Impact of prior different abdominal or pelvic surgery on cecal intubation time: a prospective observational study

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Abstract

Background **: Studies investigating the effect of different abdominopelvic surgeries on cecal intubation time (CIT) are limited and their results are heterogeneous. The aim of this study was to investigate the effect of different abdominopelvic surgeries on CIT.**

Methods **: The study was designed as a single-center, prospective, investigator-blinded and compared patients with previous pelvic surgery, appendectomy, hepatobiliary surgery, upper abdominal region surgery, and umbilical hernioraphy with patients that had no history of surgery. Factors associated with prolonged CIT (>600 sec) were determined using both univariate and multivariate analyses.**

Results **: This study included a total of 1,420 consecutive colonoscopy procedures that were undertaken between October 2018 and December 2019. The patients comprised 55.1% women and the mean age was 53.05±13.9 years. Mean CIT was 361.87±192.2 sec and prolonged CIT was detected in 176 (12.4%) patients. Of all patients, 523 (36.8%) of them had a history of abdominopelvic surgery. On multivariate analysis, diabetes mellitus (p=0.032, OR 1.766, 95% CI 1.051-2.968) and previous umbilical hernioraphy (p=0.002, OR 3.614, 95% CI 1.623-8.049) were found to be significant factors for CIT and prolonged CIT.**

Conclusion **: Previous umbilical hernioraphy and diabetes mellitus were identified as independent factors associated with prolonged CIT and difficult colonoscopy.** (Acta gastroenterol. belg., **2020**, 83, **541-548**).

Key words : Cecal intubation time, colonoscopy, abdominopelvic surgery, umbilical hernioraphy.

Introduction

Colonoscopy is a reliable diagnostic method with high diagnostic accuracy, commonly used in the diagnosis and treatment of colorectal diseases. Colonoscopy screening is accepted as the gold standard of colorectal cancer screening methods and is considered to significantly decrease the incidence of and mortality from colorectal cancer by allowing the removal of adenomas (1,2). A primary goal of colonoscopy is to reach the cecum and to explore the ileum when clinically necessary. Effective colonoscopists should be able to intubate the cecum in ≥90% of all cases and ≥95% of cases when screening is indicated in a healthy adult (3,4). Moreover, reaching the cecum, which is a quality marker of colonoscopic examination, may not always be possible. Accordingly, the rates of incomplete colonoscopy vary between 4%-25%. Additionally, attempting to reach the cecum may also prolong the procedure, necessitate the need for more sedation and analgesia for the patient and may increase the risk of complications. On the other hand, risk factors for incomplete colonoscopy include inadequate colon cleansing, female gender, advanced age, low body mass index (BMI), prior abdominopelvic surgery, diverticular disease, elongated or tortuous colon, nonsedated procedures, and lack of colonoscopic experience (5-11).

Acquired peritoneal adhesions may occur secondary to inflammation (cholecystitis, appendicitis, diverticulitis) or surgery. Moreover, adhesions occur after almost 90% of major abdominal and pelvic surgeries. Postsurgical adhesions are a consequence resulting when injured tissue surfaces fuse together to form scar tissue following incision, cauterization, suturing or other means of trauma. On the other hand, anatomical distortion and fixation occurring in the sigmoid colon after pelvic surgery and in the transverse colon after gastrectomy have been found to be associated with difficult colonoscopy (12-14). In a previous meta-analysis, Clancy et al.[15] reported that hysterectomy led to reduced rates of complete colonoscopy.

Appendectomy, cholecystectomy, and umbilical hernioraphy are commonly performed surgical procedures. However, to our knowledge, there are a limited number of studies investigating the effect of these procedures on colonoscopy. The aim of this study was to investigate the effect of different surgical procedures on cecal intubation time (CIT) and the factors affecting CIT.

