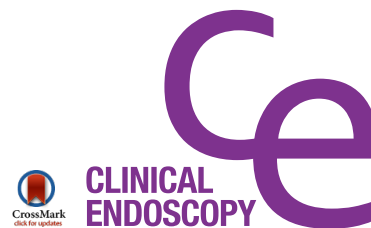


REVIEW

Clin Endosc 2016;49:346-349
http://dx.doi.org/10.5946/ce.2016.094
Print ISSN 2234-2400 • On-line ISSN 2234-2443



Open Access

Predictors of Inadequate Bowel Preparation and Salvage Options on Colonoscopy

Ju Sung Sim and Ja Seol Koo

Division of Gastroenterology and Hepatology, Department of Internal Medicine, Korea University College of Medicine, Seoul, Korea

Inadequate bowel preparation is observed in more than 25% of all colonoscopies. Identification of predictive factors for inadequate colon cleaning is helpful and more detailed preparation methods should be used for patients at high risk. Age, male sex, inpatient status, and comorbidities were identified as independent risk factors in several previous studies. In patients with insufficient colon preparation, colon irrigation with endoscopic pumps or next-day colonoscopy following further bowel cleaning should be performed. In order to improve the efficacy and safety of both bowel preparation and colonoscopy, the endoscopic team should identify the patient's medical conditions and choose the optimal bowel preparation agent and regimen. **Clin Endosc 2016;49:346-349**

Key Words: Bowel preparation; Colonoscopy; Colon cleaning

INTRODUCTION

Colonoscopy is regarded as the most effective tool for colorectal screening in older patients (>50 years of age) with an average risk of colorectal cancer and in younger patients with a high risk of colorectal cancer.¹

Decreased incidence of colon cancer is associated with optimal colonoscopic examination of the entire colon. Regardless of indication, the success of colonoscopy is closely related to adequate colon preparation. However, it has been reported that inadequate bowel cleaning is observed in approximately 25% of all colonoscopies.^{2,3} Adverse results of insufficient colon cleaning include decreased adenoma detection and cecal intubation rates, prolonged procedural times, and shortened surveillance intervals.³⁻⁶

Numerous studies have investigated the risk factors of

inadequate bowel cleaning⁷⁻⁹ and found that it occurs more frequently in patients with a history of insufficient colon cleaning, polypharmacy (due to the effect of constipating medication), obesity, old age, male patients, and in those with combined medical diseases such as diabetes mellitus, stroke, dementia, and Parkinson's disease.¹⁰⁻¹² In addition, poor compliance with bowel cleaning procedures, inadequate administration of bowel preparation agent, and prolonged pre-procedure waiting times have been shown to result in poor colon cleaning.^{11,12} It is crucial that physicians bear these numerous modifiable factors in mind, with the aim of reducing the incidence of failed colonoscopies and to improve results. In this section, patient-associated risk factors for inadequate colon cleaning and salvage methods will be discussed.

PATIENT-RELATED RISK FACTORS OF INADEQUATE BOWEL PREPARATION

Several studies have reported that advanced age is a predictive factor for inadequate bowel cleaning in colonoscopy. One retrospective study showed that patients aged older than 66 years were associated with insufficient bowel cleaning for colonoscopy.¹² In two recent studies in Asia, patients aged older than 60 years were found to be closely associated with

Received: July 1, 2016 Revised: July 18, 2016

Accepted: July 18, 2016

Correspondence: Ja Seol Koo

Division of Gastroenterology and Hepatology, Department of Internal Medicine, Korea University Ansan Hospital, Korea University College of Medicine, 123 Jeokgeum-ro, Danwon-gu, Ansan 15355, Korea
Tel: +82-31-412-5580, Fax: +82-31-412-5582, E-mail: jskoo@korea.ac.kr

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

inadequate colon cleaning.^{13,14}

It is recognized that advanced age is associated with decreased colon transit, increased comorbidity, and polypharmacy; all of which are known risk factors for poor colon cleansing.¹⁵⁻¹⁹ However, a large-scale prospective study found that age was not likely to affect the quality of bowel cleaning for colonoscopy,²⁰ although patient mean age (56 years) was significantly lower than that reported by other studies.

