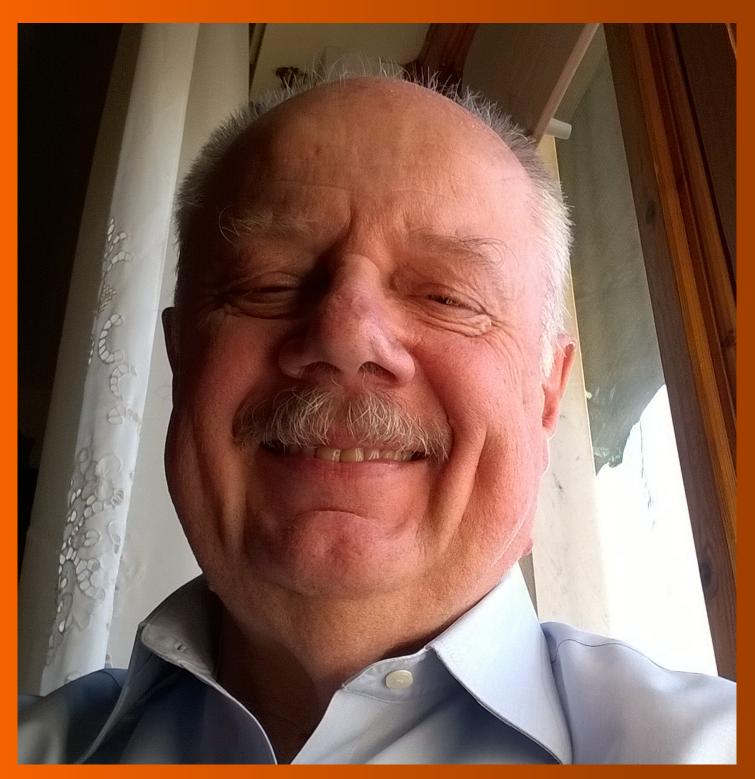
## World Journal of *Gastroenterology*

World J Gastroenterol 2017 April 7; 23(13): 2269-2452





Published by Baishideng Publishing Group Inc

# United Sector of World Journal of Gastroenterology

#### Contents

Weekly Volume 23 Number 13 April 7, 2017

#### **EDITORIAL**

2269 Gastroesophageal reflux disease and morbid obesity: To sleeve or not to sleeve? Rebecchi F, Allaix ME, Patti MG, Schlottmann F, Morino M

#### **REVIEW**

2276 Advanced pancreatic ductal adenocarcinoma - Complexities of treatment and emerging therapeutic options Diwakarla C, Hannan K, Hein N, Yip D

#### **MINIREVIEWS**

2286 Indoleamine 2,3-dioxygenase: As a potential prognostic marker and immunotherapeutic target for hepatocellular carcinoma

Asghar K, Farooq A, Zulfiqar B, Rashid MU

#### **ORIGINAL ARTICLE**

#### **Basic Study**

- Disruption of the TWEAK/Fn14 pathway prevents 5-fluorouracil-induced diarrhea in mice 2294 Sezaki T, Hirata Y, Hagiwara T, Kawamura YI, Okamura T, Takanashi R, Nakano K, Tamura-Nakano M, Burkly LC, Dohi T
- 2308 CMA down-regulates p53 expression through degradation of HMGB1 protein to inhibit irradiation-triggered apoptosis in hepatocellular carcinoma Wu JH, Guo JP, Shi J, Wang H, Li LL, Guo B, Liu DX, Cao Q, Yuan ZY

2318 Cullin 4A is associated with epithelial to mesenchymal transition and poor prognosis in perihilar cholangiocarcinoma Zhang TJ, Xue D, Zhang CD, Zhang ZD, Liu QR, Wang JQ

- 2330 Notch signaling mediated by TGF-β/Smad pathway in concanavalin A-induced liver fibrosis in rats Wang Y, Shen RW, Han B, Li Z, Xiong L, Zhang FY, Cong BB, Zhang B
- MicroRNA-145 exerts tumor-suppressive and chemo-resistance lowering effects by targeting CD44 in 2337 gastric cancer Zeng JF, Ma XQ, Wang LP, Wang W

#### **Case Control Study**

2346 Predictors for difficult cecal insertion in colonoscopy: The impact of obesity indices Moon SY, Kim BC, Sohn DK, Han KS, Kim B, Hong CW, Park BJ, Ryu KH, Nam JH



#### Contents

#### **Retrospective Cohort Study**

2355 Impact of interferon-free antivirus therapy on lipid profiles in patients with chronic hepatitis C genotype 1b Endo D, Satoh K, Shimada N, Hokari A, Aizawa Y

#### **Retrospective Study**

- 2365 Transition after pediatric liver transplantation Perceptions of adults, adolescents and parents Junge N, Migal K, Goldschmidt I, Baumann U
- 2376 Minimally invasive surgery for gastric cancer: A comparison between robotic, laparoscopic and open surgery Parisi A, Reim D, Borghi F, Nguyen NT, Qi F, Coratti A, Cianchi F, Cesari M, Bazzocchi F, Alimoglu O, Gagnière J, Pernazza G, D'Imporzano S, Zhou YB, Azagra JS, Facy O, Brower ST, Jiang ZW, Zang L, Isik A, Gemini A, Trastulli S, Novotny A, Marano A, Liu T, Annecchiarico M, Badii B, Arcuri G, Avanzolini A, Leblebici M, Pezet D, Cao SG, Goergen M, Zhang S, Palazzini G, D'Andrea V, Desiderio J
- 2385 Clinical implication of FDG uptake of bone marrow on PET/CT in gastric cancer patients with surgical resection

Lee JW, Lee MS, Chung IK, Son MW, Cho YS, Lee SM

#### **Observational Study**

- 2396 Safety and efficacy of tenofovir in chronic hepatitis B-related decompensated cirrhosis Lee SK, Song MJ, Kim SH, Lee BS, Lee TH, Kang YW, Kim SB, Song IH, Chae HB, Ko SY, Lee JD
- 2404 Can mean platelet volume play a role in evaluating the severity of acute pancreatitis? *Lei JJ, Zhou L, Liu Q, Xiong C, Xu CF*

#### **Prospective Study**

2414 Proposed criteria to differentiate heterogeneous eosinophilic gastrointestinal disorders of the esophagus, including eosinophilic esophageal myositis *Sato H, Nakajima N, Takahashi K, Hasegawa G, Mizuno K, Hashimoto S, Ikarashi S, Hayashi K, Honda Y, Yokoyama J, Sato Y, Terai S* 

2424Therapeutic experience of 289 elderly patients with biliary diseasesZhang ZM, Liu Z, Liu LM, Zhang C, Yu HW, Wan BJ, Deng H, Zhu MW, Liu ZX, Wei WP, Song MM, Zhao Y

#### **META-ANALYSIS**

2435 What is the quantitative risk of gastric cancer in the first-degree relatives of patients? A meta-analysis *Yaghoobi M, McNabb-Baltar J, Bijarchi R, Hunt RH* 

#### **CASE REPORT**

2443 Hepatic angiosarcoma with clinical and histological features of Kasabach-Merritt syndrome *Wadhwa S, Kim TH, Lin L, Kanel G, Saito T* 



#### Contents

#### **LETTERS TO THE EDITOR**

2448 Tumor biopsy and patient enrollment in clinical trials for advanced hepatocellular carcinoma Rimassa L, Reig M, Abbadessa G, Peck-Radosavljevic M, Harris W, Zagonel V, Pastorelli D, Rota Caremoli E, Porta C, Damjanov N, Patel H, Daniele B, Lamar M, Schwartz B, Goldberg T, Santoro A, Bruix J



