

ORIGINAL ARTICLE

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Real-life risk factors of inadequate procedure prior to colonoscopy in a Turkish population

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Abstract

Colonoscopy is one of the main diagnostic tools for symptoms related to the colon and colorectal cancer screening programs. Inadequate cleansing of colonoscopy leads to misdiagnosis of adenomas. It is recommended to re-evaluate ineffective colonoscopy. It is of utmost importance to predict whether the bowel is clean or not because the procedure is expensive, invasive and time-consuming. This study aimed to identify the risk factors of inadequate bowel preparation. The consecutive two hundred and fifty-three patients who were referred for colonoscopy were enrolled into the study. The demographic and clinical data were obtained using a questionnaire. Only 79.1% of colonoscopy were assessed as adequate. In the univariate analysis; adherence to protocol, older age, consuming high-fiber diet in last two days, number of days of low residue diet, consumed all laxative, consumed 1.5 L water after laxative usage, regular diet for dinner before the day of colonoscopy, amount of water consumed before the day of colonoscopy, amount of water consumed in the morning of the day of colonoscopy, fasting status in the morning of the CD, and were found significantly relevant for adequate bowel preparation. Older age, number of days of low residue diet, consuming high-fiber diet in last two days, regular diet for the dinner before the day of colonoscopy, not Consumed all laxatives were independent risk factors for inadequate colonoscopy. These factors are reversible risk factors except older age. Increasing the adherence to the protocol with education seems to improve the bowel preparation quality.

Keywords: Bowel preparation, colonoscopy, colorectal cancer screening, quality

Introduction

Colonoscopy is an essential tool since it is used in the diagnosis of symptoms related to the colon as well as in colo-rectal cancer (CRC) screening programs. Precancerous lesions are detected and removed via colonoscopy. Endoscopic polypectomy, endoscopic mucosal resection and endoscopic submucosal dissection prevent CRC-related deaths [1].

Accurate visualization of the colon mucosa is essential for detecting preneoplastic lesions, and it depends directly on adequate bowel preparation. Interval CRC is a newly emerging issue in the literature that defines CRC which is diagnosed between the last colonoscopy and scheduled colonoscopy [2]. The interval CRC is related to missed or ineffectively removed preneoplastic lesions

[3]. Inadequate cleansing of the colon causes skipping adenomas and a high burden on the economy because ineffective colonoscopy procedures must be repeated.

Inadequate bowel cleansing has been attributed to many factors. There are many studies aimed to compare different bowel preparation regimens, but there are relatively fewer studies that aimed to assess the risk factors of inadequate bowel cleansing. It is very important to predict if the bowel is clean beforehand since the procedure is expensive, invasive and time-consuming. Patients with inadequately cleansed bowels may be rescheduled before starting the procedure. This prevents the patient from unnecessary sedation and the risks of complications related to the invasive procedure.

There are studies which evaluated risk factors for inadequate bowel preparation. Sociodemographic features such as age, sex and educational level were shown to be relevant as predictive factors for inadequate bowel preparation. On the other hand, family history of colorectal cancer or personal history of polyps have been associated with better quality of bowel cleansing attributed to a higher motivation. There were also other situations related

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with disturbed colonic transit such as constipation[4], previous abdominal or pelvic surgery, narcotic use [5], or comorbidities such as diabetes and obesity [6] were declared as risk factors for inadequate bowel preparation. Physician-related factors also have an important role in bowel cleansing such as inadequate indication and a delay of colonoscopy after completion of bowel preparation [7]. Adherence to preparation instructions is dependent on the types of diets and preparation drugs used before colonoscopy and is directly related to good cooperation between the patient and the healthcare provider. Our study aimed to investigate the risk factors for inadequate bowel preparation in a Turkish cohort.

Materials and Methods

This study was prospective and conducted between April 2015 and April 2016 at the endoscopy unit of the Gaziosmanpaşa University Research and Training Hospital. The consecutive patients referred for colonoscopy from various clinical departments (Gastroenterology, General Surgery, Internal Medicine Departments) were assessed before enrollment into the study. Hospitalized patients referred for colonoscopy were also enrolled into the study.

This study was implemented after a pilot study that was conducted at the same center [8]. The patients were informed about the instructions for the bowel preparation procedure and given instruction documents. A low-residue diet was recommended for two days prior to the procedure. 250 mL of *Senna alkaloids* (containing 500 mg sennoside A + B calcium) (X-M, Solusyon®, Yenisehir Pharmaceuticals, Turkey) with 1.5 L of water at 6 am on the day of colonoscopy was the preferred bowel preparation regimen and all colonoscopies were scheduled after 10 am. Bisacodyl tablets (each containing 5 mg bisacodyl and 3 mg sennoside) (Bekunis®, Abdi İbrahim Pharmaceuticals, Turkey) were added to the regimen. The patients were told to consume two tablets after lunch and dinner with 1.5 L of water before the day of colonoscopy.