Studies conducted in both the West and the East^{20,21} have previously reported that male sex is an independent risk factor for inadequate bowel cleaning. In a study of 649 patients, 141 patients were shown to have undergone poor bowel preparation and male sex was found to be a significant predictive factor for poor bowel cleaning.²⁰

The relationship of comorbidities with optimal bowel preparation has previously been investigated in several studies. In a recent study of 300 outpatients who underwent colonoscopies, polypharmacy (defined as more than eight active medications available by prescription), which is an indicator of comorbidities, was found to be a risk factor for inadequate bowel cleaning.²²

Among frequent chronic diseases, diabetes in particular has been consistently associated with inadequate bowel cleaning. In a study of 367 Korean patients, it was demonstrated that the risk of poor bowel cleaning was higher in diabetic patients when compared with non-diabetic patients (odds ratio, 8.6).¹³ Taylor and Schubert²³ used a standard polyethylene glycol (PEG) bowel preparation and showed that the optimal bowel cleaning rate was 97% in non-diabetic patients compared to 62% in diabetic patients. Diabetes is associated with reduced colonic and general gastrointestinal transit,^{24,25} resulting in a higher occurrence of inadequate bowel cleaning.

In addition, stroke and dementia are known to be high risk factors for inadequate bowel cleaning,²⁰ possibly associated with decreased gastrointestinal motility and the patients' capacity to follow bowel cleaning instructions. One study further revealed that previous surgery of the abdominal or pelvic organs was a risk factor for poor bowel cleaning.²¹

In both inpatients and outpatients referred from other clinic, bowel preparation for colonoscopy can be inadequate and is likely associated with comorbidities. Previous studies^{20,21} have shown that inpatient status is associated with increased inadequate bowel cleaning, which is further associated with prolonged immobility and low compliance with preparation procedures, due to underlying disease. In colon surgery, outpatient bowel cleaning has been associated with a better result than that of inpatients, who have increased comorbidities.²⁴

However, a model based on the aforementioned risk factors for inadequate bowel preparation has been shown to have a prediction rate of just 60%.¹¹ Therefore, in patients

undergoing their first colonoscopy, the European Society of Gastrointestinal Endoscopy (ESGE) guidelines do not recommend the use of this model for identifying those with a high risk of poor colon cleaning and modifying the colon preparation.²⁶

SALVAGE OPTIONS FOR INADEQUATE PREPARATION

In patients with insufficient bowel preparation, the use of endoscopic irrigation pumps or repeated colonoscopy on the following day (after further colon cleaning) is recommended by the ESGE guidelines, although evidence supporting these approaches is weak.²⁶

If patients with a high risk of inadequate preparation can be identified before colonoscopy, salvage options to improve the quality of bowel preparation could be used before sedation. In patients with brown liquid or solid effluent, the probability of inadequate bowel preparation has been reported to be 54%.²⁷ In such cases, additional bowel cleaning using large-volume enemas or extra oral purgatives could be performed.

The usefulness of an endoscopic enema as a salvage method at colonoscopy has been previously described.^{28,29} In those studies, patients were able to use the bathroom to remove residual fluid. One study investigated the method in 21 adults (mean age, 66 years) with insufficient bowel preparation.²⁹ After inserting the colonoscope as proximally as possible, enemas of either sodium phosphate (133 mL/19 g) followed by bisacodyl (37 mL/10 mg), or two bisacodyl, were administered into the colon via the colonoscope channel. After administration of the enema, successful colon preparations were reported in all cases. Another study evaluated 26 adults (median age, 59 years) using the Aronchick scale for assessment of preparation quality on the rectosigmoid colon.²⁸ In those patients with insufficient bowel preparation, a salvage enema with PEG (500 mL) was applied on the area of hepatic flexure through an accessory channel of the colonoscope. By adapting the method, 25 patients (96%) were converted to cases of successful bowel preparation (excellent or good).

The main cause of failure at second colonoscopy was insufficient colon preparation (23%) among patients undergoing a second examination due to inadequate cleaning at first colonoscopy.³⁰ In such cases, examination on the following day could improve bowel preparation as opposed to examination at any other time.