Methods

This prospective study was conducted in a tertiary health care hospital between October 2018 and December 2019. The study was performed in accordance with the Helsinki Declaration and the study protocol was approved by the local ethics committee (IBD No : 2018/17/08). All patients gave informed consent prior to participation in the trial. The study included patients who were aged over 18 years and had no comorbidities that could prevent sedation. Prior to the colonoscopy procedure, patient data were recorded for each patient by

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a nurse using an information form. The procedure was performed by the same endoscopist who was blind to the patient's history of surgery. Exclusion criteria included history of colorectal surgery, inflammatory bowel disease, emergency procedures, procedures performed for therapeutic purposes, and inadequate bowel preparation.

Mechanical bowel cleansing

All the patients were advised to switch to a soft-food diet three days prior to the colonoscopy procedure and to consume clear liquids one day before the procedure. Mechanical bowel cleansing was performed with sodium phosphate in two equal doses of 90 mL. A single dose of enema was administered in the morning of the procedure. In patients with chronic kidney disease, bowel preparation was achieved with polyethylene glycol. The quality of bowel preparation in our study was divided into four groups ; excellent (adequate visualization of the entire colon without washing and suction), good (adequate visualization of the entire column (>90%) with clear liquids requiring minimal absorption and no or little washing), fair (all or part of the colon needs absorption and washing insufficient visualization with colored liquid and liquid feces) and weak (insufficient visualization of the whole or part of the colon with colored liquid and solid feces) absorption and washing and re-examination according to the bowel preparation scale described earlier (16).

Colonoscopy procedure

All colonoscopic examinations were performed using a video colonoscopy device (EC530WL3, Fujınon, Willich, Germany) under sedation. A complete colonoscopy was defined as visualization of the ileocecal valve and the appendiceal orifice and a scope capable of reaching the cecum. CIT was defined as the time in which colonoscopy reached from the anal region to the cecum and was recorded in seconds. The colonic mucosa was explored and the additional processes were performed during the withdrawal of the colonoscope from the cecum. The procedures with a CIT of more than 10 min (>600 sec) was accepted as difficult colonoscopy (13, 17).

Age, gender, comorbidities, indication for colonoscopy (screening or diagnosis), BMI, previous abdominopelvic surgery, CIT, and presence of polyps and diverticular disease were recorded for each patient. Previous abdominopelvic surgeries were divided into five groups : (I) pelvic surgeries (hysterectomy, cesarean section, and bladder and prostate surgery), (II) appendectomy, (III) umbilical hernia, (IV) hepatobiliary surgery (cholecystectomy, hydatid cyst, hepatectomy), and (V) upper abdominal region surgeries (gastric, splenic, hiatal hernia, and reflux surgeries). Patients that had undergone more than one surgery were excluded from the study. Moreover, patients in whom the cecum could not be reached due to various reasons (looping, external compression, unprepared bowel) were also excluded from the study. The group with no previous surgery was compared with each of the five groups with previous surgery. The effect of previous abdominopelvic surgeries and other factors on CIT was analyzed using univariate and multivariate analyses.

Statistical Analysis

Statistical analyses were conducted with SPSS 19.0 (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY : IBM Corp). Baseline characteristics of study participants and colonoscopic data were expressed as frequencies (percentages) and mean ± standard deviation (SD). Pearson's chi-square test was used for the statistical comparison of group means in univariate analysis. Only factors with a p value of <0.05 in univariate analysis were subsequently estimated with odds ratios (ORs) and 95% confidence interval (CI) using Multivariate Logistic Regression Analysis. A p value of less than 0.05 was considered significant.