Contents	<i>World Journal of Gastroenterology</i> Volume 23 Number 13 April 7, 2017				
ABOUT COVER	Editorial board member of <i>World Journal of Gastroenterology</i> , Piero Luigi Almasio, MD, Associate Professor, Biomedical Department of Internal and Specialist Medicine, University of Palermo, Palermo 90127, Italy				
AIMS AND SCOPE	<i>World Journal of Gastroenterology (World J Gastroenterol, WJG</i> , print ISSN 1007-9327, online ISSN 2219-2840, DOI: 10.3748) is a peer-reviewed open access journal. <i>WJG</i> was established on October 1, 1995. It is published weekly on the 7 <sup>th</sup> , 14 <sup>th</sup> , 21 <sup>st</sup> , and 28 <sup>th</sup> each month. The <i>WJG</i> Editorial Board consists of 1375 experts in gastroenterology and hepatology from 68 countries. The primary task of <i>WJG</i> is to rapidly publish high-quality original articles, reviews, and commentaries in the fields of gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, hepatobiliary surgery, gastrointestinal oncology, gastrointestinal radiation oncology, gastrointestinal imaging, gastrointestinal inferventional therapy, gastrointestinal infectious diseases, gastrointestinal pharmacology, gastrointestinal pathology, gastrointestinal laboratory medicine, gastrointestinal molecular biology, gastrointestinal immunology, gastrointestinal microbiology, gastrointestinal translational medicine, gastrointestinal diagnostics, and gastrointestinal therapeutics. <i>WJG</i> is dedicated to become an influential and prestigious journal in gastroenterology and hepatology, to promote the development of above disciplines, and to improve the diagnostic and therapeutic skill and expertise of clinicians.				
INDEXING/ABSTRACTING	<i>World Journal of Gastroenterology (WJG)</i> is now indexed in Current Contents <sup>®</sup> /Clinical Medicine, Science Citation Index Expanded (also known as SciSearch <sup>®</sup> ), Journal Citation Reports <sup>®</sup> , Index Medicus, MEDLINE, PubMed, PubMed Central, Digital Object Identifier, and Directory of Open Access Journals. The 2015 edition of Journal Citation Reports <sup>®</sup> released by Thomson Reuters (ISI) cites the 2015 impact factor for <i>WJG</i> as 2.787 (5-year impact factor: 2.848), ranking <i>WJG</i> as 38 among 78 journals in gastroenterology and hepatology (quartile in category Q2).				
FLYLEAF I-IX	Editorial Board				
EDITORS FOR Respon		le Science Editor: Ze-Mao Gong Editorial Office Director: Jin-Lei Wang			
NAME OF JOURNAL	CA 90822, United States	http://www.wjgnet.com			
World Journal of Gastroenterology ISSN ISSN 1007-9327 (print) ISSN 2219-2840 (online)	EDITORIAL BOARD MEMBERS All editorial board members resources online at http:// www.wignet.com/1007-9327/editorialboard.htm	PUBLICATION DATE April 7, 2017 COPYRIGHT			
LAUNCH DATE October 1, 1995	EDITORIAL OFFICE Jin-Lei Wang, Director Yuan Qi, Vice Director	© 2017 Baishideng Publishing Group Inc. Articles pub- lished by this Open-Access journal are distributed under the terms of the Creative Commons Attribution Non-			
FREQUENCY Weekly	Ze-Mao Gong, Vice Director World Journal of Gastroenterology Baishideng Publishing Group Inc	the terms of the Creative Commons Attribution Non- commercial License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non commercial and is			
EDITORS-IN-CHIEF Damian Garcia-Olmo, MD, PhD, Doctor, Profes- sor, Surgeon, Department of Surgery, Universidad Autonoma de Madrid; Department of General Sur- gery, Fundacion Jimenez Diaz University Hospital, Madrid 28040, Spain	8226 Regency Drive, Pleasanton, CA 94588, USA Telephone: +1-925-2238242 Fax: +1-925-2238243 E-mail: editorialoffice@wjgnet.com Help Desk: http://www.f6publishing.com/helpdesk http://www.wjgnet.com	otherwise in compliance with the license. SPECIAL STATEMENT All articles published in journals owned by the Baishideng Publishing Group (BPG) represent the views and opin- ions of their authors, and not the views, opinions or policies of the BPG, except where otherwise explicitly			
<ul> <li>Stephen C Strom, PhD, Professor, Department of Laboratory Medicine, Division of Pathology, Karo- linska Institutet, Stockholm 141-86, Sweden</li> <li>Andrzej S Tarnawski, MD, PhD, DSc (Med), Professor of Medicine, Chief Gastroenterology, VA Long Beach Health Care Stream University of Cali-</li> </ul>	PUBLISHER Baishideng Publishing Group Inc 8226 Regency Drive, Pleasanton, CA 94588, USA Telephone: +1-925-2238242 Fax: +1-925-2238243 E-mail: bpgoffice@wjgnet.com	indicated. <b>INSTRUCTIONS TO AUTHORS</b> Full instructions are available online at http://www. wjgnet.com/bpg/gerinfo/204 <b>ONLINE SUBMISSION</b>			
Long Beach Health Care System, University of Cali- fornia, Irvine, CA, 5901 E. Seventh Str., Long Beach,	E-mail: bpgotfice@wjgnet.com Help Desk: http://www.f6publishing.com/helpdesk	ONLINE SUBMISSION http://www.f6publishing.com			





Submit a Manuscript: http://www.f6publishing.com

World J Gastroenterol 2017 April 7; 23(13): 2346-2354

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

DOI: 10.3748/wjg.v23.i13.2346

**Case Control Study** 

ORIGINAL ARTICLE

### Predictors for difficult cecal insertion in colonoscopy: The impact of obesity indices

Soo Yun Moon, Byung Chang Kim, Dae Kyung Sohn, Kyung Su Han, Bun Kim, Chang Won Hong, Bum Joon Park, Kum Hei Ryu, Ji Hyung Nam

Soo Yun Moon, Byung Chang Kim, Dae Kyung Sohn, Kyung Su Han, Bun Kim, Chang Won Hong, Center for Colorectal Cancer, Research Institute and Hospital, National Cancer Center, Gyeonggi-do 10408, South Korea

Byung Chang Kim, Dae Kyung Sohn, Kyung Su Han, Bun Kim, Chang Won Hong, Bum Joon Park, Kum Hei Ryu, Ji Hyung Nam, Center for Cancer Prevention and Detection, Research Institute and Hospital, National Cancer Center, Gyeonggi-do 10408, South Korea

Soo Yun Moon, Department of Surgery, School of Medicine, Kyung Hee University, Seoul 02447, South Korea

Author contributions: Moon SY collected and analyzed the data, and drafted the manuscript; Kim BC provided analytical oversight; Kim BC designed and supervised the study; Sohn DK, Han KS, Kim B, Hong CW, Park BJ, Ryu KH and Nam JH revised the manuscript for important intellectual content; Moon SY, Kim BC, Sohn DK, Han KS, Kim B and Hong CW provided administrative support; all authors have read and approved the final version to be published.

Supported by National Cancer Center, South Korea, No. NCC-1610250, No. NCC-1410250, and No. NCC 0810200-1.

Institutional review board statement: This study was approved by the institutional review board of National Cancer Center, Korea (NCC2016-0217).

**Informed consent statement:** This study is exempt from informed consent, since it is a retrospective study and the data collection and analysis were carried out without disclosing patient's identity.

**Conflict-of-interest statement:** All authors declare that there are no potential conflicting interests related to the submitted manuscript.

Data sharing statement: There are no available additional data.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external

reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/ licenses/by-nc/4.0/

Manuscript source: Unsolicited manuscript

Correspondence to: Byung Chang Kim, MD, Center for Colorectal Cancer, Research Institute and Hospital, National Cancer Center, 111 Jungbalsan-ro, Ilsandong-gu, Goyang-si, Gyeonggi-do 10408, South Korea. mdzara@ncc.re.kr Telephone: +82-31-9201649 Fax: +82-31-9202624

Received: November 21, 2016 Peer-review started: November 23, 2016 First decision: December 28, 2016 Revised: January 16, 2017 Accepted: February 17, 2017 Article in press: February 17, 2017 Published online: April 7, 2017

#### Abstract

#### AIM

To identify the factors influencing cecal insertion time (CIT) and to evaluate the effect of obesity indices on CIT.

