


Cecal intubation time in screening colonoscopy

Hyun Young Kim, MD* 

Abstract

The time required to intubate the cecum varies. The aim of this study was to determine whether demographic and anthropometric factors, such as body mass index (BMI), percent body fat, muscle mass, and fat mass, affect the cecal intubation time (CIT) during complete colonoscopy.

A retrospective chart review of 1229 patients (aged 40–80 years) was performed. These patients underwent average-risk screening colonoscopies performed by expert gastroenterologists at Health Check-up Center, Seoul National University Bundang Hospital, during a health check-up. We collected data on age, sex, BMI, percent body fat, muscle mass, fat mass, history of prior abdominal or pelvic surgery, CIT, and bowel preparation quality (Boston Bowel Preparation Scale [BBPS] score).

Of the 1229 patients, 62% were men. The mean age was 55 years, and the mean BMI was 24 kg/m². The median CIT was 5 min. The patients were categorized into two groups according to CIT: easy colonoscopy (CIT ≤ 10 min) and difficult colonoscopy (CIT > 10 min). In univariate analysis, CIT was prolonged by the following factors: older age, poor bowel preparation, lower BMI, lower percent body fat, and less fat mass. Multivariate analysis showed that anthropometric indices including BMI, percent body fat, muscle mass, and fat mass were not significant factors for CIT. Older age (≥ 70 years) (odds ratio [OR]: 2.272, 95% confidence interval [CI]: 1.056–4.890, *P* = .036) and poor bowel preparation (BBPS score ≤ 5) (OR: 3.817, 95% CI: 1.866–7.808, *P* = .000) were found to be correlated with difficult colonoscopy.

Our study suggests that anthropometric indices including BMI, percent body fat, muscle mass, and fat mass are not associated with significantly different CIT. Furthermore, sex and prior abdominal or pelvic surgery are not useful factors for a prolonged CIT. Older age (≥ 70 years) and poor bowel preparation (BBPS score ≤ 5) are significant variables predicting the CIT of expert gastroenterologists.

Abbreviations: BBPS = Boston Bowel Preparation Scale, BIA = bioelectrical impedance analysis, BMI = body mass index, CIT = cecal intubation time.

Keywords: anthropometry, cecal intubation time, colonoscopy

1. Introduction

The incidence and mortality of colorectal cancer are rapidly increasing in Korea.^[1] Current Korean guidelines recommend screening colonoscopy beginning at age 50 years in the average-risk population.^[2] Screening colonoscopy is considered to be one of the strategies for the early detection and prevention of

colorectal cancer development from the adenoma-carcinoma pathway.^[3,4]

Cecal intubation time (CIT) is defined as the time from the insertion of the colonoscope tip into the anal verge until reaching the cecal base or cecal end.^[5] A longer CIT is an indicator of a technically difficult colonoscopy.^[6] A prolonged CIT is associated with a higher burden for the colonoscopist (gastroenterologist), colonoscopist fatigue, lower rate of polyp detection, increased pain for the patient, and higher risk of procedure-related complications, leading to a lower quality of colonoscopy.^[7]

However, the failure of colonoscopy depends on the colonoscopist's skill, level of training, and duration or amount of experience. Previous studies have reported that age, sex, body mass index (BMI), bowel preparation quality, and previous surgery are the factors affecting CIT.^[8–11] An effective colonoscopy with a shortened CIT is necessary for the early diagnosis of precursor lesions of colorectal cancer such as adenomas or serrated lesions.

The aim of this study was to investigate factors, including anthropometric indices, that are associated with CIT among expert endoscopists.

2. Methods

2.1. Study population

This study analyzed colonoscopies and anthropometric measurements performed at a single tertiary hospital. This retrospective,

Editor: Kiran Panuganti.

The author have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Department of Internal Medicine, Seoul National University Bundang Hospital, Seongnam-si, Gyeonggi-do, Korea.

* Correspondence: Hyun Young Kim, Department of Internal Medicine, Health Promotion Center, Seoul National University Bundang Hospital, 82, Gumi-ro, 173beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do 13620, South Korea (e-mail: cecilup@naver.com).

