



Risk Factors and Incidence of Poor Bowel Preparation in Elderly Patients: Prospective Study

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Aim: The aim of this study was to identify the incidence of and the risk factors for poor bowel preparation in elderly patients.

Patients and methods: We enrolled 240 patients over 60 years of age hospitalized in the Clinic of Gastroenterology, Kaspela University Hospital between October 2016 and May 2017 and scheduled for colonoscopy. We recorded patients' demographics data, clinical characteristics and the rate of bowel preparation. Factors associated with poor bowel preparation were identified by multivariate logistical regression analysis.

Results: The rate of poor bowel preparation was 33.6%. Factors associated with poor bowel preparation were a history of abdominal surgery (OR, 2.617, CI, 1.324-5.174), chronic constipation (OR, 3.307; CI, 1.551-7.054), non-compliance with dietary instructions (OR, 2.239, CI, 1.122-4.471), noncompliance with polyethylene glycol (PEG) dosage (OR, 4.576, CI, 1.855-11.287), walking less than 30 min during preparation (OR, 2.474; CI, 1.261-4.855), interval between PEG ingestion and the onset of bowel activity (OR, 1.025, CI, 1.010-1.040), the latest stool that was not clear and watery (OR, 4.191; CI, 1.529-11.485).

Conclusions: Elderly patients tend to have suboptimal preparation for colonoscopy. Walking less than 30 min during the PEG ingestion period may be a surrogate for bowel preparation failure. Future studies should identify patients at risk for poor bowel preparation. Methods and interventions should be developed to improve outcomes.

Key words:

bowel preparation, colonoscopy, elderly patients, risk factors

INTRODUCTION

Due to its high morbidity and mortality, colorectal carcinoma is a serious global health problem. There is an increasing incidence of this type of neoplasm in many countries worldwide. In some of them it is the third leading cause of death from malignancy. Early diagnosis and endoscopic treatment of adenomatous polyps can significantly reduce the risk of colorectal cancer (CRC) development. Colonoscopy is considered a "gold standard" in diagnosing and

treatment of adenomatous polyps and CRC due to its high informability and the possibility of histological test or even resection of benign and initial malignant lesions. Success of the colonoscopy depends to a large extent on the adequate bowel cleaning. Poor preparation reduces the diagnostic value of the procedure and increases the risk of complications and the need for re-testing. Although ongoing studies aim at optimization of bowel preparation, currently the incidence of poor bowel preparation is as high as 20-40%.

The aging of the population and the increased incidence of malignant pathology among this group determine the frequency of colonoscopy in elderly patients. Studies have identified multiple factors associated with poor preparation, including old age, male gender, education, constipation, history of abdominal surgery, cerebrovascular accident, dementia, treatment with psychotropic medications, lack of patient co-operation.^{1,2,3} Fewer studies have been investigating the incidence and the risk factors for poor preparation in elderly patients. In Bulgaria such research is practically absent.

In this study, we investigate the incidence and the risk factors associated with poor bowel preparation for colonoscopy in elderly patients. Our aim is to identify actions that would lead to optimization of the preparation.

PATIENTS AND METHODS

PATIENTS

In this study, we enrolled 240 patients over 60 years of age hospitalized in the Clinic of Gastroenterology, University Hospital Kaspela between October 2016 and May 2017 and scheduled for colonoscopy. Excluding criteria included the presence of intestinal obstruction or stenosis, a history of abdominal surgery or inflammatory bowel diseases, a history of partial colonoscopy due to reasons not related to poor preparation such as a refusal to participate in the study.

PREPARATION FOR THE TEST

Polyethylene glycol (PEG) - macrogol 4000 electrolyte solution, dissolved in 4 liters of water is used to clean the bowel. All patients are informed to take 200 ml of PEG solution every 20 minutes until they take all of the 4L. Patients take the PEG solution between 2 p.m. and 8 p.m. the day before the test and they are informed to walk for at least 30 minutes during the preparation. The endoscopic test is performed between 8 a.m. and 11 a.m. on the following day. Although some studies recommend a divided administration of the PEG solution, we consider that the choice of the method of preparation largely depends on the hour of the study. Patients are informed to follow a low fiber diet at least two days before the colonoscopy and they should not eat or drink after the start of the preparation as well as on the test day.

