The success of colonoscopy as a screening modality for colorectal cancer is highly dependent on the ability to purge the colon of fecal material in order to provide an unobstructed view of the bowel wall. Inadequate cleansing of the colon, reported to occur in about 27% of all examinations, results in missed adenomas.1

Suboptimal bowel preparation leads to prolonged procedure times, lower rates of cecal intubation, reduced screening intervals, higher screening costs, and possibly an increased risk for procedure-related complications. Furthermore, recent studies demonstrate that colonoscopy is more effective in the prevention of left-sided than right-sided cancers.2-5 Possible reasons for this include suboptimal cleansing of the right side of colon and increased difficulty in detecting right-sided lesions because they often are flat or sessile. The adoption of more effective methods of bowel cleansing and a greater emphasis on patient compliance with preparation instructions will improve the effectiveness and efficiency of colonoscopy, as well as minimize the risk for procedural complications.

The available purgatives for colonoscopy can be divided into 3 categories: osmotic agents, polyethylene glycol (PEG)-based solutions, and stimulants. Osmotic laxatives increase intraluminal water by promoting the passage of extracellular fluid across the bowel wall. Examples of osmotic preparations include sodium phosphate (NaP), magnesium citrate, and sodium sulphate. The PEG-based solutions consist of a high-molecular-weight nonabsorbable polymer in a dilute electrolyte solution. PEG solutions are designed to be osmotically balanced, limiting the exchange of fluid and electrolytes across the colonic membrane. Stimulant laxatives work by increasing smooth muscle activity within the wall of the colon. Examples of stimulant purgatives include senna, bisacodyl, and sodium picosulfate. Bisacodyl’s laxative effect is based on 2 mechanisms of action: stimulation of small intestinal secretion and increased motor activity within the colon. Dietary modification, consisting of a clear liquid or a low-fiber diet for 24 hours before the procedure, usually is combined with a purgative regimen.

This section provides a brief overview of the available purgatives for bowel preparation (Table 1). Several comprehensive reviews on the comparative efficacy, safety, and tolerability of these agents recently have been published, and readers who want a more in-depth analysis of this subject are referred to these sources.6-8

**Polyethylene Glycol**

A variety of PEG-based lavage regimens currently are available for bowel cleansing before colonoscopy. These preparations differ with respect to volume of lavage solution, electrolyte content, molecular weight of the polymer, requirement for an adjunctive laxative,
and the presence of artificial sweeteners. FDA-approved PEG lavage solutions include the traditional 4-L preparations (GoLYTLEY, Braintree; Colyte, Schwarz Pharma; NuLYTLEY, Braintree; Trilyte, Schwarz Pharma), and low-volume 2-L regimens (HalfLYTely, Braintree; MoviPrep, Salix). The recommended dosing of most PEG solutions is 240 mL (8 oz) every 10 minutes. A “split-dose” regimen—in which part of the laxative is taken the evening before and the remainder is taken the morning of the procedure—has been demonstrated to be more effective and better tolerated than a single dose taken the evening before the procedure. It is estimated that 5% to 38% of patients are unable to complete the 4-L PEG preparation because of volume-related symptoms of abdominal fullness, nausea, and vomiting. Two low-volume PEG preparations are approved by the FDA at the present time. Patients using HalfLYTely ingest 2 bisacodyl delayed-release tablets (10 mg) at approximately noon the day before the procedure and start ingesting lavage solution following evacuation or no more than 6 hours later. MoviPrep, another 2-L formulation, combines PEG-3350 with sodium sulfate and ascorbic acid. The 2 compounds provide osmotic activity in order to enhance bowel cleansing. A multicenter, randomized, single-blind study found MoviPrep to be as effective as 4 L of PEG. Another comparative study, MoviPrep and an oral NaP-based preparation produced comparable results in colon cleansing and patient satisfaction. A recent study comparing MoviPrep and HalfLYTely demonstrated improved bowel cleansing and higher rates of adenoma detection with MoviPrep.