#### **METHODS**

We retrospectively reviewed the data for participants who received both colonoscopy and abdominal computed tomography (CT) from February 2008 to May 2008 as part of a comprehensive health screening program. Age, gender, obesity indices [body mass index (BMI), waist-to-hip circumference ratio (WHR), waist circumference (WC), visceral adipose tissue (VAT)



WJG | www.wjgnet.com

volume and subcutaneous adipose tissue (SAT) volume on abdominal CT], history of prior abdominal surgery, constipation, experience of the colonoscopist, quality of bowel preparation, diverticulosis and time required to reach the cecum were analyzed. CIT was categorized as longer than 10 min (prolonged CIT) and shorter than or equal to 10 min, and then the factors that required a CIT longer than 10 min were examined.

#### RESULTS

A total of 1678 participants were enrolled. The mean age was  $50.42 \pm 9.931$  years and 60.3% were men. The mean BMI, WHR, WC, VAT volume and SAT volume were  $23.92 \pm 2.964 \text{ kg/m}^2$ ,  $0.90 \pm 0.076$ , 86.95 ± 8.030 cm, 905.29 ± 475.220 cm<sup>3</sup> and 1707.72 ± 576.550 cm<sup>3</sup>, respectively. The number of patients who underwent abdominal surgery was 268 (16.0%). Colonoscopy was performed by an attending physician alone in 61.9% of cases and with the involvement of a fellow in 38.1% of cases. The median CIT was 7 min (range 2-56 min, IQR 5-10 min), and mean CIT was 8.58 ± 5.291 min. Being female, BMI, VAT volume and involvement of fellow were significantly associated with a prolonged CIT in univariable analysis. In multivariable analysis, being female (OR = 1.29, P = 0.047), lower BMI (< 23 kg/m<sup>2</sup>) (OR = 1.62, P = 0.004) or higher BMI ( $\ge$  25 kg/m<sup>2</sup>) (OR = 1.80, P < 0.001), low VAT volume (< 500 cm<sup>3</sup>) (OR = 1.50, P = 0.013) and fellow involvement (OR = 1.73, P < 0.001) were significant predictors of prolonged CIT. In subgroup analyses for gender, lower BMI or higher BMI and fellow involvement were predictors for prolonged CIT in both genders. However, low VAT volume was associated with prolonged CIT in only women (OR = 1.54, P = 0.034).

#### **CONCLUSION**

Being female, having a lower or higher BMI than the normal range, a low VAT volume, and fellow involvement were predictors of a longer CIT.

**Key words:** Visceral obesity; Difficult colonoscopy; Cecal insertion time; Body mass index; Female

© **The Author(s) 2017.** Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** There are well known predictive factors of longer cecal intubation time (CIT). Old age, female, poor quality of bowel preparation, history of prior abdominal surgery, trainee, diverticulosis and constipation are associated with longer CIT. A low visceral adipose tissue (VAT) volume, female, having a lower or higher body mass index, and fellow involvement were predictors of a longer CIT based on the present study. Especially, low VAT volume was associated with prolonged CIT in only women.

Moon SY, Kim BC, Sohn DK, Han KS, Kim B, Hong CW, Park BJ, Ryu KH, Nam JH. Predictors for difficult cecal

insertion in colonoscopy: The impact of obesity indices. *World J Gastroenterol* 2017; 23(13): 2346-2354 Available from: URL: http://www.wjgnet.com/1007-9327/full/v23/i13/2346.htm DOI: http://dx.doi.org/10.3748/wjg.v23.i13.2346

#### INTRODUCTION

Colonoscopy is widely used for the diagnosis and treatment of colon disorders and is one of the recommended options for colorectal cancer screening<sup>[1]</sup>. Although the success rate of complete colonoscopy is reported to be as high as 95% to 99%, cecal insertion time (CIT) varies greatly in different cases and is considered a surrogate measure for difficult colonoscopy<sup>[2-4]</sup>. The mean CIT by experienced colonoscopists has been reported to be between 10 and 20 min<sup>[5]</sup>. The authors of another study insisted that experienced endoscopists should intubate the cecum in > 90% of cases in < 15 min<sup>[6]</sup>. Although there is no</sup> standard definition of a difficult colonoscopy, procedure times with more than 10 min for insertion or more than two attempts to reach the cecum, or finally failed insertion are often considered difficult<sup>[4,7,8]</sup>.

Identifying the factors predicting longer CIT is important to colonoscopists, especially for recognition of patients who may need a longer scheduled interval, sedation and vital monitoring requirements, and better colonoscopic expertise<sup>[9]</sup>. Various factors have been implicated in influencing CIT. These factors included age, gender, quality of bowel preparation, history of prior abdominal surgery, experience of the colonoscopist, diverticulosis and constipation<sup>[4,10-14]</sup>. In addition, research on the relationship between CIT and obesity indices, such as body mass index (BMI), waist circumference (WC), visceral adipose tissue (VAT) area and subcutaneous adipose tissue (SAT) area, has been reported<sup>[9,13,15-17]</sup>. However, the results of previous studies are conflicting. A few studies on the association between VAT and CIT were reported based on the visceral fat amount using abdominal computed tomography (CT) scan<sup>[4,13]</sup>. In these previous studies, visceral fat was calculated on the basis of only one slice of abdominal CT at the umbilical level.

The aims of this study were to identify the factors influencing CIT and to evaluate the effect of obesity indices on CIT. For reflecting the effects of visceral fat on CIT more accurately, visceral fat was calculated as volume in this study.

#### MATERIALS AND METHODS

#### Patients

We selected participants who received colonoscopy, abdominal CT, and questionnaire assessment from February 2008 to May 2008 among persons enrolled in our previous study on the association between abdominal VAT volume and colorectal adenoma<sup>[18]</sup>. Participants who previously had undergone surgery

#### Moon SY et al. Predictors for difficult colonoscopy

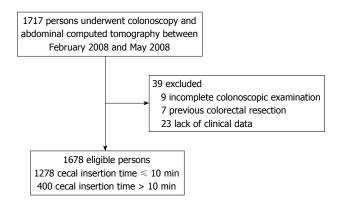


Figure 1 Inclusion and exclusion of study participants.

for colorectal disease including malignancy, or had incomplete examination, inflammatory bowel disease or lack of clinical data were excluded. Surgical history and constipation were investigated through a questionnaire. Between February 2008 to May 2008, 1717 participants received colonoscopy and abdominal CT in a health screening program. Of the 1717 persons, 1678 participants met the inclusion criteria (Figure 1).

Data were collected in a prospectively maintained database that was further supplemented by a retrospective chart review. This study was approved by the institutional review board (NCC2016-0217).

#### Anthropometric measurements

BMI was calculated as body weight by height squared  $(kg/m^2)$  and then divided into three categories as in previous studies: BMI < 23 kg/m<sup>2</sup>, 23-24.9 kg/m<sup>2</sup>, and  $\geq$  25 kg/m<sup>2[9,13]</sup>. WC was measured at the midpoint between the lower -costal margin and the upper pole of the iliac crest. Patients were classified into two categories by WC according to WHO criteria: normal WC ( $\leq$  102 cm for men,  $\leq$  88 cm for women) and high WC (> 102 cm for men, > 88 cm for women). Hip circumference (HC) was measured using the greatest circumference between the iliac crest and thighs. The waist-to-hip circumference ratio (WHR) was calculated as WC divided by HC. Two levels of WHR were classified as follows according to WHO criteria: normal WHR ( $\leq 0.9$  for men,  $\leq 0.8$  for women) and high WHR (> 0.9 for men, > 0.8 for women).

