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Optimizing bowel preparation for colonoscopy: what are the predictors of an inadequate preparation?



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Abstract

BACKGROUND: This retrospective study evaluates factors that are associated with an inadequate bowel preparation.

METHODS: A chart review was performed on 2,101 patients who underwent colonoscopy. The quality of preparation was classified as adequate or inadequate. Univariate and multivariate regression analyses identified factors associated with inadequate preparations.

RESULTS: A total of 91.5% of preparations were adequate. Standard preparations using polyethylene glycol-electrolyte solution and sodium picosulfate alone were 91.1% adequate. Regimens with adjuncts were 91.9% adequate. Factors that predicted an inadequate preparation include the following: stroke/dementia (odds ratio [OR] 3.5, 95% confidence interval [CI] 1.6 to 7.7, $P = .002$), opioids (OR 2.3, 95% CI 1.1 to 4.6, $P = .02$), male sex (OR 2.0, 95% CI 1.4 to 2.9, $P = .000$), calcium channel blockers (OR 1.9, 95% CI 1.1 to 3.3, $P = .03$), and antidepressants (OR 1.7, 95% CI 1.1 to 2.7, $P = .02$).

CONCLUSIONS: Several factors are associated with inadequate preparations. Adjuncts do not improve preparation quality. The effect of patient education on preparation quality is an area for further research.

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Inadequate bowel preparations are known to jeopardize quality, safety, speed, and efficacy of colonoscopy,^{1,2} and can result in cancelled or incomplete procedures. Both patients and the healthcare system must bear the additional

costs associated with repeat colonoscopies. There is also evidence that inadequate bowel preparations increase the risk of missed adenomas.¹ Lebowohl et al³ found a 42% miss rate for all adenomas in inadequately prepped patients with 27% of them being advanced adenomas.

There is a large body of research focused on determining the superiority of bowel preparations available, with the 2 most common being polyethylene glycol-electrolyte solution (PEG-ES) and sodium picosulfate (SP). All in all, there is no one regimen that is considered superior. More recently, researchers have discovered that certain clinical and demographic factors are associated with

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inadequate preparations. These factors include age,^{4,5} sex,^{3,4,6,7} body mass index (BMI)^{4,7,8} diabetes,^{4,5,7,8} stroke and dementia,⁶⁻⁸ and medications, such as tricyclic antidepressants (TCAs), calcium channel blockers (CCBs), and opioids.⁶⁻¹⁴ However, many studies enrolled small cohorts, were single-centered studies, and methodologies varied greatly. There was also little mention of patient education, which is a factor that could play an important role in determining the quality of bowel cleanse. The purpose of this large, multicenter, retrospective study is to evaluate factors associated with an inadequate bowel preparation. Our study has the unique benefit of having a defined cohort of patients in a screening and surveillance program with an extensive patient education program and a well-regimented data collection process. We hypothesized that there are factors that increase the risk of an inadequate preparation independent of the preparation regimen used.

Methods

This was a retrospective study involving 4 major hospitals on Vancouver Island: Victoria General Hospital (VGH), Royal Jubilee Hospital (RJH), Saanich Peninsula Hospital, and Nanaimo Regional General Hospital. The study was approved by the Vancouver Island Health Authority Ethics Board. We performed a chart review on all consecutive patients who underwent outpatient screening and surveillance colonoscopies at Nanaimo Regional General Hospital, RJH, and VGH between September 2011 and July 2013. The cohort was expanded further to include all consecutive patients who underwent a colonoscopy at VGH, RJH, and Saanich Peninsula Hospital from July 2013 to January 2014. Indications for colonoscopy included a positive family history, positive fecal immunochemical test or fecal occult blood test, history of polyps, and rectal bleeding.

Nurse navigators performed pre-endoscopic documentation on all patients referred for colonoscopy. The following information was systematically collected: (1) demographic data (age, sex, height, weight, BMI); (2) indication for colonoscopy; (3) personal medical and surgical history (medications, chronic diseases, history of cancer, history of abdominal surgery); and (4) personal habits (smoking, alcohol use, bowel movement frequency). The medical and surgical history was obtained from patients as a simple yes or no answer. During our analysis, BMI was divided into categories of underweight (BMI < 18.5), normal (BMI 18.5 to 24.9), overweight (BMI 25 to 29.9), and obese (BMI > 30). Unfortunately, complete data were not available for all 2,101 patients. Therefore, the number of patients with data available under each characteristic varies.

At the time of colonoscopy, endoscopists assessed bowel preparation quality on a predetermined 4-point scale. Endoscopy nurses recorded the quality rating for each patient during the procedure. The ratings used are as follows: (1) "excellent": no more than small bits of

adherent fecal matter; (2) "good": small amounts of fluid or fecal matter not interfering with examination; (3) "fair": fecal matter present but visualization was adequate to detect all polyps greater than 5 mm; and (4) "poor": inadequate to detect all polyps greater than 5 mm. There is slight variability between the rating of excellent and good between institutions because of the subjective interpretation of the amount of fluid in the bowel. For the purpose of this study, we dichotomized the rating into adequate being excellent and good and inadequate being fair and poor. We chose to classify the fair group as inadequate because these patients were recommended a shorter follow-up interval for subsequent colonoscopy than the good and excellent groups. Post-procedure, we calculated the preparation-to-colonoscopy (PC) interval for each patient to assess the association between the PC interval and bowel preparation quality. The PC interval is defined as the time between the last dose of bowel preparation agent and the beginning of the colonoscopy. Studies suggest that the PC interval is more predictive of bowel preparation quality than colonoscopy time.^{15,16} Therefore, we did not assess colonoscopy time in this study.

The data extracted from charts were collected on one Excel spreadsheet and then exported to Stata 13 (StataCorp, Redmond, TX) for statistical analysis. A total of 10% of charts were randomly reviewed to assess data entry accuracy. We allowed for 1% error in primary outcome variables; however, there were no errors found in the charts reviewed.

Our outcome of interest was an inadequate bowel preparation at the time of colonoscopy as determined by the endoscopist. Assuming that 80% of bowel preparations are adequate, with an alpha error of .05 and a beta error of .20, with 80% power to detect a 15% difference between the proportion of patients with an inadequate versus an adequate bowel preparation before colonoscopy, our study needed at least 151 subjects in each group to find a statistically important difference between the groups. At this sample size, if the adequate preparation rate was 75% we would be able to detect a 25% difference in adequacy between the groups. If the adequacy rate is as high as 90%, we would need only 113 patients per group to find a 15% difference in adequacy to be statistically significant.

For demographic and individual variables, normally distributed variables are expressed as the mean, and non-normally distributed variable results are expressed as a median with interquartile range. Proportions are expressed with 95% confidence intervals (CIs) of the estimate.

We employed univariate logistic regression to assess each variable for its association with inadequate bowel preparation (odds of an inadequate preparation). In order for a variable to be considered predictive of inadequate preparation, we defined that the odds ratio (OR) for that association had to be greater than 1, the 95% CI for the estimate of the OR could not include 1, and the variable had to achieve a *P* value of less than or equal to .05.

Multivariate backward stepwise logistic regression analysis was employed to assess which variables in

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