mg were instructed to add the contents of each sachet to a full glass of water, and consume the first dose at 8:00 AM, the second at 2:00 PM and the third at 8:00 PM on the day before colonoscopy. Patients were instructed to drink at least one glass of water (200 ml) per h between doses, until midnight.

Patients receiving PEG-EL began consuming the laxative at 4:00 PM, 1 glass (200 ml) every 10–15 min until 3 L were consumed (2.5–4 h). All patients, regardless of laxative used, were instructed to begin a clear liquid diet on the morning of the day before colonoscopy.

Data collection

Shortly before colonoscopy each patient was interviewed by a nurse, using a standardized interview form, to assess compliance with the preparation instructions, and to determine the degree of discomfort and the prevalence of side effects associated with the preparation. Discomfort experienced during the preparation was rated as follows: 1 = none or mild discomfort, 2 = moderate, and 3 = severe discomfort. All colonoscopies were performed by one of the investigators. The quality of bowel cleansing was rated by a colonoscopist who was unaware of the preparation regimen used by the patient. The quality of bowel preparation was rated as follows: 1 = poor (repeated examination suggested), 2 = fair (small lesions may be missed), 3 = good (some suctioning required, no limitations), and 4 = excellent. In addition, the extent of colonoscopy was noted for every patient.

Mean scores for preparation discomfort and quality of bowel preparation were compared using the Mann-Whitney

TABLE 1
Demographic Data of Colonoscopy Groups Prepared With SPS-Mg Versus PEG-EL

	SPS-Mg	PEG-EL
Number of patients	39	29
Age, range (yr)	29–86	36–85
Age, mean (yr \pm SD)	60 \pm 15	62 \pm 14
Gender, F/M (%)	51/49	55/45

SPS-Mg = sodium picosulphate with magnesium citrate; PEG-EL = polyethylene glycol-electrolyte lavage solution.

TABLE 2
Main Indications for Colonoscopy

Indication	SPS-Mg (n = 39), n (%)	PEG-EL (n = 29), n (%)
Anemia	8 (21)	5 (17)
Follow-up after colonic resection	6 (15)	4 (14)
Follow-up after polypectomy	5 (13)	5 (17)
Abdominal pain	5 (13)	3 (10)
Family history of colonic cancer	2 (5)	4 (14)
Positive test for fecal occult blood	3 (8)	1 (3)
Rectal bleeding	4 (10)	2 (7)
Changes in bowel habits	4 (10)	4 (14)
Follow-up for inflammatory bowel disease	2 (5)	1 (3)

SPS-Mg = sodium picosulphate with magnesium citrate; PEG-EL = polyethylene glycol-electrolyte lavage solution.

test. The prevalences of side effects were compared using the χ^2 test.

RESULTS

Sixty-eight patients were randomized. Of these, 39 patients (20 women and 19 men) were enrolled in the SPS-Mg (Pico-salax) group, and 29 (16 women and 13 men) in the PEG-EL (New-Meroken) group. The results of the demographic data analysis are shown in Table 1. The two groups were similar in patient age and gender. The mean age of patients in the SPS-Mg group was 60 \pm 15 yr, and in the PEG-EL 62 \pm 14 yr (mean \pm SD). The indications for colonoscopy for the two groups were similar (Table 2).

Tolerance

All 39 patients prepared with SPS-Mg followed the preparation instructions completely. Of the 29 patients prepared with PEG-EL, four (14%) did not complete the preparation and did not consume all the preparation solution because of severe discomfort or side effects (nausea, vomiting, and palpitations). In one of these patients colonoscopy was deferred because of sinus tachycardia with severe palpitations on the day of the procedure. Preparation discomfort scores are shown in Figure 1. Mean score of preparation discomfort was significantly greater with PEG-EL (2.3 \pm 0.7) than with SPS-Mg (1.4 \pm 0.5) ($p < 0.01$). Specific side effects (*i.e.*, nausea, vomiting, abdominal cramps, dizziness, palpitations, and headache) occurred in 10 patients (26%) of the