DATA COLLECTION

On the basis of a literature review, we developed a questionnaire based on which we identify the risk factors leading to poor bowel preparation in elderly patients. The questionnaire consists of three parts and should be completed before the procedure.

The first part aims at obtaining demographic and clinical data and includes questions about age, sex, body mass

index (BMI), history of abdominal surgery or colonoscopy, comorbidities and indications for colonoscopy.

The second part consists of questions about the preparation for the test including compliance with the preparation instructions (dietary instructions, dosage and time of administration of PEG), time spent walking during preparation, side effects of taking the PEG solution. Failure to comply with the dietary restrictions or walking times as well as the intake of less than 75% of the solution are considered as a lack of patient cooperation.

The third part consists of questions about identifying the predictors of poor bowel cleaning just before the colonoscopy. This includes questions about the number of stools after PEG ingestion, the interval between the initial PEG ingestion and the onset of bowel activity and the characteristic of the last stool before the colonoscopy.

ASSESSMENT OF THE QUALITY OF BOWEL PREPARATION

The quality of bowel preparation was assessed using Ottawa bowel preparation scale.⁴ The scale evaluates the quality of preparation in the right (cecum and ascendens), the middle (transversum and descendens) and the rectosigmoid segment of the colon. The quality of preparation is categorized according to a score system from 0 to 4 (0 = no fluid, 1 = minimal amount of fluid, no need for suction, 2 = need for suction to visualize the mucous, 3 = need for washing and aspiration of solid faeces, 4 = inability to be washed). Additionally, points are added to the final result, based on the total amount of fluid in the colon: small (0 points), moderate (1 point) and large (2 points). The results of each colon segment and the total amount of fluid are added which results in a score of 0 to 14 points where 14 points present the poorest cleaning. Ottawa Scale score (OBPS) less than 6 points presents an adequate colon preparation, while score ≥ 6 indicates poor cleaning. All procedures were performed by highly qualified examiners, each of them having done over 5000 colonoscopies. Prior to the start of the study, all participating examiners were introduced to OBPS in detail.

STATISTICAL ANALYSIS

The statistical analysis was performed using SPSS, version 18. The quantitative variables are presented in the form of mean values \pm standard deviation and the qualitative ones in the form of percentages (%). The qualitative variables are compared by χ^2 or the Fisher's exact test. T- test is used to compare the quantitative variables with even distribution and the nonparametric U Mann-Witney test for variables with uneven distribution. Both univariate and multivariate logistic regression analyzes were used to identify independent predictors for poor bowel preparation. Only variables showing statistical significance during the univariate analysis were subsequently analyzed by multivariate analysis. Values of $P < 0.05$ were considered statistically significant. The results are presented in the form of an odd ratio (OR) with a confidence interval (CI) of 95%.

RESULTS

BASELINE CHARACTERISTICS

In the course of the study, colonoscopy was performed in 1325 patients. 1085 of these were excluded from analysis due to any of the following: age below 60 years ($n = 875$), incomplete colonoscopy due to reasons not related to bowel preparation ($n = 8$), history of colon resection ($n = 79$), inflammatory intestinal disease ($n = 123$). The rest 240 patients were analyzed. The mean age of the patients was 67.61 ± 5.78 years. 46.7% (112) of them were men. The average BMI was 26.94 ± 3.58 kg/m². 92 patients (38.3%) had higher education. 42 patients (17.5%) had a history of abdominal surgery, 25 (10.4%) were burdened with CRC and 82 (34.2%) had had colonoscopy in the past. Comorbidities included arterial hypertension ($n = 98$, 40.8%), diabetes mellitus ($n = 51$, 21.3%), constipation ($n = 65$, 27.08%), cerebrovascular accident ($n=40$, 16.6%), liver cirrhosis ($n = 21$, 8.8%). The most common cause for colonoscopy is abdominal pain ($n = 105$, 43.8%), followed by constipation ($n = 55$, 22.9%), diarrhea ($n = 43$, 17.9%), hematochezia ($n = 40$, 16.6%), follow-up after polypectomy ($n = 22$, 9.2%). The mean interval of colonoscopy planning until its perfor-