#### Measurement of abdominal adipose tissue volume

Adipose tissue volume was calculated using 20 slices covering 100 mm from 50 mm above to 50 mm below the umbilicus as previously mentioned<sup>[18]</sup>. VAT volume was measured as intra-abdominal fat bound by parietal peritoneum or transversalis fascia, excluding the vertebral column and paraspinal muscles. The SAT volume was calculated by subtracting the VAT volume from the total adipose tissue volume. The participants were classified into 3 groups according to VAT volume (< 500 cm<sup>3</sup>, 500-1499 cm<sup>3</sup>, and  $\geq$  1500 cm<sup>3</sup>) and according to SAT volume (< 1000 cm<sup>3</sup>, 1000-1999 cm<sup>3</sup>, and  $\geq$  2000 cm<sup>3</sup>) based on a previous study<sup>[18]</sup>.

#### Colonoscopy

All colonoscopies were performed with an Olympus CF-Q260AL video colonoscope (Olympus Optical, Co, Ltd, Tokyo, Japan) after preparatory bowel cleansing with a 4-L of aqueous Fleet Phospho-soda (Fleet Company, Inc, Lynchburg, VA, United States). All colonoscopy procedures were performed by attending physicians specializing in endoscopy and fellows under the direction of attending physicians. Patients who chose to have sedation were given intravenous midazolam before colonoscopy initiation. The dosages were adjusted according to the patient's age and weight. The quality of bowel preparation was graded by the colonoscopist according to the Aronchick scale<sup>[19]</sup> and reclassified into two classes as excellent to fair and poor to inadequate for statistical analysis. The presence of diverticular disease was recorded by the colonoscopist. CIT was categorized as longer than 10 min (prolonged CIT) and shorter than or equal to 10 min<sup>[4,7,8]</sup>.

#### Statistical analysis

Baseline characteristics of study participants and colonoscopic data were reported as the mean  $\pm$  SD or number (percentage). Pearson's  $\chi^2$  testing was performed for the statistical comparison of proportions among groups in univariate analysis. Only factors with *P* values < 0.05 in univariable analysis were subsequently estimated with odds ratios (ORs) and 95%CI using logistic regression multivariable analysis. We performed the further subgroup analysis according to the gender. A *P* value of less than 0.05 was considered significant. Statistical analyses were performed using the SPSS program (SPSS Inc., Chicago, IL, United States).

#### RESULTS

#### **Baseline characteristics**

Baseline characteristics of study participants and colonoscopic data are shown in Table 1. The mean age of 1678 participants was  $50.42 \pm 9.93$  years and 60.3% were male. The mean BMI, WHR, WC, VAT volume, and SAT volume were  $23.92 \pm 2.96$  kg/m<sup>2</sup>,  $0.90 \pm 0.08$ ,  $86.95 \pm 8.03$  cm,  $905.29 \pm 475.22$  cm<sup>3</sup> and  $1707.72 \pm 576.55$  cm<sup>3</sup>, respectively. The number of participants who received abdominal surgery was 268 (16.0%). Colonoscopy was performed by an attending physician alone in 61.9% of cases and with the involvement of a fellow in 38.1% of cases. The median CIT was 7 min (range 2-56 min, IQR 5-10 min), and mean CIT was  $8.58 \pm 5.29$  min. Four hundred (23.8%) of participants required longer than 10 min.

#### Predictors of prolonged CIT

The univariable analysis for predictors of prolonged CIT is shown in Table 2. Gender, BMI, VAT volume and



Baseline characteristics ( $n = 1678$ )	
Age (yr) (mean ± SD)	$50.42 \pm 9.93$
< 65	1518 (90.5)
≥ 65	160 (9.5)
Gender	
Male/female	1012 (60.3)/666 (39.7)
Obesity indices (mean ± SD)	
BMI $(kg/m^2)$	$23.92 \pm 2.96$
WHR ( <i>n</i> =1674)	$0.90 \pm 0.08$
WC (cm) (n =1676)	$86.95 \pm 8.03$
VAT volume (cm <sup>3</sup> )	$905.29 \pm 475.22$
SAT volume (cm <sup>3</sup> )	$1707.72 \pm 576.55$
History of abdominal surgery	
Gynecological surgery	231 (13.8)
Gastrectomy	163 (9.7)
Other abdominal surgery	5 (0.3)
Constipation	
Yes/no	182 (10.8)/1496 (89.2)
Experience	
Attending physicians/Fellow	1039 (61.9)/639 (38.1)
Bowel preparation	
Excellent to fair/Poor to inadequate	1209 (72.1)/469 (27.9)
Diverticulosis on colonoscopy	
Yes/no	95 (5.7)/1583 (94.3)
CIT (min)	
Median CIT (range)	7 (2-56) (IQR, 5-10)
Mean CIT (SD) <sup>1</sup>	$8.58 \pm 5.29$
$\leq 10 \min$	1278 (76.2)
> 10 min	400 (23.8)

<sup>1</sup>One hundred thirty one patients were undergone multiple surgeries and duplicated with other type operation. BMI: Body mass index; WHR: Waist-to-hip circumference ratio; WC: Waist circumference; VAT: Visceral adipose tissue; SAT: Subcutaneous adipose tissue; CIT: Cecal insertion time.

involvement of a fellow were significantly associated with a prolonged CIT. Among these variables, being female (OR = 1.29, 95%CI: 1.00-1.67, P = 0.047), BMI less than 23 kg/m<sup>2</sup> (OR = 1.62, 95%CI: 1.16-2.25, P = 0.004) or greater than or equal to 25 kg/m<sup>2</sup> (OR = 1.80, 95%CI: 1.31-2.49, P < 0.001), VAT volume smaller than 500 cm<sup>3</sup> (OR = 1.50; 95%CI: 1.09-2.07, P = 0.013) and fellow involvement (OR = 1.73; 95%CI: 1.38-2.19, P < 0.001) were significant predictors of prolonged CIT in multivariable analysis (Table 2). When BMI and VAT volume were considered separately by multivariable analysis in total cohort (Supplement Table 2), being female, BMI less than 23 kg/m<sup>2</sup> (OR = 1.84, 95%CI: 1.35-2.50, P < 0.001) or greater than or equal to 25 kg/m<sup>2</sup> (OR = 1.83, 95%CI: 1.34-2.50, P < 0.001), VAT volume smaller than 500 cm<sup>3</sup> (OR = 1.57, 95%CI: 1.18-2.09, P = 0.002) or greater than or equal to 1500  $cm^{3}$  (OR = 1.45, 95%CI: 1.00-2.09, P = 0.047) and fellow involvement were independently associated with prolonged CIT.

We performed a subgroup analysis by gender. In the subgroup analysis of men (n = 1012), BMI and fellow involvement were associated with a prolonged CIT in univariable analysis (Table 3). Among these variables, BMI less than 23 kg/m<sup>2</sup> (OR = 1.69; 95%CI: 1.10-2.60, P = 0.017) or greater than or equal to 25

 $kg/m^2$  (OR = 1.88; 95%CI: 1.28-2.75, P = 0.001), and fellow involvement (OR = 1.92, 95%CI: 1.41-2.63, P < 0.001) were significant predictors of prolonged CIT in multivariable analysis (Table 4). In the subgroup analysis of women (n = 666), BMI, VAT volume and fellow involvement were associated with a prolonged CIT in univariable analysis (Table 3). Among these variables, BMI less than 23 kg/m<sup>2</sup> (OR = 1.66, 95%CI: 1.02-2.69, P = 0.041) or greater than or equal to 25  $kg/m^{2}$  (OR = 1.79, 95%CI: 1.02-3.13, P = 0.042), VAT volume smaller than 500  $\text{cm}^3$  (OR = 1.54, 95%CI: 1.03-2.31, P = 0.034) and fellow involvement (OR = 1.53, 95%CI: 1.08-2.16, P = 0.016) were significant predictors of prolonged CIT in multivariable analysis (Table 4). When BMI and VAT volume were considered separately by multivariable analysis for gender, in men, BMI less than 23 kg/m<sup>2</sup> (OR = 1.69, 95%CI: 1.10-2.60, P = 0.017) or greater than or equal to 25  $kg/m^2$  (OR = 1.88, 95%CI: 1.28-2.75, P = 0.001) and fellow involvement were independently associated with prolonged CIT. VAT volume, however, was not associated with prolonged CIT. In women, BMI less than 23 kg/m<sup>2</sup> (OR = 1.96, 95%CI: 1.25-3.10, P =0.004), VAT volume smaller than 500 cm<sup>3</sup> (OR = 1.66, 95%CI: 1.17-2.35, P = 0.005) and fellow involvement were independently associated with prolonged CIT. BMI greater than or equal to 25 kg/m<sup>2</sup> (OR = 1.71, 95%CI: 0.99-2.96, P = 0.053) was marginally associated with prolonged CIT.