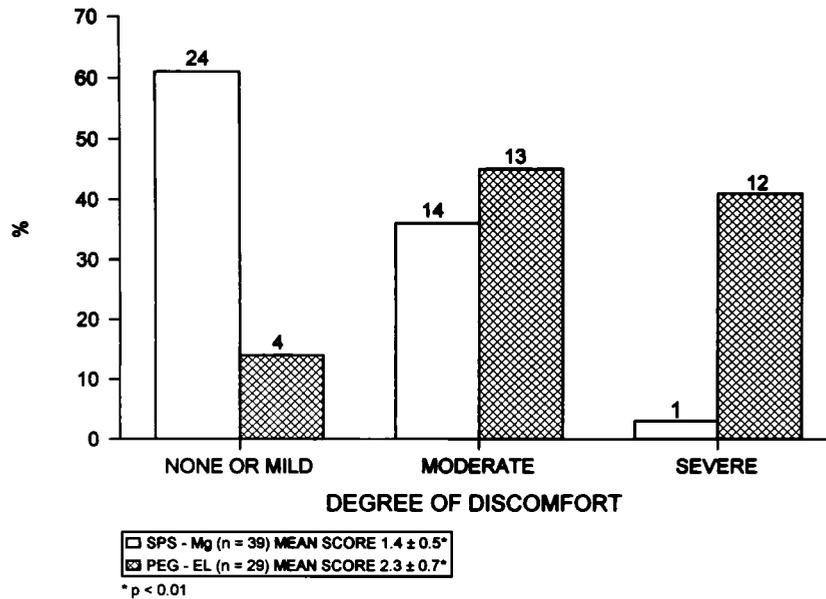


FIG. 1. Preparation discomfort in colonoscopy groups prepared with SPS-Mg versus PEG-EL.

TABLE 3
Prevalence of Side Effects in Colonoscopy Groups Prepared With SPS-Mg Versus PEG-EL

	SPS-Mg (n = 39), n (%)	PEG-EL (n = 29), n (%)
Nausea	5 (13)*	9 (31)*
Vomiting	0 (0)*	2 (7)*
Abdominal cramps	1 (3)	2 (7)
Dizziness	2 (5)	1 (3)
Palpitations	1 (3)	3 (10)
Headache	2 (5)	0 (0)
Total prevalence of side effects	10 (26)	12 (41)

* p < 0.05.

SPS-Mg = sodium picosulphate with magnesium citrate; PEG-EL = polyethylene glycol-electrolyte lavage solution.

SPS-Mg group and in 12 (41%) of the PEG-EL group (Table 3). Nausea and vomiting were significantly more frequent with the PEG-EL preparation (38% of the patients) than with SPS-Mg (13%) (*p* < 0.05).

Efficacy

Colonoscopy was performed in all 39 patients of the SPS-Mg group and in 28 of the PEG-EL group. The quality of bowel cleansing, as assessed by the endoscopists, and the mean quality scores for bowel cleansing are shown in Figure 2. In the SPS-Mg group the the mean score was 3.05 ± 0.91. In the patients who completed preparation with PEG-EL (n = 25) the mean score was 2.80 ± 0.91. No significant difference was found between the mean scores of bowel cleansing of the SPS-Mg group and of the patients who consumed the PEG-EL completely. In the whole group of patients treated with PEG-EL (including the patients who did not consume all the preparation solution; n = 28) the

mean score for quality of bowel cleansing was 2.57 ± 1.03. When the SPS-Mg group was compared with the whole group of patients assigned to preparation with PEG-EL (using the intention-to-treat analysis), bowel cleansing score was found to be significantly superior in the former (3.05 ± 0.91 vs 2.57 ± 1.03, *p* = 0.036). No significant difference was found in the extent of colonoscopy between the two groups. The cecum was reached in 35 (90%) of the SPS-Mg group and 25 (89%) of the PEG-EL group.

DISCUSSION

Since their first introduction by Davis *et al.* (1) in 1980, intestinal lavage solutions based on polyethylene glycol have become the standard method for preparing the colon for colonoscopy. Most reports show excellent or good results in >80% of patients prepared with PEG-EL solutions (17–19). PEG-EL was designed to minimize salt and water absorption and therefore has no significant effect on intra- or extravascular volume, or on serum electrolytes (1, 2, 13). Despite their proven efficacy and safety, these laxatives are difficult for many patients to tolerate. This may lead to decreased compliance and reduced quality of bowel cleansing. Attempts to improve acceptance of these preparations have centered mostly on changing their taste by altering electrolyte content or by adding flavoring, generally with little improvement in tolerability (20–22). New-Meroken (Golytely-RSS) is a PEG-EL preparation designed to taste better through reduced sodium and sulfate content (1).

