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Gastrointestinal Endoscopy

Predictors of inadequate bowel preparation for inpatient colonoscopy

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Original Article

ABSTRACT

Background/Aims: Adequate colonic cleansing is essential for achieving effective and safe colonoscopy. Inpatient status is one of several factors associated with poor bowel preparation leading to incomplete colonoscopy procedures, which in turn may cause increased patient morbidity, missed pathology, prolonged hospital stay, and increased cost. The aim of this study was to identify predictors of inadequate bowel preparation for inpatient colonoscopy.

Materials and Methods: Medical records of inpatients who underwent colonoscopy at a university hospital between January 2015 and June 2016 were reviewed. Logistic regression analysis was used to identify predictors of "inadequate" bowel preparation. Odds ratios (OR) with 95% confidence intervals (CI) were reported.

Results: We included 130 patients in the analysis with a mean age of 58.2 (17.3) years. Fifty-seven percent of the patients underwent the procedure before noon, and the remaining between noon and 4 pm. The most common indications for inpatient colonoscopies were gastrointestinal bleeding and screening for colorectal cancer, and the majority of patients received meperidine for sedation (38.5%). The overall bowel preparation success rate was 57%, and the success rate was higher in the morning procedures compared to the afternoon procedures (71% vs. 46%, p=0.004). Regression analysis identified procedure time as a significant predictor of bowel preparation success such that procedures performed in the afternoon had lower chances of success (OR=0.32, 95% CI=0.14-0.74, p=0.007). Aspirin use was also a positive predictor for bowel preparation success (OR=3.1, 95% CI=1.03-9.24, p=0.044).

Conclusion: Incomplete colonoscopies for inpatients due to inadequate bowel preparation are very common. Procedures performed in the afternoon are less likely to be successful.

Keywords: Colonoscopy, inpatients, forecasting

INTRODUCTION

Gastrointestinal symptoms attributed to colonic pathology frequently require a detailed examination of the colon prior to making a diagnosis (1). In order to perform an optimal endoscopic evaluation of the colon, adequate cleansing of the colonic walls of stool is needed (2). Otherwise, both large and small colonic lesions, whether benign or malignant, can be missed (3). In order to properly cleanse the colon, patients must carefully adhere to bowel preparation regimens and follow instructions given by their physicians including dietary restrictions and fasting (4,5). However, such requirements can be challenging for patients in certain circumstances such as in the presence of comorbidities or physical conditions that may restrict access to toilets. Based on a study by Hautefeuille et al. (6) that utilized multi-regression modeling, intolerance to bowel preparation regimens, incomplete intake of regimens, constipation, and concomitant use of neuroleptics or antidepressants have been associated with bowel preparation failure for outpatients. Another study by Nguyen et al. (7) that involved 300 patients identified language barrier, Medicaid insurance, single status, and poly-pharmacy as predictors of bowel preparation fail-

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ure for average-risk outpatient colonoscopy procedures, which occurred in 15% of cases.

According to results from a prospective study by Ness et al. (8) involving a cohort of 649 patients, inpatient status is a risk factor for bowel preparation failure. Bowel preparation for hospitalized patients can be challenging due to the presence of ongoing acute illnesses, dehydration, comorbidities, and newly prescribed medications. Failure of bowel cleansing typically leads to aborting and re-scheduling procedures after better preparation is achieved, which in turn leads to prolonged hospitalizations. Therefore, identifying factors associated with failure of inpatient colonoscopic bowel preparation is needed.

In this retrospective analysis, we aimed to identify predictors of inpatient colonoscopy bowel preparation failure.

MATERIALS AND METHODS

After acquiring research ethics committee approval from the institute's ethics committee, all adult patients referred for inpatient colonoscopy at our university hospital between January 2015 and June 2016 were identified through our hospital electronic medical records. Patients from the hospital's intensive care units were not included. Written informed consent was obtained from all patients.