Results

This prospective study included a total of 1,671 consecutive patients that met the inclusion criteria between October 2018 and December 2019. Of these, 251 patients were excluded from the study due to poor bowel preparation, history of multiple abdominopelvic surgeries, and incomplete colonoscopy (looping, diverticulosis, etc.). As a result, the remaining 1,420 patients were enrolled in the study. Fig. 1 presents the flowchart of patient selection. The patients comprised 781 (55.1%) women and 639 (44.9%) men with a mean age of

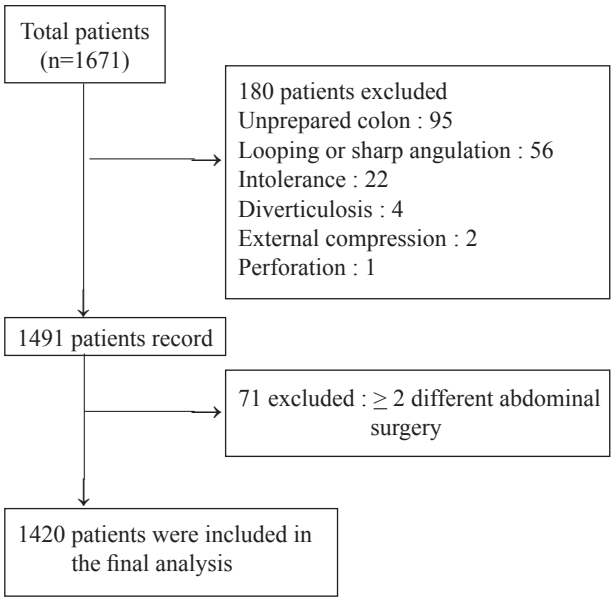

Figure 1. — Flow-chart of the study

Table 1. — **Baseline Charasteristics**

Variables	n	%
Age (mean ± SD)		53.05±13.9
<65	1115	78.5
≥65	305	21.5
Sex		
Male	639	44.9
Female	781	55.1
Comorbidities	581	40.9
Diabetes mellitus	227	16.0
Coronary artery disease	205	14.4
Hypertension	361	25.4
Chronic obstructive pulmonary disease	68	4.8
Chronic renal failure	7	0.5
BMI (kg/m²) ± SD		27.69±4.7
<25	425	29.9
≥25	995	70.1
Colonoscopy indication		
Screening	239	16.8
Diagnostic	1181	83.2
History of abdomino-pelvic surgery		
Yes	523	36.8
No	897	63.2
Cecal intubation time (second) ± SD		361.87±192.2
<600 second	1244	87.6
≥600 second	176	12.4
Bowel cleanliness		
Excellent	555	39.1
Good	608	42.8
Fair	257	18.1
Polyp detection rate	447	31.5
Diverticula detection rate	170	12.0

SD, standard deviation. *BMI,* body mass index.

53.05±13.9 years. The reason for colonoscopy was either diagnosis (n=1,181 ; 83.2%) or screening (n=239 ; 16.8%). Of all patients, 523 (36.8%) of them had a history of abdominopelvic surgery. Mean CIT was 361.87±192.2 sec and prolonged CIT (>600 sec) was detected in 176 (12.4%) patients. When 95 patients were excluded due to poor bowel preparation, cecum was intubated in 94.6% (1491/1576). Table 1 presents the baseline characteristics of the patients.

The 253 patients with a history of pelvic surgeries comprised 95.7% women who had a lower mean age (49.90±12.18 years) compared to that of non-operated group (p=0.004). CIT was similar in patients with a history of pelvic surgeries and patients with no history of surgeries (377.39±189.5 and 352.11±187.2 sec, respectively) (p= 0.059). Table 2 presents the characteristics of patients with a history of pelvic surgeries and patients with no history of surgeries. The 89 patients with previous hepatobiliary surgery had significantly higher rates in advanced age, female gender, incidence of comorbidities, and increased BMI compared to patients with no history of surgeries (Table 3). However, no significant difference was found between these two groups with regard to CIT (352.11±187.17 and 363.43±208.24 sec, respectively) (p=0.590).