MiraLAX (PEG-3350), approved by the FDA for treatment of constipation, is available as an over-the-counter (OTC) product and has been used as a bowel preparation for colonoscopy. One often recommended regimen for MiraLAX is to instruct patients to consume 4 bisacodyl delayed-release tablets at approximately 1 PM on the day before the procedure, followed by the ingestion of 238 mg of MiraLAX (8.3-oz bottle) mixed with 64 oz of Gatorade. In some cases, 10 oz of magnesium citrate also is recommended. Unlike the FDA-approved 2- and 4-L PEG products that contain additional electrolytes in order to produce an osmotically balanced solution, thereby minimizing net absorption or secretion of fluid or electrolytes into the intestinal lumen, the MiraLAX/Gatorade preparation is hypotonic. The safety and efficacy of this preparation are unknown and well-conducted randomized trials that are sufficiently powered to demonstrate differences in these end points are needed.

Overall, the safety record with PEG-based preparations has been excellent. During the 6-year period ending in 2002, the FDA received 100 reports of adverse events with PEG solutions, including 30 serious and 6 fatal events. Complications of PEG preparations include hypothermia, hyponatremia, intestinal perforation, aspiration, and Mallory-Weiss tear. The use of PEG-based bowel cleansing is contraindicated in patients with gastric outlet obstruction, high-grade small bowel obstruction, and suspected bowel perforation.

**Oral Sodium Phosphate**

For many endoscopists, a new era in bowel cleansing for colonoscopy was ushered in on Dec. 11, 2008 when the FDA issued an alert about the safe use of oral sodium phosphate (OSP) products. The agency expressed its concern about the risks associated with the use of OSP at the higher doses typically used for bowel cleansing before colonoscopy, and it recommended that consumers not use the OTC OSP products designed specifically for bowel cleansing. The FDA said, however, that the available data continue to indicate the safety of OSP at the lower dose used for the laxative. In response to the FDA warning, CB Fleet immediately announced a voluntary recall of its OTC products, Fleet Phospho-soda and Fleet Phospho-soda EZ-Prep. The future of these products, either in the OTC or prescription market, is uncertain at this time.

The FDA alert also indicated that the manufacturer of prescription NaP tablets (Osmoprep, Salix) would be required to put a black box warning on its product labels. The warning highlights several key concepts related to the use of NaP laxatives for bowel cleansing, including the following: 1) acute phosphate nephropathy, sometimes resulting in permanent renal impairment, has been observed rarely following ingestion of OSP; 2) identifiable patient risk factors for acute phosphate nephropathy include increased age, hypovolemia, increased bowel transit time (such as bowel obstruction), active colitis, and baseline kidney disease; and 3) use of certain medications, including diuretics, angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers, and possibly nonsteroidal anti-inflammatory drugs, may increase the risk for kidney damage. Physicians, nurses, and other health care professionals who are involved in the process of advising patients about bowel cleansing for colonoscopy or other procedures should be thoroughly familiar with these cautions.

The tablet formulation of NaP (Visicol, Salix) was approved by the FDA in 2000. The recommended dose of the initial formulation of Visicol was 48 to 60 g, or 32 to 40 tablets taken in 2 doses. Because of the presence of insoluble microcrystalline cellulose—an insoluble excipient within the NaP tablet that obscured visualization of colonic mucosa in some instances—a residue-free NaP tablet (OsmoPrep, Salix) was developed. OsmoPrep is smaller and has a smooth waxy surface that facilitates swallowing. The recommended dosage is 32 tablets—20 tablets the evening before and 12 tablets 3 to 5 hours before the examination. Compared with Visicol, OsmoPrep induced smaller changes in electrolyte levels and fewer adverse events, including abdominal distention, nausea, pain, and vomiting.

