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Optimal and Safe Bowel Preparation for Colonoscopy

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Effective colonoscopy requires an adequate level of cleansing as a basic component. This review will describe a compact review about general considerations in bowel preparation for colonoscopy and specific considerations for various patients. A low-fiber diet instead of a regular diet on the day before colonoscopy is an independent predictor of adequate bowel preparation. Improved bowel cleansing does not result from the routine use of enemas or prokinetics in addition to oral bowel preparation. For morning colonoscopy, a split method of 4 L polyethylene glycol on the day before and the day of colonoscopy is recommended, while patients scheduled for afternoon colonoscopy typically receive a full method of 4 L polyethylene glycol on the day of the procedure. Valid alternatives are 2 L polyethylene glycol plus ascorbic acid or 2 L sodium picosulphate plus magnesium citrate. Although there are no statistically significant differences between polyethylene glycol and oral sodium phosphate for colon cleansing, polyethylene glycol-based bowel preparation is advisable in most situations because of safety concerns.

Key Words: Colonoscopy; Preparation; Polyethylene glycols; Ascorbic acid; Magnesium

INTRODUCTION

Colonoscopy is the standard method for evaluating the colon. Cecal intubation and polyp detection rates are two key indicators associated with the quality of bowel cleansing prior to this procedure. Effective colonoscopy requires an adequate level of cleansing.^{1,2} Patients with inadequate levels of bowel cleansing may need examinations rescheduled or force practitioners to organize alternative investigations.³

At the same time, the discomfort from bowel preparation may affect the acceptability of colonoscopy for colon cancer screening.⁴ Although these preparations are generally safe and well-tolerated, there are potential risks associated with the use of oral bowel-cleansing agents. Harm is more likely to result from bowel preparation in patients who have definite contraindications (gastrointestinal obstruction or perforation, ileus or gastric retention, severe acute inflammatory bowel disease or toxic megacolon, reduced levels of consciousness, hy-

persensitivity to any of the ingredients, inability to swallow without aspiration, and ileostomy). Common complications in those without contraindications include hypovolemia and electrolyte disturbances, such as hypokalemia, hyponatremia and hypermagnesemia.⁵ The aim of this article was to review general considerations for colonoscopy bowel preparations and more focused concerns for specific patients.

GENERAL CONSIDERATIONS

Diet

A low-fiber diet on the day before colonoscopy is an independent predictor of adequate bowel preparation rather than a regular diet and is more frequent in satisfactory colon cleanliness; it is also better tolerated than a clear liquid diet.⁶⁻⁹ A low-fiber diet for more than 24 hours prior to colonoscopy has not shown a relationship with any aspect of the colonoscopy process.

Adjuncts

Improved bowel cleansing does not result from the routine use of enemas or prokinetics in addition to oral bowel preparation.^{10,11} However, mosapride or itopride may reduce nausea, vomiting, bloating, and abdominal pain that may be experienced during bowel preparation.^{12,13} The administration of simethicone with bowel preparation may decrease the amount

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of bubbles in the colon, and it has no impact on colon cleanliness and the definite efficacy of colonoscopy for detection of lesions.¹⁴

Main oral bowel-cleansing solution and timing

Patients scheduled for a morning colonoscopy are often prescribed a split method of 4 L polyethylene glycol (PEG) on the day before and again on the day of the procedure. When compared with a full dosage of 4 L PEG on the previous day, the split method significantly improves the incidence of satisfactory colon cleanliness, significantly increases patient compliance and significantly decreases nausea.¹⁵ In the case of afternoon colonoscopy, a full dose of 4 L PEG on the day of colonoscopy provides better colon cleanliness, less sleep disturbances, and less bloating.^{16,17}

