

Predictors of inadequate bowel preparation using two liters of polyethylene glycol for colonoscopy

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Abstract

Background: Inadequate bowel preparation can result in missed pathological lesions and cancellation of procedures thereby increasing the cost and delay in the diagnosis.

Objectives: The aim of the study was to identify the potential predictors of inadequate bowel preparation using 2 liters of polyethylene glycol solution.

Methodology: A prospective study was done, which included 138 consecutive patients who underwent colonoscopy over a period of 6 months. Patient's demographics, medical history, and preparation quality were collected and compared. Factors associated with inadequate bowel preparation were identified by univariate statistics and multivariate logistical regression analysis.

Results: Out of 138 colonoscopy procedure, 119 (86.2%) preparations were adequate and 19 (13.8%) were inadequate. The mean age of the patient was 52.62 (SD ±10.51) years. Out of which, 82 (59.4%) were male and 56 (40.6%) were female. In the multivariate regression analysis, constipation [adjusted OR 8.55, 95% CI 1.79-41.67] and non-compliance [adjusted OR 58.82, 95% CI 5.99-500] were independently associated with inadequate bowel preparation.

Conclusion: Constipation, non-compliance, overweight, neurological disorders like stroke, dementia and age >60 years were associated with inadequate bowel preparation. Early identification of patients with a high risk of inadequate preparation can be salvaged with change in bowel cleaning strategy.

Key words: Colonoscopy; Inadequate bowel preparation; Polyethylene glycol.

INTRODUCTION

Colonoscopy is a key investigation for screening, diagnosis and therapeutic procedure of colon and rectal disorders. It also enables procedures like biopsy and

treatment of polyps and superficial colorectal tumors. It is estimated that about one third of the colonoscopy procedures is performed for screening purposes¹.

Adequate bowel preparation is essential for the successful completion of colonoscopy procedures. Inadequate preparation has an adverse impact on the procedure efficiency and diagnostic yield thereby decreasing the colonic adenoma detection rate and increasing the cost associated with repeated procedures and delay in diagnosis². According to a French epidemiological survey in 1.2 million colonoscopy procedures, about 40% had procedure failure due to inadequate bowel preparation and 5 % had redo colonoscopy³. It has also been reported that about 20-25% of bowel preparation are inadequate^{4,5}.

An ideal bowel cleansing agent should be effective in cleaning the bowel, well-tolerated, and convenient to use, with minimal side effects. Numerous studies are comparing the superiority of different solutions available for bowel preparation in an attempt to improve the

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ways of colonic preparation, with polyethylene glycol (PEG) and Sodium Phosphate (NaP); which is the widely used formulas⁶. However, no one regimen is superior to others in terms of completeness. Recently, it has been mentioned that certain diseases (stroke, diabetes, dementia)⁷ demographic factors (age, sex, body mass index)⁸ and medications (calcium channel blockers, tri-cyclic antidepressant, opioids)^{9,10} are associated with incomplete preparation. Other factors include noncompliance due to discomfort in consuming the solution¹¹ and timing of bowel preparation¹².

The aim of this study was to assess the predictive factors of inadequate bowel preparation and identify those patients who are at high risk for inadequate bowel preparation before colonoscopy procedure so that alternative preparation regimen can be planned accordingly.

METHODOLOGY

A prospective observational study was conducted from June 2019 to November 2019 at Kathmandu Medical College & Teaching Hospital. All patients (>18years) who underwent a routine colonoscopy, irrespective of indications were eligible for the study. Colonoscopy failure was defined as incomplete colonoscopy (no cecal intubation), or complete colonoscopy but requiring a further check colonoscopy due to poor bowel preparation. All participants received verbal and written instructions (English and Nepali) that included a structured low-fiber diet on second pre procedure days and only liquids on the night before the procedure. Patients were instructed how to mix and drink the bowel preparation solution [A sachet of PEG dissolved in 2L water, two 5 mg bisacodyl tablets at 2 pm followed by 8 oz of PEG solution and oral rehydration solution (ORS) every 15 minutes between 5pm – 8pm the night before the procedure.]

Patients below 18 years of age, history of inflammatory bowel disease, colonoscopy failure due to reasons other than inadequate bowel preparation was excluded from this study. All procedures were performed in the morning without any sedation.