At least 16 studies have compared the efficacy and tolerability of PEG with that of NaP. Overall, the
trials demonstrated that NaP is as effective as either the 2- or 4-L PEG-based preparations. In most of the studies, patient tolerance and compliance with bowel preparation was improved with NaP, compared with the PEG formulations. These conclusions are supported by the findings of 2 meta-analyses and an evidence-based position statement prepared by the Canadian Association of Gastroenterology.6-8

The use of NaP often is associated with abnormalities in serum electrolytes, including hypernatremia, hypokalemia, hypocalcemia, and hyperphosphatemia. Although these electrolyte alterations usually are transient and patients are clinically asymptomatic, the FDA received 34 reports of adverse events between 1997 and 2002, including 18 serious events and 8 fatalities related to the use of NaP preparations.8 A 2005 study reported 21 cases of acute phosphate nephropathy, all occurring in patients who recently had taken a NaP bowel preparation.17 Seventeen patients (81%) were female, the mean age of the patients was 64 years, 16 (76%) of the 21 patients had a history of hypertension, and 14 (67%) were taking an ACE inhibitor or angiotensin receptor blocker. Although the exact incidence of this complication cannot be quantified accurately, the risk appears to be quite low considering the relatively small number of cases reported and the extraordinarily large number of exposures to NaP (estimated to be in excess of 5 million per year).18 On the basis of its overall safety and efficacy, NaP is an appropriate option for bowel preparation in healthy individuals without any of the contraindications previously discussed. A recent study suggests that in low-risk patients, hyperphosphatemia following standard NaP doses is related to body weight.19 Accordingly, it may be advisable to recommend a reduced dosage of NaP in low-weight individuals.

### OTHER BOWEL PREPARATIONS

Magnesium citrate is a hyperosmotic saline laxative that increases intraluminal fluid volume and, via stimulation of cholecystokinin release, enhances gut motility. It is administered as a split dose, 300 mL (10 oz) taken the evening before colonoscopy and 300 mL taken 3 to 5 hours before the procedure. Bisacodyl delayed-release

**Table 1. Commonly Used Purgatives for Colonoscopy Preparation**

<table>
<thead>
<tr>
<th>Class</th>
<th>Product</th>
<th>Recommended Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium phosphate</td>
<td>Tablet</td>
<td>OsmoPrep (Salix) 20 tablets (4 tablets every 15 min) at 5 to 6 PM the evening before colonoscopy; repeat with 12 tablets 10 to 12 h later (at least 3 h before procedure)</td>
</tr>
<tr>
<td>Polyethylene glycol</td>
<td>4-L PEG-ELS</td>
<td>GoLYTELY (Braintree) 240 mL (8 oz) every 10 min beginning at 5 to 6 PM the evening before colonoscopy (total, 3 L); remaining 1 L 10 to 12 h later (at least 3 h before procedure)</td>
</tr>
<tr>
<td></td>
<td>4-L SF-PEG</td>
<td>NuLYTELY (Braintree) Same as above</td>
</tr>
<tr>
<td></td>
<td>2-L PEG-ELS and bisacodyl</td>
<td>HalfLyte (Braintree) 2 bisacodyl delayed-release tablets at noon the day before colonoscopy; 240 mL (8 oz) every 10 min beginning at 5 to 6 PM (total, 1 L); repeat 240 mL (8 oz) every 10 min beginning 3 to 4 h before procedure (total, 1 L)</td>
</tr>
<tr>
<td></td>
<td>delayed-release tablets</td>
<td>MiraLAX (Schering-Plough) Same as above</td>
</tr>
<tr>
<td></td>
<td>2-L PEG and bisacodyl</td>
<td>MoviPrep (Salix) 240 mL (8 oz) every 15 min beginning at 5 to 6 PM the evening before colonoscopy (total, 1 L), followed by at least 16 oz of fluid; 240 mL (8 oz) every 15 min at least 3 to 4 h before procedure (total, 1 L), followed by 16 oz of fluid</td>
</tr>
<tr>
<td></td>
<td>delayed-release tablets</td>
<td>LoSo Prep (Bracco Diagnostics) Magnesium citrate (premeasured quantity) at 5 to 6 PM the evening before colonoscopy; 4 bisacodyl delayed-release tablets at 7 to 8 PM (2 h after magnesium citrate); bisacodyl suppository 2 to 3 h before procedure</td>
</tr>
<tr>
<td>Magnesium citrate</td>
<td>Sodium sulfate</td>
<td>Suprep (Braintree) 6-oz bottle diluted with 16 oz of water followed by 32 oz water over the next hour; take the evening before colonoscopy and repeat the morning of examination</td>
</tr>
</tbody>
</table>

ELS, electrolyte lavage solution; PEG, polyethylene glycol; SF, sulfate-free

*a in some cases, these recommendations do not correspond with the FDA-approved dosage.
tables (20 mg) often are used in combination with magnesium citrate. Because magnesium is eliminated by the kidneys, it should not be used in patients with renal disease or impaired renal function.