Valid alternatives may include a split method for morning colonoscopy or a full-dose method for afternoon colonoscopy of 2 L PEG plus ascorbic acid (PEGA) or of 2 L sodium picosulphate plus magnesium citrate (SPMC), particularly for elective outpatient colonoscopy.¹⁸ The time interval between the last dose of bowel preparation agents and the colonoscopy start time should be no longer than 4 hours.¹⁹⁻²¹ SPMC provides similar colon cleansing results with less frequent adverse events, nausea, vomiting, abdominal pain, and sleep disturbances and a higher degree of willingness to repeat the same bowel preparation than PEG. However, mucosal inflammation may be more frequent with magnesium-based bowel preparations.²²⁻²⁴ Compared with PEG, PEGA provides similar colon cleanliness for the entire colon with a higher proportion of patients being willing to repeat the same bowel preparation.²⁵⁻²⁷ However, PEG tends to produce more satisfactory cleanliness in the right colon than PEGA.²⁷⁻²⁹

While no statistically significant differences between PEG and oral sodium phosphate (OSP) for overall colon cleansing have been reported, the routine use of OSP for bowel preparation should be avoided because of safety concerns.^{30,31} Although a meta-analysis found no statistically significant association between OSP and kidney injury, 171 cases of renal failure were reported between 2006 and 2007 with the use of OSP. Only 10 were identified with PEG.^{32,33} Furthermore, an Iceland study estimated that the risk of biopsy-proven acute phosphate nephropathy was approximately 1 per 1,000 OSP doses.³⁴ Other complications of OSP are hyperphosphatemia, hypocalcemia, hypokalemia, hypernatremia, and hyponatremia.³³ To prevent complications associated with OSP, physicians need to be aware of the contraindications of OSP and also the risk factors for acute phosphate nephropathy, and they must carefully screen patients before prescribing OSP. The absolute contraindications to OSP are pregnancy, age <18 years, stage 3 to 5 chronic kidney disease (glomerular filtration rate [GFR] <60

mL/min/1.73 m²), inability to maintain adequate fluid intake, pre-existing electrolyte disturbances, ascites, symptomatic congestive heart failure, and recent (within <6 months) symptomatic ischemic heart disease (unstable angina or myocardial infarction). Relative contraindications include active inflammatory bowel disease, parathyroidectomy, and delayed bowel transit.³⁵ The risk factors for acute phosphate nephropathy associated with OSP are age >55 years, hypovolemia, baseline kidney disease, bowel obstruction, active colitis, and the intake of drugs that affect renal perfusion or function, such as diuretics, angiotensin-converting enzyme inhibitors (ACEI), angiotensin receptor blockers (ARB), and nonsteroidal anti-inflammatory drugs (NSAIDs).³⁶ Minimizing the dose of OSP and requiring a minimum of 12 hours between the administration of the two OSP doses are essential.³⁷ Modification of the standard dose of OSP 45/45 mL 9 to 12 hours apart to 45/30 mL should be considered; each method provides equally effective bowel cleansing with significantly lower serum phosphate levels. In addition, increasing the interval to 24 hours reduces the incidence of significant hyperphosphatemia (>2.1 mmol/L) without compromising its efficacy.³⁸ Therefore, OSP should be used in limited cases that are not met by other bowel preparation agents in patients without risks of OSP-associated side effects.

SPECIFIC CONSIDERATIONS

Previous failure of adequate bowel preparation

Inadequate bowel preparation has been reported in up to one third of colonoscopies. Therefore, identification of its risk factors could be very important. However, a model based on risk factors, such as male gender, inpatient status, and older age, correctly predicted inadequate bowel preparation in only 60% of patients.³⁹ An intensive bowel preparation should be prescribed for patients scheduled for a colonoscopy who have experienced previous inadequate bowel preparation, which might be a predictor of inadequate bowel preparation.^{40,41}

Pregnancy and breastfeeding

PEG is considered safe during pregnancy.⁴² During and after the bowel preparation, it may be advisable to pause breastfeeding.

