Does constipation predict the quality of bowel preparation during colonoscopy?

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ABSTRACT

Background Suboptimal bowel preparation has several consequences, including reduced polyp detection rate and increased cost of colorectal cancer screening. The presence of constipation is thought to be a feature associated with poor bowel preparation.

Objectives To characterise the relationship between features of constipation and the quality of bowel preparation during colonoscopy.

Design Patients presenting for an outpatient colonoscopy were asked to complete a questionnaire which included demographics, type of bowel purgative and features of bowel movements (BMs)—derived from the ROME III criteria for diagnosis of chronic constipation.

Patients 101 patients from the community undergoing surveillance colonoscopy completed the study.

Interventions Patients underwent standard bowel preparation, completed a pre-endoscopy survey, followed by routine surveillance colonoscopy.

Main outcome measurements The endoscopist rated the quality of bowel preparation using the previously validated Ottawa scoring scale. Statistical analysis was performed to characterise the relationship between the existence of chronic constipation and quality of bowel preparation.

Results BM frequency of <1/day, 1/day, 2/day, or 3/day was inversely correlated with average total Ottawa score (range 5.93 to 4.00, $p=0.028$) as well as recto-sigmoid Ottawa score (range 1.8 to 1.0, $p=0.006$). Among women, there was a statistically significant ($p=0.025$) association between those who reported hard stools (Ottawa=6.3) and those who denied hard stools (4.5).

Conclusion Eliciting features of BMs before colonoscopy may predict those at risk for poor bowel preparations and increase cost effectiveness of colonoscopy.

Background

Effectiveness of colonoscopy, regardless of the indication, is dependent to a large

degree on the quality of bowel preparation. A suboptimal bowel purge reduces detection rates of small and large polyps,¹ prolongs caecal intubation and withdrawal rates² and significantly adds to the overall cost of colonoscopy and colon cancer screening.³

Several factors have been identified which may predict the adequacy of bowel preparation. Ness *et al* prospectively examined the relationship between various patient characteristics and the status of bowel preparation for colonoscopy. Approximately 20% of 649 patients had inadequate colonic preparation. Among the features significantly associated with poor bowel preparation was constipation.⁴ Previously reported studies have supported the association between a history of constipation and prolonged caecal intubation rates during colonoscopy.^{5 6}

Introduction

The purpose of this study was to better characterise the relationship between a personal history of chronic constipation and the quality of bowel preparation. The questions designed to elicit a history of constipation are derived from the guidelines found in the ROME III criteria.⁷ Additionally, we used the Ottawa scale as an objective, validated score to assess the quality of bowel preparation endoscopically.⁸ Our hypothesis was that the presence and/or degree of chronic constipation, as assessed by the medical history, positively correlated with a suboptimal bowel preparation as observed at colonoscopy and assessed as numerical values based on the Ottawa scale.

Methods

Study setting and patient population

This study was conducted in the endoscopy unit at St Vincent's Catholic Medical Center in Manhattan, New York, USA. It was approved by the internal review

board committee of our hospital. Between July 2008 and January 2009, patients who met the inclusion criteria were asked to complete a questionnaire before a colonoscopy. The patients were previously scheduled for outpatient colonoscopies for various indications, including colon cancer screening, rectal bleeding and constipation. Most subjects were 'service' patients, initially seen in the gastrointestinal (GI) clinic by the GI fellows—the remainders were considered 'private' and referred by GI attendances. The patients were of various races, ethnicities and ages (table 1).

Inclusion/exclusion criteria

Patients included were those scheduled for an outpatient colonoscopy. The procedural indication was not part of the inclusion criteria; however, most patients were scheduled for colon cancer screening, rectal bleeding or chronic constipation. Additional inclusion criteria were successful completion of the entire bowel preparation and documented caecal intubation. If a particular questionnaire was completed, but the subsequent colonoscopy did not achieve caecal intubation, the questionnaire was discarded.

Patients excluded from the study—that is, not asked to complete the questionnaire, included those who

were hospital inpatients, those who did not complete the bowel purgative prescribed for them and those who were not able to give an accurate history of bowel movements (BMs). This group included patients with advanced dementia, and those with significant language barriers. Patients were included irrespective of the type of bowel preparation used. Questionnaires that were found to be incomplete were not included in the data analysis.

Questionnaire

The questionnaire included demographic information—for example, age, race, sex, as well as inquiries designed to elicit features of constipation derived from the Rome III criteria for the diagnosis of chronic constipation.

Colonoscopy was performed using paediatric colonoscopes in the usual method for caecal intubation and withdrawal. Following the test, the endoscopist rated the quality of preparation using the previously validated⁸ Ottawa scoring scale.