Of 32 patients (2.25%) with a history of umbilical hernioraphy, 22 (68.7%) were female, BMI mean was 30.23 ± 6.65 kg / m², and statistically significant compared to patients with no history of surgeries (p<0.001) (Table 4). CIT was significantly higher in these patients compared to patients with no history of surgeries (520.31±324.78

Table 2. — **Comparison of pelvic surgery and non-operated group (n,%)**

Variables	Non operated group (n=897)	Pelvic surgery (n=253)	*p value*
Age (mean ± SD)	52.75±14.16	49.90±12.18	0.004*
<65	709 (79.0)	220 (87.0)	0.002*
≥65	188 (21,0)	33 (13,0)	
Sex			
Male	518 (57.7)	11 (4.3)	
Female	379 (42.3)	242 (95.7)	<0.001*
Comorbidities	349 (78.8)	94 (21.2)	0.333
Diabetes mellitus	125 (74.9)	42 (25.1)	0.168
Coronary artery disease	129 (85.4)	22 (14.6)	0.010*
Hypertension	219 (78.5)	60 (21.5)	0.445
Chronic obstructive pulmonary disease	35 (72.9)	13 (27.1)	0.240
Chronic renal failure	2 (100.0)	0(0.0)	0.608
BMI (kg/m²) ± SD	27.29±4.55	28.27±4.96	0.003*
<25	286 (31.9)	68 (26.9)	0.073
≥25	611 (68.1)	185 (73.1)	
Colonoscopy indication			
Screening	157 (17.5)	30 (16.0)	0.018*
Diagnostic	740 (82.5)	223 (84)	0.016*
Cecal intubation time (second) ± SD	352.11±187.2	377.39±189.5	0.059
<600 second	795 (88.6)	216 (85.4)	0.100
≥600 second	102 (11.4)	37 (14.6)	
Bowel cleanliness			
Excellent	354 (39.5)	104 (41.1)	0.095
Good	374 (41.7)	116 (45.8)	
Fair	169 (18.8)	33 (13.0)	

SD, standard deviation ; *BMI* : body mass index. * : p<0.05

Table 3. — **Comparison of hepatobiliary surgery group and non-operated group (n %)**

Variables	Non operated group (n=897)	Hepatobiliary surgery (n=89)	*p value*
Age (mean ± SD)	52.75±14.16	58.81±12.15	<0.001*
<65	709 (79.0)	58 (65.1)	0.003*
≥65	188 (21.0)	31 (34.8)	
Sex			
Male	518 (57.7)	19 (21.3)	<0.001*
Female	379 (42.3)	70 (78.7)	
Comorbidities	349 (86.6)	54 (13.4)	<0.001*
Diabetes mellitus	125 (82.2)	27 (17.8)	<0.001*
Coronary artery disease	129 (87.2)	19 (12.8)	0.059
Hypertension	219 (84.2)	41 (15.8)	0.001*
Chronic obstructive pulmonary disease	35 (81.4)	8 (18.6)	0.033*
Chronic renal failure	2 (33.3)	4 (66.7)	0.001*
BMI (kg/m^2) ± SD	27.29±4.55	30.29±4.65	<0.001*
<25	286 (31.9)	9 (10.1)	<0.001*
≥25	611 (68.1)	80 (89.9)	
Colonoscopy indication			
Screening	157 (17.5)	14 (15.7)	0.401
Diagnostic	740 (82.5)	75 (84.3)	0.497
Cecal intubation time (second) ± SD	352.11±187.17	363.43±208.24	0.590
<600 second	795 (88.6)	80 (89.9)	0.442
≥600 second	102 (11.4)	9 (10.1)	
Bowel cleanliness			
Excellent	354 (39.5)	35 (39.3)	0.828
Good	374 (41.7)	35 (39.3)	
Fair	169 (18.8)	19 (21.4)	

SD, standard deviation ; *BMI,* body mass index ; *, p<0.05

Table 4. — **Comparison of umbilical herniorraphy and non-operated group (n, %)**