Sodium picosulphate is a stimulant laxative related to bisacodyl. It is metabolized by colonic bacteria to an active compound (free diphenol), which increases intestinal motility (23). Magnesium citrate stimulates intestine peristalsis partly by osmotic action and partly by release of cholecystokinin. Sodium picosulphate is usually effective within

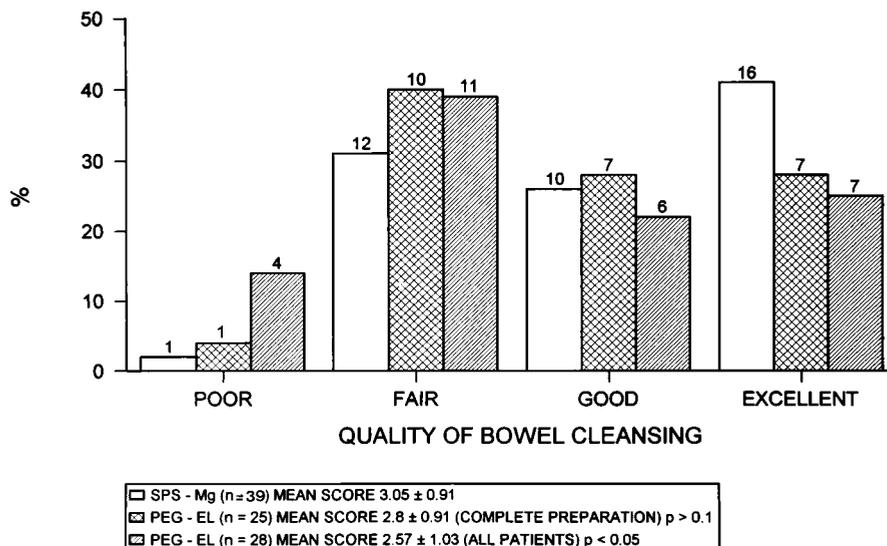


FIG. 2. Endoscopist's assessment of quality of bowel cleansing in colonoscopy groups prepared with SPS-Mg versus PEG-EL.

10–14 h, although when used with magnesium citrate for bowel evacuation an effect may be seen after only 3 h. The combination of sodium picosulphate and magnesium citrate (SPS-Mg) is usually well tolerated (4–11) and is associated with no disturbances of fluid or electrolyte balance (7, 9). It was found by Lee and Ferrando (4) to be superior to senna (X-Prep) for the preparation of the large intestine for double-contrast barium enema examination. Several authors found no significant difference between SPS-Mg and combinations of laxatives with cleansing enemas in the general quality of bowel preparation for barium enema (8–10). Boulos *et al.* (9) found SPS-Mg to be associated with better patient acceptability than the combination of bisacodyl, sennosides A + B, and cleansing enemas. SPS-Mg was not associated with significant changes in hematocrit, plasma proteins, urea, creatinine, and serum electrolytes (7, 9). Another advantage of this preparation is that it does not result in hyperphosphatemia, as seen with sodium phosphate preparations (16), and hence presumably would not have the potential to cause hypocalcemia. SPS-Mg has also been demonstrated to be a safe and effective bowel cleansing agent in adults (5) and children (6) with inflammatory bowel disease.

Dakkak *et al.* (24) compared bowel preparation with sodium picosulphate as a single agent to preparation with polyethylene glycol before colonoscopy. They found that the overall cleanliness of the colon was significantly better in the polyethylene glycol group. They also showed that there were more completed colonoscopies in the polyethylene glycol group.

In this study we compared the combination of sodium picosulphate and magnesium citrate (SPS-Mg, Pico-salax) with sulphate-free polyethylene glycol electrolyte lavage (PEG-EL) solution (New Meroken) for quality of bowel cleansing, patient discomfort, and side effects. SPS-Mg was given in three doses, each containing 5.0 mg sodium picro-

sulphate, which is a smaller total dose than that used by most authors (two doses of 10.0 mg) (3–5, 7–10). This triple-dose regimen was associated with few side effects and relatively little discomfort. Nausea and vomiting were significantly less prevalent with SPS-Mg than with PEG-EL. There was no statistically significant difference in the prevalence of other side effects between the two preparations. Moreover, preparation with SPS-Mg was associated with significantly less general discomfort than preparation with PEG-EL.

When the SPS-Mg group was compared with the group who followed the PEG-EL preparation completely and consumed all the preparation solution (n = 25), there was no significant difference between the mean scores for quality of bowel cleansing. However, when the patients who did not consume the entire amount of PEG-EL were included, the mean bowel cleansing score was further reduced, increasing the difference between the SPS-Mg and the PEG-EL groups. When the SPS-Mg group was compared with the whole PEG-EL group, using the intention-to-treat analysis, bowel cleansing with SPS-Mg was found to be significantly superior to that of PEG-EL. The effects of SPS-Mg on intravascular volume and electrolyte balance were not addressed in this study, and this issue requires additional studies.

In summary, we conclude that colonic preparation with SPS-Mg is better tolerated and associated with significantly fewer side effects than preparation with PEG-EL. In patients who follow the preparation instructions completely there is no significant difference in the quality of bowel cleansing between the two preparations. However, with intention-to-treat analysis, bowel cleansing with SPS-Mg was found to be significantly superior to that of PEG-EL.

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