A prepackaged low-fiber diet (NutraPrep, Bracco Diagnostics) has been introduced that contains 3 low-residue meals and snacks. The product is intended for use in combination with a bowel cleansing system that contains low-sodium magnesium citrate, bisacodyl delayed-release tablets, and a bisacodyl suppository (LoSo Prep, Bracco Diagnostics). Patients are instructed to take magnesium citrate and 4 bisacodyl tablets (20 mg) the evening before colonoscopy plus a bisacodyl suppository on the morning of the procedure. A randomized, investigator-blinded study reported superior bowel cleansing and patient tolerability with this regimen compared with NaP. In a study from Korea, researchers randomized 285 patients undergoing colonoscopy to receive a 4-L PEG preparation, administered as either a 1-day or split-dose regimen, or 250 mL of magnesium citrate taken the day before the procedure followed by 2 L of PEG the morning of the procedure. The magnesium citrate and split-dose 4-L PEG preparations achieved comparable rates of satisfactory bowel cleansing (75% and 76%, respectively) and were significantly better compared with the 1-day 4-L PEG preparation (51%, \( P=0.001 \)). Rates of patient satisfaction and willingness to repeat the same preparation were higher with magnesium citrate than either 4-L PEG regimen.

Oral sodium sulfate (Suprep, Braintree) is a newly developed bowel cleansing preparation that contains sodium sulfate, magnesium sulfate, and potassium sulfate, plus flavoring agents in an aqueous form supplied in 2, 6-ounce bottles. Each 6-ounce bottle is diluted with water to 16 ounces. Sulfate salts have long been used as osmotic laxatives, dating back to the 17th century. The traditional 4-L PEG preparation (GoLytely) includes sodium sulfate in order to improve bowel cleansing and to minimize fluid shifts and changes in serum electrolytes. Unlike OSP, sulfate salts do not produce renal tubular injury in animal models.

The efficacy of oral sodium sulfate as a bowel cleansing preparation for colonoscopy has been established in 2 multicenter, randomized, single-blind studies. The sulfate preparation administered as a split-dose regimen produced better bowel cleansing than standard 4-L PEG and was comparable with MoviPrep. Patient tolerability and the safety profile were comparable for oral sodium sulfate and MoviPrep. The new drug application for Braintree’s oral sodium sulfate was approved by the FDA on Aug. 5, 2010.

Clinical Considerations

An effective preparation for colonoscopy should consistently produce a high-quality bowel cleansing that is adequate for the detection of all adenomatous polyps. It also must be safe and, ideally, work quickly without producing gastrointestinal (GI) distress. None of the products currently marketed for colonoscopy preparation meet all of these criteria. Although most are effective when properly administered, they require 12 to 24 hours for adequate bowel cleansing, and a significant proportion of patients experience disturbing GI side effects. Consequently, the choice of purgative(s) and the regimen of administration vary considerably among endoscopists.

This section examines strategies for colon cleansing and provides suggestions for improving the quality and safety of bowel preparation. Recommendations for colonoscopy preparation within special patient populations are also presented.

Bowel Preparation: One Size Does Not Fit All

Some endoscopists prefer to offer all patients a single method of bowel preparation. The benefits of such an approach include simplicity and an economy of time, eliminating the need to discuss with the patient more than one regimen of bowel cleansing. Among the disadvantages, however, is an inability to adjust for differences between patients. For example, individuals vary in their tolerance and reaction to purgatives. The same cathartic may be well tolerated by one patient but produce nausea, vomiting, and abdominal cramps in another. Individuals with chronic constipation may require a more rigorous regimen for adequate bowel cleansing. Differences such as these are best accommodated by offering several bowel preparations, so that each patient can be matched with the preparation that is most likely to be effective, safe, and well tolerated.