#### DISCUSSION

We found that being female, lower or higher BMI, low VAT volume and fellow involvement were predictors of a longer CIT. In subgroup analysis by gender, lower or higher BMI and fellow involvement were predictors for prolonged CIT in both genders. However, a low VAT volume was associated with a longer CIT in only women.

In this study, female gender was identified as a predictor of longer CIT. In addition, ninety three patients of CIT more than 15 min were all women in our study. The female pelvis is deeper and more rounded than the male pelvis, which may predispose to loop formation in the sigmoid colon<sup>[16,20]</sup>. Saunders *et al*<sup>[20]</sup> reported total colonic length was greater in women compared to men (155 cm vs 145 cm, P = 0.005). Transverse colon length is, especially, longer in women than in men (48 cm vs 40 cm, P < 0.0001) and redundancy of the transverse colon is more frequent in women compared with that in men (62% vs 26%, P < 0.0001), which predisposes to loop formation and difficulty in passing the colonoscope in women<sup>[20]</sup>. Arcovedo *et al*<sup>[21]</sup> suggested that the peritoneal cavity is smaller in women, which causes a more convoluted packaging of the entire colon, which eventually forms an acute angle at the colonic flexure. A longer and more slender colonoscope could overcome those factors (longer colon length and more acute angle at the flexure) in women during colonoscopy insertion.

#### Moon SY et al. Predictors for difficult colonoscopy

	Cecal insertio	on time (min)	<i>P</i> value	Multivariate logistic regression analysis	<i>P</i> value	
	≤ 10 ( <i>n</i> = 1278)	> 10 ( <i>n</i> = 400)		OR (95%CI)		
Age (yr)			0.125			
< 65	1164 (76.7)	354 (23.3)				
≥ 65	114 (71.3)	46 (28.7)				
Gender			0.001			
Male	800 (79.1)	212 (20.9)		Ref	0.047	
Female	478 (71.8)	188 (28.2)		1.29 (1.00-1.67)		
Obesity indices						
BMI $(kg/m^2)$			< 0.001			
< 23	457 (72.2)	176 (27.8) <sup>a</sup>		1.62 (1.16-2.25)	0.004	
23-24.9	388 (83.6)	76 (16.4) <sup>b</sup>		Ref		
≥ 25	433 (74.5)	148 (25.5)		1.80 (1.31-2.49)	< 0.001	
WHR ( <i>n</i> = 1674)	· /	· /	0.060	, ,		
Normal	257 (72.4)	98 (27.6)				
( $\leq 0.9$ for men, $\leq 0.8$ for women)						
High	1018 (77.2)	301 (22.8)				
WC (cm) $(n = 1676)$	× /	· · · ·	0.316			
Normal	1098 (76.6)	335 (23.4)				
( $\leq 102$ cm for men, $\leq 88$ cm for women)		()				
High	179 (73.7)	64 (26.3)				
VAT volume (cm <sup>3</sup> )	1.7 (1011)	01 (2010)	< 0.001			
< 500	237 (68.3)	110 (31.7) <sup>c</sup>	0.001	1.50 (1.09-2.07)	0.013	
500-1499	906 (78.9)	242 (21.1)		Ref	0.010	
≥ 1500	135 (73.8)	48 (26.2)		1.27 (0.86-1.88)	0.223	
SAT volume (cm <sup>3</sup> )	100 (70.0)	10 (20.2)	0.848	1.27 (0.00 1.00)	0.220	
< 1000	107 (78.1)	30 (21.9)	0.010			
1000-1999	831 (75.9)	264 (24.1)				
≥ 2000	340 (76.2)	106 (23.8)				
History of abdominal surgery	340 (70.2)	100 (25.0)	0.626			
No	1077 (76.4)	333 (23.6)	0.020			
Yes	201 (75.0)	67 (25.0)				
Constipation	201 (75.0)	07 (20.0)	0.112			
No	1148 (76.7)	348 (23.3)	0.112			
Yes	· · · ·	52 (28.6)				
Experience	130 (71.4)	52 (20.0)	< 0.001			
-	822 (80.2)	206 (10.8)	< 0.001	Ref		
Attending physicians Fellow	833 (80.2)	206 (19.8)			< 0.001	
	445 (69.6)	194 (30.4)	0.919	1.73 (1.38-2.19)	< 0.001	
Bowel preparation Excellent to fair	000(761)	280 (22.0)	0.919			
	920 (76.1)	289 (23.9)				
Poor to inadequate	358 (76.3)	111 (23.7)	0.000			
Diverticulosis	1100 (75.7)	284 (24.2)	0.099			
No	1199 (75.7)	384 (24.3)				
Yes	79 (83.2)	16 (16.8)				

#### Table 2 Cecal insertion time according to study variables, with odd ratios estimated by multivariable logistic regression analysis n (%)

 $^{a}P < 0.001 vs$  BMI 23-24.9 kg/m<sup>2</sup>,  $^{b}P < 0.001 vs$  BMI  $\ge 25 \text{ kg/m}^2$ ,  $^{c}P < 0.001 vs$  VAT volume 500-1499 cm<sup>3</sup>. BMI: Body mass index; WHR: Waist-to-hip circumference ratio; WC: Waist circumference; VAT: Visceral adipose tissue; SAT: Subcutaneous adipose tissue.

BMI was reported to be one of the predicting factors of prolonged CIT, with lower BMI was being associated with a difficult procedure<sup>[17,22]</sup>. These studies explained that this finding may be because of the relatively lower amount of visceral fat in patients with lower BMI. Visceral fat may allow for easier passage of the colonoscopy by supporting the colon in the pelvis and thus reducing loop formation<sup>[22]</sup>. However, another study has shown conflicting results. Jain *et al*<sup>[15]</sup> recently reported that BMI had a positive association with CIT for men. The discrepancy in the association of BMI and CIT might be that the enrolled patients' characteristics were different among studies. Jain *et al*<sup>[15]</sup> study excluded the patients with poor bowel

preparation, a history of abdomino-pelvic surgery, and procedure done by trainees but the present study included these types of cases. In our study, when higher BMI ( $\ge 25 \text{ kg/m}^2$ ) group was divided into overweight (25-29.9 kg/m<sup>2</sup>) and obese ( $\ge 30 \text{ kg/m}^2$ ) group, not obese group but overweight group was associated with prolonged CIT in multivariable analysis. Even though high BMI ( $\ge 30 \text{ kg/m}^2$ ) was not significant association in univariable and multivariable analysis, there was a trend of association with prolonged CIT. The cause of these result might be the low number of high BMI (n = 45) (data not shown). BMI was used as a measure of obesity, but this may not be an accurate measure of abdominal visceral fat. BMI is an overall obesity index<sup>[23]</sup>. Men have more

