

Risk Factors Predictive of Poor Quality Preparation during Average Risk Colonoscopy Screening: the Importance of Health Literacy

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Abstract

Background. Inadequate colonoscopy bowel preparation can lead to increased procedural time, decreased diagnostic yield, and an increased complication rate. Little is known about which patient characteristics may predict poor bowel preparation for routine, average-risk colonoscopy evaluation. **Methods:** 300 consecutive patients who underwent routine, average risk outpatient screening colonoscopy during 01/01/2005 to 12/30/2008 at a primary care internal medicine clinic were retrospectively identified. Patients were between 50-80 years old and used the standard preparation of 2000ml polyethylene glycol solution (MoviPrep®). Differences in mean values between each group (inadequate vs. adequate preparation) were compared using the Student t-test. Categorical variables were compared using χ^2 test. A multivariate logistical regression analysis was performed to identify characteristics predictive of poor colonoscopy preparation. **Results.** Of the 300 consecutive patients referred for routine outpatient colonoscopy examination, 15% had inadequate or poor colonoscopy preparation. The majority of patients with poor colonoscopy preparation (86.7%) reported either failure to complete the 2000 ml preparation or failure to follow written instructions. In the multivariate model, the four biggest clinical contributors to poor colonoscopy were an interpreter requirement, Medicaid insurance, single status, and having more than 8 active prescription medications. **Conclusions.** Among patients who underwent average-risk screening colonoscopy evaluation, the use of an interpreter and having Medicaid insurance were the largest predictors of inadequate colonoscopy preparation. These characteristics may be surrogate markers of lower health care literacy. Interventions to reduce poor colonoscopy preparation should be targeted at these patient populations.

Key words

Screening colonoscopy – colon cancer – poor preparation.

Introduction

Colorectal cancer (CRC) is a leading cause of cancer-related deaths in the United States [1]. Early detection and removal of adenomatous polyps reduces the risk for development of CRC [2]. Colonoscopy is considered the gold-standard in diagnosis of adenomatous polyps and CRC because of its high accuracy of detection and ability to concomitantly biopsy or resect lesions. However, the success of colonoscopy examination is highly dependent upon the quality of bowel preparation [3, 4]. Inadequate bowel preparation can result in procedural complications, lower diagnostic yield, and prolonged procedural time [5].

Prior studies have demonstrated that later colonoscopy starting time, a reported failure to follow preparation instructions, inpatient status, taking tricyclic antidepressants, male gender, history of diabetes, and prior abdominal surgeries were all independent predictors of an inadequate colon preparation [5, 6]. A recent, large retrospective study confirmed these prior findings while also demonstrating that unmarried status and Medicaid insurance status were strongly associated with suboptimal bowel preparation [7]. While these studies indexed patients who underwent colonoscopy evaluation for all indications (e.g., constipation, anemia, polyps, etc), little is known about whether patient factors play a role in predicting poor colonoscopy preparation in average-risk colonoscopy examination. Identifying these high risk patient characteristics will allow primary care physicians and gastroenterologists to derive more targeted interventions in order to optimize bowel preparation.

Methods

Patient selection

A group of 300 consecutive patients who underwent routine, average risk outpatient screening colonoscopy

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evaluation during January 1, 2005 to December 30, 2008 at an academic primary care internal medicine continuity clinic was retrospectively identified. Patients included in the study were required to be between 50-80 years old and use the standard preparation of 2000ml polyethylene glycol solution (MoviPrep®). Patients were excluded from the study if they used an alternative bowel preparation regimen; had a colonoscopy for an indication other than routine screening; had the colonoscopy performed as an inpatient; had a repeat colonoscopy during the indexed period secondary to inadequate bowel preparation. The study protocol was approved by the Mayo Clinic Institutional Review Board.

Data collection

Patient demographics, medical history, and colonoscopy reports were collected through reviewing the institutional electronic medical record on at least two separate occasions to ensure data accuracy. Inadequate colonoscopy preparation was defined by a colonoscopy report with phrases of “inadequate bowel preparation” or “poor visualization secondary to poor bowel preparation.”