mance was 9.16 ± 5.35 days (**Table 1**).

UNIVARIATE ANALYSIS: RISK FACTORS FOR POOR BOWEL PREPARATION

Adequate and inadequate bowel preparation was found in 187 (77.9%) and 53 (22.08%) patients, respectively. Eleven qualitative and six quantitative variables were subject to the univariate analysis. The differences between patients with adequate and inadequate bowel preparation are presented in **Tables 2, 3**. BMI, gender, education, family history of CRC, previous history of colonoscopies, arterial hypertension, history of cerebrovascular accident, diabetes mellitus, liver cirrhosis, side effects after PEG ingestion and the number of previous colonoscopies were not found to be associated with an increased risk of inadequate bowel cleaning ($p > 0.05$). Age ($p=0.03$), a history of abdominal surgery ($p = 0.000$), chronic constipation ($p = 0.000$), non-compliance with dietary instructions ($p = 0.000$), non-compliance with the PEG dosage ($p = 0.000$), walking less than 30 min during preparation ($p=0.000$), frequency of stools after the initial PEG ingestion ($p=0.000$), interval between initial PEG ingestion and the onset of bowel activity ($p = 0.000$) and the characteristic of the last stool ($p = 0.000$) correlate

Table 1. Baseline characteristics of the analyzed patients

	Number of patients, (n = 240)
Age (mean \pm deviation, years)	67.61 ± 5.78
Gender (male/female)	112/128
Body mass index (kg/m ²)	26.94 ± 3.58
Elementary or secondary education	139 (57.9)
Higher education	92 (38.3)
Hematochezia	40 (16.6)
Diarrhea	43 (17.9)
Abdominal pain	105 (43.8)
Constipation	55 (22.9)
Follow-up after polypectomy	22 (9.2)
History of abdominal surgery	42 (17.5)
Family history of CRC	25 (10.4)
Previous colonoscopies	82 (34.2)
Arterial hypertension	98 (40.8)
Diabetes mellitus	51 (21.3)
Cerebrovascular accident	12 (5)
Liver cirrhosis	21 (8.8)
Constipation	65 (27.08)
Interval from colonoscopy planning until its performance	9.16 ± 5.35

Table 2. Univariate analysis of factors (qualitative variables) affecting bowel preparation in elderly patients

	Adequate preparation	Inadequate preparation
P	(n = 187)	(n = 53)
Male	83	33
Female	104	20
Elementary or secondary education	123	25
Higher education	64	28
History of abdominal surgery	24	18
Family history of CRC	16	9
Previous colonoscopies	69	13
Arterial hypertension	53	45
Diabetes	24	27
Stroke	7	5
Constipation	29	36
Liver cirrhosis	12	9
Non-compliance with dietary instructions	27	35
Non-compliance with PEG dosage	7	16
Walking less than 30 minutes during preparation	53	47
Side effects after PEG ingestion	66	45
Clear and watery stool	157	41
Liquid or semi-solid stool	6	27

Table 3. Univariate analysis of factors (quantitative variables) affecting bowel preparation in elderly patients

	Adequate preparation	Inadequate preparation
P	(n = 187)	(n = 53)
Age (mean ± deviation, years)	66.58 ± 4.85	68.80 ± 5.85
Body mass index	25.65 ± 3.12	27.23 ± 3.41
Period from planning of colonoscopy to its performance (days)	9.14 ± 5.52	9.77 ± 5.56
Number of previous colonoscopies	0.99 ± 1.03	0.74 ± 0.92
Frequency of stools after PEG ingestion	9.74 ± 2.58	7.75 ± 2.87
Interval between initial PEG ingestion and the onset of bowel activity (min)	60.58 ± 21.04	74.54 ± 25.71

statistically significant with the inadequate bowel preparation.

