

Low Quality Bowel Preparation in Hospitalized Patients Undergoing Colonoscopy is Frequent and is Associated with the Need for Repeated Procedures

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Received: August 26, 2018; **Published:** September 19, 2018

Abstract

Background: The efficacy and safety of colonoscopy depend on quality of bowel preparation. Inadequate preparation might be more common in hospitalized patients requiring repeated procedures, increased costs and prolonged length of stay.

Objective: To compare the quality of bowel cleansing of inpatients and outpatients, to identify risk factors for inadequate preparation and to calculate added costs and repeated procedures.

Methods: Analysis of prospectively collected data of consecutive patients undergoing colonoscopy at our center during years 2014 - 2015.

Results: We included 9527 colonoscopies, 9083 (95.3%) were outpatients. Inpatients were more commonly male (56.4% vs. 51.6% $p < 0.001$), significantly elder [66.5 vs. 57.66 years old, $p < 0.0001$], and more frequently received preparation with polyethylene glycol (PEG) (66.7% vs 26.4% $p < 0.001$). Quality of bowel preparation was excellent, good/fair, poor or inadequate in 21.6 vs. 32.4%, 26.4 vs. 44.5%, 25.2 vs. 17.8% and 26.8 vs. 5.3% in inpatients vs. outpatients, respectively ($p < 0.0001$). Multivariate logistic regression showed that age (OR 1.008 per year) male gender (OR 1.407), inpatient status (OR 2.645) and constipation as indication (OR 1.401) were independent risk factors for poor preparation; while using sodium picosulfate based preparation (OR 0.644) and female gender (OR 0.71) were protective. Using a pre-specified definition, we found that 11% of all procedures in inpatients needed to be repeated.

Conclusions: Inpatient status was identified as the strongest independent predictor for poor preparation requiring repeated procedures in 11% of patients. Interventions designed to improve quality of bowel preparation in hospitalized patients are needed.

Keywords: Colonoscopy; Bowel Preparation; Inpatients; Pico-Sulfate; Polyethylene Glycol

Abbreviations

ADR: Adenoma Detection Rate; PEG: Polyethylene Glycol

Introduction

Adequate bowel preparation is essential for high quality colonoscopy [1-4]. Poor bowel preparation is associated with missed neoplastic lesions and lower adenoma detection rate (ADR) [5,6]; longer procedural time and lower cecal intubation rates [7]. This may lead to repeated procedures and increased costs [7,8]. Importantly poor preparation has been associated with increased risks and complications for colonoscopy [6,9,10].

In our experience the quality of bowel preparation in hospitalized patients is often poor [11]. Patients undergoing colonoscopy as inpatients are often older and suffer from multiple comorbidities; leading to greater procedural risks [12]. When the preparation is poor the benefit from the procedure may be negligible and in a population with increased risks, the risk-benefit ratio could be considered unacceptable.

Different preparation protocols for colonoscopy have been developed and overall, if done correctly, are highly effective. In general patients are asked to eat a low-residue diet the day preceding colonoscopy and drink 4L of polyethylene glycol (PEG) solution [13] or an equivalently effective laxative. These apparently simple instructions can be very difficult for hospitalized, ill and elderly patients. Additionally, comorbidities, lack of mobility and additional medications may further impair quality of bowel preparation even if the patient succeeds in fulfilling the preparation instructions [11].

To the best of our knowledge only one study to date [4] has prospectively investigated the inpatient status compared to outpatients as a specific cause of inadequate cleansing and they found no difference in the rate of inadequate bowel preparation between inpatients and outpatients [4].

Aim of the Study

The aim our study was to compare the quality of bowel cleansing of inpatients compared to outpatients, to identify risk factors for inadequate preparation and to calculate added costs in a “real life” set-up.

Methods

Patients

At our digestive disease institute, data is collected prospectively at the time of every colonoscopy and is incorporate into the electronic medical record of the patient and into a database. For this study we included all consecutive colonoscopies for any indication performed during the years 2014 and 2015. Bowel preparation was done according to common local practices according to European guidelines [13]. Both commercially available PEG (Meroken New, Taro Pharmaceutical Industries LTD) and sodium picosulfate based (Pico-Salax, Ferring Pharmaceuticals LTD) bowel preparation were acceptable.