All patients referred for colonoscopy procedure were requested to fill in the pre-procedural questionnaire form. The following data were collected: age, sex, hospital status (inpatient or outpatient), weight, height, indication for colonoscopy, comorbidities, bowel frequency pattern, current medications, past history of colonic or pelvic surgery, physical activity, volume

of solution prepared and compliance with preparation instructions (non-compliance defined as failure to complete 75% of the prepared solution). Constipation was defined according to the Rome III diagnostic criteria for functional gastrointestinal disorders¹³ and body mass index (BMI) was calculated by using the standard formula [weight (kg)/height (m)²].

Ethical approval was taken from the Institutional Review Committee of KMCTH (ref. 310520110) and informed consent was taken from the patients.

The quality of preparation was graded based on the Aronchick scale¹⁴ as Excellent, Good, Fair, Poor and Inadequate. Patients were divided into adequate (excellent, good) and inadequate (fair, poor) groups. Fair appearance on colonoscopy was placed in inadequate group as they were kept on shorter follow-up for next colonoscopy procedure.

Data were analyzed by calculating descriptive statistics for demographic variables and preparation characteristics. Each variable was tested for related association with inadequate preparation. Possible predictors of inadequate bowel preparation defined by Aronchick scale were analyzed using univariate and multivariate logistic regression models. All statistical analyses were performed using the SPSS software package, version 20 (Statistical Package for the Social Sciences, IBM Corporation, Armonk, NY, USA). Variables with p value <0.05 were considered significant.

RESULTS

Patient characteristics

During this study period, 138 colonoscopy procedures were performed out of which 119 (86.2%) preparations were adequate and 19 (13.8%) were inadequate. The mean age of the patient was 52.62 (SD ±10.51) years, out of which, 82 (59.4%) were male and 56 (40.6%) were female.

Comparisons of characteristic between patients with and without adequate bowel preparation for colonoscopy are shown in Table 2. Difference in characteristic frequency between the two outcome groups with a p value of <0.05 was considered significant. Patients with constipation, overweight (25-29.9kg/m²), age >60 years, neurological issues like stroke or dementia, use of anti-depressant drugs, compliance (consumption of less than 75% of the PEG solution) were significant univariate predictors of inadequate bowel preparation. In the multivariate analysis, constipation [adjusted OR 8.55,

95% CI 1.79-41.67] and non-compliance [adjusted OR 58.82, 95% CI 5.99-500] were independently associated

with inadequate bowel preparation. Other factors previously significant in the univariate analysis were not statistically significant in the multivariate analysis.

Table 1: Patient demographic and characteristics (n=138)

Mean age (years)	52.62 (±10.51)
Age	
>60 years	35 (25.4%)
<60 years	103 (74.6%)
Gender (M/F)	82 (59.4%) / 56 (40.6%)
BMI	
Underweight (<18.5kg/m ²)	0 (0%)
Normal (18.5-24.9kg/m ²)	125 (90.6%)
Overweight (25-29.9kg/m ²)	13 (9.4%)
Obese (>30kg/m ²)	0 (0%)
Constipation	16 (11.6%)
History of previous surgery	5 (3.6%)
Compliance	128 (92.8%)
Preparation	
Adequate	119 (86.2%)
Inadequate	19 (13.8%)
Comorbidities	
Hypertension	33 (23.9%)
Diabetes mellitus	8 (5.8%)
Stroke / Dementia	4 (2.9%)
Hypothyroidism	5 (3.6%)
Medications	
Opioids	0 (0%)
Antidepressant / Antipsychotic	3 (2.2%)

BMI- body mass index; M- male; F- female

Table 2: Univariate analysis of predictors for inadequate bowel preparation

	Adequate preparation (n = 119)	Inadequate preparation (n = 19)	P-value
Male gender [N (%)]	69 (58)	13 (68.4)	0.390
Female gender [N (%)]	50 (42)	6 (31.6)	0.390
Age [≥60 years [N (%)]	24 (20.2)	11 (57.9)	0.000
Overweight [N (%)]	7 (5.9)	6 (31.6)	0.000
Constipation [N (%)]	6 (5)	10 (52.6)	0.000
Abdominal surgery [N (%)]	4 (3.4)	1 (5.3)	0.680
Diabetes [N (%)]	7 (5.9)	1 (5.3)	0.915
Stroke/Dementia [N (%)]	1 (0.8)	3 (15.8)	0.000
Tricyclic use [N (%)]	1 (0.8)	2 (10.5)	0.007
Compliance [N (%)]	118 (99.2)	10 (52.6)	0.000
Hypothyroidism [N (%)]	2 (1.7)	2 (10.5)	0.033
Calcium Channel Blocker use [N (%)]	3 (100)	0	0.484

Table 3: Multivariate analysis of predictors of inadequate bowel preparation

	P- value	Adjusted odd's ratio	95% C.I.	
			Lower	Upper
Constipation	.007	8.55	1.79	41.67
Non-compliance	.000	58.82	5.99	500
Hypothyroidism	.029	12.35	1.29	125
Overweight	.173	3.69	0.56	2.44
Age > 60 years	.355	2.06	0.45	9.43
Stroke/ Dementia	.168	8.62	0.40	200
Antidepressant use	.731	1.83	0.05	58.82

Note: p <0.05 considered significant. Both forward and backward models used to decide the final model.

