

Enhancing the quality of colonoscopy: the importance of bowel purgatives CME

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Colorectal cancer (CRC) is one of the leading causes of cancer and cancer deaths in American men and women. In 2007, an estimated 153,760 Americans will be diagnosed with CRC and 52,180 will die from the disease.¹ In the National Health Interview Survey conducted in 2000, less than 34% of American men and women aged ≥ 50 years reported undergoing endoscopic CRC screening within the previous 10 years.² The commonly cited barriers to patient participation in screening include bowel preparation, fear of discomfort, lack of awareness of the need for screening, and lack of physician recommendation (Fig. 1).²⁻⁵ Bowel preparation is currently one of the predominant deterrents to colonoscopy, and improving the tolerability of colon-cleansing regimens may promote patient compliance with CRC screening guidelines.

Adenomatous polyps are believed to be the precursor for the majority of CRCs.⁶⁻⁸ Limited data suggest that polypectomy during colonoscopy may reduce the incidence of CRC,⁷ but large prospective studies of patients undergoing colonoscopic surveillance have not fully corroborated these findings.⁹⁻¹¹ Recent studies identified that up to 5.4% of individuals who were diagnosed with CRC had undergone colonoscopy within the previous 3 to 5 years.¹²⁻¹⁵ Although these studies cannot identify the cause of incomplete protection of colonoscopic surveillance and polypectomy against CRC, most studies suggest that the quality of colonoscopy may be at least partly responsible.

Improving the quality of colonoscopy is a major initiative of many digestive disease organizations. The American Society for Gastrointestinal Endoscopy (ASGE) and the American College of Gastroenterology (ACG) Task Force on Quality in Endoscopy published quality indicators to measure the performance of colonoscopy.¹⁶ A number of factors were selected to establish competence in the performance of colonoscopy and to help define areas for continuous quality improvement. The factors that can be impacted by the quality of the bowel preparation include (1) cecal intubation, which should be achieved in $\geq 90\%$ of all cases and in $\geq 95\%$ of screening procedures

performed on healthy adults; (2) photodocumentation of the cecum and its landmarks (appendiceal orifice, cecal strap, ileocecal valve); and (3) adenoma detection, wherein adenomas should be detected by screening colonoscopy in $\geq 25\%$ and $\geq 15\%$ of healthy men and women, respectively, aged ≥ 50 years. Many studies showed that the overall rate of detection of adenomas, including detection of multiple adenomas and ability to detect large polyps, varies widely among endoscopists.¹⁷⁻¹⁹ Prospective studies showed that, in expert hands, the overall miss rate for adenomas is up to 24%; 27% for adenomas ≤ 5 mm, 13% for adenomas 6 to 9 mm, and 6% for adenomas ≥ 1 cm.^{20,21}

In addition, the ASGE-ACG Task Force recommends that the quality of the bowel preparation should be documented in the procedure report. Currently, there is no standardized system to describe bowel preparation. The U.S. Multi-Society Task Force on Colorectal Cancer suggests the use of the descriptors "adequate" or "inadequate," where an adequate examination is one that allows confidence that mass lesions other than small (≤ 5 mm) polyps were generally not obscured by the preparation.²² Many clinical studies used the descriptors "excellent," "good," "fair," and "poor" to rate the quality of bowel preparation. "Excellent" is typically defined as no or minimal solid stool and only small amounts of clear fluid that require suctioning. "Good" is typically used to describe no or minimal solid stool with large amounts of clear fluid that require suctioning. "Fair" generally refers to collections of semisolid debris that are cleared with difficulty. "Poor" generally refers to solid or semisolid debris that cannot be cleared effectively. Although such narrative descriptors are common, only 2 bowel-preparation scales have been validated prospectively.²³⁻²⁷ Regardless of the validity of grading schemas, however, it is clear that poor preparation prolongs overall procedure time, decreases cecal intubation rates, reduces the detection of colorectal neoplasms, and leads to increased costs associated with colonoscopy.