Copyright © 2021 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Kim HY. Cecal intubation time in screening colonoscopy. *Medicine* 2021;100:19(e25927).

Received: 12 June 2020 / Received in final form: 7 April 2021 / Accepted: 18 April 2021

<http://dx.doi.org/10.1097/MD.00000000000025927>

cross-sectional study included 1229 subjects aged 40–80 years with an average risk for colorectal cancer, who underwent complete screening colonoscopy from January 2019 to May 2019. Anthropometric data including height, weight, BMI, percent body fat, fat mass, and muscle mass were collected. Weight was measured to the nearest 0.1 kg. Height was measured to the nearest 0.1 cm. Weight was measured using Inbody S-10 (Inbody Co., Ltd., Seoul, Korea), and BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). All anthropometric results were based on a single-body measurement examination.

A single tertiary hospital, Health Check-up Center, provided various packages of screening examinations including colonoscopy. All screened subjects volunteered or were sponsored by their employer to undergo colonoscopy regardless of age (including asymptomatic subjects in their 20s and 80s who were undergoing a routine health check-up). Subjects with an inflammatory bowel disease requiring current medication and those with a history of colorectal cancer were excluded. This retrospective study was approved by the institutional review board (approval no. B-2006-621-101), which waived the requirement for written informed consent.

2.2. Endoscopic examination

Colonoscopy was conducted in all study subjects by six expert gastroenterologists (> 10 years of endoscopy experience) certified by the Korean Society of Gastrointestinal Endoscopy, using conventional white light videoscopy (CIF-H260 or CIF-H290; Olympus, Aizu, Japan). The score on the Boston Bowel Preparation Scale (BBPS), a 10-point scale assessing bowel preparation after the use of all cleansing agents, was calculated for all subjects. Each region of the colon received a “segment score” ranging from 0 to 3, and these segment scores were summed for the total BBPS score ranging from 0 to 9. Therefore, the maximum BBPS score for a perfectly clean colon without any residual liquid was 9 and the minimum BBPS score for an unprepared or failed colon was 0. The BBPS is the most popular validated scoring system.^[12,13] In our clinical setting, a BBPS score of 6 to 9 indicates good bowel preparation and a BBPS score of 0–5 indicates poor bowel preparation.

2.3. Bioelectrical impedance analysis

A multifrequency bioelectrical impedance analyzer, InBody S5 Biospace device (Model 720, Inbody Co., Ltd.), was used according to the manufacturer’s instructions. Bioelectrical impedance analysis (BIA) estimates body composition using the difference in the conductivity of various tissues given the different biological characteristics of the subjects. Conductivity is proportional to water content, and more specifically for electrolytes, and it decreases as the cell approaches a perfect spherical shape. Adipose tissue is composed of round-shaped cells and contains relatively little water compared with other tissues such as muscle; therefore, conductivity will decrease as body fat increases. In practice, electrodes are placed at six precise tactile points of the body to achieve a multisegmental frequency analysis. A total of 30 impedance measurements were obtained using six different frequencies (1, 5, 50, 250, 500, and 1000 kHz) at the following five body segments: right and left arms, trunk, and right and left legs.

2.4. Statistical analysis

Data were analyzed using SPSS software (version 21.0; SPSS Inc., Chicago, IL). Continuous variables are expressed as mean \pm standard deviation or median and range of values, or number (percentage), whereas categorical variables are expressed as absolute values and percentages. Pearson’s chi-square test was performed for the statistical comparison of proportions among groups in univariate analysis. Only factors with P values $< .05$ in univariate analysis were subsequently with odds ratio (ORs) and 95% CI using logistic regression multivariate analysis. All P values were two sided, and $P < .05$ was considered statistically significant.

3. Results

3.1. Clinical characteristics of the study subjects

This study included 1229 health check-up subjects aged ≥ 40 years who underwent complete screening colonoscopy at a health check-up center of a single tertiary hospital. The mean age of the subjects was 55 ± 9 years, and 62% were men. The prevalence of difficult colonoscopy (CIT > 10 min) in those aged > 40 years was 7%.