Variables	Non operated group (n=897)	Umbilical herniorraphy (n=32)	*p value*
Age (mean ± SD)	52.75±14.16	59.97±11.82	0.005*
<65	709 (79.0)	21 (65.6)	0.060
≥65	188 (21.0)	11 (34.4)	
Sex			
Male	518 (57.7)	10 (31.3)	0.003*
Female	379 (42.3)	22 (68.7)	
Comorbidities	349 (93.6)	24 (6.4)	<0.001*
Diabetes mellitus	125 (91.2)	12 (8.8)	0.001*
Coronary artery disease	129 (92.8)	10 (7.2)	0.014*
Hypertension	219 (95.2)	11 (4.8)	0.142
Chronic obstructive pulmonary disease	35 (92.1)	3 (7.9)	0.139
Chronic renal failure	2 (100)	0 (0.0)	0.932
BMI (kg/m^2) ± SD	27.29±4.55	30.23±6.65	<0.001*
<25	286 (31.9)	7 (21.9)	0.158
≥25	611 (68.1)	25 (78.1)	
Colonoscopy indication			
Screening	157 (17.5)	7 (21.9)	0.330
Diagnostic	740 (82.5)	25 (78.1)	0.336
Cecal intubation time (second) ± SD	352.11±187.17	520.31±324.78	<0.001*
<600 second	795 (88.6)	20 (62.5)	<0.001*
≥600 second	102 (11.4)	12 (37.5)	
Bowel cleanliness			
Excellent	354 (39.5)	6 (18.8)	0.041*
Good	374 (41.7)	16 (50.0)	
Fair	169 (18.8)	10 (31.2)	

SD, standard deviation ; *BMI,* body mass index ; *, p<0.05

vs. 352.11±187.17 sec, $p \leq 0.001$). Moreover, prolonged CIT (>600 sec) was detected in 12 (37.5%) of patients with previous umbilical herniorraphy and in 102 (11.4%) of patients with no history of surgeries ($p<0.001$).

A history of upper abdominal surgeries and a history of appendectomy were present in 47 (3.3%) and 102 (7.18%) patients, respectively. The mean CIT and the rate of prolonged CIT in these two groups were similar to those in patients with no history of surgeries (Table 5, 6). Nevertheless, patients with a history of two or more surgeries (combined surgery) were not included in the primary analysis of the present study since the inclusion

Table 5. — **Comparison of upper abdominal surgery group and non- operated group (n, %)**

Variables	Non operated group (n=897)	Upper abdominal surgery (n=47)	*p value*
Age (mean ± SD)	52.75±14.16	58.13±13.51	0.011*
<65	709 (79.0)	32 (68.1)	0.059
≥65	188 (21.0)	15 (31.9)	
Sex			
Male	518 (57.7)	26 (55.3)	0.427
Female	379 (42.3)	21 (44.7)	
Comorbidities	349 (95.4)	17 (4.6)	0.416
Diabetes mellitus	125 (98.4)	2 (1.6)	0.035*
Coronary artery disease	129 (94.2)	8 (5.8)	0.371
Hypertension	219 (95.2)	11 (4.8)	0.518
Chronic obstructive pulmonary disease	35 (92.1)	3 (7.9)	0.292
Chronic renal failure	2 (100)	0 (0.0)	0.903
BMI (kg/m²) ± SD	27.29±4.55	26.49±4.09	0.242
<25	286 (31.9)	18 (38.3)	0.222
≥25	611 (68.1)	29 (61.7)	
Colonoscopy indication			
Screening	157 (17.5)	11 (23.4)	0.198
Diagnostic	740 (82.5)	36 (76.6)	0.204
Cecal intubation time (second) ± SD	352.11±187.17	354.36±157.25	0.935
<600 second	795 (88.6)	41 (87.2)	0.455
≥600 second	102 (11.4)	6 (12.8)	
Bowel cleanliness			
Excellent	354 (39.5)	15 (31.9)	0.436
Good	374 (41.7)	24 (51.1)	
Fair	169 (18.8)	8 (17.0)	