	Male $(n = 1012)$			Female $(n = 666)$			
	Cecal insertion time (min)		P value	Cecal insertio	P value		
	<pre>10 (n = 800)</pre>	> 10 ( <i>n</i> = 212)		<pre>10 (n = 478)</pre>	> 10 ( <i>n</i> = 188)		
Age (yr)			0.089			0.619	
< 65	726 (90.8)	184 (86.8)		438 (91.6)	170 (90.4)		
≥ 65	74 (9.3)	28 (13.2)		40 (8.4)	18 (9.6)		
Obesity indices							
BMI $(kg/m^2)$			0.007			0.013	
< 23	202 (25.3)	58 (27.4)		255 (53.3)	118 (62.8) <sup>b</sup>		
23-24.9	261 (32.6)	46 (21.7) <sup>a</sup>		127 (26.6)	30 (16.0)		
≥ 25	337 (42.1)	108 (50.9)		96 (20.1)	40 (21.3)		
WHR	· · · ·	· · ·	0.414	· · · ·		0.332	
Normal	118 (14.8)	36 (17.1)		139 (29.1)	62 (33.0)		
High	680 (85.2)	175 (82.9)		338 (70.9)	126 (67.0)		
WC (cm)	× /		0.396	· · · ·		0.508	
Normal	768 (96.1)	201 (94.8)		330 (69.0)	134 (71.7)		
High	31 (3.9)	11 (5.2)		148 (31.0)	53 (28.3)		
VAT volume (cm <sup>3</sup> )	( )	· · · ·	0.123	· · · ·	( )	0.020	
< 500	73 (9.1)	24 (11.3)		164 (34.3)	86 (45.7) <sup>c</sup>		
500-1499	606 (75.8)	146 (68.9)		300 (62.8)	96 (51.1)		
≥ 1500	121 (15.1)	42 (19.8)		14 (2.9)	6 (3.2)		
SAT volume (cm <sup>3</sup> )			0.511	( )		0.082	
< 1000	90 (11.3)	23 (10.8)		17 (3.6)	7 (3.7)		
1000-1999	575 (71.9)	146 (68.9)		256 (53.6)	118 (62.8)		
≥ 2000	135 (16.9)	43 (20.3)		205 (42.9)	63 (33.5)		
History of abdominal surgery	100 (100)	10 (2010)	0.087	200 (12.5)	00 (00.0)	0.213	
No	687 (85.9)	172 (81.1)		390 (81.6)	161 (85.6)	00	
Yes	113 (14.1)	40 (18.9)		88 (18.4)	27 (14.4)		
Constipation	110 (1111)	10 (1007)	0.480	00 (1011)	_, (11.1)	0.350	
No	740 (92.5)	193 (91.0)	0.100	408 (85.4)	155 (82.4)	0.000	
Yes	60 (7.5)	19 (9.0)		70 (14.6)	33 (17.6)		
Experience	00 (1.0)	1) ().0)	< 0.001	, (110)	00 (11.0)	0.015	
Attending physicians	552 (69.0)	115 (54.2)	. 0.001	281 (58.8)	91 (48.4)	0.010	
Fellow	248 (31.0)	97 (45.8)		197 (41.2)	97 (51.6)		
Bowel preparation	210 (01.0)	<i>)(</i> 10.0 <i>)</i>	0.561	177 (11.2)	57 (01.0)	0.462	
Excellent to fair	561 (70.1)	153 (72.2)	0.001	359 (75.1)	136 (72.3)	0.102	
Poor to inadequate	239 (29.9)	59 (27.8)		119 (24.9)	52 (27.7)		
Diverticulosis	200 (20.0)	57 (27.0)	0.135	11) (21.))	52 (27.7)	0.966	
No	734 (91.8)	201 (94.8)	0.100	465 (97.3)	183 (97.3)	0.900	
Yes	66 (8.3)	11 (5.2)		13 (2.7)	5 (2.7)		

Table 3 Cecal insertion time according to study variables, by gender, with P values estimated by univariable analysis n (%)

WHR: male *n* = 1009, female *n* = 665; WC: male *n* = 1011, female *n* = 665. <sup>a</sup>*P* = 0.004 *vs* BMI  $\ge$  25 kg/m<sup>2</sup>, <sup>b</sup>*P* = 0.009 *vs* BMI 23-24.9 kg/m<sup>2</sup>, <sup>c</sup>*P* = 0.015 *vs* VAT volume 500-1499 cm<sup>3</sup>. BMI: Body mass index; WHR: Waist-to-hip circumference ratio; WC: Waist circumference; VAT: Visceral adipose tissue; SAT: Subcutaneous adipose tissue.

abdominal and visceral fat than women, in whom fat is distributed in more femoral and gluteal regions<sup>[24]</sup>. In our study, while in women BMI and VAT volume both showed an association with CIT, in men BMI could absorb the association between VAT volume and CIT.

In this study, lower VAT volume was a significant predictive factor of prolonged CIT in multivariable analysis in women. Visceral fat may provide a direct support for the colon in the pelvis, assisting for the easier passage of the colonoscope<sup>[25]</sup>. However, the association between VAT volume and prolonged CIT was not statistically significant in men. A plausible explanation about this discrepancy between the genders may be that loop formation in the sigmoid colon is more frequent without supporting visceral fat in women owing to their anatomical feature of a deeper and rounded pelvis. In addition, the increased abdominal wall musculature in men may provide more external resistance and act as an external splint to the

colonoscope, preventing loop formation<sup>[17,20]</sup>.

A study demonstrated that smaller WC was associated with prolonged CIT<sup>[9]</sup>. In contrast, consistent with our result, Chung *et al*<sup>[16]</sup> reported that there was no direct correlation between WC and CIT. It might be because WC does not seem to reflect real volume of the peritoneal cavity.

In our study, fellow involvement was significantly associated with prolonged CIT both in univariable and multivariable analysis (P < 0.001). Similar results were obtained in a few previous studies<sup>[13,17]</sup>. This can be explained by the learning curve for trainees performing the colonoscopy. Park et al<sup>[26]</sup> reported that CIT was inversely proportional to the number of colonoscopies the trainee had performed; CIT was 12 min and 8.7 min for 150 cases and 250 cases, respectively. They analyzed the factors affecting cecal intubation based on the pre- and post- colonoscopic competency of trainees. Park et al<sup>[26]</sup> reported low BMI, inadequate

Table 4 Predictive parameters of prolonged cecal insertion time according to gender by multivariable logistic regression analysis when body mass index and visceral adipose tissue volume were considered simultaneously or separately

		OR	95%CI	<b>P</b> value	OR	95%CI	<b>P</b> value	OR	95%CI	<i>P</i> value
		UK	70,001	7 Vulue	UN	70,001	7 Tulue	UN	70 /001	7 Value
Male	BMI $(kg/m^2)$						=			
	< 23	1.58	1.00-2.50	0.049	1.69	1.10-2.60	0.017			
	23-24.9	Ref			Ref					
	≥ 25	1.82	1.22-2.71	0.003	1.88	1.28-2.75	0.001			
	VAT volume (cm <sup>3</sup> )									
	< 500	1.40	0.80-2.43	0.236				1.41	0.86-2.33	0.178
	500-1499	Ref						Ref		
	$\geq 1500$	1.24	0.81-1.90	0.323				1.42	0.96-2.12	0.082
	Experience									
	Attending physicians	Ref			Ref			Ref		
	Fellow	1.93	1.41-2.63	< 0.001	1.92	1.41-2.63	< 0.001	1.88	1.38-2.57	< 0.001
Female	BMI (kg/m <sup>2</sup> )									
	< 23	1.66	1.02-2.69	0.041	1.96	1.25-3.10	0.004			
	23-24.9	Ref			Ref					
	≥ 25	1.79	1.02-3.13	0.042	1.71	0.99-2.96	0.053			
	VAT volume (cm <sup>3</sup> )									
	< 500	1.54	1.03-2.31	0.034				1.66	1.17-2.35	0.005
	500-1499	Ref						Ref		
	≥ 1500	1.31	0.47-3.64	0.606				1.47	0.55-3.96	0.446
	Experience									
	Attending physicians	Ref			Ref			Ref		
	Fellow	1.53	1.08-2.16	0.016	1.52	1.08-2.14	0.016	1.54	1.10-2.17	0.013

BMI: Body mass index; VAT: Visceral adipose tissue.

bowel preparation and history of stomach surgery influenced cecal intubation during the pre-competency period and a previous history of gastric operation and inadequate bowel preparation also affected cecal intubation. The present study did not completely discriminate the status of colonoscopic competency of fellow trainees. However, our training program has rules of changing the trainee when patients suffer pain or colonoscope is sluggish at the same segment.