Collected data

The database is elaborated automatically from the electronic medical records of the patients during regular, real life clinical practice. Collected data includes age, sex, indication for colonoscopy (screening or surveillance, rectal bleeding, anemia, weight loss, abdominal pain, change of bowel habits, suspected inflammatory bowel disease or after a positive occult blood stool test) and setting (outpatients or inpatient). The details of bowel preparation included only the main type of laxative (PEG or sodium picosulfate based). The efficacy of bowel cleansing was rated using a local version of the Aronchik scale. The Aronchik scale is a validated scoring systems that has been devised to rate the quality of colonoscopy preparation in the colon as a whole (colon segments are not evaluated separately) [6]. It is a simple scale and is easy to use in the busy endoscopy suit. Its rating consists of 5 points:

1. Excellent (> 95% of mucosa seen).
2. Good (clear liquid covering up to 25% of mucosa, but >90% of mucosa seen).
3. Fair (semisolid stool could not be suctioned, but >90% of mucosa seen).
4. Poor (semisolid stool could not be suctioned and <90% of mucosa seen).
5. Inadequate (repeat preparation needed).

Since in points 2 and 3 the end result is visualization of > 90% of the mucosa, at our center we consider these points in the same degree of quality. The endoscopists determined the preparation immediately at the end of each procedure. Therefore this is a retrospective analysis of prospectively collected data from consecutive patients.

Definitions

For the purpose of this study we considered inadequate preparation if less than 90% of the mucosa was seen. For the purpose of cost analysis we defined a procedure as futile (i.e. generating costs and exposing patients to risks without benefit) if the preparation was inadequate and the procedure was repeated for the same indication within 30 days of the index colonoscopy. If the preparation was inadequate but the procedure was not repeated, the index procedure was not considered futile and its cost was not calculated. In order to identify futile procedures we did a manual review of all colonoscopies with inadequate preparation in the inpatient group. We were unable to determine costs adjacent to the futile procedure (mainly complications and increment in length of stay) therefore we knew a priori that our calculations underestimate the “real” increment in cost.

Statistical Analysis

Patients’ data and clinical parameters are given as means with 95% confidence intervals in parenthesis, for normally distributed variables. For categorical variables results are reported as absolute numbers with population proportions (percentages) in parenthesis. To analyze differences in the distribution of categorical data, chi-square test or Fisher exact test was used, as appropriate. Mean differences in continuous variables between the two patient groups (inpatients and outpatients) were analyzed by t-test. Logistic regression with backward stepwise variable selection was used to identify the independent predictors of inadequate bowel preparation. Odds ratios are provided in brackets and 95% confidence intervals in parenthesis. In order to verify whether age and PEG preparation (both significantly related to inpatient status) acted as effect modifiers an interaction term between these variables was included in the model. Two-tailed tests with a significance level of 5% were used in all analyses. All calculations were performed using IBM statistics SPSS v20, Chicago IL.

The study was approved by the Institutional Helsinki Committee of the Shaare Zedek Medical Center.

Results

The complete cohort consisted of 11184 colonoscopies; 10560 (94.4%) were outpatients. Data about quality of bowel preparation were available for 9527 (85.2% of total).

Population (Table 1): In this study we found that at our center, patients that undergo colonoscopy as outpatients and those who undergo the procedure as inpatients represent two substantially different population groups. Inpatients were more commonly male (56.4% vs. 51.6% p < 0.001), significantly elder [66.5 (95% CI 66.79 - 69.46) vs. 57.66 (95% CI 57.36 - 57.95) years old, p < 0.0001], more frequently received preparation with PEG (66.7% vs 26.4% p< 0.001) as opposed to sodium picosulfate and the main indication for colonoscopy was rectal bleeding (37% vs. 9.5% p < 0.001). In outpatients the main indication was screening or surveillance (43.9% vs. 8.2% p < 0.001).

