Predictors of Inadequate Bowel Preparation and Salvage Options on Colonoscopy

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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.

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.4,6

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
inadequate colon cleaning.\textsuperscript{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.\textsuperscript{15-19} However, a large-scale prospective study found that age was not likely to affect the quality of bowel cleaning for colonoscopy,\textsuperscript{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\textsuperscript{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.\textsuperscript{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.\textsuperscript{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).\textsuperscript{13} Taylor and Schubert\textsuperscript{23} 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,\textsuperscript{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,\textsuperscript{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.\textsuperscript{21}

In both inpatients and outpatients referred from other clinics, bowel preparation for colonoscopy may be inadequate and is likely associated with comorbidities. Previous studies\textsuperscript{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.\textsuperscript{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%.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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%.\textsuperscript{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.\textsuperscript{28-30} 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.\textsuperscript{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 Akronchick scale for assessment of preparation quality on the rectosigmoid colon.\textsuperscript{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.\textsuperscript{31} 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.\textsuperscript{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.

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