IMPORTANCE OF EFFECTIVE COLON CLEANSING

Bowel preparation and colonoscopy efficiency and cost

The optimal bowel preparation should efficiently and quickly clear the colon of solid and liquid residue to allow

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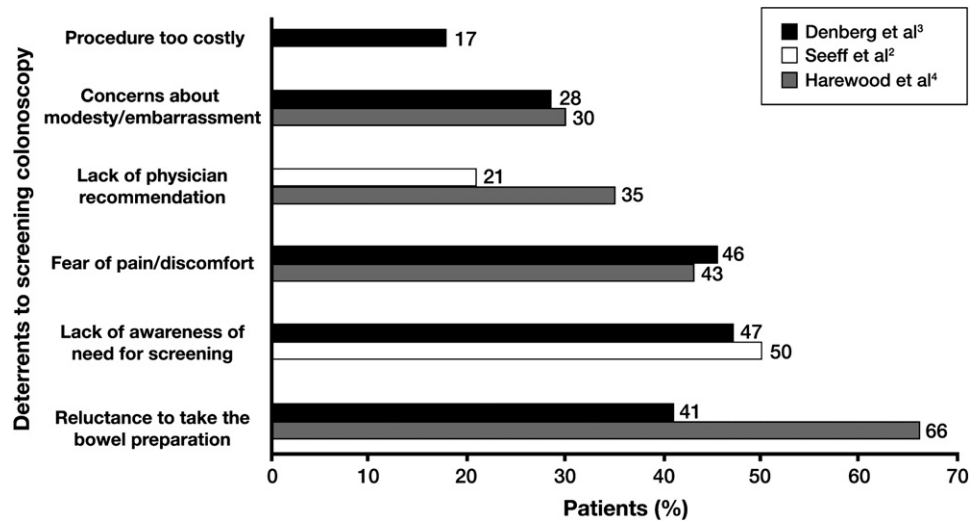


Figure 1. Common reasons that deter patients from undergoing screening colonoscopy. Not every reason was examined by each study reviewed.

maximal visualization of the mucosa, preserve the gross and microscopic appearance of the colon, and be safe and well tolerated.²⁸ Reports show that bowel preparation is inadequate for up to 25% of patients undergoing colonoscopy,^{29,30} and the impact of poor preparation on procedure duration, difficulty, completion, and cost is substantial (Table 1).^{29,31-35}

Cecal intubation rates are widely viewed as an indicator of technical expertise for colonoscopy. Recent studies suggest that the quality of bowel preparation is an important factor for procedural success in this area. A prospective study of 693 consecutive outpatient colonoscopies identified poor bowel preparation as a significant predictor of prolonged cecal-intubation time (≥ 20 minutes, $P = .0077$).³¹ Another prospective study of 991 patients undergoing colonoscopy performed by a single endoscopist reported that inadequate bowel preparation (fair or poor vs good) was a significant predictor of prolonged (> 10 minutes) insertion time (odds ratio [OR] 2.80, 95% CI 1.41-5.56, $P = .003$).³² In a multicenter European study of 5832 patients, cecal intubation was achieved in 90% of patients with high-quality bowel preparation but in only 71% of patients with low-quality bowel preparation ($P < .001$).²⁹ Mean (\pm SD) intubation time was 12 ± 9 minutes versus 16 ± 11 minutes in patients with high-quality versus low-quality cleansing, respectively ($P < .001$). Similarly, another prospective, multicenter study of screening colonoscopy in 3196 individuals aged 50 to 75 years reported that a poor-quality bowel preparation was the single variable statistically related to incomplete colonoscopy. Procedural failure rates were significantly higher in patients with poor-quality cleansing (19%) compared with those with adequate bowel preparation (2%, $P = .001$).³³ In a retrospective review of 5477 colonoscopies performed by 10 gastroenterologists at a university hospital, Aslinia et al³⁶ reported that inadequate bowel preparation was a

significant predictor for the inability to reach the cecal base (OR 0.15, 95% CI 0.12-0.18, $P < .001$).