Variable	Outpatients (n = 10560)	Inpatients (n = 624)	P value
Mean age (SD)	57.66 (15.45)	68.13 (17.05)	< 0.0001
Gender (% of females)	49.4	43.6	0.005
Days in hospital before colonoscopy (SD)	n/a	6.1 (7.3)	n/a
Preparation (%)			
PEG	26.4	66.7	< 0.0001
Sodium picosulfate	59.3	8.3	< 0.0001
Other/unspecified	14.3	25	< 0.0001
Indication (%)			
Screening/surveillance	43.9	8.2	< 0.0001
Rectal Bleeding	9.5	37.0	
Abdominal Pain	12.1	8.3	
Occult Blood	6.0	0.2	
Constipation	4.1	2.1	
Anemia	6.6	13.1	
Weight loss	1.3	0.8	
Diarrhea	2.1	3.7	
Suspected IBD	3.5	1.6	
Other	3.6	10.3	
Unspecified	7.3	14.7	

Table 1: Characteristics of the population.

Quality of preparation: Visibility was rated by the endoscopists as excellent, good/fair, poor or inadequate in 21.6 vs. 32.4%, 26.4 vs. 44.5%, 25.2 vs. 17.8% and 26.8 vs. 5.3% in inpatients vs. outpatients, respectively ($p < 0.0001$) (Figure 1). When the quality of preparation was dichotomized as adequate (more than 90% of mucosa seen) or inadequate (less than 90% of mucosa seen) only 48% of inpatients had adequate bowel cleansing compared to 76.9% of outpatients ($p < 0.0001$) (Figure 2).