When endoscopy is performed in an open-access setting, it is necessary to prescreen patients before selecting a purgative regimen. In our practice, a receptionist or medical assistant completes a brief medical questionnaire for each patient at the time of scheduling. Information obtained that pertains to the choice of purgative regimen includes the following: a list of current medications and drug/food allergies; a history of heart failure, kidney disease, ascites, or fluid/electrolyte abnormalities; and a history of chronic constipation or incomplete colonoscopy. Based on the responses, a bowel cleansing regimen (NaP vs PEG) is then suggested. When a PEG-based regimen is used, the 2-L PEG preparation is chosen, except for patients with chronic constipation. In this way, the method of bowel cleansing for colonoscopy is selected individually to maximize safety, efficacy, and patient satisfaction.

Patient Education

Some endoscopy centers use a patient education program when preparing patients for GI endoscopy. The topics to be covered include a description of the procedure, possible adverse effects and complications, and preparation instruction. The impact of bowel preparation on the success of colonoscopy and the importance of compliance with instructions should be emphasized. This message may be communicated through 1-on-1 sessions, group meetings, or self-instruction with either a videotape or a computer-based program. Communicating this information effectively to the patient helps to
hydration is widely believed to play an important role in such complications. Therefore, adequate hydration during bowel preparation should be emphasized, particularly in high-risk individuals, such as the elderly, patients on diuretics or other medications that alter electrolyte levels, and patients with preexisting electrolyte abnormalities. Patients should be advised to consume at least 64 oz (approximately 2 L) of clear fluid on the day before colonoscopy. The use of a carbohydrate-electrolyte solution (eg, Gatorade) has been reported to improve hydration, tolerance for the preparation, and the quality of bowel preparation.\[^35\] Patients also should be reminded to continue hydration after colonoscopy; we advise that they consume at least 32 oz (4, 8-oz glasses) of clear fluid during the 8 hours following completion of the procedure.\[^36\]

**The Role of Hydration**

Colon cleansing produces significant volume loss through the GI tract that can result in intravascular volume depletion. The fluid loss during bowel preparation may exceed 2 to 3 L, based on an assessment of hemodynamic parameters and indirect measures such as body weight, serum osmolality, and hematocrit.\[^28\] Significant differences in fluid loss between NaP and PEG formulations have been reported in some studies.\[^29-32\] Decreases in systolic blood pressure (>10 mm Hg from baseline) and/or postural tachycardia (≥10 beats/min from baseline) have been described in 10% to 35% of patients who completed a bowel-cleansing regimen.\[^29\] Additionally, the use of NaP preparations often is associated with changes in serum electrolytes, including transient increases in phosphate and sodium and reductions in calcium and potassium. Despite these changes, serum electrolytes generally remain within the normal range, and patients are clinically asymptomatic. Serious electrolyte disturbances, however, have been reported with both NaP\[^33\] and PEG.\[^34\]

Figure 1. Images of the cecum during colonoscopy demonstrate incomplete versus complete bowel cleansing.

A thin layer of ileal fluid and chyme can partially obscure the cecum (A). In contrast, optimal preparation allows for clear imaging of the cecum and careful inspection of mucosa (B).

Figure 2. Inflammatory changes: distinguishing artifact from disease.

The appearance of multiple, punctate red spots surrounded by normal intervening mucosa is an artifact due to bowel preparation with sodium phosphate in patients with inflammatory bowel diseases (A). This appearance is readily distinguished from that of active colitis (B).