DISCUSSION

In this prospective study, we examined the predicting factors for inadequate bowel preparation using two litres of PEG solution. Our results showed 13.8% of patients undergoing colonoscopy had inadequate bowel preparation, which was consistent with other studies^{7,8,15}. However, our percentage of inadequate bowel preparation is less than the previous reports of nearly 30% in patients using PEG solution for bowel cleaning¹⁶.

We identified several patient characteristics that were independently associated with inadequate bowel preparation, which included constipation, overweight, age >60 years, neurological issues like stroke or dementia, use of anti-depressant drugs and compliance. Patient compliance to bowel preparation technique is an important factor to adequate bowel preparation. We identified that 6.5% of our patients were noncompliant to the preparation instructions. When asked about the reason for non-compliance, they described nausea and vomiting were the primary reasons. We believe preparation with low volume of drinking and low emetic effect would reduce the adverse effect, thereby increasing the compliance. Some studies have shown that misunderstanding the preparation instructions as an important factor for poor preparation quality¹⁵. Therefore, patient's education could be an efficient option in improving bowel preparation^{17, 18}. Another factor for inadequate bowel preparation could be timing of the procedure. Studies have shown that afternoon colonoscopies might have lower success rates with more frequent inadequate bowel preparations¹⁹. Adequate bowel preparation could be achieved if the optimal interval between the last dose of PEG solution and start of colonoscopy was 3-5 hours²⁰.

Out of the other predictors of inadequate bowel preparation, we identified that, our patients with altered

bowel motility were associated with inadequate colonic preparation. Factors like chronic or severe constipation due to intestinal dysmotility, anticholinergic effect of tricyclic antidepressant drugs, and altered bowel motility in hypothyroidism, stroke and dementia were independent risk factors. Constipation and non-compliance were significant predictors in univariate as well as multivariate analysis. The presence of diabetes has been reported as an independent factor for incomplete bowel preparation,^{7, 8, 21} however, in our study diabetes was not a significant (P=0.915) predictor for inadequate bowel preparation. Hospitalized, bed bound patients are also reported to be independent predictors of incomplete bowel preparation due to decreased intestinal motility and non-compliance due to underlying disease^{7, 22}. Previous intestinal surgeries have been reported as a predicting factor for inadequate bowel preparation. This could be secondary to altered bowel motility and advancing age. In our study, previous intestinal surgery was not associated with inadequate bowel preparation (P=0.680).

Obesity is a common metabolic disorder associated with multiple gastrointestinal disorders like colonic polyps and colorectal cancers²³. The impact of obesity on bowel preparation has mixed results till date. Some studies have shown that high BMI (>30kg/m²) is independently associated with inadequate bowel preparation^{24, 25} while others showing no significant impact^{7, 26}. Our study had 9.4% of overweight patients and was identified as an independent predicting factor (P=0.000) for inadequate bowel preparation. Of note, none of our patients were under weight or obese.

Additionally, low socioeconomic status and low health literacy were identified as risk factors because patients were not following the preparation instructions^{22, 27}. Low health education may result in poor understanding of the requirement therefore unable to comply with

the instructions. Our study indicates that few patient specific variables may help to predict patients at risk for inadequate bowel preparation for whom alternative techniques could be employed. In such cases, low fiber diet for 3 days followed by liquid diet only the day before colonoscopy and split dose PEG consumption (one litre in the evening, one litre early morning on the day of procedure) was advised.

Our study has few limitations. This is a single institution study with limited number of patients. Another factor not considered in this study was socioeconomic status and low health literacy of the patient.

CONCLUSION

Inadequately prepared bowel affects the diagnostic yield of colonoscopy thereby increasing the cost with repeated procedures and delay in diagnosis. We found, constipation, non-compliance, overweight, neurological disorders like stroke, dementia and age >60 years were associated with inadequate bowel preparation. If patients with a high risk of inadequate preparation can be identified early, salvage options could be used to improve the quality of bowel preparation.

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