Another variable related to the efficiency and quality of colonoscopy is colonoscope withdrawal time. Currently, the U.S. Multi-Society Task Force on Colorectal Cancer and the ASGE-ACG Task Force on Quality in Endoscopy recommend 6 minutes as the minimum withdrawal time to ensure a high-quality colonoscopy.^{16,22} In a recent study (12 endoscopists in private practice) of 2053 consecutive patients undergoing screening colonoscopy in which the bowel preparation was graded as excellent or good in $> 90\%$ of patients, withdrawal time averaged (\pm SD) 6.3 ± 3.9 minutes (range 3.1-16.8 minutes) for examinations in which no polyps were removed and 10.6 ± 5.8 minutes (range 5.6-19.1 minutes) for procedures during which polyps were removed.¹⁹ Endoscopists with a mean withdrawal time of ≥ 6 minutes versus those with withdrawal times < 6 minutes had higher detection rates of any neoplasia (28.3% vs 11.8%, respectively, $P < .001$) and of advanced neoplasia (6.4% vs 2.6%, respectively, $P = .005$). Another study of 10,955 colonoscopies performed by 43 endoscopists reported withdrawal times that ranged from 4.2 minutes to 11.9 minutes (median 6.3 minutes) and a significant correlation between mean withdrawal time and overall rate of polyp detection (Pearson correlation coefficient 0.76, $P < .0001$).³⁷ Higher detection rates were dependent on longer withdrawal times (median > 6.3 minutes; OR 11.8, 95% CI 2.3-78.4, $P = .005$). Neither of the previous studies evaluated the effect of bowel-preparation quality on withdrawal time, but other published studies addressed this issue. A study of 99 patients undergoing colonoscopy reported a shorter mean withdrawal time when the quality of colon cleansing was adequate (4.4 vs 5.8 minutes for inadequate preparation, $P < .001$).³⁵ Similarly, Froehlich et al²⁹ reported a significantly shorter mean withdrawal time in patients with

TABLE 1. Impact of inadequate bowel preparation on colonoscopy

Factor	Bowel preparation		P value	Study
	Adequate	Inadequate		
Efficiency of colonoscopy				
Mean procedure time, min	21.7	27.4	<.001	Froehlich et al ²⁹
Completion of colonoscopy, % of cases				
Incomplete	2.2	19.3	.001	Nelson et al ³³
Complete*	90.4	71.1	<.001	Froehlich et al ²⁹
Difficult colonoscopy, % of cases†	12.4	34.2	<.001	Froehlich et al ²⁹
Cost of colonoscopy, \$‡	214,000-220,000	239,000-268,000	NA	Rex et al ³⁴
Diagnostic yield of colonoscopy, % of cases				
Lesion detection	29.1	26.4	≤.0001	Harewood et al ³⁰
Lesion detection	29.4	23.9	.007	Froehlich et al ²⁹

NA, Not applicable.

*Cecum reached.

†Rated by endoscopist.

‡Estimated by using Medicare charges in a cohort of 200 individuals followed for 7 years.

high-quality colon cleansing (n = 3445) versus those with poor preparation (n = 360; 9.8 vs 11.3 minutes, respectively, $P < .001$). In this study, a shorter withdrawal time did not adversely impact the efficacy of a colonoscopy, because detection of polyps was more frequent in patients with high-quality versus low-quality cleansing.²⁹ It should be noted that diligent endoscopists who spend more time looking carefully for polyps may also take extra measures and time to improve the quality of an otherwise suboptimal bowel preparation, which would tend to prolong the procedural withdrawal time.