In conditions of suspicious inflammatory bowel disease

With OSP and SPMC, preparation-induced mucosal inflammation has been reported 10 times more frequently than with PEG.²⁴ Erosion, aphthoid lesions, and ulcers are often multiple and occur primarily in the distal sigmoid colon and rectum.⁴³

Lower gastrointestinal bleeding

In emergent colonoscopy to evaluate a patient with lower gastrointestinal bleeding, PEG is advisable. Urgent colonoscopy following a rapid colon preparation performed within 24 hours of admission is safe and may facilitate the detection and management of bleeding lesions. In a report regarding patients with acute lower intestinal bleeding, the cecal intubation rate was 41% without full bowel preparation compared with 74% in the PEG group.^{44,45}

Situations bring out hypovolemia

Comorbidities bring out hypovolemia such as diarrhea, vomiting, dysphagia, hyperglycemia, and diuretics use, which should be evaluated before the administration of bowel preparation agents. Isotonic electrolyte-mixed fluid is advisable for intravenous fluid replacement.⁴⁶ Fluid intake should continue until 2 hours before the colonoscopy, and isotonic electrolyte oral rehydration solutions may be of more benefit than plain water.⁴⁷ With SPMC or OSP, isotonic electrolyte oral rehydration solutions should be taken to prevent hyponatremia rather than plain water. Some patients receiving PEG may achieve adequate bowel preparation without consuming the full 4 L. Therefore, patients should discontinue the oral bowel-cleansing agent if their diarrhea becomes clear.⁴⁸

Chronic kidney disease

Information about renal function in patients is important in order to identify an appropriate bowel preparation agent. The most important factor in acute phosphate nephropathy after OSP use is pre-existing chronic kidney disease. Kidney function should be evaluated in patients with any of the known predisposing conditions of kidney disease. With chronic kidney disease, OSP should be avoided. For early chronic kidney disease, PEG or SPMC are acceptable. Cases with late chronic kidney disease without dialysis should be prescribed with PEG or PEGA. SPMC have a risk of hypermagnesemia in patients with kidney disease without dialysis. Thrombosis through arteriovenous fistulae for hemodialysis could be accompanied with dehydration and hypotension. Because PEG may expand intravascular volume, the schedule of dialysis should be adjusted according to the intravascular volume status. In order to preserve the residual renal function, intravascular volume depletion should be avoided in patients with peritoneal dialysis.

Heart failure

PEG is the best oral bowel preparation agent for patients with heart failure. Because heart failure, a risk factor of acute phosphate nephropathy, is accompanied by a reduction in GFR, patients with significant heart failure should not receive OSP.

Liver cirrhosis

Because liver cirrhosis is a risk factor for acute phosphate nephropathy by OSP, PEG is the best oral bowel preparation agent.

Use of ACEI or ARB, diuretics, and NSAID

ACEI or ARB use should be discontinued on the day of administration of oral bowel preparation agents and until 3 days following the colonoscopy. Renal function during ACEI use is prone to aggravate during hypovolemia. ARB intensifies bicarbonaturia by promoting calcium and phosphate precipitation, the risk of acute phosphate nephropathy with OSP. PEG is advisable in patients who use diuretics. In patients taking diuretics, intravascular volume status and electrolyte balance may be imbalanced. Therefore, discontinuation of diuretics should be considered with bowel preparation agent. NSAIDs should be discontinued on the day of administration of oral bowel preparation agents and until 3 days after the colonoscopy.⁵

CONCLUSIONS

Effective colonoscopy requires an adequate level of cleansing as a basic component. A low-fiber diet is an independent predictor of adequate bowel preparation. Improved bowel cleansing does not result from the routine use of enemas or prokinetics in addition to oral bowel preparation. Generally, a split method of 4 L PEG on the day before and the day of colonoscopy is recommended and valid alternatives are 2 L PEGA or 2 L SPMC. PEG-based bowel preparation is advisable in most situations in terms of safety concerns.

Conflicts of Interest

The author has no financial conflicts of interest.

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