In subgroup analysis by experience of the colonoscopist, patient age of 65 years or over (OR = 2.08, 95%CI: 1.13-3.82, P = 0.018), BMI of 25 kg/m<sup>2</sup> or over (OR = 1.94, 95%CI: 1.21-3.12, P = 0.006), and VAT volume less than 500 cm<sup>3</sup> (OR = 1.70, 95%CI: 1.02-2.86, P = 0.044) were associated with prolonged CIT in fellow group in multivariable analysis (Supplement Table 1). Several studies have reported different results whether older age associate with prolonged CIT. A prospective study by Zuber-jerger et al<sup>[27]</sup> showed CIT was not related with age. However, consistent with our results of fellow group, a study for colonoscopy learning curves of gastroenterology fellows reported an older age was associated with a longer insertion time<sup>[28]</sup>. Length of the entire colon has been reported to increase with age, resulting in increased redundancies and loop formation<sup>[29]</sup>. Also, decreased elasticity of the colon associated with advanced age predisposes to loop formation during colonoscopy<sup>[9]</sup>. These might impede the advancement of the colonoscope, especially among fellows who lack the skills. In the attending physician group, being female (OR = 1.42, 95%CI: 1.01-2.00, P = 0.043), BMI less than 23 kg/m<sup>2</sup> (OR = 1.79, 95%CI: 1.15-2.79, P = 0.010) and greater than or equal to 25

kg/m<sup>2</sup> (OR = 1.68, 95%CI: 1.07-2.64, P =0.024) were associated with prolonged CIT in multivariable analysis (Supplement Table 1).

In previous studies, poor bowel preparation prolonged CIT<sup>[13,30,31]</sup>. However, quality of bowel preparation was not associated with prolonged CIT in our study and several other studies<sup>[4,16]</sup>. This discrepancy might be due to different criteria for the bowel preparation state<sup>[16]</sup>. In subgroup analysis by experience of the colonoscopist, poor bowel preparation was marginally associated with prolonged CIT in the fellow group but not in the attending physician group in multivariable analysis (P =0.056, Supplement Table 1). Consistent with our study, it was reported that poor bowel preparation was a predictive factor of difficult colonoscopy in colonoscopy trainees who lacked techniques for insertion<sup>[26]</sup>.

The advantage of this study is its large sample size including various obesity indices and prospectively collected data that was retrospectively analyzed. However, there were some limitations. First, the present study was performed by a single center. However, seven expert colonoscopists performed the endoscopy and analyzed a large number colonoscopy cases. Second, factors such as pain tolerance and use of narcotic agents, which may affect difficult colonoscopy, were not assessed. Colonoscopy provokes anxiety and discomfort in some patients. Patient stress may result in increased sympathetic outflow, an increase in bowel sensitivity with a greater need for sedative medication, and decreased procedure tolerance, resulting thereby in prolonged CIT<sup>[32]</sup>. These factors should be evaluated in future studies.

In conclusion, Prediction of potentially difficult

WJG www.wjgnet.com

patient may help the colonoscopist decide on scheduling, sedation and vital monitoring requirements, and the need for better colonoscopic expertise. Being female, lower or higher BMI than the normal range, low VAT volume and fellow involvement were predictors of longer CIT. Among obesity indices, lower or higher BMI than the normal range and low VAT volume were associated with longer CIT. Our findings suggest a role of VAT volume, not VAT area, in colonoscope insertion for the first time.

#### COMMENTS

#### Background

Colonoscopy has been the standard examination for the screening and surveillance of colorectal cancer. Cecal insertion time (CIT) varies greatly in different cases and is considered a surrogate measure for difficult colonoscopy. It is important to identify the factors predicting longer CIT. These factors included age, gender, quality of bowel preparation, history of prior abdominal surgery, experience of the colonoscopist, diverticulosis and constipation. In addition, research on the relationship between CIT and obesity indices, such as body mass index (BMI), waist circumference (WC), visceral adipose tissue (VAT) area and subcutaneous adipose tissue (SAT) area, has been reported. However, the results of previous studies are conflicting. The aims of this study were to identify the factors influencing CIT and to evaluate the effect of obesity indices on CIT.

#### **Research frontiers**

Being female, lower or higher BMI than the normal range, low VAT volume and fellow involvement were predictors of longer CIT. Among obesity indices, lower or higher BMI than the normal range and low VAT volume were associated with longer CIT.

#### Innovations and breakthroughs

In this study, its large sample size including various obesity indices (BMI, WHR, WC, VAT volume and SAT volume) and prospectively collected data that was retrospectively analyzed. Visceral fat was calculated as volume for precise evaluating the effects of VAT on CIT. They performed a subgroup analysis by gender.

#### Applications

The patients with female gender, lower or higher BMI than the normal range, low VAT volume may need a longer scheduled interval, sedation and vital monitoring requirements, and better colonoscopic expertise.

#### Terminology

Prolonged CIT: defined as longer than 10 min in CIT. VAT volume: measured as intra-abdominal fat bound by parietal peritoneum or transversalis fascia, excluding the vertebral column and paraspinal muscles.

#### Peer-review

The authors retrospectively reviewed the data of patients who underwent colonoscopy at a single Endoscopy Unit and retrieved data about various obesity indices, as well as specific data about the exams.

#### REFERENCES

- Davila RE, Rajan E, Baron TH, Adler DG, Egan JV, Faigel DO, Gan SI, Hirota WK, Leighton JA, Lichtenstein D, Qureshi WA, Shen B, Zuckerman MJ, VanGuilder T, Fanelli RD. ASGE guideline: colorectal cancer screening and surveillance. *Gastrointest Endosc* 2006; 63: 546-557 [PMID: 16564851 DOI: 10.1016/j.gie.2006.02.002]
- 2 Rex DK, Goodwine BW. Method of colonoscopy in 42

consecutive patients presenting after prior incomplete colonoscopy. *Am J Gastroenterol* 2002; **97**: 1148-1151 [PMID: 12014719 DOI: 10.1111/j.1572-0241.2002.05681.x]

