

Effect of Functional Status on the Quality of Bowel Preparation in Elderly Patients Undergoing Screening and Surveillance Colonoscopy

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Background/Aims: Optimal bowel preparation is essential for successful screening or for surveillance colonoscopy (SC). Inadequate bowel preparation is associated with older age, the male gender, and the presence of certain comorbidities. However, the association between patients' functional status and bowel preparation quality has not been studied. We prospectively examined the relationship between functional status, namely, the ability to perform activities of daily living (ADLs) and ambulate, and the quality of bowel preparation in elderly patients undergoing SC. **Methods:** Before undergoing SC, 88 elderly patients were surveyed regarding their functional status, specifically regarding their ability to perform ADLs and ambulate a quarter of a mile. Gastroenterologists then determined the quality of the bowel preparation, which was classified as either adequate or inadequate. Then, the frequency of inadequate bowel preparation in patients who did or did not experience difficulty performing ADLs and ambulating was calculated. **Results:** Difficulty ambulating (unadjusted odds ratio [OR], 4.83; $p < 0.001$), difficulty performing ADLs (OR, 2.93; $p = 0.001$), and history of diabetes (OR, 2.88; $p = 0.007$) were significant univariate predictors of inadequate bowel preparation. After adjusting for the above variables, only difficulty ambulating (adjusted OR, 5.78; $p = 0.004$) was an independent predictor of inadequate bowel preparation. **Conclusions:** Difficulty with ambulation is a strong predictor of inadequate bowel preparation in elderly patients undergoing SC. (*Gut Liver* 2016;10:569-573)

Key Words: Colonoscopy; Bowel preparation; Geriatric; Practice improvement

INTRODUCTION

Colorectal cancer (CRC) is the second leading cause of cancer-related mortality in the United States, with over 50,000 deaths in 2013.^{1,2} Colonoscopy is the preferred modality for CRC screening, as its accuracy in detecting and resecting CRC and its precursor lesions reduce disease mortality.³ A clean colon is critical for successful colonoscopy. Inadequate bowel preparation can lead to decreased adenoma detection rate, aborted procedures, increased procedure time, and worsened patient discomfort.^{4,5}

Studies demonstrate that the most commonly used preparation type, polyethylene glycol (PEG), has a mean frequency of inadequate preparation of 28%.⁶ Several demographic and clinical factors have been associated with suboptimal colonic preparation, including older age, male gender, presence of comorbidities such as diabetes and stroke disease, and the use of opiate pain medications and tricyclic antidepressants (TCAs).⁷⁻⁹ However, the association between patients' functional status and bowel preparation quality has not been studied.

Successful completion of bowel preparation is an especially challenging process for elderly patients, as they have to obtain the preparation solution, determine a schedule for administering the preparation, modify their diet and other medications, and use the restroom frequently. Toileting requires intact cognition and the ability to transfer to and from the bathroom. Patients who cannot easily ambulate may fear incontinence and take less of the preparation solution than prescribed.

In this study, we prospectively examined the relationship between a two-item assessment of functional status and the

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quality of bowel preparation in elderly patients undergoing first time screening or surveillance colonoscopy (SC).

MATERIALS AND METHODS

This prospective study was conducted between September 2013 and June 2014 at the gastrointestinal endoscopy unit at Mount Sinai Medical Center, a tertiary-care academic hospital in New York, NY. Institutional Review Board permission was obtained and all patients signed informed consent (Study ID# IF1488050, approved 3/26/13). Patients were eligible for the study if they were ≥ 65 years old, asymptomatic, and scheduled to undergo outpatient first-time screening or polyp SC. Patients were excluded if they had a symptomatic indication for colonoscopy or had a personal history of CRC, inflammatory bowel disease, colectomy, or colostomy. We determined indication for procedure by reviewing office notes, endoscopy orders, and booking indication.