Data on demographics, comorbidities, indications for referral, endoscopic findings, and success of bowel preparation were collected. The bowel preparation protocol for inpatients during the review period consisted of a clear fluid diet starting the day before the scheduled colonoscopy in addition to consuming low-volume 2-L polyethylene glycol-electrolyte lavage solution (PEG-ELS) with ascorbic acid in two separate doses, starting after 3 p.m., and both in 1 liter of water over 2 h. Patients were encouraged to drink an additional 1 liter of water or clear liquids after each dose followed by fasting at midnight. Fleet enemas were administered in some cases when preparation was anticipated to be insufficient. All colonoscopies were performed or supervised by one of our unit's eight certified and experienced endoscopists. After the colonoscopy, bowel preparation quality was subjectively graded in an electronically generated procedure report as excellent, good, fair, or poor. For this retrospective review, patients labeled as having excellent or good bowel preparation were considered "adequate" and those labeled as having fair or poor bowel preparation were considered "inadequate".

Data were entered using a standard data extraction sheet and prepared for statistical analysis.

Outcomes

Bowel preparation success, as judged by the endoscopist, was considered the primary outcome. Cecal intubation rate and polyp or mass detection and predictors of bowel preparation failure were considered secondary outcomes.

Statistical Analysis

Baseline descriptive statistics were calculated for all characteristics. We reported means (standard deviations [SD]) for continuous variables and percentages for categorical variables. Student's t-test and the chi-square test were used to compare means and frequencies, respectively. Model selection through backward elimination was used to identify predictors of inadequate bowel preparation for inpatient colonoscopy procedures. Variables with infrequent occurrences were automatically eliminated from the model selection. A p-value of 0.05 was used as threshold for statistical significance, and precision was measured using 95% confidence intervals. STATA 11.2 (StataCorp, Texas, USA) was used in our analysis.

RESULTS

Baseline Characteristics

A total of 130 patients were included in the analysis with a mean age of 58.2 (17.3) years. Fifty-one percent were males, and 51% were native Saudis. Mean body mass index was 26.2 (5.8), and most patients were referred from the surgical ward (51%). Fifty-seven percent of the patients underwent the procedure before noon and the remaining between noon and 4 p.m. The most common indications for inpatient colonoscopies were gastrointestinal bleeding and screening for colorectal cancer, and the majority of patients received meperidine for sedation (38.5%). Approximately 23% of the patients were known to have hypertension, and 14% had a history of prior colonic resection. More patients on warfarin (p=0.002) and who underwent procedures in the afternoon (p=0.004) had unsuccessful bowel preparation (Table 1).

Outcomes

The overall bowel preparation success rate was 57%, and the success rate was higher in morning procedures compared to afternoon procedures (71% vs. 46%, p=0.004).

A total of 26 polyps (20% of the patients) and 22 masses (17% of the patients) were detected. The cecum was reached in 52% of cases.

Predictors of Successful Bowel Preparation

Statistical analysis identified procedure time as a significant predictor of bowel preparation success such that procedures performed before afternoon had lower chances of success (odds ratio [OR]=0.32, 95% confidence interval [CI]=0.14-0.74, p=0.007). Aspirin use was also a positive predictor for bowel preparation success (OR=3.1, 95% CI=1.03-9.24, p=0.044). A statistical trend was observed with hypertension (OR 0.44, 95% CI=0.17-1.15, p=0.095) and with the use of meperidine for sedation (OR=1.82, 95% CI 0.96-3.42, p=0.063) (Table 2).