MULTIVARIATE ANALYSIS: RISK FACTORS FOR INADEQUATE BOWEL PREPARATION

Based on the results of the univariate analysis, we performed

multivariate logistic regression analysis (**Table 4**). Previous history of abdominal surgery (OR, 2.217; CI, 1.334-5.184), chronic constipation (OR, 3.207; CI, 1.561-7.154), non-compliance with dietary instructions (OR, 2.249; CI, 1.132-4.451), non-compliance with PEG dosage (OR, 4.566; CI, 1.875-11.277), walking less than 30 min during preparation (OR, 2.464, CI, 1.251-4.865), interval between

Table 4. Binary logistic regression analysis of the independent risk factors for inadequate bowel preparation in elderly patients.

Variables	Corrected Odds Ratio	95% Confidence interval
History of abdominal surgery	2.217	1.334 - 5.184
Chronic constipation	3.207	1.561 - 7.154
Non-compliance with dietary instructions	2.249	1.132 - 4.451
Non-compliance with the PEG dosage	4.566	1.875-11.277
Walking less than 30 minutes during preparation	2.464	1.251-4.865
Interval between the initial PEG ingestion and the onset of bowel activity (min)	1.015	1.011-1.042
Last stool which is not clear and watery	4.181	1.539-11.475

PEG ingestion and the onset of bowel activity (OR, 1.015; CI, 1.011-1.042), and the last stool which is not clear and watery (OR, 4.181; CI, 1.539-1.475) are independent risk factors for inadequate bowel preparation.

DISCUSSION

We conducted a prospective study aimed at assessing the incidence and the risk factors for poor bowel preparation before performing a colonoscopy in patients over 60 years of age. The incidence of inadequate bowel preparation is about 22.1% which is a better result than other studies that evaluate an incidence of about 30% in patients preparing with PEG solution.⁵ The difference in the results can be easily explained with regard to the age of the analyzed patients (over 60 years old), which was not considered as an excluding criterion in other studies. Many studies confirm that an age over 60 years is a major predictor of inadequate bowel cleaning.^{5,6} This is probably related to the impaired intestinal motility in elderly patients as well as to the significant comorbidities in the described group and the increased intake of medicines which undoubtedly also increases the risk of inadequate preparation. Moreover, the conducted studies vary according the used regimen for preparation (3L PEG, 4L PEG, 2L PEG + bisacodyl/vit.c per os), which compromises the comparability of the results.^{7,8}

Adequate bowel preparation is a prerequisite for a successful colonoscopy. The ability to fully visualize the whole mucous surface increases the success of the colonoscopy and the diagnosis of polyps thus reduces the duration of the test and optimizes its quality. Therefore, the identification of the risk factors for inadequate preparation is essential. Despite the ongoing studies in this area, only few studies focus on the bowel preparation in elderly patients.

By analyzing the risk factors for inadequate bowel preparation in compliance with OBPS, we found that history of previous abdominal surgeries was associated statistically significant with poor bowel preparation. These results coincide with the results obtained by Chung, Han et al., accord-

ing to which the abdominal surgery is an independent risk factor for poor preparation.⁵ This can be explained in terms of the fact that such patients are predisposed to intestinal adhesions that affect the intestinal release, thus reducing the effect of the preparation. Another study by Cheng, Chui et al. does not support this opinion.⁹ However, it should be noted the small number of patients with a history of abdominal surgery in the above mentioned study, which can undoubtedly explain the difference in the results. Chronic constipation in elderly patients is also associated with an increased risk of inadequate preparation which is also confirmed by a study by Fang et al.¹⁰ We think that these results are due to the intestinal hypo-motility, which combined with the chronic constipation could result in a disorder of intestinal release and the presence of a large amount of residual fecal mass after the bowel preparation.