A total of 88 elderly patients were surveyed regarding functional status prior to undergoing SC. Our evaluation of functional status was adapted from the Schonberg index,¹⁰ and was based on self-report of patient's ability to perform activities of daily living (ADLs; "Because of physical, mental, or emotional problems, do you need the help of any other persons in handling routine needs such as everyday household chores, doing necessary business, shopping, or getting around for other purposes?") and ambulate ("By yourself, and without equipment, how difficult is it for you to walk a quarter of a mile or about three city blocks?"). Regarding ADLs, patients who answered "Yes" were characterized as having difficulty with ADLs, while those who answered "No" were characterized as having no difficulty with ADLs. Regarding ability to ambulate, patients who answered "A little difficult to very difficult" or "Can't do at all/do not do" were characterized as having difficulty with ambulation, while those who answered "Not at all difficult" were characterized as having no difficulty with ambulation. Patients were asked these questions during the preprocedure assessment on the day of the colonoscopy. The following data were also collected during preprocedure interview and confirmed via chart abstraction: age, sex, history of diabetes, history of stroke disease, and use of certain medications (opiates, TCAs) within 6 months of colonoscopy.

All patients received a standard split dose bowel preparation, comprised of PEG-3350 and bisacodyl. Specifically, on the day before the study, patients were advised to drink only clear liquids, take two 5-mg bisacodyl tablets at 4:00 PM, and consume 2 out of 4 total liters of PEG solution mixed with water between 5:00 PM and 6:00 PM. On the day of colonoscopy, patients were instructed to complete the remaining 2 liters of PEG solution 6 hours before procedure and to stop all oral consumption 3 hours before procedure. While time of procedure varied during the day, the above intervals were standardized because previous

studies have shown that the relationship between the time that patients finish preparation ingestion and colonoscopy start time impacts preparation quality.⁶ Only patients who successfully completed the entirety of the bowel preparation were surveyed for this study. Gastroenterologists then determined the quality of bowel preparation. Cleansing was evaluated on a standard institutional four-point scale using the following criteria: "excellent" (no or nearly no fecal material in the colon with small amount of clear liquid), "good" (small amounts of liquid fecal material in the colon suctioned out easily so that entire mucosa could be observed), "fair" (moderate amounts of thick, semisolid fecal material that could be suctioned such that 90% of mucosa could be observed), and "poor" (large amounts of solid fecal matter such that less than 90% of colonic mucosa could be observed).⁷ Cleansing scores of excellent and good were categorized as "adequate preparation," whereas scores of fair and poor were categorized as "inadequate preparation."

SPSS version 20.0 (IBM SPSS Inc., Armonk, NY, USA) was used to perform all statistical analyses. Descriptive statistics were used to characterize the demographics of the population. Chi-square tests were used to evaluate whether there was a difference in bowel preparation quality between patients who were able to perform ADLs with and without difficulty as well as patients who were able to ambulate with and without difficulty at the $p=0.05$ level. After similar analyses was performed to examine the relationship between bowel preparation quality and age, sex, diabetes, stroke, and use of opiate pain medications, and TCAs, a multivariate logistic regression model was designed to evaluate the confounding effect of these variables.

RESULTS

Table 1 shows the clinical characteristics of the patients at study entry. The mean age of the population was 71.6 years, and 51% of the patients were men. With regard to functional status, 36 patients (40.9%) reported difficulty with ambulation and 20 patients (22.7%) reported difficulty with performing ADLs. Overall colon preparation quality was considered inadequate (fair or poor) in 26 patients (29.5%). No adverse events were reported and the adenoma detection rate was 36.3%, consistent with institutional standards.

Difficulty ambulating ($p<0.001$), difficulty performing ADLs ($p=0.001$), and history of diabetes ($p=0.007$) were significant univariate predictors of inadequate bowel preparation (Table 2). The unadjusted odds ratio (OR) was 4.83 (95% confidence interval [CI], 2.15 to 10.97) for difficulty ambulating, 2.93 (95% CI, 1.62 to 5.25) for difficulty with ADLs, and 2.88 (95% CI, 1.47 to 5.65) for diabetes. There was no correlation between age and gender with respect to bowel preparation quality. Additionally, history of stroke, use of opiates, and use of TCAs were not predictors of inadequate colon preparation quality.