It should not be surprising that the quality of the bowel preparation can affect the cost of a colonoscopy. Rex et al³⁴ prospectively analyzed 400 colonoscopies (200 performed at a university hospital and 200 performed at a public hospital) to evaluate the impact of the bowel preparation on the efficiency and cost of a colonoscopy. The time spent managing the preparation during colonoscopy (ie, suctioning fluid and feces from the colon, washing the colon) was recorded, as was the number of aborted colonoscopies and repeat procedures with shortened surveillance intervals necessitated by suboptimal bowel preparation. Colonoscopies performed at the public hospital were associated with a longer mean cecal intubation time (11 vs 6 minutes, respectively, $P < .01$), a greater likelihood of aborted examination (7% vs 1%, respectively, $P = .004$), and an increased incidence of a repeat colonoscopy because of inadequate bowel preparation compared with colonoscopies performed at the university hospital (20% vs 13%, respectively, $P = .04$). The investigators calculated that, to complete the initial

examinations and the first round of surveillance in each cohort of 200 individuals, inadequate bowel preparation increased colonoscopy costs by 12% (\$25,227 in 2000) at the university hospital and by 22% (\$47,306 in 2000) at the public hospital.³⁴

Bowel preparation and diagnostic yield

In addition to impacting the speed and the completeness of a colonoscopy, the quality of colon cleansing can impact detection of adenomas and CRC. In a retrospective evaluation of more than 5000 colonoscopies performed over a 3.5-year period, Leaper et al³⁸ identified 17 patients with a missed CRC. Poor bowel preparation was noted in 6 of these patients, which suggested that cleansing quality may impact the diagnostic yield during a colonoscopy.³⁸ In a larger retrospective study, Harewood et al³⁰ analyzed the impact of bowel-preparation adequacy on the detection of polypoid lesions for approximately 93,000 colonoscopies recorded in the Clinical Outcome Research Initiative database. Suspected neoplasms were identified in 26,490 colonoscopies (29%) overall, with higher detection rates in cases with adequate preparation (rated excellent or good by endoscopist) versus those with inadequate preparation (fair or poor) (29% vs 26%, respectively, $P < .0001$). Although significant lesions (polyp >9 mm or mass lesion) were detected in approximately 7% of colonoscopies, regardless of preparation quality ($P = .82$), lesions ≤9 mm were more likely to be detected when bowel preparation was adequate (15,615 cases [22%]) versus inadequate (4092 cases [19%], $P < .0001$). Thus, detection of suspected neoplasia was critically dependent on the

adequacy of the preparation (OR 1.21, 95% CI 1.16-1.25).³⁰ These findings were supported by another study of 5832 patients.²⁹ Investigators from this study reported that the detection of neoplasms, including polyps of any size, as well as large lesions (> 10 mm), was associated with the quality of bowel preparation; polyps were detected in 29% of patients with high-quality cleansing versus 24% of patients with low-quality cleansing ($P < .007$). Identification of polyps of any size depended significantly on cleansing quality (intermediate-quality vs low-quality preparation: OR 1.73, 95% CI 1.28-2.36; high-quality vs low-quality preparation: OR 1.46, 95% CI 1.11-1.93). For polyps ≥ 10 mm in size, the OR was 1.83 (95% CI 1.11-3.05) for intermediate-quality cleansing and 1.72 (95% CI 1.11-2.67) for high-quality cleansing, respectively.²⁹

Chiu et al³⁹ also observed a correlation between colon cleansing and the yield of neoplasia in a prospective study of 121 patients randomized to receive 2-L polyethylene glycol electrolyte lavage solution (PEG-ELS) as a bowel preparation, either on the day of the procedure (group A, $n = 60$) or on the night before the procedure (group B, $n = 58$). Significantly more patients in group A achieved adequate colon cleansing than in group B (93% vs 72%, respectively, $P = .003$). Moreover, the number of neoplasms detected was higher in patients in group A versus group B (2.8 vs 1.9, respectively, $P = .03$).³⁹ A study of similar design randomized 177 patients to receive a bowel preparation on a same-day, a previous-day, or a split-day (ie, half the preparation administered on the day before and the other half administered on the day of colonoscopy) regimen relative to the day of examination.⁴⁰ Poor-quality preparation was observed in 11 of 89 patients (12%) prepared the previous day compared with only 2 of 88 patients (2%) who received half or all of the preparation on the day of the colonoscopy (ie, same-day or split-day regimen) ($P = .02$).