In a study of adult patients with a previous inadequate preparation for colonoscopy, an intensive bowel preparation method was performed before the second examination.³¹ Us-

ing the Boston Bowel Preparation Scale (BBPS), a score of 0 or 1 on any segment was regarded as inadequate preparation at first colonoscopy. In such cases, the intensive preparation method included a low-fiber diet for 3 days, followed by a liquid diet the day before colonoscopy. On the evening of the colonoscopy, bisacodyl (10 mg) with PEG-electrolyte lavage solution (ELS; 1.5 L) was administered. A second dose of PEG-ELS (1.5 L) was provided on the day of the examination. Using this method, 90% of patients were scored as having optimal cleaning on the BBPS (≥ 2 for each segment).

CONCLUSIONS

Adequate bowel preparation is crucial to the efficacy and safety of the colonoscopy procedure. However, bowel preparation is limited by the patient's special conditions; such as age, sex, and underlying diseases that can prevent compliance with bowel preparation orders. Therefore, it is essential that the endoscopy team identifies the patient's special situation and selects a proper cleaning agent and regimen, including supplemental measures, in order to improve the efficacy and safety of bowel preparation and hence colonoscopy.

Conflicts of Interest

The authors have no financial conflicts of interest.

REFERENCES

- Johnson DA, Barkun AN, Cohen LB, et al. Optimizing adequacy of bowel cleansing for colonoscopy: recommendations from the US Multi-Society Task Force on Colorectal Cancer. *Am J Gastroenterol* 2014;109:1528-1545.
- Vanner SJ, MacDonald PH, Paterson WG, Prentice RS, Da Costa LR, Beck IT. A randomized prospective trial comparing oral sodium phosphate with standard polyethylene glycol-based lavage solution (Golytely) in the preparation of patients for colonoscopy. *Am J Gastroenterol* 1990;85:422-427.
- Kolts BE, Lyles WE, Achem SR, Burton L, Geller AJ, MacMath T. A comparison of the effectiveness and patient tolerance of oral sodium phosphate, castor oil, and standard electrolyte lavage for colonoscopy or sigmoidoscopy preparation. *Am J Gastroenterol* 1993;88:1218-1223.
- Cohen SM, Wexner SD, Binderow SR, et al. Prospective, randomized, endoscopic-blinded trial comparing precolonoscopy bowel cleansing methods. *Dis Colon Rectum* 1994;37:689-696.
- Afridi SA, Barthel JS, King PD, Pineda JJ, Marshall JB. Prospective, randomized trial comparing a new sodium phosphate-bisacodyl regimen with conventional PEG-ES lavage for outpatient colonoscopy preparation. *Gastrointest Endosc* 1995;41:485-489.
- Golub RW, Kerner BA, Wise WE Jr, et al. Colonoscopic bowel preparations: which one? A blinded, prospective, randomized trial. *Dis Colon Rectum* 1995;38:594-599.
- Rex DK, Bond JH, Winawer S, et al. Quality in the technical performance of colonoscopy and the continuous quality improvement process for colonoscopy: recommendations of the U.S. Multi-Society Task Force on Colorectal Cancer. *Am J Gastroenterol* 2002;97:1296-1308.
- Rex DK, Petrini JL, Baron TH, et al. Quality indicators for colonoscopy. *Am J Gastroenterol* 2006;101:873-885.
- Chokshi RV, Hovis CE, Hollander T, Early DS, Wang JS. Prevalence of missed adenomas in patients with inadequate bowel preparation on screening colonoscopy. *Gastrointest Endosc* 2012;75:1197-1203.
- Wexner SD, Beck DE, Baron TH, et al. A consensus document on bowel preparation before colonoscopy: prepared by a task force from the American Society of Colon and Rectal Surgeons (ASCRS), the American Society for Gastrointestinal Endoscopy (ASGE), and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). *Gastrointest Endosc* 2006;63:894-909.