Table 1. Baseline characteristics of 130 patients who underwent inpatient colonoscopy*

	Total (n=130)	Successful bowel preparation (n=74)	Unsuccessful bowel preparation (n=56)	p
Mean age (SD), years	58.2 (17.3)	56.1 (19.4)	60.9 (13.9)	0.113
Mean BMI (SD), kg/m^2	26.2 (5.8)	26.5 (6.4)	26 (5.1)	0.630
Male gender	66 (51)	38 (51)	28 (50)	0.879
Saudi nationality	66 (51)	43 (58)	23 (41)	0.054
Ward				
Medicine	55 (42)	28 (38)	27 (48)	0.273
Surgery	66 (51)	42 (57)	24 (43)	
Other	9 (7)	4 (5)	5 (9)	
Comorbidities				
Diabetes mellitus	55 (42)	29 (39)	26 (46)	0.408
Hypertension	58 (45)	29 (39)	29 (52)	0.172
Depression	1 (<1)	1 (1)	0 (0)	0.383
Thyroid disorder	7 (5)	3 (4)	4 (7)	0.440
Coronary artery disease	22 (17)	9 (12)	13 (23)	0.096
Ulcerative colitis	1 (<1)	1 (1)	0 (0)	0.383
Crohn's disease	3 (2)	3 (4)	0 (0)	0.127
Chronic constipation	1 (<1)	0 (0)	1 (2)	0.249
Chronic kidney disease	12 (10)	4 (5)	8 (14)	0.083
Chronic liver disease	5 (4)	3 (4)	2 (4)	0.887
Chronic obstructive pulmonary disease	4 (3)	2 (3)	2 (4)	0.776
Previous colonic resection	14 (11)	7 (10)	7 (13)	0.580
Previous diverticulitis	2 (2)	1 (1)	1 (2)	0.842
Previous abdominal surgery	15 (12)	8 (11)	7 (13)	0.765
Indication				
Anemia	34 (26)	16 (22)	18 (32)	0.176
GI bleeding	32 (25)	18 (24)	14 (25)	0.929
Positive FOBT	4 (3)	2 (3)	2 (4)	0.776
Weight loss	18 (14)	12 (16)	6 (11)	0.368
Constipation	14 (11)	8 (11)	6 (11)	0.986
Abdominal pain	32 (25)	22 (30)	10 (18)	0.120
Diarrhea	16 (12)	9 (12)	7 (13)	0.954
Screening for CRC	22 (17)	14 (19)	8 (14)	0.485
Thickened TI	1 (< 1)	1 (1)	1 (2)	0.383
Thickened colon	13 (10)	7 (9)	6 (11)	0.813
Post diverticulitis	2 (2)	2 (1)	0 (0)	0.215
Suspected colonic mass on cross sectional imaging	18 (14)	9 (12)	9 (16)	0.523
Metastasis of unknown primary	8 (6)	3 (4)	5 (9)	0.252
Medications				
Aspirin	36 (28)	22 (30)	14 (25)	0.551
Warfarin	7 (5)	0 (0)	7 (13)	0.002
Plavix	10 (8)	6 (8)	4 (7)	0.838
TCA	1 (<1)	1 (1)	0 (0)	0.383
SSRI	2 (2)	1 (1)	1 (2)	0.842
Benzodiazepines	2 (2)	1 (1)	1 (2)	0.842
Insulin	20 (15)	9 (12)	11 (20)	0.242
Procedure timing				
Morning	56 (43)	40 (54)	16 (29)	0.004
Afternoon	74 (57)	34 (46)	40 (71)	
Sedation				
Midazolam	34 (26)	18 (24)	16 (29)	0.112
Fentanyl	22 (17)	14 (19)	8 (14)	
Meperidine	50 (39)	33 (45)	17 (30)	
Aborted	24 (18)	9 (12)	15 (27)	

BMI: Body Mass Index; CRC: colorectal cancer; FOBT: fecal occult blood test; TI: terminal ileum; TCA: tricyclic antidepressants; SD: standard deviation; SSRI: selective serotonin reuptake inhibitors

*The data are presented as frequency (percent) unless otherwise specified

Table 2. Final model for predicting successful bowel preparation for inpatient colonoscopy based on backward elimination model selection