The impact of preparation quality on lesion detection has also been assessed for flexible sigmoidoscopy. Thomas-Gibson et al⁴¹ analyzed the United Kingdom Flexible Sigmoidoscopy Screening Trial data set, which consisted of more than 38,000 examinations performed by 13 endoscopists across 13 centers. Bowel-preparation quality was rated excellent, good, adequate, or poor in 15,679, 12,346, 7507, and 2363 procedures, respectively. Overall adenoma detection rates were significantly higher among examinations in which preparation quality was excellent (12%) or good (12%) versus adequate (11%) ($P = .02$); poor-quality examinations were excluded from analyses. These results suggest that the timing of purgative administration impacts the quality of bowel preparation and also underscore the importance of high-quality bowel preparation for the detection of neoplasia.

It is well known that the risk of advanced neoplasia increases with polyp size,⁶ but high-grade dysplasia and carcinoma can occur in adenomas of any size.^{8,42-47} Studies report high-grade dysplasia in 0.9% to 3.4% of adenomas

≤ 5 mm,^{43-45,47} in 3.6% to 12.5% of adenomas 5 or 6 mm to 10 mm,^{43-45,47} and in 5.7% to 43.3% of adenomas > 10 mm.^{42,44-47} Cancer is detected in up to 1.5% of adenomas ≤ 10 mm and in up to 10.1% of those > 10 mm.⁴²⁻⁴⁵ Reports of flat and depressed neoplasms, common among Japanese populations, are increasing in Western countries.⁴⁸⁻⁵² Adenomas are usually defined as flat or depressed if their height is less than half the diameter of the lesion. They are typically smaller than polypoid lesions and are most often localized to the right colon.⁵² Although flat and depressed lesions are rarer than protruding lesions, they more frequently contain advanced neoplasia, including invasive carcinoma.⁵²⁻⁵⁵ Analyses of the occurrence of adenomas in the United States showed that flat neoplasms are detected in up to 23% of colonoscopic examinations and comprise nearly a third of the adenomas detected by colonoscopy.^{53,56} In 1 study, the number of flat lesions detected in patients with an inadequate bowel preparation was significantly lower than in patients with an adequate bowel preparation (9 vs 28, respectively, $P = .002$).⁴⁰ With current recommendations suggesting that postpolypectomy surveillance colonoscopy intervals should lengthen, the need for high-quality colonoscopy and ongoing efforts to improve the quality of colon cleansing are of paramount importance.⁵⁷

COMPARISON OF EFFICACY, SAFETY, AND TOLERABILITY AMONG BOWEL PURGATIVES

Efficacy of bowel preparations

The most commonly administered bowel preparations include PEG-ELS regimens and sodium phosphate (NaP) preparations (Table 2). Formulations of PEG-ELS include standard 4-L preparations, as well as reduced-volume (2 L) preparations coupled with irritant laxatives, such as bisacodyl or magnesium citrate.^{58,59} A newer 2-L PEG-ELS formulation contains ascorbic acid and does not require coadministration of a laxative.⁶⁰ The efficacy of bowel cleansing with 4-L PEG-ELS regimens varies widely, with 33% to 83% of patients achieving good or excellent cleansing.^{23,61-69} Reduced-volume PEG-ELS products generally provide comparable colon cleansing compared with 4-L PEG-ELS preparations,⁷⁰⁻⁷³ but 1 study⁷⁴ reported better cleansing with a 2-L formulation, and 2 other studies reported better efficacy with 4-L formulations.^{27,63} NaP preparations include liquid and tablet formulations (Table 2).⁵⁹ Two tablet formulations are approved by the U.S. Food and Drug Administration for use as bowel preparations. The original formulation includes microcrystalline cellulose (MCC), an excipient reported to hinder visualization of the mucosal lining during colonoscopy, whereas a newer formulation does not contain this excipient.⁷⁵ Clinical studies reported good or excellent colon cleansing in 70% to 90% of patients taking an NaP solution.^{23,61-69} and in 72% to 100% of patients taking NaP tablets.^{23,75-78} A recent meta-