Tables 1 and 2 show the differences in demographic and clinical characteristics between subjects with easy colonoscopy and those with difficult colonoscopy. In the univariate analysis, subjects with difficult colonoscopy had a higher likelihood of having old age ($P = .028$), poor bowel preparation (BBPS score ≤ 5) ($P = .000$), low BMI ($P = .024$), low percent body fat ($P = .045$), and low fat mass ($P = .025$) than subjects with easy colonoscopy. No significant difference in the risk factors of difficult colonoscopy was found according to sex and muscle mass.

Table 1
Demographics and baseline characteristics of subjects (n = 1229).

Variables	
Age (yr)	55.4 \pm 8.7
40–49	333 (27.6)
50–59	520 (43.0)
60–69	262 (21.7)
≥ 70	93 (7.7)
Sex	
Male	743 (61.5)
Female	465 (38.5)
BMI (kg/m^2)	24.2 \pm 3.2
< 23	424 (35.1)
23 \leq , < 25	325 (26.9)
≥ 25	459 (37.9)
History of prior surgery	206 (16.8)
Abdominal surgery	111 (9.1)
Pelvic surgery	95 (7.7)
Quality of bowel preparation	
BBPS score 6–9	1176 (95.7)
BBPS score 0–5	53 (4.3)
Cecal intubation time (min)	5.0 \pm 4.2 (range, 1–51)
Easy, ≤ 10 min	1144 (93.2)
Difficult, > 10 min	85 (6.8)
Percent body fat (%)	26.9 \pm 6.5
Muscle mass (kg)	45.5 \pm 9.1
Fat mass (kg)	18.0 \pm 6.1

BMI = body mass index, BBPS = Boston Bowel Preparation Scale.
Data are mean \pm standard deviation or n (%).

Table 2
Comparison of characteristics between the easy colonoscopy and difficult colonoscopy groups.

	Easy colonoscopy (n=1144) (%)	Difficult colonoscopy (n=85) (%)	P value
Age (yr)	55.3±8.6	57.5±10.4	.028*
40–49	317 (27.8)	22 (26.2)	
50–59	497 (43.5)	29 (33.3)	
60–69	244 (21.4)	22 (26.2)	
≥ 70	84 (7.4)	12 (14.3)	
Sex			.418
Male	706 (61.7)	49 (57.1)	
Female	438 (38.3)	36 (42.9)	
Poor bowel preparation	42 (3.7)	11 (13.0)	.000*
BMI (kg/m ²)	24.3±3.2	23.4±3.5	.024*
< 23	393 (34.4)	40 (47.6)	
23 ≤ < 25	304 (26.6)	21 (25.0)	
≥ 25	447 (39.1)	24 (27.4)	
Percent body fat	27.0±6.4	25.6±7.0	.045*
Muscle mass (kg)	45.5±9.1	44.9±8.8	.544
Fat mass (kg)	18.2±6.2	16.6±5.8	.025*

BMI=body mass index.
 Data are mean±standard deviation or n (%).
 Asterisk (*) indicates statistically significant.

3.2. Factors affecting difficult colonoscopy in multiple logistic regression analysis

The results of multiple logistic regression analysis of the association of difficult colonoscopy with components of anthropometric data and bowel preparation are shown in Table 3. Old age (≥ 70 years vs. 40–49 years) was associated with an increased risk for difficult colonoscopy (odds ratio [OR]: 2.272, 95% confidence interval [CI]: 1.056–4.890, P=.037). Poor bowel preparation (BBPS score ≤ 5) (vs. good bowel preparation: BBPS score 6–9) was associated with an increased risk for difficult colonoscopy (OR: 3.817, 95% CI: 1.866–7.808, P=.000). No significant interactions were found between difficult colonoscopy and the components of anthropometric data, such as low BMI, low percent body fat, and low fat mass.

Table 3
Logistic regression analysis of covariates for cecal intubation time and anthropometric data components.