Statistical analysis

The distribution of patient clinical characteristics was summarized overall and by specific subgroups (adequate vs inadequate colonoscopy preparations) with percentages for categorical variables and mean for continuous variables. Differences in mean values between each group were compared using the Student t-test. Categorical variables were compared using χ^2 test. Variables that were found to be statistically significant in the univariate analysis predicting poor colonoscopy preparation were assessed in the multivariate logistic regression modeling. In the final model, a $p < 0.05$ was considered statistically significant.

Results

Baseline patient characteristics

Of the first 300 consecutive patients who were referred for routine, average risk, outpatient colonoscopy examination in our Primary Care Internal Medicine clinic during 2006-2008, 45 patients (15%) had inadequate or poor colonoscopy preparation. The majority of patients with poor colonoscopy preparation (86.7%) reported either failure to complete the 2000ml preparation (68.9%) or failure to follow written instructions on dietary restrictions or timing of preparation 24 hours prior to scheduled colonoscopy (29.8%). The mean age at the time of colonoscopy evaluation was 63 years with a slight male predominance (52.0%). Of the 45 patients with inadequate colonoscopy preparation, a total of 33 (73.3%) patients had a repeat colonoscopy within 12 calendar months. The mean waiting time from receiving instructions for colonoscopy bowel preparation to time of colonoscopy was 4.39 weeks. Mean body mass index (BMI) of the patient population was 28.57, with more than one-third of the patients ($n=92$) having a BMI greater than 30. Patient characteristics are summarized in Table I.

Table I. Baseline patient characteristics (N= 300)

Mean age at time of colonoscopy, years \pm SD	63.09 \pm 9.14
Number of poor preparation on colonoscopy	45
a) Failure complete entire 2000ml regimen	31/45 (68.9%)
b) Failure follow dietary restriction or timing instructions	8/45 (17.8%)
c) Unknown	6/45 (13.3%)
Female	144 (48.0%)
Single or widowed status	110 (36.7%)
Interpreter requirement	37 (12.6%)
Mean number of active prescriptions \pm SD	6.05 \pm 3.09
Mean waiting time to colonoscopy, weeks \pm SD	4.39 \pm 2.01
History of prior colonoscopy in the past 10 years	14 (4.7%)
Proportion with Medicaid insurance	38 (12.7%)
Diabetes mellitus	34 (11.3%)
Prior abdominal surgery	25 (8.3%)
Mean body mass index \pm SD	28.57 \pm 5.95

Univariate model predicting poor colonoscopy preparation

The study population was dichotomized into two groups - inadequate colonoscopy preparation ($n=45$) and adequate colonoscopy preparation ($n=255$). Compared to the adequate colonoscopy preparation group, patients in the inadequate colonoscopy preparation group were older; more likely to be widowed or single; more likely to require an interpreter; were likely to have more active prescription medications (8.18 medications/patient versus 5.67 medications/patient); higher proportion with Medicaid insurance; higher proportion of diabetics; and higher proportion of patients with prior abdominal surgery (Table II).

Multivariate model predicting poor colonoscopy preparation

In the multivariate model, the four biggest clinical contributors to poor colonoscopy were an interpreter requirement, Medicaid insurance, single status, and having more than 8 active prescription medications (Table III). In our cohort, having three of four of these characteristics accurately predicted inadequate colonoscopy preparation with a sensitivity of 67% and specificity of 89%.

Older age, diabetes, and a history of prior abdominal surgery also predicted higher risk for poor colonoscopy preparation.

Discussion

High quality colon cleansing improves detection of colonic lesions, shortens total procedural time, and results in lower rates of complications during colonoscopy evaluation. The rate of poor colonoscopy preparation in our cohort is 15%, which is less than prior reports of rates of nearly 30% among patients using the PEG-based solution [5, 8]. The lower rate of poor colonoscopy preparation in our study is explained by the fact that our study only indexed patients

Table II. Univariate analysis of patient's characteristics predicting poor colonoscopy preparation