Quality of bowel preparation	Odds ratio	p	95% Confidence interval
Meperidine	1.820	0.063	0.969-3.420
Previous abdominal surgery	0.408	0.148	0.121-1.374
Hypertension	0.441	0.095	0.168-1.153
Procedure time	0.322	0.007	0.141-0.735
Metastasis of unknown primary	0.285	0.156	0.050-1.618
ASA	3.087	0.044	1.031-9.244
CKD	0.368	0.189	0.083-1.634
Anemia	0.507	0.170	0.192-1.337

ASA: aspirin; CKD: chronic kidney disease

DISCUSSION

Hospitalized patients may undergo colonoscopy for various indications either electively or on an emergency basis, such as lower gastrointestinal bleeding. An efficient colonoscopy requires proper visualization of the entire colonic mucosa to detect important pathologies and to perform necessary endoscopic therapies that can only be achieved by adequate bowel cleansing. The negative impact of poor bowel preparation on colonoscopy completion rates and adenoma detection has been clearly demonstrated in many studies (9-11).

For inpatients, inadequate bowel preparation has also been associated with a significant increase in hospital stay and

costs (12). Therefore, we found it important to assess possible predictors of inadequate bowel preparation that can help guide future improvement in institutional procedure planning. In our cohort of hospitalized patients, 43% had inadequate bowel preparation, which is a high rate compared with previous studies, and this contributed to a low cecal intubation rate of 52% and polyp detection not meeting guideline recommendations (2,4,12-14). We found that patients having colonoscopy in the afternoon were less likely to have successful bowel preparation (OR=0.32, 95% CI=0.14-0.74, p=0.007). The most frequently prescribed preparation in our center is low-volume PEG-ELS with ascorbic acid to be completed the night before the scheduled colonoscopy in addition to Fleet enemas when tolerated, which results in a long interval (>12h for the afternoon procedures) between the end of bowel preparation and the start of colonoscopy. Such a long interval is known to be associated with worse preparation quality. This can be avoided by prescribing a split dose (evening and morning) or same day bowel preparation. A pilot study by Yang et al. (15) demonstrated the feasibility of implementing split dose bowel preparation for inpatient colonoscopy using a standardized electronic order set. Morning-only polyethylene glycol preparation is another option but might be less preferred by patients as shown in another single-center study (16). Additionally, educating ward nurses and providing patients with educational booklets can have a positive influence on bowel preparation quality (17,18).

A recent retrospective study of 244 patients by McNabb-Baltar et al. (14) identified advanced age as the only predictor of inadequate inpatient colonoscopy in their cohort. Conversely, results from a retrospective study of 524 patients identified a number of significant predictors for poor inpatient bowel preparation, including lower income, opiate or tricyclic antidepressant use, afternoon colonoscopy, American Society of Anesthesiologists class ≥3 (8), and symptoms of nausea/vomiting (12). Our study identified only aspirin use as another positive predictor for bowel preparation success (OR=3.1, 95% CI=1.03-9.24, p=0.044), which is likely a surrogate marker for patient diligence in adhering to the preparation regimen. Failure to detect other predictors of poor preparation can be attributed to our small sample size.

We acknowledge that our study is limited by many factors, including its small sample size, retrospective design, and single-center data source. Furthermore, the ability of individual patients to completely ingest the prescribed laxative dose was not recorded due to the study's retrospective design. Regarding grading of bowel preparation quality, the 4-point scale used is not as precise as newer validated scales. However, we believe that these results might aid in correcting in-hospital protocols for inpatient pre-colonoscopy bowel preparation to help improve the likelihood of success.

In conclusion, bowel preparation is unsuccessful in a significant proportion of patients undergoing inpatient colonoscopy, and procedure timing appears to be the most significant predictor of success. Larger, prospectively designed studies are needed to further identify optimal conditions for inpatient colonoscopy bowel preparation.

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