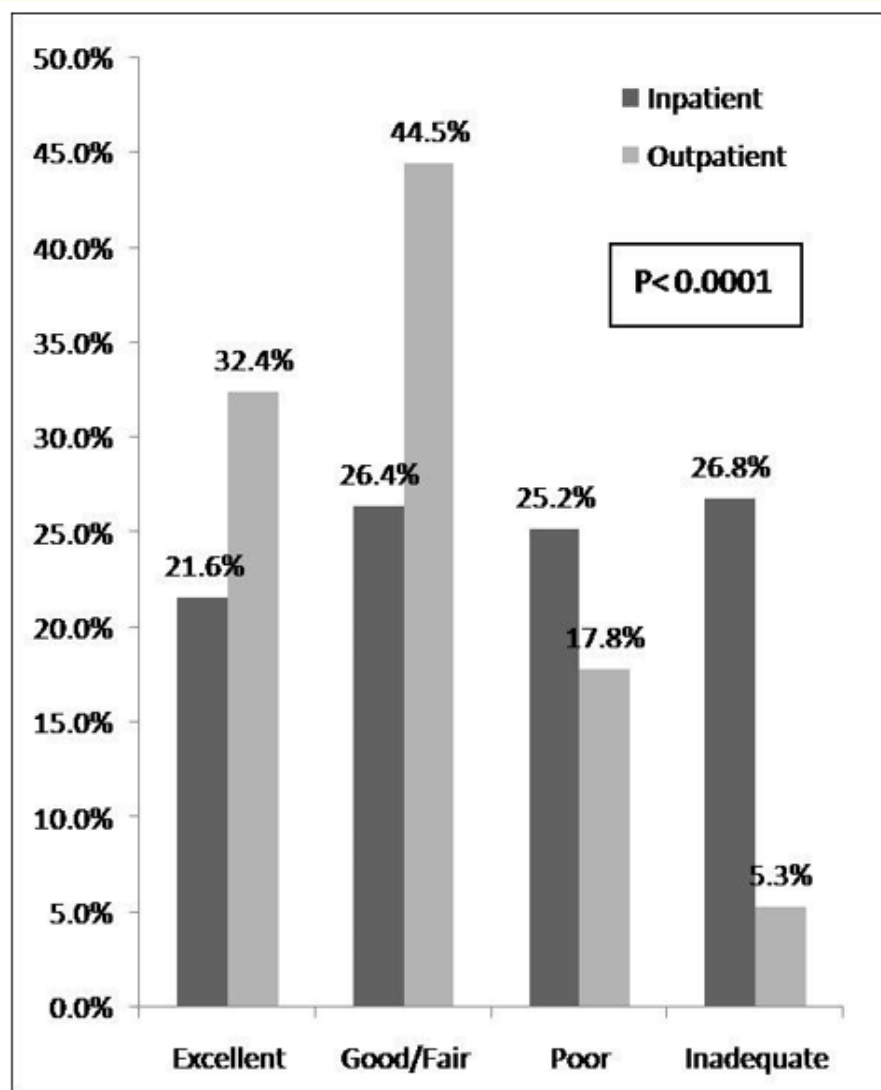


Figure 1: Quality of bowel preparation.

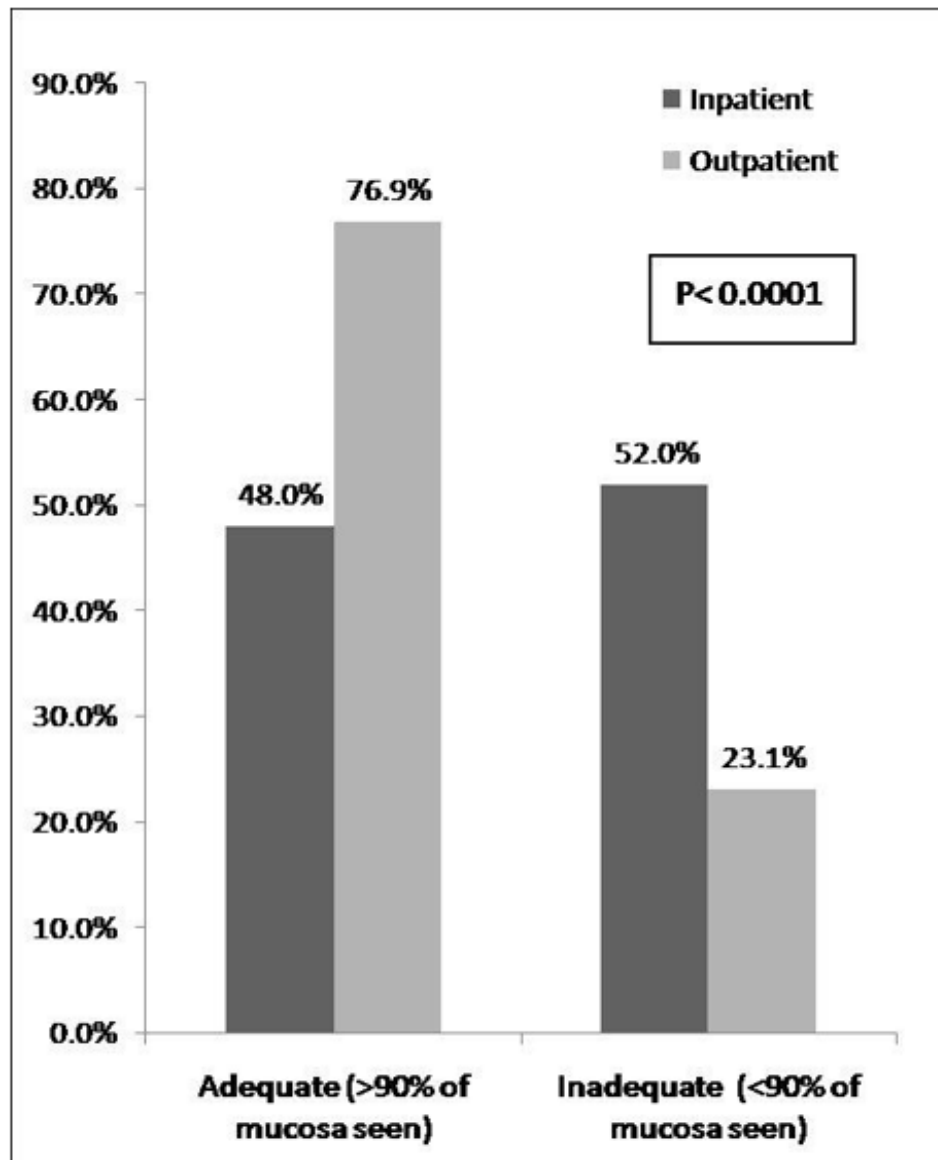


Figure 2: Quality of bowel preparation dichotomized according to overall mucosa seen with a cutoff of > 90%.