- Hassan C, Fuccio L, Bruno M, et al. A predictive model identifies patients most likely to have inadequate bowel preparation for colonoscopy. *Clin Gastroenterol Hepatol* 2012;10:501-506.
- Nguyen DL, Wieland M. Risk factors predictive of poor quality preparation during average risk colonoscopy screening: the importance of health literacy. *J Gastrointest Liver Dis* 2010;19:369-372.
- Chan WK, Saravanan A, Manikam J, Goh KL, Mahadeva S. Appointment waiting times and education level influence the quality of bowel preparation in adult patients undergoing colonoscopy. *BMC Gastroenterol* 2011;11:86.
- Chung YW, Han DS, Park KH, et al. Patient factors predictive of inadequate bowel preparation using polyethylene glycol: a prospective study in Korea. *J Clin Gastroenterol* 2009;43:448-452.
- Schiller LR. Clinical pharmacology and use of laxatives and lavage solutions. *J Clin Gastroenterol* 1999;28:11-18.
- Gallagher P, O'Mahony D. Constipation in old age. *Best Pract Res Clin Gastroenterol* 2009;23:875-887.
- Heppner HJ, Christ M, Gosch M, et al. Polypharmacy in the elderly from the clinical toxicologist perspective. *Z Gerontol Geriatr* 2012;45:473-478.
- Cameron AJ, Shaw JE, Zimmet PZ. The metabolic syndrome: prevalence in worldwide populations. *Endocrinol Metab Clin North Am* 2004;33:351-375.
- Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics: 2012 update. A report from the American Heart Association. *Circulation* 2012;125:e2-e220.
- Ness RM, Manam R, Hoen H, Chalasani N. Predictors of inadequate bowel preparation for colonoscopy. *Am J Gastroenterol* 2001;96:1797-1802.
- Bowles CJ, Leicester R, Romaya C, Swarbrick E, Williams CB, Epstein O. A prospective study of colonoscopy practice in the UK today: are we adequately prepared for national colorectal cancer screening tomorrow? *Gut* 2004;53:277-283.
- Lebwohl B, Wang TC, Neugut AI. Socioeconomic and other predictors of colonoscopy preparation quality. *Dig Dis Sci* 2010;55:2014-2020.
- Taylor C, Schubert ML. Decreased efficacy of polyethylene glycol lavage solution (golytely) in the preparation of diabetic patients for outpatient colonoscopy: a prospective and blinded study. *Am J Gastroenterol* 2001;96:710-714.
- Lee EC, Roberts PL, Taranto R, Schoetz DJ Jr, Murray JJ, Collier JA. Inpatient vs. outpatient bowel preparation for elective colorectal surgery. *Dis Colon Rectum* 1996;39:369-373.
- Hunter A, Mamula P. Bowel preparation for pediatric colonoscopy procedures. *J Pediatr Gastroenterol Nutr* 2010;51:254-261.
- Hassan C, Bretthauer M, Kaminski MF, et al. Bowel preparation for colonoscopy: European Society of Gastrointestinal Endoscopy (ESGE) guideline. *Endoscopy* 2013;45:142-150.
- Fatima H, Johnson CS, Rex DK. Patients' description of rectal effluent and quality of bowel preparation at colonoscopy. *Gastrointest Endosc* 2010;71:1244-1252.e2.
- Horiuchi A, Nakayama Y, Kajiyama M, et al. Colonoscopic enema as rescue for inadequate bowel preparation before colonoscopy: a prospective, observational study. *Colorectal Dis* 2012;14:e735-e739.
- Sohn N, Weinstein MA. Management of the poorly prepared colonos-

- copy patient: colonoscopic colon enemas as a preparation for colonoscopy. *Dis Colon Rectum* 2008;51:462-466.
30. Ben-Horin S, Bar-Meir S, Avidan B. The outcome of a second preparation for colonoscopy after preparation failure in the first procedure. *Gastrointest Endosc* 2009;69(3 Pt 2):626-630.
31. Ibáñez M, Parra-Blanco A, Zaballa P, et al. Usefulness of an intensive bowel cleansing strategy for repeat colonoscopy after preparation failure. *Dis Colon Rectum* 2011;54:1578-1584.