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Frequency and risk factors for inadequate preparation on boston bowel scale during colonoscopic examination.

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ABSTRACT… Objective: To determine the frequency and risk factors for inadequate bowel preparation using Boston Bowel Preparation Scale. **Study Design:** Cross-sectional study. **Setting:** Gastroenterology Department, Liaquat National Hospital, Karachi, Pakistan. **Period:** September 2022 to June 2023. **Methods:** The study comprised of patients between 18 to 70 years undergoing colonoscopy. Boston bowel preparation score (BBPS) was used to evaluate the quality of bowel preparation before washing or suctioning. Total score was calculated taking sum of scores in all three segments. Adequate preparation was defined as all 3 BBPS segment scores ≥ 2. **Results:** In a total of 136 patients, the mean age was 55.8±14.1 years. The mean BBPS score was 5.7±3.5. Based on the criteria of overall adequate rate, inadequate preparation was seen among 44 (32.4%) patients. Lower risk of inadequate preparation was significantly associated with outpatient patients, patients consuming more water and patients with liquid stool consistency whereas odds were significantly higher among patients with age 50 years and above, males, diabetic patients, patients receiving movcal sachet and dulcolex for preparation, patients with lower number of stools (2-4 stools per day) and, patients receiving insulin. **Conclusion:** The risk of inadequate preparation was higher among older age patients, male gender, diabetic patients, and patients with less number of stools with semi solid consistency.

Key words: Bowel Preparation, Colonoscopy, Endoscopy, Esophagogastroduodenoscopy, Intestinal Obstruction.

INTRODUCTION

The best method for detecting colorectal cancer is a colonoscopy, however, the quality of bowel preparation is crucial for a successful colonoscopy.[1] A good view of the colon's mucosal surface is necessary for a successful colonoscopy. One of the most critical factors in determining the examination's effectiveness, thoroughness, and most crucially, adenoma detection rate (ADR) is how well the colon was cleaned. However, about 25% of colonoscopies show signs of insufficient intestinal cleaning.[2]

Patients with a history of insufficient colon cleaning, taking multiple medications that can cause constipation, obesity, advanced age, male patients, and comorbidities like diabetes mellitus, stroke, dementia, and Parkinson's disease are at a higher risk of experiencing inadequate bowel cleaning.[3] Inadequate bowel preparation is linked to one-fourth of colonoscopies and can lead to failure screenings, a higher chance of repeat procedures, and lower rates of polyp and adenoma discovery.[4,5] Inadequate colonoscopy bowel preparation can lead to longer operations, shorter-than-recommended intervals between repeat colonoscopies and associated cost increases, and a decreased rate of cecal intubation.[6]

The most validated scale with a strong association to the ADR is the Boston Bowel Preparation Scale (BBPS), which is advised as the preferred measure in clinical practice. The BBPS states that a colon segment score of at least two and a worldwide score of at least six points indicate that a sufficient bowel cleansing has occurred.[7] The majority of prior research has concentrated

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on the general hygiene of the entire colon and rectum. Furthermore, the relationship between a specific bowel preparation segment and ADR and the advanced adenoma detection rate has not been extensively studied.[8]

A significant obstacle for those thinking about having a colonoscopy is the colonoscopy preparatory procedure. A low-residue diet has been demonstrated to be a viable substitute for the traditional clear liquid diet used to get ready for a colonoscopy.[9] The optimal colon preparation technique should quickly remove all faecal material from the colon, be as comfortable as feasible for the patient to use, have the fewest possible hazards, and be economical.[10] The objective of this study was to determine the frequency and risk factors for inadequate bowel preparation using Boston Bowel Preparation Scale.

METHODS

This cross-sectional study was performed in gastroenterology department of Liaquat National Hospital, Karachi after permission from the hospital ethics committee (Ref:App#0719-2022-LNH-ERC). The study was carried-out during September 2022 to June 2023. Informed and written consents were obtained from patients before they were enrolled. The study comprised of patients between 18 to 70 years undergoing colonoscopy. Patients with previous bowel surgery, intestinal obstruction, metastatic disease and on maintenance hemodialysis were excluded. Sample of 136 size was estimated taking proportion of 34.6%[11] for inadequate bowel preparation with 95% confidence level and 8% margin of error. Non-probability convenient sampling technique was used to enlist patients.

Senior endoscopists with over 1000 colonoscopy procedures performed all of the colonoscopies. BBPS used to evaluate the quality of bowel preparation before washing or suctioning. Score ranges from 0-3 with assessment of adequate preparation in three different regions including right colon (from cecum to ascending colon), transverse colon (the hepatic and splenic flexures) and left colon (the descending colon, sigmoid colon, and rectum). Total score was calculated taking sum of scores in all three segments. Adequate preparation was defined as all 3 BBPS segment scores ≥ 2.[12]

Data was analyzed using IBM-SPSS version 26.0. Qualitative data were shown as frequency and percentages. Quantitative variables were represented as mean and standard deviation (SD), or median and inter-quartile range (IQR). Chi-square test was applied to compare categorical data. Univariate analysis were performed along with odds ratio and 95% confidence interval (CI) taking $p<0.05$ as significant.