Risk Factors for poor preparation: Variables associated with poor preparation at unadjusted logistic regression were, age [OR 1.016 (1.013 - 1.019) per increment in one year], inpatient status [OR 3.611 (2.97 - 4.37)] and preparation with PEG [OR 2.007 (1.818 - 2.215)]; female gender [OR 0.682 (0.620 - 0.749)] and preparation with sodium picosulfate [0.487 (0.443 - 0.536)] were protective (Table 2). In univariate analysis indications associated with poor preparation were: rectal bleeding [OR 1.376 (1.195 - 1.858)], occult blood in stool [OR 1.277 (1.053 - 1.548)], constipation [OR 1.558 (1.256 - 1.932)], and anemia [OR 0.692 (0.521 - 0.920)]. Indications negatively associ-

ated with poor preparation were: screening or surveillance [OR 0.749 (0.679 - 0.827)], abdominal pain [OR 0.818 (0.704 - 0.951)], and suspected IBD [0.692 (0.521 - 0.920)]. Multivariate logistic regression showed that age [OR 1.008 (1.005 - 1.012) per increment in one year] male gender [OR 1.407 (1.272 - 1.555)], inpatient status [OR 2.646 (1.776 - 3.941)] and constipation as indication [1.401 (1.059 - 1.168)] were identified as independent risk factors for poor preparation while using picosulfate preparation [OR 0.644 (0.551 - 0.754)] and female gender [OR 0.71 (0.64 - 0.78)] were protective (Table 2). When the same analysis was applied to the inpatient population alone, only male gender was associated with inadequate preparation [OR 1.9 (1.275 - 2.85)].

Predictors	Unadjusted Odds ratio (95% CI) for poor preparation	P value	Adjusted# Odds ratio (95% CI) for poor preparation	P value
Age	1.016 (1.013 - 1.019)*	< 0.0001	1.008 (1.005 - 1.012)*	< 0.0001
Gender (females)	0.682 (0.620 - 0.749)	< 0.0001	0.711 (0.643 - 0.787)	< 0.0001
Inpatient status	3.611 (2.97 - 4.37)	< 0.0001	2.645 (1.776 - 3.941)	< 0.0001
Preparation				
PEG	2.007 (1.818 - 2.215)	< 0.0001	1.139 (0.963 - 1.348)	< 0.0001
Sodium picosulfate	0.487 (0.443 - 0.536)	< 0.0001	0.644 (0.551 - 0.754)	< 0.0001
Indication				
Screening/surveillance	0.749 (0.679 - 0.827)	< 0.0001	0.822 (0.676 - 1.0)	0.05
Rectal Bleeding	1.376 (1.195 - 1.858)	< 0.0001	1.112 (0.889 - 1.362)	
Abdominal Pain	0.818 (0.704 - 0.951)	0.009	0.883 (0.702 - 1.111)	
Occult Blood	1.277 (1.053 - 1.548)	0.013	1.171 (0.901 - 1.52)	
Constipation	1.558 (1.256 - 1.932)	< 0.0001	1.401 (1.059 - 1.168)	0.017
Anemia	1.329 (1.116 - 1.583)	0.001	1.05 (0.819 - 1.346)	
Suspected IBD	0.692 (0.521 - 0.920)	0.011	0.83 (0.591 - 1.168)	

Table 2: Risk factors for inadequate bowel cleansing at logistic regression analysis.

*: For every increment of one year in age.

#: Adjusted for age, gender, inpatient status, preparation type and indication.

Futile procedures: Using a strict pre-specified definition (procedures that had to be repeated for the same indication within one month due to poor preparation), we found 69 (11%) “futile” procedures that were performed in inpatients; this translates into approximately 30000 USD/year.