Multivariate modeling results are shown in Table 3, adjusted

for the three variables found significant in univariate analysis. In the final model, only difficulty ambulating (adjusted OR, 5.78; 95% CI, 1.78 to 18.80) was shown to be an independent predictor of inadequate colon preparation.

DISCUSSION

Adequate bowel preparation is critical for successful detec-

tion of CRC and precancerous lesions, ensuring colonoscopy completeness,¹¹ and limiting procedural risk and examination time.^{12,13} The economic implications of inadequate bowel preparation are substantial, as unsatisfactory colonoscopies warrant repeat procedures.⁴ Given the need to improve bowel preparation quality, recent research, including the new U.S. Multi-Society Task Force on Colorectal Cancer guidelines on bowel preparation, has aimed to identify demographic and clinical predictors of inadequate colon preparation.¹⁴

Herein, we sought to examine the association between functional status and inadequate bowel preparation. While prior studies have examined the influence of age, gender, comorbidities, and medication use on colon preparation, the influence of ability to ambulate and ability to perform ADLs on bowel preparation has never been quantified to our knowledge. We found that difficulty with ambulation was an independent risk predictor of inadequate bowel preparation. The odds of suboptimal colon preparation were nearly six times higher in patients who reported difficulty ambulating than patients who did not. The ability to ambulate well is essential for patients to successfully complete the various steps of preprocedure bowel preparation, failure of which is a commonly cited reason for suboptimal

Table 1. Clinical Characteristics of the Patients at Study Entry

Characteristic	Value
Demographics	
Age, yr	71.6±4.7
Male	45 (51.1)
Female	43 (48.9)
Clinical history	
Difficulty with ambulation	36 (40.9)
Difficulty with ADLs	20 (22.7)
Diabetes	35 (39.8)
Stroke	6 (6.8)
Opiate analgesics	14 (15.9)
TCAs	6 (6.8)
Bowel preparation	
Adequate	62 (70.5)
Excellent	1 (1.1)
Good	61 (69.3)
Inadequate	26 (29.5)
Fair	20 (22.7)
Poor	6 (6.8)

Data are presented as mean±SD or number (%). This table provides the demographic information and clinical characteristics of all patients enrolled in the study.

ADLs, activities of daily living; TCAs, tricyclic antidepressants.

Table 3. Multivariate Regression Analysis of Risk Factors for Inadequate Preparation

Factor	Adjusted OR*	95% CI	p-value
Difficulty with ambulation	5.78	1.78–18.80	0.004
Difficulty with ADLs	2.60	0.77–8.82	0.125
Diabetes	1.91	0.63–5.78	0.252

This table shows the multivariate modeling results after adjusting the data for the three variables that were significant in the univariate analysis.

OR, odds ratio; CI, confidence interval; ADLs, activities of daily living. *Adjusted for all variables found to be significant in the univariate analysis.

Table 2. Results of the Univariate Analysis

Characteristic	Adequate bowel preparation (n=62)	Inadequate bowel preparation (n=26)	p-value
Demographics			
Age, yr	71.2±4.3	72.5±4.9	0.802
Male sex	31 (50.0)	14 (53.8)	0.742
Clinical history			
Difficulty with ambulation	16 (25.8)	20 (76.9)	<0.001
Difficulty with ADLs	8 (12.9)	12 (46.2)	0.001
Diabetes	19 (30.6)	16 (61.5)	0.007
Stroke	4 (6.5)	2 (7.7)	0.833
Opiate analgesics	9 (14.5)	5 (19.2)	0.581
TCAs	5 (8.1)	1 (3.8)	0.474

Data are presented as the mean±SD or number (%). This table compares the recorded characteristic frequencies between patients with an adequate bowel preparation and those with an inadequate preparation, allowing us to calculate the unadjusted odds ratio for inadequate preparation.