	Inadequate colonoscopy preparation (N = 45)	Adequate colonoscopy preparation (N=255)	p-value
Mean age at time of colonoscopy, years \pm SD	66.24 \pm 2.70	62.52 \pm 1.13	0.0131
Female	20 (44.4%)	124 (48.6%)	0.6308
Single status	31 (68.9%)	79 (31.0%)	<0.0001
Interpreter requirement	19 (42.2%)	18 (7.1%)	<0.0001
Mean number of active prescription medications \pm SD	8.18 \pm 0.98	5.67 \pm 0.36	<0.0001
Mean waiting time to colonoscopy, weeks \pm SD	4.04 \pm 0.45	4.26 \pm 0.26	0.2567
History of prior colonoscopy in the past 10 years	6 (13.3%)	19 (7.5%)	0.2367
Proportion with Medicaid insurance	22 (48.9%)	18 (7.1%)	<0.0001
Diabetes mellitus	16 (35.6%)	18 (7.1%)	0.0152
Prior abdominal surgery	13 (28.9%)	12 (4.7%)	<0.0001
Mean body mass index	27.86 \pm 1.94	28.69 \pm 0.73	0.3862

Table III. Multivariate analysis of patient characteristics predicting poor colonoscopy preparation (N= 300, R-squared=0.68)

	Poor colonoscopy preparation* (95% CI)	p-value
Age at time of colonoscopy, per decade	1.76 (1.29, 2.22)	0.0055
Single or widowed status	6.72 (2.49, 9.78)	<0.0001
Interpreter requirement	15.17 (4.49, 20.6)	<0.0001
\geq 8 active prescription medications	6.22 (5.12, 8.56)	<0.001
Medicaid insurance	8.70 (3.34, 15.78)	0.0105
Diabetes mellitus	4.97 (1.24, 6.01)	<0.001
Prior abdominal surgery	4.27 (3.45, 19.57)	0.0077

*Relative to adequate colonoscopy preparation group

who underwent routine, average-risk outpatient screening colonoscopy evaluation rather than all patients who underwent colonoscopy examination. The majority of patients (86.7%) who had poor colonoscopy preparation reported either failure to complete the total required volume or failure to follow written instructions on dietary restrictions and timing of preparation, suggesting that there may be specific patient characteristics predictive of barriers to understanding preparation instructions accurately. Identification of these high risk patients will allow for more targeted interventions at promoting improved patient instructions and education regarding colonoscopy preparation.

Consistent with prior reports of patients receiving colonoscopy for any indication, we confirmed that older age, single or widowed status, having diabetes, a prior abdominal history, and having government-sponsored (Medicaid) insurance all were characteristics predictive of poor colonoscopy preparation in patients undergoing average risk CRC screening [5, 9]. It has been proposed that diabetic patients have underlying altered gastrointestinal dysmotility, which may contribute to delayed transit times. Diabetic patients, irrespective of diabetic control or insulin use, have been shown to have significantly poorer response to standard

PEG preparation compared to non-diabetics [10]. The exact mechanism for higher risk for poor colonoscopy preparation among patients with prior abdominal surgery is uncertain, but it may be related to altered bowel anatomy, resulting in delayed colonic transit.

Our study adds to the literature by demonstrating that low English language literacy (interpreter requirement) was a dramatic predictor of poor colonoscopy preparation. This finding implies that use of targeted native language education interventions should be engaged and evaluated to reduce this gap. Furthermore, this study demonstrated that patients with high medical complexity (more than eight active prescriptions) are much more likely to have a poor preparation. The reason for this is unclear, but may reflect colonoscopy preparation instructions being lost in a list of issues at a busy office counter. In contrast to prior studies, male gender did not appear to be a risk factor [7]. This study is limited by the fact that it is retrospective, observational, and by the availability of particular variables for analysis. Therefore, causality cannot be implied by these findings. Additionally, this is a single center study at an academic medical center and generalizability of our results is unknown, though our findings are consistent with prior reports.

In **conclusion**, among patients who underwent average-risk screening colonoscopy evaluation, the use of an interpreter and Medicaid insurance appears to be the largest predictors of inadequate colonoscopy evaluation. These may be surrogate markers indicative of lower socioeconomic position and limited health care literacy. Therefore, interventions to reduce poor colonoscopy preparation should be developed to target these particular patient populations.

Conflicts of interests

None to declare.

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