TABLE 2. Common bowel preparations

Preparation	Brand	Manufacturer	Dosage form
PEG-ELS			
4 L PEG-ELS	GoLYTELY	Braintree Laboratories, Inc (Braintree, Mass)	4-L solution
	NuLYTELY	Braintree Laboratories, Inc	4-L solution
	Colyte	Schwarz Pharma, Inc (Milwaukee, Wis)	4-L solution
	TriLyte	Schwarz Pharma, Inc	4-L solution
Reduced-volume PEG-ELS	HalfLyte and Bisacodyl tablets	Braintree Laboratories	2-L solution plus 4 (5 mg) bisacodyl tablets
	MoviPrep	Salix Pharmaceuticals, Inc (Morrisville, NC)	2-L solution
NaP preparations			
Solutions	Fleet Phospho-soda	C.B. Fleet Company, Inc (Lynchburg, Va)	60 g NaP: 2 × 45-mL solution
	Fleet Phospho-soda EZ-PREP	C.B. Fleet	50 g NaP: 1 × 45-mL solution and 1 × 30-mL solution
	ACCU-PREP	C.B. Fleet	60 g NaP: 6 × 15-mL solution
Tablets	OsmoPrep	Salix Pharmaceuticals	48 g NaP: 32 tablets

analysis of 16 clinical trials, including 3484 patients, compared the efficacy of a NaP solution with 4 L PEG-ELS and concluded that a NaP solution is more likely to provide adequate (good or excellent) bowel preparation ($P = .0004$).⁷⁹ Tablet NaP formulations are less well studied. Although reports of cleansing efficacy with the older, MCC-containing tablet formulation are variable,⁷⁶⁻⁷⁸ recent clinical trials reported high-quality cleansing with the MCC-free tablet formulation.^{75,80,81} One study demonstrated a significantly better mean overall cleansing score (1, excellent; 2, good; 3, fair; 4, inadequate) in patients who took the MCC-free tablet formulation ($n = 33$) versus the MCC-containing tablet regimen ($n = 29$; 1.2 vs 1.7, respectively, $P < .05$).⁸¹ Similarly, a larger study of 236 patients who took the MCC-free tablet formulation and 235 patients who took the MCC-containing tablet regimen reported favorable cleansing efficacy with the MCC-free formulation (1.3 vs 1.5, respectively, $P < .0001$).⁷⁵ Moreover, another study reported significantly better cleansing scores in patients who took the MCC-free tablet formulation ($n = 205$) versus 2 L PEG-ELS plus bisacodyl tablets ($n = 206$; 1.5 vs 1.8, respectively, $P < .0001$).⁸⁰ Additional clinical trials that compared the efficacy of MCC-free NaP tablets versus PEG-ELS preparations and NaP solution are needed.

Tolerability of bowel preparations

Measures of tolerability of bowel preparations include adverse-event profiles and patient compliance. The most common adverse events reported by patients who take

PEG-ELS preparations are abdominal fullness and pain, nausea, and bloating;^{76,82} reduced-volume regimens may reduce volume-related symptoms.^{71,73} As with PEG-ELS preparations, NaP products result in similar GI disturbances.⁸³ A recent meta-analysis concluded that adverse-event profiles for 4-L PEG-ELS regimens and NaP solution are generally comparable, although abdominal pain is more frequent with PEG-ELS administration, and dizziness is more common in patients who take NaP solution.⁷⁹ Clinical trials that compared NaP tablets with 4 L PEG-ELS⁷⁶ or 2 L PEG-ELS plus bisacodyl tablets⁸⁴ favor NaP tablets in terms of significantly fewer reports of GI adverse events ($P \leq .0007$).