	B	Adjusted odds ratio	95% Confidence interval	P value
Age		1.032	0.981–1.020	.016*
40–49 yr		1		
50–59 yr		0.899	0.503–1.606	.719
60–69 yr		1.478	0.789–2.769	.223
≥ 70 yr		2.272	1.056–4.890	.036*
Poor bowel preparation				.000*
Good (BBPS score 6–9)		1		
Poor (BBPS score 0–5)		3.817	1.866–7.808	.000*
BMI		0.927	0.770–1.115	.422
< 23 kg/m ²		1		
23–25 kg/m ²	–.383	0.682	0.382–1.218	.196
> 25 kg/m ²	–.489	0.613	0.324–1.161	.133
Percent body fat	–.028	0.972	0.929–1.018	.229
Fat mass	.003	1.003	0.953–1.055	.907

BBPS=Boston Bowel Preparation Scale, BMI=body mass index.
 Asterisk (*) indicates statistically significant.

4. Discussion

Previous studies have identified several factors affecting prolonged CIT, including age,^[14] sex,^[15] BMI,^[9,14] fat adipose tissue, waist circumference,^[16] diverticulosis,^[8] bowel preparation status,^[17] and prior abdominal or pelvic surgery^[14]; however, these findings remain controversial. Understanding the factors affecting prolonged CIT is meaningful toward complete colonoscopy, as it will allow decreasing the burden on the colonoscopist or the fatigue of procedure, the discomfort of patients, and the risk of complications. Some previous studies tended to show controversial results. One recent meta-analysis study reported older age, female sex, low BMI, and poor bowel preparation as factors significantly associated with a longer CIT.^[18] We hypothesized that optimal bowel preparation leads to decreased procedure time (from insertion to withdrawal) and increased polyp detection rate. We found a positive correlation between old age and poor bowel preparation and prolonged CIT. However, when the components of anthropometric data were analyzed, no association with CIT was found for BMI, percent body fat, fat mass, and muscle mass.

The first mechanism for prolonged CIT may be related to an anatomically atypical colon.^[19] The anatomic causes of technically difficult colonoscopy are of three types: redundant (dilated) colon; angulated, narrowed sigmoid; or abdominal wall hernia.^[19] A redundant colon, which holds an abundant amount of feces or liquids, results in inappropriate bowel preparation and, subsequently, failed or incomplete colonoscopy.

The second mechanism for prolonged CIT may be based on the aging process. In one cohort study in asymptomatic adults, computed tomography colonography revealed that the transverse colon was the major factor affecting colon-length differences according to age,^[20] although the total length of the colon in older patients (aged > 60 years) did not differ from that in younger patients. The longer transverse colon in older adults could lead to loop formation during colonoscopy owing to the tortuous and angulated structure. In other study^[21] among aged 75 to 79 years vs. aged 90 years over, the reason for lower completion rates and higher poor bowel preparation showed inactive peristaltic gastrointestinal movements, which could result in inadequate bowel preparation and worsening difficulties with colonoscopy completion. Hypotonic colon in older patients would be recognized as an elongated colon by endoscopists. The anthropometric data in this study, as well as age and bowel preparation status, have a relationship with each other, so those factors may bias the results.

Our results demonstrated that anthropometric data including BMI, percent body fat, fat mass, and muscle mass were not related to prolonged CIT. With respect to the relationship between the amount of abdominal fat or muscle mass and difficult colonoscopy, our assumption was that patients with less intra-abdominal fat or abdominal muscle (thinner patients) might tend to have an angulated sigmoid colon or a transverse colon dipping into the pelvis, leading to a longer CIT. A previous meta-analysis found that a lower BMI is associated with a longer CIT.^[18] In contrast, our study did not find any significant association between anthropometric data and prolonged CIT. Therefore, the amount of abdominal fat or muscle did not affect the difficulty of colonoscopy in expert colonoscopists. Results of the present study correspond with the earlier study which reported that less experienced colonoscopists may affect by anthropometric data, as low BMI.^[11]

BBPS is a routinely and widely used, well-validated, and reliable method for assessing the colon cleansing status in gastroenterology departments.^[22] Several previous studies have reported an association between BBPS and adenoma detection rate.^[23,24] The adenoma detection rate of the colonoscopist serves as the quality indicator for a screening colonoscopy. Some studies have reported no relationship between endoscopist fatigue and adenoma detection rate.^[25] Theoretically, the less fatigued the endoscopist, the better the quality of the colonoscopy. The technical difficulty of endoscope insertion, subsequently increasing endoscopist fatigue, leads to decreased quality of colonoscopy.