Each major segment of the bowel (recto-sigmoid/left, transverse and right colon) was individually assessed with a scale from 0 to 4. A score of 0 was considered 'excellent', indicating mucosa clearly visible with minimal stool residue. A score of one was considered 'good' with some turbid fluid or stool, yet with visible mucosa. A score of 2 indicated a 'fair' assessment with residual stool obscuring the mucosa, however mucosal detail became clear with suctioning. A score of 3 marked 'poor' preparation with stool obstructing mucosal detail and required both wash and suctioning to clear. Finally, a score of 4 indicated an 'inadequate' preparation, with solid stool obscuring mucosal detail despite aggressive wash and suctioning.

In addition to the segmental assessment, a global score was given to each patient's bowel preparation. This score ranged from 0 to 2 and reflected the total fluid quantity throughout the colon. A score of 0 indicated a small amount of fluid, 1 a moderate amount of fluid and 2 a large amount of fluid. Once completed, a total score was calculated by adding the three segmental scores and the global score. The total score ranged from 0 to 14, with 0 indicating a perfect preparation and 14 indicating a completely unprepared colon.

Statistical analysis

Results were entered into a software database (Microsoft Excel; Microsoft). Statistical analysis was performed using SPSS V.16.0 (SPSS, Chicago, Illinois, USA). One-way analysis of variance was used to compare categorical variables with more than two values—for example, preparation type and nationality with the total Ottawa score, a continuous variable. Pearson's correlation coefficient was used to establish an association between number of BMs per day—an interval variable—and colon segments, global and total Ottawa scores—that is, continuous variables. Categorical variables with two values such as hard consistency and straining during BM were compared with continuous

Table 1 Descriptive data on all surveys returned (all study participants)

Demographics	
Sex	69 male, 32 female
Private patient (n (%))	16 (15.8)
Age (years)	mean 55.4, range 25–81
Ethnicity(n (%))	
African-American	32 (31.6)
Hispanic	28 (27.7)
White	35 (34.7)
Other	6 (6.0)
Preparation type (n (%))	
GoLyteLy	85 (84.2)
Fleet	8 (7.9)
HalfLyteLy	5 (5.0)
Moviprep	1 (0.9)
MgCit	2 (2.0)
Survey questions	
BM frequency (n (%))	
1/day	50 (49.5)
2/day	21 (20.7)
3/day	10 (9.9)
4/day	3 (3.0)
5/day	2 (2.0)
3/week	8 (7.9)
2/week	5 (5.0)
1/week	2 (2.0)
Straining (n (%))	22 (21.8)
Hard, n ((%))	24 (23.8)

BM, bowel movement.

variables—for example, right, mid, recto-sigmoid, global and total Ottawa scores using a Student *t* test. Logistic regression was used to identify a predilection for race and BM characteristics. Ordinal regression was used for colon segment Ottawa scores and global scores, while linear regression was used for total Ottawa scores to determine factors and covariates that were independently associated with a poor preparation. *p* Values <0.05 were considered statistically significant and *p* values <0.10 were considered to be marginally significant.

Results

Demographics

A total of 101 patients who underwent colonoscopy completed and returned the questionnaire. The demographic characteristics of survey respondents are summarised in table 1. Men comprised the majority of participants (*n*=69), with an average age of 55.4 years among the sample size. There were no statistically significant associations between age and BM frequency (*p*>0.5) or characteristics (*p*>0.5 for straining and 0.323 for consistency).

There were no associations between sex and Ottawa scores for the right (*p*>0.5), transverse (*p*>0.5) and recto-sigmoid colons (*p*=0.234). There was also no association between sex and global score (*p*=0.499), or sex and total Ottawa score (*p*>0.5). Age appeared to have no association with Ottawa scores of the right colon (*p*>0.5), transverse colon (*p*=0.272) or recto-sigmoid colon (*p*=0.359). Age also did not correlate with total Ottawa score (*p*=0.479) or global score (*p*>0.5).

For the racial groups, African-American, White and Hispanic each represented approximately one-third of survey respondents (*n*=32, 35 and 28, respectively). There was no association between race and BM frequency (*p*=0.295). Additionally, logistic regression showed no predilection for race when compared with straining with BMs or self-reported hard stools. The Ottawa score did not differ significantly when comparing race for the right colon (*p*>0.5), transverse colon (*p*>0.5) or recto-sigmoid colon (*p*>0.5). There was also no significant association between race and global score (*p*=0.211), or between race and total Ottawa score (*p*>0.5).

Eighty-five participants were 'service' patients, while the remainder was considered 'private'. A comparison of 'service' patients with 'private' patients showed no association with total Ottawa score (*p*>0.5), global score (*p*>0.5), right colon (*p*>0.5), transverse colon (*p*=0.144) or recto-sigmoid colon (*p*=0.156) Ottawa scores.