SD, standard deviation ; *BMI,* body mass index ; *, p<0.05

Table 6. — **Comparison of appendectomy group and non-operated group (n, %)**

Variables	Non operated group (n=897)	Appendectomy group (n=102)	*p value*
Age (mean ± SD)	52.75±14.16	54.08±15.20	0.378
<65	709 (79.0)	75 (74.0)	0.150
≥65	188 (21.0)	27 (26.0)	
Sex			
Male	518 (57.7)	55 (54.0)	0.269
Female	379 (42.3)	47 (46.0)	
Comorbidities	349 (89.0)	43 (11.0)	0.245
Diabetes mellitus	125 (86.8)	19 (13.1)	0.114
Coronary artery disease	129 (88.4)	17 (11.6)	0.283
Hypertension	219 (92.0)	19 (8.0)	0.139
Chronic obstructive pulmonary disease	35 (85.4)	6 (14.6)	0.221
Chronic renal failure	2 (66.7)	1 (33.3)	0.272
BMI (kg/m²) ± SD	27.29±4.55	27.19±4.52	0.842
<25	286 (31.9)	37 (36.0)	0.234
≥25	611 (68.1)	65 (64.0)	
Colonoscopy indication			
Screening	157 (17.5)	20 (19.6)	0.399
Diagnostic	740 (82.5)	82 (80.4)	0.319
Cecal intubation time (second) ± SD	352.11±187.17	360.95±167.25	0.651
<600 second	795 (88.6)	92 (89.8)	0.301
≥600 second	102 (11.4)	10 (10.2)	
Bowel cleanliness			
Excellent	354 (39.5)	41 (40.0)	0.979
Good	374 (41.7)	43 (42.0)	
Fair	169 (18.8)	18 (18.0)	

SD, standard deviation ; *BMI,* body mass index ; *, p<0.05

of those patients could have made it difficult to determine as to which surgical procedure was more effective than the other. In subgroup analyses, mean CIT was 425.58±223.11 and 352.11±187.17 sec in the combined surgery group and the non-operated group, respectively, and the difference was statistically significant (p=0.002). Moreover, prolonged CIT (>600 sec) was detected in 22.5% of the patients in the combined surgery group

Table 7. — **Comparison of combined surgery group and non operated group (n %)**

Variables	Non operated group (n=897)	Combined surgery (n=71)	*p value*
Age (mean ± SD)	52.75±14.16	53.75±13.30	0.568
<65	709 (79.0)	52 (73.2)	0.251
≥65	188 (21.0)	19 (26.8)	
Sex			
Male	518 (57.7)	14 (19.7)	<0.001*
Female	379 (42.3)	57 (80.3)	
Comorbidities	349 (91.1)	34 (8.9)	0.136
Diabetes mellitus	125 (88.0)	17 (12.0)	0.022*
Coronary artery disease	129 (92.8)	10 (7.2)	0.945
Hypertension	219 (90.1)	24 (9.9)	0.079
Chronic obstructive pulmonary disease	35 (89.7)	4 (10.3)	0.475
Chronic renal failure	2 (100.0)	0 (0.0)	0.690
BMI (kg/m²) ± SD	27.29±4.55	29.33±5.08	<0.001*
<25	286 (31.9)	15 (21.1)	0.059
≥25	611 (68.1)	56 (78.9)	
Colonoscopy indication			
Screening	157 (17.5)	9 (12.7)	0.299
Diagnostic	740 (82.5)	62 (87.3)	
Cecal intubation time (second) ± SD	352.11±187.17	425.58±223.11	0.002*
<600 second	795 (88.6)	55 (77.5)	0.006*
≥600 second	102 (11.4)	16 (22.5)	
Bowel cleanliness			
Excellent	354 (39.5)	27 (38.0)	
Good	374 (41.7)	31 (43.7)	0.949
Fair	169 (18.8)	13 (18.3)	

SD, standard deviation ; *BMI,* body mass index ; *, p<0.05

Table 8. — **Prolonged (>600 second) cecal insertion time according to study variables, with odd ratios estimated by multivariable logistic regression analysis**

