Factors effecting cecal intubation time during colonoscopy

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AIM: *The aim of this study is to evaluate the factors that has an effect on Cecal Intubation time (CIT), and to define the relationship between quality of bowel preparation and body mass index (BMI).*
PATIENTS METHODS: *The Boston Bowel Preparation Scale (BBPS) was used for the evaluation of bowel cleansing. A total of 346 patients were included. The time from anus to caecum was recorded as the time of the cecal intubation time. Patients were defined under 3 subgroup BMI-1; ≤ 24.9, BMI-2; 25-29.9, BMI-3; ≥30.*
RESULTS: *The mean BMI of women was 29.30±4.25 and men were 26.19±6.14 (p<0,001). Mean Cecal Intubation time was 9.11±6.00 and 10.21±3.45 minutes for women and men (p=0.012). Women with High BMI (≥30) have shorter Cecal Intubation time compared to women with BMI less than 30 (p=0001). When BBPS evaluated, there was a significant difference in BMI-3 due to high scores compared to both BMI-1 and BMI-2 (p<0.001). In BMI-3 group, also women had significantly higher scores in terms of BBPS(p=0.006). Also a negative correlation between BBPS and BMI with CIT has been found (r = – 0.371, p<0.001 / r = –0.191 p<0.001).*
CONCLUSION: *In our study, women gender and increased BMI has a positive impact on the quality of intestinal cleansing that is associated with shortened Cecal Intubation time.*

KEY WORDS: Body Mass Index, Colonoscopy, Cecal intubation

Introduction

Colonoscopy is widely used in the diagnosis, monitoring and treatment of some colon diseases such as colon mucosal bleeding, polyps and luminal stenosis [1-3]. Cecal intubation, which is an important step in the evaluation of colonoscopy performance, is necessary to ensure complete colon examination [3]. Cecal intubation is based on the visualization of cecal valve and appendix orifice. Cecal intubation time (CIT) defines the time to reach colonoscope from the anal region to the caecum. Fast cecal intubation should be the goal during colonoscopy [4,5]. The long cecal intubation time indicates the difficulty in reaching the colonoscope to the cecum and is accepted as a determining factor for difficult colonoscopies which has been described as a painful and unpleasant experience when evaluated from the patient's point of view. In addition as CIT prolonges, the patient may have an increase in the risk of complications and additional medication for sedation and analgesia is needed much [4].
CIT is effected by many factors such as age, gender, increased or decreased body mass index (BMI), waist circumference, abdominal or pelvic surgical history, endoscopist experience and poor bowel preparation [3,4,6,7]. Intestinal preparations is measured as "excellent, good, acceptable and bad" with scales formed by the American Gastrointestinal Endoscopy Association (ASGE) and the American Gastroenterology Association (AGA) [8,9]. The Boston Bowel Preparation Scale (BBPS) which is a more detailed a bowel cleanliness evaluation scale has been validated for colonoscopy-oriented research. The scale consists the sum of points that were defined for left colons, transverse, and the right separately [10].

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The time required to complete the colonoscopy varies greatly, with times ranging from 10 to 60 minutes in difficult situations. The average period of cecal intubation was reported by experienced endoscopists in the literature as 4 to 10 minutes [11,12]. The aim of this study is to evaluate the factors that has an effect on CIT, and to define the relationship between quality of bowel preparation and BMI.

Material Method

Between January 2019 - February 2020, a total of 786 patients who underwent colonoscopy were analyzed retrospectively. Inclusion criteria' s are: over 18 years of age and patients undergoing diagnostic colonoscopy for elective indications. Exclusion criteria's are as follows: a history of unsuccessful cecal intubation, inflammatory bowel disease, insufficient intestinal cleansing, a colorectal carcinoma diagnosis and patients with colostomy. Patients who had previously undergone abdominal surgery for any reason and who underwent any procedure that could effect the cecal intubation time (such as balloon dilatation to the stenosis) were also excluded from the study.