ADLs, activities of daily living; TCAs, tricyclic antidepressants.

colon cleansing.⁶ Elderly patients with limited mobility might not ingest the required preparation volume due to the physical toll of having to repeatedly walk to obtain more solution or frequently walk to the restroom to defecate. The fear of fecal incontinence due to the challenge of ambulating to the restroom could further impede preparation ingestion. Another reason for the association between difficulty ambulating and inadequate bowel cleansing could be diminished intestinal motility. Prior research has demonstrated decreased mass colonic movements and peristalsis during periods of immobility,^{15,16} although these studies have been limited by size and the pathogenesis of this change in motility is unknown.

Interestingly, while both difficulty with ADLs and history of diabetes were significantly associated with inadequate bowel preparation in univariate analysis, these effects disappeared in multivariate analysis. The ability to ambulate is a prerequisite to performing ADLs, such as completing household chores and shopping. The influence of the ability to perform ADLs on bowel preparation likely disappeared at the multivariate level because 80% of patients reporting difficulty with ADLs also reported difficulty with ambulation. Chung *et al.*⁷ reported a history of diabetes to be their strongest clinical predictor of suboptimal colon preparation (adjusted OR, 8.6; $p < 0.001$). Similarly, Taylor and Schubert¹⁷ demonstrated that an adequate bowel preparation was found in 97% of nondiabetic patients compared to 62% of diabetic patients. Diabetes impedes gastrointestinal motility and delays colonic transit times,^{18,19} which are potential mechanisms that underlies its potent effect on bowel preparation. However, these previous studies did not consider ambulation status. When difficulty with ambulation was added to our multivariate model, the previously significant influence of diabetes disappeared. Besides demonstrating the strength of the association between difficulty ambulating and suboptimal colon preparation, this effect suggests that diabetes could be a confounding variable rather than a true predictor and warrants the inclusion of ambulation status in future multivariate analyses of predictors of inadequate bowel preparation.

Our study has several limitations. First, our small sample size may have precluded finding other significant predictors of inadequate bowel preparation, namely difficulty with ADLs and history of diabetes. This may also explain the lack of association with stroke, and use of opiates and TCAs. Second, we only included patients ≥ 65 undergoing SC and excluded those with history of certain prior gastrointestinal diseases or surgeries. These exclusion criteria may have excluded sicker patients potentially more likely to take opiate analgesics or TCAs, impeding our ability to examine the association between these medications and suboptimal bowel preparation. Finally, due to our age restriction, we cannot generalize that difficulty ambulating will predict suboptimal bowel preparation in the younger population.

The present results can hopefully be used to reduce the inci-

dence of inadequate bowel preparation. Realizing that patients who have difficulty ambulating are at increased risk for inadequate bowel preparation, gastroenterologists can target this population with specific interventions. Physicians can enlist the help of family members or home health aides to oversee bowel preparation efforts in these patients, ensuring that these caregivers are well informed about preparation instructions. Additionally, such caregivers can be advised specifically to help patients with ambulating to and from the restroom. Alternatively, such patients could be provided with bedside commodes, to limit the need for repeated transferring. Finally, a longer or more intensive preparation regimen may be indicated for such patients, including options such as a prolonged period clear liquid diet or double administration during a 2-day period. The U.S. Multi-Society Task Force recommends avoidance of sodium phosphate preparation for elderly patients in these scenarios due to the potential for electrolyte abnormalities. However, overall tolerance of bowel preparation has been found to be similar between octogenarians and young patients.^{20,21}

In conclusion, inadequate bowel preparation for colonoscopy is a substantial problem that gastroenterologists face, with appreciable clinical and economic costs. Our novel finding that difficulty with ambulation is highly associated with inadequate bowel preps lays the foundation for interventions to improve this metric of colonoscopy quality.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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