Bowel preparation

Bowel preparations used are summarised in table 1. The majority (*n*=85) of patients underwent colon preparation with polyethylene glycol-3350 (PEG-3350) solution (GoLytely, Braintree Labs, Braintree,

Massachusetts, USA). The total Ottawa score showed a significant association among the different preparations (*p*=0.038). Whereas magnesium citrate had the highest mean total Ottawa (8.50), sodium biphosphate/sodium phosphate (Fleet Phospho soda, C.B. Fleet Labs, Lynchburg, Virginia, USA) and PEG-3350/electrolytes/bisacodyl (HalfLytely, Braintree Labs, Massachusetts, USA), had the lowest at 3.50 and 5.2, respectively.

BM frequency

The self-reported characteristics of BM are summarised in table 1. Almost half (50) of the patients reported a BM once daily. Twenty-one patients reported a BM twice daily, while 15 patients reported more than two BMs per day. Fifteen surveys reported a BM less than once per day and of those: 53.3% (eight) reported BMs three times per week, 33.3% (five) reported twice per week and 13.3% (two) reported one BM a week. There was no association between sex and BM frequency (*p*=0.300).

Among all study participants, as the number of BMs per day increased, the total Ottawa score decreased (figure 1). This association achieved statistical significance (*p*=0.028). Further analysis showed a significant inverse relationship between number of BMs per day and recto-sigmoid Ottawa score (*p*=0.006, figure 2) as well as global score (*p*=0.041, figure 3). The association between right colon and BM frequency achieved only marginal statistical significance (*p*=0.108). Finally, there was no association between transverse colon Ottawa score and BM frequency (*p*=0.201). When analysed to control for type of bowel preparation, those who took GoLytely (*n*=85) showed a marginally significant inverse relation between BM frequency and recto-sigmoid, global score and total

Figure 1 Comparison of self-reported bowel movement (BM) frequency (BM frequency per day) and mean total Ottawa score among all study participants, as assessed by the endoscopist (*p*=0.028).

Figure 2 Comparison of self-reported bowel movement (BM) frequency (BM frequency per day) and mean recto-sigmoid Ottawa score among all study participants, as assessed by the endoscopist ($p=0.006$).

Ottawa score ($p=0.084$, 0.057 and 0.096 , respectively). Right and transverse colon failed to show a relationship with BM frequency among those who took GoLytely.

BM characteristics

Women were significantly more likely ($p=0.046$) to report straining (34%, $n=11$) than men (16%, $n=11$). Twenty-two per cent ($n=15$) of men and 31% ($n=10$) of women reported hard stools with the majority of BMs—a difference that is not statistically significant ($p=0.346$).

Patients who reported a hard consistency with most BMs had an average transverse colon Ottawa score of 1.76, compared with an average of 1.36 among patients who denied hard stools ($p=0.055$). This association was determined to be marginally significant, even when controlled for preparation type ($p=0.077$). There was no association with straining and transverse colon Ottawa score ($p=0.416$). Neither straining nor hard stool consistency had an association with either right colon or recto-sigmoid Ottawa scores (results not shown). In addition, the total Ottawa score was not associated with either straining ($p>0.5$) or hard stools ($p=0.176$).

For women who reported a hard consistency to most stools, the average total Ottawa score was 6.3, compared with 4.5 among women who denied hard stools (figure 4, left), a statistically significant difference ($p=0.025$). In the GoLytely group, women reporting hard stools continued to show significantly higher total Ottawa scores ($p=0.046$). Women who were 'service' patients had an average total Ottawa score of 4.7 compared with an average of 6.4 for 'private' patients (figure 4, right). This difference achieved marginal statistical significance ($p=0.054$). Controlling for

Figure 3 Comparison of self-reported bowel movement (BM) frequency (BM frequency per day) and mean global score among all study participants, as assessed by the endoscopist ($p=0.041$).

preparation type in this group was not feasible as only two female private patients took GoLytely.

Global scores showed no association between those who reported straining with most BMs and those who did not report straining with most BMs ($p=0.122$). Finally, patients with hard consistency to their stools had an average global score of 0.76 compared with 0.49 for patients who denied hard stools, a difference that was marginally statistically significant ($p=0.064$). However, this relationship did not show significance when controlled for bowel preparation type ($p=0.109$).

Discussion

In accordance with the overall diversity present in our endoscopy suite, the racial breakdown in the study was approximately 30% each African-American, Caucasian and Hispanic. Constipation has been reported more in non-Caucasian than in Caucasian subjects in North America.⁹ Overall, however, there was no significant difference in the Ottawa scores among the different ethnic groups. In addition, for total Ottawa scores, no significant difference was noted between men and women.