RESULTS

In a total of 136 patients, the mean age and BMI were 55.8±14.1 years and 37.6±4.97 Kg/m^2, respectively. Comorbidity was present in 101 (74.3%) patients. The mean number of water glass intake was 8.3±2.9. Table-1 shows summary of patients socio-demographic and clinical characteristics.

Overall mean BBPS score was 5.7±3.5. Based on the criteria of overall adequate rate, inadequate preparation was seen among 44 (32.4%) patients. Poor preparation was seen among in 22.1% in their right colon, 25% in their transverse colon and 25% patients in their left colon. Table-II displays frequency of BBPS scoring grade for each segment.

Odds of inadequate preparation were significantly higher for patients aged 50 years and above, male gender, diabetic patients, patients receiving colonic purgatives other than colonic wash, and receiving insulin. Odds of inadequate preparation were decreasing with increasing number of water glass intake, increasing number of stools and with stool of liquid consistency. Table-III displays distribution of patients' features among those with and without adequate preparation and its univariate association.

Variables	Frequency (%)
Age group	
30-49 years	35 (25.7)
50-59 years	47 (34.6)
60 years and above	54 (39.7)
Gender	
Male	97 (71.3)
Female	39 (28.7)
Comorbidity	
Hypertension	68 (50)
Diabetes	62 (45.6)
Chronic kidney disease	27 (19.9)
Stroke	8 (5.9)
Patient type	
Outpatient	87 (64)
Inpatient	49 (36)
Preparation shift	
Morning	115 (84.6)
Afternoon	21 (15.4)
Colonic purgative	
Dulcolex	23 (16.9)
Movcal sachet	53 (39)
Colonic wash	60 (44.1)
Number of stools	
2-4	52 (38.2)
5-6	38 (27.9)
7-8	22 (16.2)
9-12	24 (17.6)
Stool consistency	
Liquid	98 (72.1)
Semi-solid	38 (27.9)
Medications	
Insulin	57 (41.9)
Anti-hypertension	33 (24.3)
Others	2 (1.5)

Table-I. Summary of socio-demographic and clinical characteristics (n=136)

DISCUSSION

The present study demonstrated overall BBPS score of 5.7±3.5 and inadequate preparation was seen around one third of all total patients (32.4%). Zhann YY et al reported inadequate preparation among 34.6% patients.[11] A similar study from Korea reported that inadequate bowel preparation was seen among 28.1% patients.[12] Woo et al in a prospective analysis found similar results.[13] Using BBPS score, a rate of 32.8% was reported in a study by Kluge MA et al.[14] Another study using BBPS score reported a lower frequency of inadequate bowel preparation (8.5%).[15] The variability among findings could exist on account of several reasons such as expertise of evaluator, patients' features and their cooperation, criteria of adequate preparation and clinical measures by the medical team for patients' preparation.

In the present study, it was found that higher age (≥ 50 years) was significantly associated with inadequate preparation. These findings are consistently reported in literature.[15-17] According to a study by McNabb-Baltar J et al[18], the likelihood of having poor bowel preparation increased by 1.29 for every 10 years of age rise. The most likely reason of this may be presence of competing morbidities in higher age patients more frequently and usage of multiple medications for management existence of chronic comorbidity.

Differences in gender reveal a variety of physiological and psychological elements. Gender variations and hormones may have a significant impact on the onset, course, and management of diseases.[19] This study analyzed higher odds of inadequate preparation in male gender in contrast to females (OR: 6.14; 95% CI: 2.02-18.64, p<0.001). There have been some previous reports regarding gender differences in colonoscopy quality.[20-23]

BPS Score	Right Colon N (%)	Transverse Colon N (%)	Left Colon N (%)	P-Value
0	30 (22.1)	34 (25)	34 (25)	0.492
1	14 (10.3)	6 (4.4)	7 (5.1)	
2	31 (22.8)	28 (20.6)	33 (24.3)	
3	61 (44.9)	68 (50)	62 (45.6)	

Table-II. Distribution of boston bowel preparation scores with respect to different colon segments