**Timing Is Everything**

The quality of colon preparation—especially in the ascending colon—is closely related to the length of time between completion of preparation and the examination.\[^31,37\] Despite diet restriction for 24 hours, optimal cleansing of the colon requires that at least part of the preparation be ingested within 6 to 8 hours of the examination. When more than 8 hours has elapsed, ileal contents begin to fill the right colon, coating the ascending colon with a thin film of chyme that obscures mucosal detail (Figure 1). The American College of Gastroenterology (ACG) supports the concept of split-dosing as a method for enhancing the efficacy of commercial bowel cleansing preparations.\[^38\]

Split-dose regimens improve the efficacy of both NaP and PEG preparations.\[^3\] In a study of 3-L PEG plus bisacodyl, a split-dose regimen (including 1 L on the day of the procedure) increased the proportion of satisfactory preparations (75% vs 66%) and patient compliance, with lower rates of discontinuation.\[^39\] Another study sought to determine whether the quality of bowel preparation was better with a 2-L PEG solution administered on the day of (6-8 h before) versus the evening before (13-16 h before) the procedure.\[^40\] Colon preparation was better (93% vs 72%) and more lesions were detected (2.8 vs 1.9) in the group that received same-day bowel cleansing than in the group that received cleansing the evening before the examination. A randomized trial compared 2 dosing regimens of NaP, 1 consisting of 2, 45-mL doses taken the evening before (3 and 8 PM) the procedure and the other consisting of the same 2 doses with the second dose taken the morning of the procedure (8 PM and 6 AM).\[^41\] Patients who received part of their preparation on the same day had better scores for quality of cleansing compared with those who underwent preparation on the previous day (global rating of good/excellent, 80% vs 68%). These and other studies provide convincing evidence that a split-dose regimen, including 1 dose of laxative within 6 to 8 hours before the examination, improves cleansing of the mucosa, especially within the right side of the colon, where flat polyps are encountered more often.
When patients are prepared for colonoscopy, it is helpful to distinguish those scheduled for morning procedures from those scheduled for afternoon procedures. Patients undergoing a morning procedure should ingest the first dose of cathartic between 4 and 6 PM the night before and the remainder between 3 and 5 AM (depending on the time of the procedure and the laxative selected). Patients scheduled for afternoon procedures should take their first dose at 6 to 7 PM the night before and the second dose at 6 to 7 AM the morning of the procedure. Some endoscopy units have modified their endoscopy schedule, booking all colonoscopy procedures beginning at noon. This affords patients the convenience of taking the second dose of laxative at 6 to 7 AM, rather than at 3 to 5 AM. However, a study comparing the outcomes of morning versus afternoon colonoscopy reported significantly higher rates of incomplete procedures and lower rates of adequate bowel preparation in the afternoon.\(^42\) In our experience, many patients prefer to undergo colonoscopy in the morning, and most do not object to waking during the night to complete the cleansing regimen.

In Japan, the concept of split-dosing has been taken a step further, with colon cleansing performed entirely on the morning of examination.\(^43\) Little or no diet modification is required the day before colonoscopy. Patients are instructed to begin the preparation at approximately 6 AM with 2 to 3 L of PEG. The preparation is complete when the rectal effluent is clear.

A recent study from the United States compared the efficacy and tolerability of a 4-L PEG preparation administered either the evening before or the morning of the procedure in 136 patients undergoing afternoon colonoscopy. The overall quality of bowel cleansing was better in the morning group compared with the evening group (4.73 vs 7.10, \(P<0.01\)), based on the validated Ottawa scale (range 0-14, 0=best). However, there were no differences in polyp detection rates between the 2 treatment groups. Tolerability was better with the morning-only dosing regimen.\(^44\)

In some instances, the timing of bowel preparation may require alteration in order to accommodate the fasting requirements related to procedural sedation. There are no universally accepted guidelines on pre-procedural fasting, and consequently the literature contains a variety of recommendations on this subject. Guidelines published by the American Society of Anesthesiology state that patients should fast for a minimum of 2 hours for clear liquids and 6 hours for light meals before sedation.\(^45\) On the other hand, an evidence-based review by the American College of Emergency Physicians\(^46\) states that “recent food intake is not a contraindication for administering procedural sedation and analgesia, but should be considered in choosing the timing and target level of sedation.” A recent position statement from the American Gastroenterological Association\(^47\) concluded that “there is inadequate evidence to permit the development of absolute requirements for pre-procedural fasting, and the clinician should be guided by the practice parameters provided by various professional societies.”