The demographic features and comorbidities (Diabetes Mellitus, Hypertension, Coronary artery disease, etc.), body mass index (BMI), history of abdominal or pelvic surgery, history of constipation, taking any medications (including narcotic use), hospitalization status (inpatient or outpatient) and residency location were recorded. A questionnaire consisting of questions about adherence to the instructions such as number of days of low residue diet, consumed high-fiber diet in last two days, amount of water consumed before the day of colonoscopy, consumed 1.5 L of water after laxative usage on the day of colonoscopy, consumed all laxative.

The endoscopists were trained about the Boston Bowel Preparation Scale (BBPS) for assessing the bowel cleansing process according to the criteria by the Boston Medical before the study [9]. This bowel preparation rating scale was used during withdrawal of the colonoscope, after all cleansing maneuvers are completed.

If an endoscopist noticed a segment having a score of 0 or 1 (unprepared colon segment with mucosa not seen because of solid stool that cannot be cleared/ portion of mucosa of the colon segment seen, but other areas of the colon segment are not well seen because of staining, residual stool, and/or opaque liquid), the

bowel preparation was defined as inadequate. Patients with total Boston score below 3 were assessed as inadequate colonoscopy. Other endoscopic data were recorded in the colonoscopy report obtained data collecting reserschers after procedure. The continuous variables were expressed as mean $\pm$ standard deviation (SD). The categorical variables were expressed as percentages. SPSS ver. 22 (SPSS, Inc., Chicago, IL, USA) was used for the statistical analyses. The distributions of the variables were analyzed by Kolmogorov- Smirnov test. The risk factors were compared between the adequate and inadequate bowel preparation groups with student's t-test, Mann Whitney U test or Pearson's chi-square tests where appropriate. The risk factors were found significant where the p value was < 0.1 in the univariate analyses, and then, included in the multivariate Cox proportional hazard test. The Odds ratio is expressed in a 95% confidence interval for each risk factor that was analyzed in the multivariate analyses. A p value of < 0.05 was considered statistically significant. The study was approved by the local ethical committee of Tokat Gaziosmanpaşa University. All patients who participated gave their written informed consent.

Results

Two hundred fifty-three consecutive patients were enrolled into the study and 48.6 % of the patients were female. The mean age was 56.6 ± 15 years (min. 15 - max. 86). Fifty-three patients' (20.9%) colonoscopy procedures were assessed as inadequate according to Boston score by the endoscopists, and the procedure was not completed due to ineffective bowel preparation.

Caecum intubation was succeeded in 73.1% of the patients. Caecum was intubated in none of the inadequate preparation group. Some procedures could not be completed for several different reasons such as pain (2.4%), cardiac problems (0.4%), respiratory problems (0.8%) and technical problems (2.4%).

Opioids were not prescribed in none of the patients as it was not included in the univariate analysis. Taking any medication did not affect bowel preparation quality (Table 1). Furthermore, the patients' sex, BMI, hours between the last laxative dose and colonoscopy time, history of surgery, history of constipation, patient hospitalization status (inpatient or outpatient), patients' residency locations did not significantly differ between the adequate and inadequate bowel preparation groups (Table 1). Neither comorbidities nor colonoscopy indication contributed to the quality of bowel preparation.

Although the patients were given written preparation instructions, only 75 patients (29.6%) adhered to the bowel preparation regimen. Other patients consumed laxatives in different ways, while 4 patients did not use them at all. Sixty-eight (34 %) patients adhered to the bowel preparation regimen in adequate group whereas only seven (13.2%) adhered to the appropriate regimen inadequate group. ($p < 0.05$) (Table 1).

Older age, consuming high-fiber diet in last two days, number of days of low residue diet, consumed all laxatives, consumed 1.5 L of water after the laxative usage, regular diet for dinner before the day of colonoscopy, amount of water consumed before the day of colonoscopy, amount of water consumed in the morning of the day of colonoscopy, fasting in the morning of the day of colonoscopy

were predictive factors (Table 1). The factors which were found significant in the univariate analysis were also analyzed in the multivariate Cox proportional hazard test. The patients' age, number of days of low residue diet, consuming high-fiber diet

in the last two days, regular diet for dinner before the day of colonoscopy and not consumed all laxatives were independently significant after being adjusted for other factors (Table 2).