In addition to adverse-event profiles, patient compliance with the bowel-cleansing regimen is also a useful indicator of tolerability. A meta-analysis of 15 trials, including 3293 patients, assessed completion of bowel preparation and reported that significantly more patients who took a NaP solution versus 4 L PEG-ELS were able to complete the preparation (94% vs 71%, respectively, $P < .00001$).⁷⁹ Similarly, a study that included 427 patients who took NaP tablets and 432 patients who took 4 L PEG-ELS reported a significantly higher completion rate for NaP tablets (94% vs 56%, respectively, $P < .0001$).⁷⁶ Recent studies demonstrated better patient compliance with reduced-volume PEG-ELS regimens versus 4-L PEG-ELS products.^{27,73} Hookey et al²⁷ reported that 38% of patients who took 4 L PEG-ELS ($n = 79$) were unable to finish the preparation, compared with 6% of patients who took 2 L PEG-ELS

TABLE 3. Impact of bowel preparation on colonoscopy variables

Factor	Bowel preparation				P value	Study
	NaP product		PEG-ELS			
	90 mL	Tablets	4 L	2 L		
Efficiency of colonoscopy						
Mean adjusted procedure time, min	NA	14.2	NA	15.9	.0124	Cohen et al ⁸⁶
Mean procedure time, min	NA	NA	37	31	.018	Sharma et al ⁷⁴
Mean withdrawal time, min	4.3	NA	5.8	NA	.0001	Kössi et al ³⁵
Irrigation required, % of cases	NA	39	NA	58	.0001	Kastenberg et al ⁸⁷
Mean aspiration volume, mL	NA	NA	181	97	<.001	Sharma et al ⁷⁴
Aborted colonoscopy, % of cases	0.7	NA	5.7	NA	.01	Rex et al ³⁴
Repeat colonoscopy scheduled sooner, % of cases	10.5	NA	19.8	NA	.01	Rex et al ³⁴
Diagnostic yield of colonoscopy						
≥1 Intervention in patients with excellent cleansing, %	NA	60	NA	36	.0002	Cohen et al ⁸⁶

NA, Not applicable.

The NaP product was 90 mL oral NaP^{34,35} or 32 (48 g) NaP tablets.^{86,87} In 1 study,⁷⁴ 4 L PEG-ELS were compared with 2 L PEG-ELS regimens (with bisacodyl tablets or magnesium citrate supplementation). In the other studies, the PEG-ELS regimen was 3-4 L PEG-ELS,³⁵ 2 L PEG-ELS plus bisacodyl tablets,^{86,87} or not reported.³⁴ Cleansing efficacy was not assessed in 1 study.³⁴ Reduced-volume (2 L) PEG-ELS achieved better colon cleansing vs 4 L PEG-ELS in 1 study ($P = .03$).⁷⁴ In the other studies,^{35,86,87} cleansing was superior with NaP vs PEG-ELS ($P \leq .005$).

plus sennosides ($n = 81$; $P < .001$). Similarly, Ker⁷³ reported that 11 of 150 patients (7%) who took 4 L PEG-ELS but only 1 of 150 patients (0.6%) who took 2 L PEG-ELS plus bisacodyl tablets did not complete the preparation. Notably, a recent study reported that significantly more patients randomized to receive NaP tablets ($n = 205$) versus 2 L PEG-ELS plus bisacodyl tablets ($n = 206$) found it easy or fairly easy to drink the amount of liquid prescribed (94% vs 60%, respectively, $P < .0001$).⁸⁵ Thus, higher-quality colon cleansing achieved with NaP products versus PEG-ELS preparations may be because of, or partly because of, to better patient tolerability and higher rates of completion of the preparation.⁷⁹