A prospective study comparing residual gastric volume in patients receiving split-dose versus evening-before bowel preparation showed no significant difference between the 2 regimens (19.7 vs 20.2 mL, respectively; \(P=0.85\)). Based on the current available data, it is reasonable to recommend that patients undergoing colonoscopy with sedation fast for a minimum of 2 hours before the procedure.\(^48\)

**Special Patient Subpopulations**

**Elderly Patients.** Individuals aged 65 years and older comprise at least 20% of the patient population undergoing routine colonoscopy and are more likely to have an incomplete preparation.\(^1,49\) The reasons for this are multifactorial and include an increased likelihood of constipation, reduced mobility, and difficulty completing the preparation. Elderly patients using NaP also are more likely to manifest hyperphosphatemia as a result of impaired renal function, comorbid illness, and concomitant medications.\(^32\)

The efficacy, safety, and tolerability of various purgatives in older individuals have been evaluated in several studies. A randomized controlled trial in octogenarians compared NaP with a 4-L PEG preparation.\(^49\) The quality of preparation was similar in the 2 groups, with a good or excellent rating in 77% to 81% of patients receiving NaP or PEG, respectively. As anticipated, PEG produced less change than NaP in the clinical parameters of dehydration and laboratory values. Fewer patients were unable to complete the NaP preparation than the PEG preparation, although the difference did not reach statistical significance. Overall, patients preferred NaP to PEG and were more willing to repeat this preparation in the future. A second study comparing NaP with PEG in elderly patients reported that the overall quality of colon cleansing was comparable for the 2 preparations.\(^50\) Furthermore, patients who received NaP tolerated the preparation better than those who received PEG, although the difference was not statistically significant.

**Patients With Inflammatory Bowel Disease.** In general, patients with inflammatory bowel disease can prepare for colonoscopy with any of the standard bowel purgatives. An exception is the patient with moderate to severe diarrhea (more than 6-8 bowel movements per day); for this patient, the dose of cathartic may be reduced or eliminated altogether. NaP preparations can produce aphthoid lesions in the colon, most prominently within the rectum and sigmoid. This endoscopic appearance is distinct and can be readily distinguished from the endoscopic appearances of Crohn’s disease and ulcerative colitis (Figure 2).

**Pediatric Patients.** In older children (≥12 years), an oral NaP solution at a dosage of 45 mL taken twice was probably the most widely used preparation.\(^10\) For younger children (6-11 years), the dosage often is reduced to 30 mL taken twice. NaP is not recommended for children aged 5 years and younger. A second method of
preparation for children is a PEG-based formulation (MiraLAX) administered at a dose of 1.25 to 1.5 g/kg daily for 4 days. In some instances, a laxative, such as bisacodyl, may be added to the regimen 1 day before colonoscopy. The least commonly used preparation is either a saline or a phosphate enema in combination with a senna laxative.

In the pediatric population, there are inadequate data assessing efficacy and safety to recommend a particular regimen over another. The PEG-based preparations generally are effective but often are accompanied by abdominal bloating and vomiting. A modified PEG preparation that is administered over 4 days appears to be better tolerated but has the potential for disrupting a child’s ability to attend school and participate in other activities. Generally, oral NaP is better tolerated by a child’s ability to attend school and participate in other activities. Oral NaP is better tolerated by children than PEG, although hyperphosphatemia often is observed. Practice recommendations for bowel preparation in children undergoing colonoscopy vary. A recent consensus statement prepared by a joint task force within the United States concluded that NaP, PEG, and phosphate enema/senna preparations all are “safe and adequate bowel cleansing, especially within the ascending colon.” The authors caution, however, that “in certain circumstances, such as bowel preparation in children, ... it may be advisable to adhere to PEG-based solutions because of the risks for occult physiologic disturbances that may potentially contraindicate the use of NaP-based regimens.”

Regardless of the regimen selected, it is important to provide children with adequate hydration during the process of bowel preparation. A carbohydrate-electrolyte solution designed specifically for children often is helpful for this purpose.

### Patients With Lower Gastrointestinal Bleeding.
In most circumstances, patients undergoing colonoscopy for hematochezia must be prepared quickly. Colon transit is hastened by the presence of blood, and in most cases, bowel cleansing can be completed within 2 to 3 hours by using 0.5 to 2 L of PEG solution. Patients who are unresponsive or mechanically ventilated may receive the PEG solution through a nasogastric tube.