Table 1. Univariate analysis of risk factors which may predict bowel preparation quality

RISK FACTORS	ADEQUATE (200)	INADEQUATE (53)	P value
Age (years)	55 ± 14.7	62.3 ± 15.09	p=0.002
Sex (Female/male)	97/103	26/27	p=1
Number of days of low residue diet	2.19 ± 0.72	1.75 ± 0.91	p = 0.002
Regular diet for dinner before the day of colonoscopy (number, %)	5 (2.5 %)	8 (3.2 %)	p<0.05
Fasting status in the morning of the day of colonoscopy			p=0.78
Fasting	148	37	
Clear diet or liquid	38	11	
Low residue	14	5	
Regular	0	0	
Consuming high-fiber diet in last two days (number, %)	39 (19.5 %)	29 (54.9 %)	p<0.05
Amount of water consumed before the day of colonoscopy (ml)	1753 ± 837	1198 ± 613	p < 0.05
Amount of water consumed in the morning of the day of colonoscopy (ml)	931 ± 831	500 ± 705	p= 0.001
Adherence to the protocol (number, %)	68 (34 %)	7 (13.2 %)	p=0.004
Hours between the last laxative dose and colonoscopy (hours)	9.5 ± 4.18	10.98 ± 5.44	p= 0.68
Consumed 1.5 lt water after laxative usage (number, %)	144 (72.4%)	17 (32.1%)	p < 0.05
Consumed all laxative (number, %)	197 (98.5%)	45 (84.9%)	p < 0.05
Hospitalization status (number; outpatient/inpatient)	176/24	46/7	p = 0.815
History of any surgery (number, %)	85 (42.5%)	28 (52.5%)	p > 1
Comorbidities (number)			p>1
None	101	23	
Diabetes mellitus	11	4	
Neurologic	4	1	
Hypertension	47	10	
Depression	9	1	
Cirrhosis	1	1	
Other	8	4	
Diabetes mellitus + Hypertension	19	9	
Taking any medication (number, %)	93 (46.5%)	27 (50.9%)	p=0.643
Constipation (number, %)	72 (36%)	25 (47.2)	p = 0.154
Body mass index (BMI)	27.71 ± 5.2	28.5 ± 6.72	p = 0.632
Colonoscopy indication			p = 0.519
Constipation	34	9	
Abdominal pain	20	7	
Screening	74	18	
Anemia	13	6	
GIS bleeding	5	1	
Hematochezia	26	6	
Diarrhea	18	1	
Postoperative control	10	5	
Residency location (city center/urban)	80/120	20/33	p = 0.764
History of abdominal surgery (number, %)	9 (4.5%)	4 (7.5%)	p = 0.481

Table 2. Independent risk factors for inadequate colonoscopy

	P value	Odds Ratio	95% C.I.	
			Lower	Upper
Older Age (years)	0.001	1.054	1.023	1.086
Number of days of low residue diet	0.047	0.559	0.315	0.993
Regular diet for dinner before the colonoscopy day	0.033	6.516	1.163	36.517
Consuming high-fiber diet in last two days	0.001	4.713	1.944	11.425
Consumed all laxative	0.025	0.108	0.015	0.757

Discussion

An adequate bowel preparation process is defined as visualization of the entire colon mucosa that allows detection of polyps over 5 mm in diameter [10]. Inadequate procedures cause prolongation of the operation, as well as increased procedural adverse events [11]. The primary outcome of screening programs is to decrease the mortality rate of colon cancer which depends on detection of preneoplastic lesions in colonoscopy. Inadequate bowel preparation leads to missed adenomas, meaning ineffective screening.

In this study, we aimed to analyze various factors that may contribute to the quality of the bowel preparation process. We included factors that have been assessed in previous studies [12-15]. Moreover, some factors that can affect bowel cleansing were reassessed and included in the analyses. For example, drinking water was divided into three new group. The amount of water consumed before the day of colonoscopy, the amount of water consumed in the morning of the day colonoscopy and consumed 1.5 L of water after laxative usage were the new factors that might be important in prediction of bowel preparation success. All these three factors were found significant in the univariate analysis, but none of them remained significant after the multivariate analysis. One study reported that the mean amount of water intake did not differ between good and poor colon preparations [16]. Although there is no evidence, individualized water intake may be recommended to patients for colonoscopy preparation. Older age is considered as a common risk factor for an inadequate bowel preparation process because of the decreased intestinal motility due to aging. Our study determined that the inadequate bowel preparation group was older than the adequate group. Some of studies did not reach the same conclusion [12, 17] while others supported our findings.

Patient adherence to preparation instructions is a reversible risk factor unlike older age or gender as proper patient education before colonoscopy will improve the quality of the bowel cleansing process. Although we recommended morning dose regimen, the patients used the laxatives in four different ways, and in fact, 4 of the patients did not use them at all. Only 75 (29.7%) of the patients followed our instructions. The patients who followed our instructions have significantly more adequate bowel preparation outcomes in comparison to the others. Previous studies did not include such a risk factor. Most studies have conducted a patient education program, and one study reported a high preparation adequacy rate due to this patient education session [15].