Impact of tolerability on efficacy

In addition to directly impacting efficacy of colon cleansing by promoting completion of the entire regimen as directed, more tolerable bowel purgatives may promote the efficiency of colonoscopy (Table 3).^{34,35,74,86,87} A study of 59 patients who took 4 L PEG-ELS and 91 patients who took a reduced-volume (2 L) regimen reported better patient satisfaction, higher-quality preparation, shorter mean colonoscopic procedure time, and reduced mean volume of liquid stool aspiration with a 2-L versus a 4-L preparation.⁷⁴ A study of 47 patients who took 3 to 4 L PEG-ELS and 52 patients who took a NaP solution reported that superior colon cleansing with a NaP solution versus 4 L PEG-ELS resulted in significantly shorter withdrawal time.³⁵ Another study reported a significant improvement in colon cleansing and a significant reduction in adjusted procedure time

in patients who took NaP tablets ($n = 205$) versus patients who took 2 L PEG-ELS with bisacodyl tablets ($n = 206$).⁸⁶ The need for irrigation is another procedural component dependent on the quality of the bowel preparation, and NaP preparations are associated with significant reductions in irrigation requirements compared with 4 L PEG-ELS⁶² and 2 L PEG-ELS plus bisacodyl tablets.⁸⁷ Moreover, a prospective study of 400 patients reported that those who took a NaP solution were less likely to have an aborted examination or a repeat colonoscopy scheduled at an earlier interval because of imperfect bowel preparation compared with patients who took a PEG-ELS regimen.³⁴ Thus, superior colon cleansing associated with more tolerable bowel preparations appears to maximize the efficiency of a colonoscopy.

In addition to improving the technical aspects of a colonoscopy, the quality of bowel preparation achieved with tolerable cleansing products impacts screening efficacy in terms of diagnostic yield. As discussed, the detection of adenomas increases as the quality of bowel cleansing increases.^{29,30} A recent study of 205 patients who took NaP tablets and 206 patients who took 2 L PEG-ELS plus bisacodyl tablets reported that significantly more patients in the NaP tablet group had ≥ 1 endoscopic intervention (ie, biopsy, lesion cauterization, polypectomy, or polyp ablation) when colon cleansing was rated excellent.⁸⁶ Although additional clinical trials that evaluate the role of cleansing quality associated with various bowel purgatives on the detection of neoplasia are needed, these results suggest that optimal cleansing achieved with tolerable

bowel preparations may minimize the risk of missing small lesions during colonoscopy.

CONCLUSIONS

High-quality colonoscopy is imperative to enhance the efficacy and to decrease the costs associated with the procedure. Bowel preparation is one of the most common patient objections to participation in screening colonoscopy, and inadequate preparation is a major obstacle for achieving a high-quality colonoscopy. NaP cleansing regimens have been shown to be superior to PEG-ELS regimens with respect to increased patient tolerability and acceptance of the bowel preparation, improved quality of bowel preparation, better mucosal visualization, and more efficient endoscopic examination. Further research is needed to determine whether these advantages will translate into improved adenoma detection and a reduction in the risk of colon cancer. Advancements in the palatability of bowel-cleansing agents, reductions in volume requirements, and an increased variety of available formulations are likely to improve patient compliance, cecal intubation rates, adenoma detection rates, and overall efficiency in the endoscopy unit.

DISCLOSURE

C. Burke is an adviser to Salix Pharmaceuticals. J. Church does not have any conflicts of interest to report.

Abbreviations: ACG, American College of Gastroenterology; ASGE, American Society for Gastrointestinal Endoscopy; CRC, colorectal cancer; MCC, microcrystalline cellulose; NaP, sodium phosphate; OR, odds ratio; PEG-ELS, polyethylene glycol electrolyte lavage solution.

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