### Patients With a History of Inadequate Preparation or Chronic Constipation.
There are no studies to provide the clinician with guidance for preparation of the patient with chronic constipation or a history of inadequate bowel cleansing during a previous colonoscopy. Measures that have been recommended include the following: extending the period of diet modification from 24 to 48 hours; adding oral bisacodyl or senna to a PEG or a NaP regimen; and increasing the total volume of PEG from 4 to 6 L, with administration split over 48 hours (usually 1-2 L on day 1, and 3-4 L on day 2). In addition, adequate hydration will help to improve the adequacy of cleansing.

### Reporting the Quality of Bowel Preparation.
The American Society for Gastrointestinal Endoscopy (ASGE)/ACG Task Force on Quality in Endoscopy has recommended that the quality of bowel cleansing be documented for every colonoscopy. The terms “excellent,” “good,” “fair,” and “poor” often are used in clinical practice to characterize the quality of bowel cleansing, without reference to a standardized definition of these qualifiers. Preferably, clinicians should become familiar with 1 of the validated bowel preparation assessment scales and incorporate it into a structured endoscopy reporting system. One such scoring system that is useful for the clinician is the following: extending the period of diet modification from 24 to 48 hours; adding oral bisacodyl or senna to a PEG or a NaP regimen; and increasing the total volume of PEG from 4 to 6 L, with administration split over 48 hours (usually 1-2 L on day 1, and 3-4 L on day 2). In addition, adequate hydration will help to improve the adequacy of cleansing.

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<table>
<thead>
<tr>
<th>1 = Excellent</th>
<th>2 = Good</th>
<th>3 = Fair</th>
<th>4 = Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 90% of mucosa observed</td>
<td>Greater than 90% of mucosa observed</td>
<td>Greater than 90% of mucosa observed</td>
<td>Less than 90% of mucosa observed</td>
</tr>
<tr>
<td>Presence of mostly liquid stool</td>
<td>Presence of mostly liquid stool</td>
<td>Presence of mixture of liquid and semisolid stool</td>
<td>Presence of mixture of semisolid and solid stool</td>
</tr>
<tr>
<td>Minimal suctioning required</td>
<td>Significant suctioning required</td>
<td>Stool could be suctioned and/or washed</td>
<td>Stool could not be suctioned or washed</td>
</tr>
</tbody>
</table>

*a Modified from reference 55

### Key Points

1. The choice of bowel cleansing regimen for colonoscopy should be based on the patient’s age, health status, comorbid diseases, and personal preference.

2. A split-dose bowel cleansing regimen that includes 1 dose of laxative within 6 to 8 hours before the examination improves the quality of bowel cleansing, especially within the ascending colon.

3. Sodium phosphate (NaP) regimens have demonstrated better efficacy and tolerability than polyethylene glycol (PEG)-based preparations for colonoscopy preparation. NaP should be avoided in patients with impaired renal function, congestive heart failure, advanced liver disease, or hypercalcemia.

4. All purgatives have been associated with serious adverse events. The risk for complications can be minimized by selecting the most appropriate bowel cleansing regimen for each patient and highlighting the importance of adherence to preparation instructions.

5. The importance of adequate hydration during and after bowel preparation should be emphasized for all patients undergoing colonoscopy.
practical and easily adopted in clinical practice is presented in Table 2. The Task Force recommends that an examination be considered complete if it enables the detection of colon polyps 5 mm or larger. An incomplete examination that results from poor bowel preparation will often necessitate repeat examination.

**Conclusion**

A substantial number of colonoscopy procedures are suboptimal because of inadequate bowel preparation. This figure ranges from 17% to 30% in randomized trials and is probably higher in clinical practice. Several patient characteristics have been associated with poor bowel preparation, including a history of constipation, in-patient status, use of antidepressants, and noncompliance with bowel preparation instructions. An awareness of these factors, combined with strategies designed to optimize the results of purgative regimens and an emphasis on patient education and compliance, will maximize the efficiency of colonoscopy and minimize its risks (Key Points).

**References**


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