		Univariate analysis	Multivariate analysis		
		p value	OR	95% - Cl	*p value*
Age (mean ± SD)		0.016*	1.010	0.991-1.028	0.310
	<65	0.002*			0.088
	≥65		1.597	0,932-2.736	
Sex	Male	0.230			
	Female				
Comorbidities		0.144			
Diabetes mellitus		0.004*	1.766	1.051-2.968	0.032**
Coronary artery disease		0.035*	1.413	0.833-2.396	0.200
Hypertension		0.212			
Chronic obstructive pulmonary disease		0.378			
Chronic renal failure		0.605			
BMI (kg/m2) ± SD		0.465			
	<25	0.363			
	≥25				
Bowel cleanliness	Excellent	0.138			
	Good				
	Fair				
Pelvic surgery		0.140			
Hepatobiliary surgery		0.301			
Umblical hernoraphy		<0.001*	3.614	1.623-8.049	0.002**
Upper abdominal surgery		0.537			
Appendectomy		0.182			

SD, standard deviation ; *CI*, confidence interval ; *OR*, odds ratio ; *BMI* : body mass index ; *, Significant in univariate analysis ; **, significant in multivariate analysis

(p<0.006). Table 7 presents the comparison of these two groups.

On univariate analysis, advanced age (≥65 years), diabetes mellitus (DM), coronary artery disease, and previous umbilical herniorraphy were found to be significant factors for CIT and prolonged CIT (Table 8). On multivariate analysis, however, only DM (p=0.032, OR 1.766, 95% CI 1.051-2.968) and previous umbilical herniorraphy (p=0.002, OR 3.614, 95% CI 1.623-8.049) were found to be significant factors for CIT and prolonged

CIT. Nevertheless, pelvic surgery, appendectomy, hepatobiliary surgery, and upper abdominal region surgeries were not revealed as significant risk factors for CIT or prolonged CIT on both univariate and multivariate analyses.

Discussion

Colonoscopy is the gold standard in the diagnosis and treatment of colorectal disorders. The primary goal in performing colonoscopy is to visualize the whole colonic mucosa and to reach the terminal ileum if possible. Colonoscopy is commonly recommended in adults aged over 50 years and in the diagnosis and treatment of familial adenomatous polyposis, iron-deficiency anemia, symptoms associated with colon diseases, abnormal colon findings detected on radiography, heme-positive stool, and inflammatory bowel disease. Moreover, it is also used in the follow-up of patients undergoing polypectomy and of patients undergoing surgical resection due to colorectal malignancies. Polyps can be removed during colonoscopy, thereby reducing the risk of colorectal cancer (3). Moreover, reaching the cecum is highly important for the inspection of colonic mucosa. Accordingly, an incomplete colonoscopy examination can result in missed cancer if additional tests for completion are not performed. However, reaching the cecum and performing a complete inspection of the whole colon may not always be possible due to prolonged and incomplete colonoscopy that may be caused by several factors including old age, female gender, low BMI, surgical history, and poor bowel preparation (10, 13-19). Meaningfully, shorter CIT is essential to ensure increased patient tolerance, a high-quality examination of the colon, and higher polypectomy rates (9,20,21).

To our knowledge, there has been no study in the literature investigating the effect of umbilical hernioraphy on colonoscopy. In the present study, umbilical hernioraphy was found to be associated with prolonged CIT both on univariate and multivariate analyses, which could be attributed to the predominance of females among patients with previous umbilical hernioraphy (67.8%) and the high prevalence of DM (p=0.001) and CAD (p=0.014) in our patients. On the other hand, the adhesion and fixation of the transverse colon to the hernia repair area may be a factor that makes colonoscopy difficult by creating a new angle in the colon. Nevertheless, this anatomic alteration could not be confirmed by the other radiological techniques (Fig. 2A, 2B). In the literature, there are a limited number of studies reporting on the fixation and angulation of the transverse colon. Kim et al[14]. reported that patients with previous gastrectomy had higher rates of poor bowel preparation and incomplete colonoscopy. The authors also noted that the extent of surgical dissection and reconstruction type were risk factors for the angulation and fixation of the transverse colon and that the consumption of colon-cleansing fluid decreased and the intolerance to the diet increased