Discussion

Inadequate bowel preparation is not uncommon; rates of poor preparation are reported to be between 20 and 25% of all colonoscopies [3]. Insufficient visualization of the mucosa is a major drawback on colonoscopy and is associated with multiple negative outcomes [1-11,13]. The issue of poor preparation in all patients has been extensively studied, the main risk factors are considered to be poor adherence to preparation instructions, erroneous timing of bowel purgative administration, previous inadequate bowel preparation, being single, inpatient status, polypharmacy, obesity, advanced age, male sex, lower health literacy and multiple comorbidities [6,14-16]. Despite being commonly cited, studies specifically examining the inpatient status as a risk factor for poor preparation compared to outpatients and controlling for multiple covariates are scarce.

In a previous Israeli study done at a different medical center [17], 613 outpatients and 209 inpatients were analyzed; hospitalized patients were found to be significantly older (mean age of 68.5 years old), were more dependent on caregivers and suffered from more comorbidity. The indications for colonoscopy were weight loss, rectal bleeding, iron-deficiency anemia, and less often screening or sur-

veillance. PEG was used more often in hospitalized patients than in ambulatory patients for colonoscopy preparation. The hospitalized group was characterized by more incomplete colonoscopies, less adherence to preparation instructions, and in accordance to the findings of our study, more cases of poor preparation. The similarity of the demographic characteristic and outcomes of the hospitalized group in this study to the population in our study is noteworthy and is probably expected as it represents accepted clinical practices in Israel. Interestingly a secondary aim of that study was to assess the impact of a staff educational program on the preparation of hospitalized patients for colonoscopy. The program had no influence on preparation quality.

On the other hand a large prospective Italian study [4] of 1098 inpatients and 2178 outpatients found that inpatient status had no significant effect in bowel cleansing rates. Independent predictors of inadequate cleansing in their cohort were male gender, diabetes mellitus, chronic constipation, incomplete purge intake and a runaway time >12h. The discrepancy between these findings and the findings in our study can be explained by discerning that the demographic and clinical dissimilarities between inpatients and outpatients in the Italian study were less pronounced. In our study, inpatients were significantly older; the primary indication for colonoscopy for inpatients in the Italian study was screening/surveillance while in our study the primary indication was rectal bleeding. In summary the inpatient population in the Italian study is different to the inpatient population in ours.

The reason for poor preparation in hospitalized patients is attributed to patient depended variables, such as comorbidities and additional medications. In our opinion there is at least one additional factor that has not been studied. Despite that we did not look specifically at the diet restrictions and time of purgative regimen in the different departments; in a busy medical or surgical ward, with multiple unstable patients, it is understandable that the colonoscopy preparation for the elderly patient at the end of the hallway would not be the priority of the caring staff. Therefore important aspects of the protocol such as diet and timing of purgative administration could be overlooked.

Our calculations of added costs as we expected was low at first glance. It should be noted that our database allowed us to calculate only a small portion of the total cost, based only on repeated colonoscopies while only the price of futile procedure was calculated. This in conjunction with the strict pre-specified definition for futility led us to an underestimation of the “real” economic burden of the problem; which in our opinion is substantially higher.

The main strengths of our study are the prospectively collected data, the large sample size; indeed this is the largest study comparing these two populations to date, and the fact that all colonoscopies performed during a two year period were included in the analysis. Therefore this can be considered as a population based “real life” study of prospectively collected data.

On the other hand several limitations must be acknowledged. First quality of preparation data were not documented in 14.2% of procedures. Second we were unable to control for significant co-variables; especially compliance with instructions for preparation, comorbidities and additional medications, and third we were unable to obtain data about the effect of bowel preparation on length of stay.

Conclusion

In summary in this large study the strongest independent risk factor for poor quality preparation was inpatient status. Low quality preparation for colonoscopy was associated with repeated procedures leading to unnecessary risks and increased costs. Interventional studies to improve preparation in inpatients are needed.

Financial Support

This work was done without financial support or academic grants.

Disclosures

All authors declare that they have no financial, personal or professional conflicts of interest relevant to this work.

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Volume 5 Issue 10 October 2018

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