Variables	Groups	Adequate Preparation		OR (95% CI)	P-Value
		Yes (%)	No (%)		
Age (in years)	30-49	27 (77.1)	8 (22.9)	Reference category	
	50-59	30 (63.8)	17 (36.2)	1.28 (0.42-3.85)	0.653
	60+	35 (64.8)	19 (35.2)	2.97 (1.12-7.85)	0.028
Gender	Male	57 (58.8)	40 (41.2)	6.14 (2.02-18.64)	<0.001
	Female	35 (89.7)	4 (10.3)	Reference category	
Hypertension	Yes	41 (60.3)	27 (39.7)	1.97 (0.94-4.11)	0.069
	No	51 (75)	17 (25)	Reference category	
Diabetes	Yes	35 (56.5)	27 (43.5)	2.58 (1.23-5.41)	0.012
	No	57 (77)	17 (23)	Reference category	
Chronic kidney disease	Yes	20 (74.1)	7 (25.9)	0.68 (0.26-1.75)	0.425
	No	72 (66.1)	37 (33.9)	Reference category	
Stroke	Yes	6 (75)	2 (25)	0.68 (0.13-3.52)	0.649
	No	86 (67.2)	42 (32.8)	Reference category	
Colonic purgatives	Dulcolex	13 (56.5)	10 (43.5)	3.07 (1.08-8.69)	0.034
	Movcal sachet	31 (58.5)	22 (41.5)	2.83 (1.23-6.54)	0.014
	Colonic wash	48 (80)	12 (20)	Reference category	
Number of water glass		10 (9-11)	4 (3-5.7)	0.45(0.35-0.56)	<0.001
Patient type	Outpatient	72 (82.8)	15 (17.2)	0.14 (0.06-0.32)	<0.001
	Inpatient	20 (40.8)	29 (59.2)	Reference category	
No. of stools	2-4	32 (59.3)	22 (40.7)	Reference category	
	5-6	21 (61.8)	13 (38.2)	0.90 (0.37-2.16)	0.815
	7-8	15 (78.9)	4 (21.1)	0.38 (0.11-1.32)	0.131
	9-12	24 (82.8)	5 (17.2)	0.30 (0.10-0.92)	0.034
Stool consistency	Liquid	91 (92.9)	7(7.1)	0.02 (0-0.03)	<0.001
	Semi-solid	1 (2.6)	37(97.4)	Reference category	
Shift	Morning	81 (70.4)	34(29.6)	0.46 (0.18-1.18)	0.109
	Afternoon	11 (52.4)	10(47.6)	Reference category	
Received insulin	Yes	31 (54.4)	26(45.6)	2.84 (1.35-5.95)	0.006
	No	61 (77.2)	18(22.8)	Reference category	
Received anti-hypertension	Yes	27 (81.8)	6(18.2)	0.38 (0.14-1.04)	0.051
	No	65 (63.1)	38(36.9)	Reference category	

Table-III. Comparison of patients features and its univariate association with bowel preparation status

Hwang YJ and coworkers demonstrated that females had better preparation than males as 82.1% females had overall BBPS ≥ 2 whereas in males it was 79.5%.[22] Similarly, Rotondano et al[23] looked at characteristics related to the quality of bowel cleansing and discovered that male gender was a predictor of poor cleansing in the right and left colons.

In this study, we encountered 4 comorbidities including hypertension, diabetes, chronic kidney disease, and stroke. However, analysis suggested that only diabetes was risk factor of poor bowel preparation (OR: 2.58; 95% CI: 1.23-5.41, p=0.012). Many others have also exhibited diabetes mellitus to be a contributor to poor bowel cleansing.[11,15,16] Diabetic neuropathy can impact bowel function and leads to challenges in bowel preparation. Constipation, incomplete evacuation, and altered colonic motility or transit times are potential contributors to poor bowel preparation in individuals with diabetic neuropathy. These factors underscore the importance of addressing neuropathic complications when considering bowel preparation strategies in diabetic patients.[24,25] Moreover, diabetic patients have slower gastric emptying, with some anti-hyperglycemic agents exacerbating this.[25] It has also been found that the risk of inadequate preparation was also higher among hypertensive patients but statistical significance was not seen (OR: 1.97; 95% CI: 0.94-4.11, p=0.069). It might have been possible that significance could be proved with higher sample sizes. We assume that

significance of stroke and CKD were not seen as these comorbidities were less frequent. The quality of bowel preparation is directly linked to the substances used for cleansing of bowel.[22,24] In this study, we observed that risk of inadequate preparation was higher among patients who received movcal sachet and dulcolex than patients who received colonic wash. In addition, more water intake and more number of stools were also found to be associated with lower risk of inadequate preparation. Another noticeable findings of this study was that inadequate bowel preparation risk was significantly low for outpatient department patients (OR: 0.14; 95% CI: 0.06-0.32, $p<0.001$) than those who were admitted. The reasons could have been that outpatients are mobile, active with proper intake while admitted patients are inactive and laying all the day on the bed due to which their stool evacuation ability is generally not good. However, we did not find any impact of morning or evening shifts on bowel preparation quality.

The present study was performed at a single center in Karachi with a limited sample size. Thus, study findings could not be generalized to whole Pakistani cohort. A study with larger sample size is suggested to verify the findings of the current study.

CONCLUSION

Risk of inadequate bowel preparation was higher among older age patients, male gender, diabetic patients, and patients with less number of stools with semi solid consistency.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Mashal Bai	Conceptualized the study, Involved in data collection, Initial manuscript writing.	
2	Shahid Karim	Designed the study protocol, Critically revised the initial manuscript draft.	
3	Rajesh Kumar	Data collection, Initial manuscript writing.	
4	Afsheen Faryal	Performed data analysis and involved in result writing.	
5	Sindhu Rani	Performed data analysis and involved in result writing.