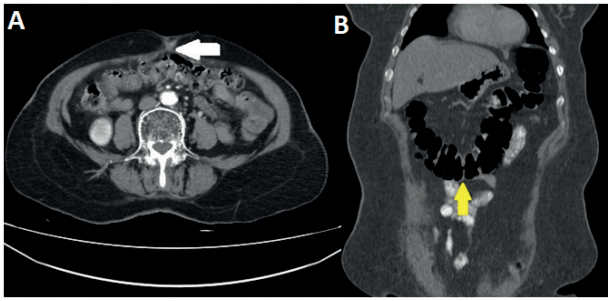

Figure 2. Axial (A) and coronal (B) computed tomography images of patients who have previously undergone umbilical hernioraphy. Transverse colon appears to adhere to the hernioraphy area.

in these patients (14). In our study, 13 patients had a history of total or subtotal gastrectomy, among whom 7 patients had undergone surgery for ulcer and 6 patients due to malignancies. However, no definitive conclusion could be drawn regarding the clinical features of these patients although it was revealed that these patients had similar CIT values with patients that had no history of surgeries (p=0.935). Additionally, appendectomy and hepatobiliary surgery were found to have no significant effect on colonoscopy, which could be explained by the localized inflammation and adhesion in appendectomy and cholecystectomy (13).

Garrett and Church[21] compared colonoscopy in women who had undergone hysterectomy with those who had undergone both hysterectomy and sigmoid colon resection and reported that women who had undergone hysterectomy alone had difficult colonoscopy while the women who had undergone both hysterectomy and sigmoid resection had no difficult colonoscopy. The authors also noted that the fixation of the sigmoid colon to the pelvic floor following hysterectomy was considered as a cause of difficult colonoscopy (22). In our study, the ratio of women in the patients that underwent pelvic surgery was 95.7% (242/253) and these patients had a relatively lower mean age (p=0.004). Although the CIT is longer than the non-operated group (352.11 ± 187.2 vs 377.39 ± 189.5 sec), it was not statistically significant (p = 0.059).

In the present study, DM was found to be another factor associated with prolonged CIT (p=0.032, OR 1.766, 95% CI 1.051-2.968). The prevalence of DM was 13.9% (125/897) in patients with no previous surgery, 19.5% (102/523) in patients with a history of surgery, and was 37.5% (12/32) in patients with previous umbilical hernioraphy, which was relatively higher. Gastrointestinal motility disorders and neuropathy are common entities in diabetic patients. Moreover, multidrug use and comorbidities are frequently seen in diabetic patients and these patients often have a worse preparation quality and longer cecal intubation and total procedure time compared with nondiabetic patients. Meaningfully, a meticulous bowel preparation and colonoscopic examination is needed in diabetic patients

due to the high prevalence of colorectal cancer in those patients (23-26).

Our study was limited in several ways. First, it was a single-center study and had a small patient population. Secondly, the study had no information regarding the mode of surgery (open vs. laparoscopic) preferred in the patients. Thirdly, no additional radiographic technique (barium enema, computed tomography) was performed to determine the anatomic structure of the colon in patients with previous umbilical hernia surgery. Finally, no subgroup analysis was performed in patients with DM.

Conclusion

Previous umbilical hernioraphy and DM are independent factors associated with prolonged CIT. Accordingly, colonoscopy is likely to be difficult in patients with a history of umbilical hernioraphy and thus the administration of colonoscopy by an experienced endoscopist will reduce the rate of incomplete colonoscopy. Further radiological studies investigating the effect of umbilical hernioraphy on the anatomy of colon are needed.

Competing Interest

No potential conflict of interest relevant to this article was reported.

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Ethical approval

Ethical approval was granted by the Fırat University Clinical Research Ethics Committee, IBD No : 2018/17/08. All patients gave informed consent prior to participation in the trial.

Abbreviations

BMI **:** body mass index
CIT **:** cecal intubation time
CI **:** confidence interval
DM **:** diabetes mellitus
ORs **:** odds ratios
SD **:** standard deviation

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