We did not set a special education program for this study. The information about the bowel preparation regimen was provided by the physician that recommended colonoscopy.

The mean number of days of low residue diet was higher than that of the inadequate group. This variable remained significant after being adjusted for other factors. We recommend that patients execute a low residue diet at least for two days. The clear liquid diet and low residue diet were the preferred diet regimens for preparation. We only chose the low residue diet because the clear diet may be found difficult by the patients.

Consumed high-fiber diet in last two days was an independent risk factor for inadequate bowel preparation. The patients who consumed high fiber diet in last two days had a risk for inadequate bowel preparation four times greater than the patients who did not. This is an important issue for our country since the traditional Turkish cuisine consists of high fiber diets, especially natural herbs in comparison to Western style diets. One study reported a regular diet consumed for dinner on the last day before colonoscopy as the strongest risk factor for inadequate bowel preparation after being adjusted for other risk factors [18].

Generally, healthcare providers keep the patient fasting in the morning of colonoscopy and this situation may decrease the patient's tolerability to the colonoscopy process, while complications due to sedation may also increase. The combination of the low residue diet before the day of colonoscopy and clear liquid diet in the morning of colonoscopy may increase the success of the colonoscopy procedure. One meta-analysis revealed that there was no difference between a low-residue diet and a clear liquid diet for colon cleansing adequacy [19]. Flexibility in the diet may increase adherence to the protocol [20]. The clear liquid diet may be changed with a low-residue diet, and patients may take liquids on the day of colonoscopy.

Taking any medications, especially tricyclic antidepressants (TCA) and opioids was assumed as a risk factor by previous studies [21]. Dik et al reported that having more than eight active prescribed medications can contribute to failure in colonoscopy [12]. Taking any medication did not influence the bowel cleansing process in our study. Incomplete usage of the prescribed laxatives is the most direct factor in colon cleansing adequacy [12]. We have also found this relationship in multivariate analysis. Most studies used 4-liter polyethylene glycol solutions and this high-volume regimen may be found intolerable by patients. Low-volume polyethylene glycol has similar efficacy in comparison to the 4-liter form. 250 mL of Senna alkaloids is preferred usually in Turkey. Although Senna alkaloids may be classified as low volume, the patients were instructed to consume 1.5 L of water after laxative usage. This pattern was also a risk factor for inadequate colonoscopy, but it lost its significance after the multivariate analyses.

There were conflicting results about the other risk factors. BMI

was not a significant predictor for inadequate bowel cleansing in our study. However, one cohort study that was conducted on colon cancer screening revealed that BMI was an independent risk factor for inadequate bowel preparation. Interestingly, the study also found that underweight patients had significantly worse preparation in comparison to individuals with normal BMI [22]. History of constipation or hospitalization status between the adequate and inadequate group was not significantly different. However, Dik et al. found that chronic constipation and inpatient status were independent risk factors [12]. Gimeno et al aimed to determine a validated score to predict the risk factors for inadequate bowel preparation and abdomino-pelvic surgery was a crucial independent risk factor [5]. In our study, history of abdominopelvic surgery was found to be a significant factor, but it did not retain significance in the multivariate analyses. In literature male gender was found as a risk factor for inadequate bowel cleansing, but our study did not comply [19].

Colonoscopy indication was not a risk factor for inadequate bowel preparation. We included all indications in our study. A real-life cohort such as gastrointestinal system bleeding patients or patients with abdominal pain that can affect bowel preparation were enrolled into the study. However, most cohort studies were conducted on screening programs. So, it may be concluded that these patients' demographic and clinical variations were more homogenous than those in our study [23].

Our study had strengths and limitations. In the first place, most studies that were aimed to find the risk factors for inadequate bowel preparation were retrospective studies. The strength of our study was its prospective design, but its relatively low number of patients may be considered as a limitation. There was also no intervention made on the study, like education of the patients or physicians or standardization of the bowel preparation protocol, so we believe that the real-life risk factors were obtained in this study.

In conclusion, number of days of low residue diet, regular diet for dinner before the day of colonoscopy, consuming a high-fiber diet in last two days, not consumed all laxatives and older age were independent risk factors for inadequate bowel preparation in our study. These factors, except for older age, were found as changeable risk factors. Increasing the adherence to the protocol with education might improve the quality of the bowel preparation process.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

The study was approved by the local ethical committee of Tokat Gaziosmanpaşa University (2013/13 13-KAEK-143).

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