The results of our study indicate that the PEG dosage, compliance with dietary instructions and walking during preparation are three of the main factors affecting the quality of the preparation. Many studies as well as the recent guidelines from the European Society for Gastrointestinal Endoscopy (ESGE), recommend a low fiber diet the day before the colonoscopy.^{7,11} Seo et al. performed a multivariate analysis that demonstrated that patients who did not take the full dose of PEG had a higher risk of inadequate preparation (OR, 4.34; CI, 1.08-16.66).¹² There was a significant correlation between the time spent walking during preparation and the rate of bowel cleaning. This is the second statement in the published reports that walking less than 30 minutes is associated with a significant risk of inadequate cleaning. This observation can be explained by the fact that walking stimulates the secretion of digestive glands and improves the intestinal motility.

According to Kim et al. the presence of semi-hard stools at the end of the preparation is a predictor of inadequate cleaning.¹³ Our observations support this statement. The interval between the initial PEG ingestion and the onset of bowel activity can also be used as a predictor for the quality of the preparation. Papastergiou et al.¹⁴ prove that the longer the interval is, the greater the probability of inadequate

cleaning is.

When interpreting the results of our study, some limitations need to be highlighted. First of all, the study is endocentric so its results can not be considered as absolute, although they are relevant to those from other studies. The importance of social status which undoubtedly affects the patient's contribution to the quality of the preparation has not been analyzed. Some preparation-related data are not reported by patients, which leads to inevitable errors while collecting information.

CONCLUSIONS

This is the first study in Bulgaria concerning the rate of bowel preparation in elderly patients analyzing the factors associated with poor preparation. In our study, poor bowel preparation was established in 22.1% of the patients and seven independent risk factors for poor cleaning have been identified. In patients who have been identified with the described risk factors, there need to be applied measures to reduce the incidence of inadequate bowel preparation.

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Факторы риска и частота плохой предоперационной подготовки кишечника у пожилых пациентов: проспективное исследование

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Цель: Целью исследования было выявление частоты и факторов риска плохой подготовки кишечника у пожилых пациентов.

Материалы и методы: Мы отобрали 240 пациентов в возрасте старше 60 лет, которые были госпитализированы в клинику гастроэнтерологии УМБАЛ „Каспела“ в период с октября 2016 года по май 2017 года и которым было назначено проведение колоноскопии. Мы описали демографические данные пациентов, клинические характеристики и частоту подготовки кишечника. Факторы, связанные с плохой подготовкой кишечника, были определены с помощью многомерного логистического регрессионного анализа.

Результаты: Частота плохой подготовки кишечника составила 33,6%. Факторами, связанными с плохой подготовкой кишечника, были: абдоминальная хирургия в анамнезе (OR, 2.617, CI, 1.324-5.174), хронический запор (OR, 3.307; CI, 1.551-7.054), несоблюдение диетических инструкций (OR, 2.239, CI, 1.122-4.471), несоблюдение дозировки полиэтиленгликоля (ПЭГ) (OR, 4.576, CI, 1.855-11.287), ходьба менее 30 минут во время подготовки (OR, 2.474; CI, 1.261-4.855), интервал между приёмом ПЭГ и началом кишечной деятельности (OR, 1.025, CI, 1.010-1.040), последний образец кала, который не был чистым и водянистым (OR, 4.191; CI, 1.529-11.485).

Заключение: Подготовка к колоноскопии у пожилых пациентов является неоптимальной. Ходьба менее 30 минут в течение периода приёма ПЭГ может быть предпосылкой неудачи при подготовке кишечника. Будущие исследования должны выявить пациентов с риском плохой подготовки кишечника. Для улучшения результата необходимо разработать методы и способы оперативных вмешательств.