- 3 Imperiale TF, Wagner DR, Lin CY, Larkin GN, Rogge JD, Ransohoff DF. Risk of advanced proximal neoplasms in asymptomatic adults according to the distal colorectal findings. N Engl J Med 2000; 343: 169-174 [PMID: 10900275 DOI: 10.1056/ NEJM200007203430302]
- 4 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**: 872-876 [PMID: 17652041 DOI: 10.1016/j.dld.2007.04.019]
- 5 Nelson DB, McQuaid KR, Bond JH, Lieberman DA, Weiss DG, Johnston TK. Procedural success and complications of large-scale screening colonoscopy. *Gastrointest Endosc* 2002; 55: 307-314 [PMID: 11868001 DOI: 10.1067/mge.2002.121883]
- 6 Takahashi Y, Tanaka H, Kinjo M, Sakumoto K. Prospective evaluation of factors predicting difficulty and pain during sedationfree colonoscopy. *Dis Colon Rectum* 2005; 48: 1295-1300 [PMID: 15793639 DOI: 10.1007/s10350-004-0940-1]
- 7 Chutkan R. Colonoscopy issues related to women. *Gastrointest Endosc Clin N Am* 2006; 16: 153-163 [PMID: 16546030 DOI: 10.1016/j.giec.2006.01.005]
- Jia H, Wang L, Luo H, Yao S, Wang X, Zhang L, Huang R, Liu Z, Kang X, Pan Y, Guo X. Difficult colonoscopy score identifies the difficult patients undergoing unsedated colonoscopy. *BMC Gastroenterol* 2015; 15: 46 [PMID: 25886845 DOI: 10.1186/s12876-015-0273-7]
- 9 Hsieh YH, Kuo CS, Tseng KC, Lin HJ. Factors that predict cecal insertion time during sedated colonoscopy: the role of waist circumference. *J Gastroenterol Hepatol* 2008; 23: 215-217 [PMID: 18289354 DOI: 10.1111/j.1440-1746.2006.04818.x]
- 10 Hsu CM, Lin WP, Su MY, Chiu CT, Ho YP, Chen PC. Factors that influence cecal intubation rate during colonoscopy in deeply sedated patients. *J Gastroenterol Hepatol* 2012; 27: 76-80 [PMID: 21649720 DOI: 10.1111/j.1440-1746.2011.06795.x]
- 11 Oh SY, Sohn CI, Sung IK, Park DI, Kang MS, Yoo TW, Park JH, Kim HJ, Cho YK, Jeon WK, Kim BI. Factors affecting the technical difficulty of colonoscopy. *Hepatogastroenterology* 2007; 54: 1403-1406 [PMID: 17708264]
- 12 Bernstein C, Thorn M, Monsees K, Spell R, O'Connor JB. A prospective study of factors that determine cecal intubation time at colonoscopy. *Gastrointest Endosc* 2005; 61: 72-75 [PMID: 15672059]
- 13 Nagata N, Sakamoto K, Arai T, Niikura R, Shimbo T, Shinozaki M, Noda M, Uemura N. Predictors for cecal insertion time: the impact of abdominal visceral fat measured by computed tomography. *Dis Colon Rectum* 2014; 57: 1213-1219 [PMID: 25203379 DOI: 10.1097/DCR.00000000000203]
- 14 Dafnis G, Granath F, Påhlman L, Ekbom A, Blomqvist P. Patient factors influencing the completion rate in colonoscopy. *Dig Liver Dis* 2005; 37: 113-118 [PMID: 15733524 DOI: 10.1016/ j.dld.2004.09.015]
- 15 Jain D, Goyal A, Uribe J. Obesity and Cecal Intubation Time. *Clin Endosc* 2016; **49**: 187-190 [PMID: 26867549 DOI: 10.5946/ ce.2015.079]
- 16 Chung GE, Lim SH, Yang SY, Song JH, Kang HY, Kang SJ, Kim YS, Yim JY, Park MJ. Factors that determine prolonged cecal intubation time during colonoscopy: impact of visceral adipose tissue. *Scand J Gastroenterol* 2014; 49: 1261-1267 [PMID: 25144912 DOI: 10.3109/00365521.2014.950695]
- 17 Krishnan P, Sofi AA, Dempsey R, Alaradi O, Nawras A. Body mass index predicts cecal insertion time: the higher, the better. *Dig Endosc* 2012; 24: 439-442 [PMID: 23078436 DOI: 10.1111/ j.1443-1661.2012.01296.x]
- 18 Nam SY, Kim BC, Han KS, Ryu KH, Park BJ, Kim HB, Nam BH. Abdominal visceral adipose tissue predicts risk of colorectal adenoma in both sexes. *Clin Gastroenterol Hepatol* 2010; 8: 443-450.e1-2 [PMID: 20144736 DOI: 10.1016/j.cgh.2010.02.001]
- 19 Aronchick CA, Lipshutz WH, Wright SH, Dufrayne F, Bergman G.

A novel tableted purgative for colonoscopic preparation: efficacy and safety comparisons with Colyte and Fleet Phospho-Soda. *Gastrointest Endosc* 2000; **52**: 346-352 [PMID: 10968848 DOI: 10.1067/mge.2000.108480]

- 20 Saunders BP, Fukumoto M, Halligan S, Jobling C, Moussa ME, Bartram CI, Williams CB. Why is colonoscopy more difficult in women? *Gastrointest Endosc* 1996; 43: 124-126 [PMID: 8635705]
- 21 Arcovedo R, Larsen C, Reyes HS. Patient factors associated with a faster insertion of the colonoscope. *Surg Endosc* 2007; **21**: 885-888 [PMID: 17149549 DOI: 10.1007/s00464-006-9116-5]
- 22 Anderson JC, Messina CR, Cohn W, Gottfried E, Ingber S, Bernstein G, Coman E, Polito J. Factors predictive of difficult colonoscopy. *Gastrointest Endosc* 2001; 54: 558-562 [PMID: 11677470]
- 23 **Björntorp P**. Obesity. *Lancet* 1997; **350**: 423-426 [PMID: 9259667 DOI: 10.1016/S0140-6736(97)04503-0]
- 24 Krotkiewski M, Björntorp P, Sjöström L, Smith U. Impact of obesity on metabolism in men and women. Importance of regional adipose tissue distribution. *J Clin Invest* 1983; 72: 1150-1162 [PMID: 6350364 DOI: 10.1172/JCI111040]
- 25 Anderson JC, Gonzalez JD, Messina CR, Pollack BJ. Factors that predict incomplete colonoscopy: thinner is not always better. *Am J Gastroenterol* 2000; **95**: 2784-2787 [PMID: 11051348 DOI: 10.1111/j.1572-0241.2000.03186.x]
- 26 Park HJ, Hong JH, Kim HS, Kim BR, Park SY, Jo KW, Kim JW. Predictive factors affecting cecal intubation failure in colonoscopy trainees. *BMC Med Educ* 2013; 13: 5 [PMID: 23331720 DOI:

10.1186/1472-6920-13-5]

- 27 Zuber-Jerger I, Endlicher E, Gelbmann CM. Factors affecting cecal and ileal intubation time in colonoscopy. *Med Klin* (Munich) 2008; 103: 477-481 [PMID: 18604482 DOI: 10.1007/ s00063-008-1071-6]
- 28 Chung JI, Kim N, Um MS, Kang KP, Lee D, Na JC, Lee ES, Chung YM, Won JY, Lee KH, Nam TM, Lee JH, Choi HC, Lee SH, Park YS, Hwang JH, Kim JW, Jeong SH, Lee DH. Learning curves for colonoscopy: a prospective evaluation of gastroenterology fellows at a single center. *Gut Liver* 2010; 4: 31-35 [PMID: 20479910 DOI: 10.5009/gnl.2010.4.1.31]
- 29 Sadahiro S, Ohmura T, Yamada Y, Saito T, Taki Y. Analysis of length and surface area of each segment of the large intestine according to age, sex and physique. *Surg Radiol Anat* 1992; 14: 251-257 [PMID: 1440190]
- 30 Lee HL, Eun CS, Lee OY, Jeon YC, Han DS, Sohn JH, Yoon BC, Choi HS, Hahm JS, Lee MH, Lee DH, Moon W, Kim SY. Significance of colonoscope length in cecal insertion time. *Gastrointest Endosc* 2009; **69**: 503-508 [PMID: 19152904 DOI: 10.1016/j.gie.2008.06.006]
- 31 Liang CM, Chiu YC, Wu KL, Tam W, Tai WC, Hu ML, Chou YP, Chiu KW, Chuah SK. Impact factors for difficult cecal intubation during colonoscopy. *Surg Laparosc Endosc Percutan Tech* 2012; 22: 443-446 [PMID: 23047390 DOI: 10.1097/SLE.0b013e3182611c69]
- 32 Williams OA. Patient knowledge of operative care. *J R Soc Med* 1993; **86**: 328-331 [PMID: 8315625]

P- Reviewer: Christodoulou DK, Hosoe N, Zorzi M S- Editor: Qi Y L- Editor: A E- Editor: Zhang FF







### Published by Baishideng Publishing Group Inc

8226 Regency Drive, Pleasanton, CA 94588, USA Telephone: +1-925-223-8242 Fax: +1-925-223-8243 E-mail: bpgoffice@wjgnet.com Help Desk: http://www.f6publishing.com/helpdesk http://www.wjgnet.com