The current study had some strengths. First, this is the first study to investigate the association of anthropometric data including BMI, percent body fat, muscle mass, and fat mass with prolonged CIT. Second, our study used a clearly defined tool for bowel preparation (BBPS). Some significant homogeneity was detected in our analyses of sex and quality of bowel preparation. Third, only highly experienced, qualified endoscopists (excluding any in-training gastroenterologists) performed all screening colonoscopies in a single health check-up center. Our previous study supported that the quality of screening colonoscopies as the adenoma detection rates and also serrated lesion detection rates of each colonoscopist in our health check-up center, published in 2013.^[26] Five expert endoscopists had adenoma detection rate ranges from 20.4% to 30.0%, and also serrated lesion detection rates ranges from 9.7% to 18.8%. Fourth, all study subjects received the same sedatives (midazolam with pethidine) and underwent colonoscopy using the same endoscope types (Olympus CF-H290L or H290I or H260L or Q260I). To enhance the reproducibility of the anthropometric data, one examiner performed two consecutive BIA measurements.

However, this study had some limitations. First, BIA, not computed tomography, was used for anthropometric data measurements. Second, we did not evaluate lifestyle factors such as alcohol drinking or smoking status. Third, this is a retrospective chart review which have some recall biases with data collection because researchers cannot control exposure leading to the absence of data on potential confounding factors. Fourth, we used the CIT as cut-off point “10 minutes” dividing easy vs difficult colonoscopy, using “10 minutes” cut-off was based on many other studies references.^[11,27–30]

5. Conclusions

This study found that older age (≥ 70 years) and poor bowel preparation (BBPS score ≤ 5) are positively correlated with difficult colonoscopy. However, anthropometric data including BMI, percent body fat, muscle mass, and fat mass are not associated with difficult colonoscopy. The key to overcoming the difficulty of endoscope insertion during colonoscopy is encouraging a proper bowel preparation status in elderly patients.

Acknowledgments

I would like to thank Editage (www.editage.co.kr) for English language editing.

Author contributions

Conceptualization: hyun young kim.

Data curation: hyun young kim.

Formal analysis: hyun young kim.

Methodology: hyun young kim.

Writing – original draft: hyun young kim.

Writing – review & editing: hyun young kim.