Similarly, advanced age by itself did not predict a higher Ottawa score. Overall, age appeared to have no impact on the frequency or characteristics of BMs. Older people have been observed to have overall poor preparations.¹⁰ This may be due to poor compliance with large-volume purgatives. However, based on our results, age would not be expected to influence the quality of bowel preparation.

An important goal of our study was to explore the association between BM frequency as well as BM characteristics (straining, stool consistency), both established features of chronic constipation and the quality of bowel preparation. Previous studies have

Figure 4 (Left) Comparison of self-reported average stool consistency (hard, yes or no) and mean total Ottawa score ($p=0.025$). (Right) Comparison of 'service' versus 'private' patients and mean total Ottawa score ($p=0.054$).

described a relationship between a self-reported history of constipation and suboptimal bowel preparation.^{6–8} However, these studies were limited in that constipation was either recorded as a yes/no patient response,⁸ or defined simply by the number of BMs per week.^{6,7}

This study was more comprehensive in that it used three established clinical features of the ROME III criteria for chronic constipation: frequency and consistency of BMs and straining during BMs.¹¹ It was then possible to correlate each feature independently with an endoscopic assessment of bowel preparation.

While men and women were equally likely to report hard BMs, there was a statistically significant association among women between hard stools and higher total Ottawa score—that is, suboptimal bowel preparation. This correlation held when analysed independently of bowel preparation, specifically among those using GoLytely. While the incidence of constipation is known to be higher in women,^{12,13} it is unclear why a reported history of hard BMs would correlate with a suboptimal bowel preparation in women but not men.

There were two notable findings with respect to BM frequency. First, among all participants, as the number of daily reported BMs increased, the total Ottawa score as well as the recto-sigmoid component score decreased independently of preparation type. The implication could be that people with several BMs a day are likely to have more complete bowel preparations. This supports a common observation that those with loose stools or chronic diarrhoea are more likely

to respond successfully to bowel purgatives than those with fewer daily BMs.

In addition, a marginally significant association was found between low BM frequency and high total Ottawa score among men. Interestingly, while straining was reported more often in women than men, the presence of straining did not appear to predict the quality of bowel preparation in either men or women.

Findings comparing 'service' patients and 'private' patients were also observed. 'Service' patients had Medicaid insurance and were initially seen in our fellow's clinic. 'Private' patients possessed private insurance and were referred from an attending doctor's office. Lack of social support, low levels of education and language barriers represent some of the challenges in preparing this patient population for outpatient colonoscopies. Yet surprisingly, female service patients had a significantly lower total Ottawa score than female private patients (figure 4, right). However, there was no difference between all service and private patients in the total Ottawa score. While service patients present an array of challenges in preparation for an outpatient colonoscopy, our data do not support difficulties in bowel preparation in this group.

As part of the patient questionnaire, the type of preparation was also recorded. A variety of published studies have compared bowel regimens by the quality of preparation during colonoscopy.^{6,14,15} Fleet Phospho Soda and HalfLytely corresponded to the lowest total Ottawa scores. These results are consistent with previous reports suggesting that preparations with smaller volumes are associated with improved bowel preparations.^{14–16} Of note, after the data collection process, Fleet Phospho Soda was removed from the market owing to a risk of worsening kidney function.^{17,18}

Our study had several limitations. First, owing to resource constraints, the endoscopist was often collecting demographic and clinical history from the subjects. Therefore the study was not blinded and this might have resulted in operator bias. Second, the definition of constipation includes more features than used in our questionnaire—for example, sense of incomplete evacuation, sense of rectal blockage and insufficient criteria for a diagnosis of irritable bowel syndrome-constipation. It is conceivable that some patients in the study met criteria for constipation but did not report the features listed on the questionnaire. Time limitations between procedures prevented a more comprehensive history of each subject. Finally, other features of the medical history may have altered the quality of bowel preparation. For example, common drugs such as antihypertensive agents and narcotics may cause constipation, while certain antiretroviral drugs used to treat the HIV virus are known to cause chronic diarrhoea.

Poor bowel preparation represents a significant barrier to high-quality examinations and this results in

a heavy financial burden on the healthcare system.³ The ability to predict the quality of bowel preparation based on a patient's history may help to tailor a preparation regimen, which may ultimately improve visualisation during the examination. Preprocedure medical evaluation of patients and analysis of other features of constipation—for example, incomplete evacuation and sense of rectal blockage, may predict those who have poor preparations. Future studies may examine a more complete evaluation of constipation, more aggressive bowel regimens in these 'susceptible' patient groups and whether such regimens improve bowel preparation.

Competing interests None.

Ethics approval This study was conducted with the approval of the institutional review board of St Vincent's Catholic Medical Center.

Provenance and peer review Not commissioned; externally peer reviewed.

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