References

- [1] Jung KW, Park S, Kong HJ, et al. Cancer statistics in Korea: incidence, mortality and survival in 2006–2007. *J Korean Med Sci* 2010;25:1113–21.
- [2] Lee BI, Hong SP, Kim SE, et al. Korean guidelines for colorectal cancer screening and polyp detection. *Clin Endosc* 2012;45:25–43.
- [3] Leggett B, Whitehall V. Role of the serrated pathway in colorectal cancer pathogenesis. *Gastroenterology* 2010;138:2088–100.
- [4] Snover DC. Update on the serrated pathway to colorectal carcinoma. *Hum Pathol* 2011;42:1–10.
- [5] Schoenfeld PS, Cohen J. Quality indicators for colorectal cancer screening for colonoscopy. *Tech Gastrointest Endosc* 2013;15:59–68.
- [6] Anderson JC, Messina CR, Cohn W, et al. Factors predictive of difficult colonoscopy. *Gastrointest Endosc* 2001;54:558–62.
- [7] Barclay RL, Vicari JJ, Doughty AS, Johanson JF, Greenlaw RL. Colonoscopic withdrawal times and adenoma detection during screening colonoscopy. *N Engl J Med* 2006;355:2533–41.
- [8] Kawasato R, Hashimoto S, Shirasawa T, et al. Correlation between obesity and metabolic syndrome-related factors and cecal intubation time during colonoscopy. *Clin Exp Gastroenterol* 2017;10:1–7.
- [9] Krishnan P, Sofi AA, Dempsey R, Alaradi O. Body mass index predicts cecal insertion time: the higher, the better. *Dig Endosc* 2012;24:439–42.
- [10] Nagata N, Sakamoto K, Arai T, et al. Predictors for cecal insertion time: the impact of abdominal visceral fat measured by computed tomography. *Dis Colon Rectum* 2014;57:1213–9.
- [11] Park HJ, Hong JH, Kim HS, et al. Predictive factors affecting cecal intubation failure in colonoscopy trainees. *BMC Med Educ* 2013;13:5.
- [12] Rostom A, Jolicoeur E. Validation of a new scale for the assessment of bowel preparation quality. *Gastrointest Endosc* 2004;59:482–6.
- [13] Parmar R, Martel M, Rostom A, et al. Validated scales for colon cleansing: a systematic review. *Am J Gastroenterol* 2016;111:197–204.
- [14] Akere A, Otegbayo JA. Complete colonoscopy: impact of patients' demographics and anthropometry on caecal intubation time. *BMJ Open Gastroenterol* 2016;3:e000076.
- [15] Poniewierka E, Dudkowiak R, Marczyński W. Impact of sex and body mass index on cecal intubation time. Is it a myth that colonoscopy is easier to perform in obese than lean people? *J Med Sci* 2016;85:298–1298.
- [16] Jain D, Goyal A, Uribe J. Obesity and cecal intubation time. *Clin Endosc* 2016;49:187–90.
- [17] Lee HL, Eun CS, Lee OY, et al. Significance of colonoscope length in cecal insertion time. *Gastrointest Endosc* 2009;69:503–8.
- [18] Jaruvongvanich V, Sempokuya T, Laoveeravatt P, Ungprasert P. Risk factors associated with longer cecal intubation time: a systematic review and meta-analysis. *Int J Colorectal Dis* 2018;33:359–65.
- [19] Rex DK. How I approach colonoscopy in anatomically difficult colons. *Am J Gastroenterol* 2020;115:151–4.
- [20] Khashab MA, Pickhardt PJ, Kim DH, et al. Colorectal anatomy in adults at computed tomography colonography: normal distribution and the effect of age, sex, and body mass index. *Endoscopy* 2009;41:674–8.
- [21] Cha JM, Kozarek RA, La Selva D, et al. Risks and Benefits of Colonoscopy in Patients 90 Years or Older, Compared With Younger Patients. *Clin Gastroenterol Hepatol* 2016;14:80–6.e81.
- [22] Calderwood AH, Jacobson BC. Comprehensive validation of the Boston Bowel Preparation Scale. *Gastrointest Endosc* 2010;72:686–92.
- [23] Guo R, Wang YJ, Liu M, et al. The effect of quality of segmental bowel preparation on adenoma detection rate. *BMC Gastroenterol* 2019;19:119.
- [24] Kluge MA, Williams JL, Wu CK, et al. Inadequate Boston Bowel Preparation Scale scores predict the risk of missed neoplasia on the next colonoscopy. *Gastrointest Endosc* 2018;87:744–51.
- [25] Lee A, Jensen CD, Marks AR, et al. Endoscopist fatigue estimates and colonoscopic adenoma detection in a large community-based setting. *Gastrointest Endosc* 2017;85:601–10.e602.
- [26] Kim HY, Kim SM, Seo JH, et al. Age-specific prevalence of serrated lesions and their subtypes by screening colonoscopy: a retrospective study. *BMC Gastroenterol* 2014;14:82.

- [27] Chutkan R. Colonoscopy issues related to women. *Gastrointest Endosc Clin N Am* 2006;16:153–63.
- [28] Chung YW, Han DS, Yoo KS, Park CK. Patient factors predictive of pain and difficulty during sedation-free colonoscopy: a prospective study in Korea. *Dig Liver Dis* 2007;39:872–6.
- [29] Chung GE, Lim SH, Yang SY, et al. Factors that determine prolonged cecal intubation time during colonoscopy: impact of visceral adipose tissue. *Scand J Gastroenterol* 2014;49:1261–7.
- [30] Jia H, Wang L, Luo H, et al. Difficult colonoscopy score identifies the difficult patients undergoing unsedated colonoscopy. *BMC Gastroenterol* 2015;15:46.