The final review was done on 346 patients. The procedures were performed by three general surgery specialists who performed more than 200 colonoscopies per year with more than 10 years of experience. The demographic data of the patients were recorded. BMI was calculated with the weight (kg)/height (m^2)" formula. Patients were defined under three subgroups according to WHO; BMI-1; ≤ 24,9, BMI-2; 25-29.9, BMI-3; ≥30. Patients were given a liquid-based diet, starting three days before the procedure. Eight hours before the procedure fasting was recommended. Intestinal cleansing was performed with Sennozid a + b calcium (X-M solution, Yenisehir Lab San. Tic. Ltd., Ankara, Turkey) 250 ml and BT enema (BT enema, Yenisehir Laboratory San. Tic. Ltd. Ankara Turkey) 210 ml. Patients sedated with midazolam (Dormicum ampoule 50 mg / 10 ml, Roche, Turkey) 0.05mg / kg and meperidin (Aldolan ampoule 100 mg / 2 ml, Liba, Turkey) 0.3 mg / kg; Additional doses were applied by anesthesiologist when needed.

Colonoscopy was performed using an Olympus Exera III Videocolonoscope (CF HQ190L). The time duration between the anus and the caecum recorded as the time of CIT. In all patients, the procedure was successfully completed, there were no complications. Table I described BBPS value [10].

Categorical variables are presented as frequency and percentage and continuous variables are given as mean and standard deviation. The normality of continuous variables was tested using the Shapiro-Wilk test. The Chi-squared test was used to compare categorical variables. Mann Whitney U test was used for comparison of non-parametric data between independent groups, and Independent Sample T test was used for parametric data. One-Way Anova test was used for 3 group comparisons and Post-Hoc Tukey test was used for intergroup comparisons. Pearson correlation analysis was used to calculate the correlation of variables.

All analyses were performed using the Social Sciences Statistics Package (version 22.0) for Windows (SPSS Inc., Chicago, Illinois, USA). $p<0.05$ was considered statistically significant.

Results

346 patients were included. The mean age of the study was 52.40±13.53. Of the patients, 57.5% (n=199) were female and 42.5% (n=147) were male. The mean age of women and men were 52.55±13.17 and 52.19±14.05. The age difference between the gender was not statistically significant ($p=0.805$). Mean of the BMI patients was 27.98±5.36.

The mean BMI of women was 29.30±4.25 and men were 26.19±6.14 and the difference was statistically significant ($p<0,001$). The average CIT was 9.58±5.10 minutes for all group, Mean CIT was 9.11±6.00 in women and 10.21±3.45 minutes for men ($p= 0.012$).

Demographic data of patients Table II. is also given.

Patients were divided into 3 groups according to BMI.

Table I - *Boston Bowel Preparation Scale (BPPS).*

Boston Bowel Preparation Scale (BPPS)	
0 =	Unprepared colon segment with mucosa not seen due to solid stool that cannot be cleared.
1 =	Portion of mucosa of the colon segment seen, but other areas of the colon segment not well seen due to staining, residual stool and/or opaque liquid.
2 =	Minor amount of residual staining, small fragments of stool and/or opaque liquid, but mucosa of colon segment seen well.
3 =	Entire mucosa of colon segment seen well with no residual staining, small fragments of stool or opaque liquid.

Each of the three segments of the colon (right, including caecum and ascending colon; transverse, including hepatic andsplenic flexures; and left, including descending colon, sigmoid and rectum) is given a score from 0–3 defined as follows: Each of the three segment scores is then summed for a total score of 0–9, where 0 is unprepared and 9 is entirely clean. If an endoscopist aborts a procedure due to an inadequate preparation, then any non-visualized proximal segments are assigned a score of 0

TABLE II - *Demographic data.*

n=346	Mean±SD	Male Mean±SD n=124 (%42,5)	Female Mean±SD n=199 (%57,5)	p value
Age	52,40±13,53	52,19±14,05	52,55±13,17	0,805
BMI	27,98±5,36	26,19±6,14	29,30±4,25	<0,001
CIT	9,58±5,10	10,21±3,45	9,11±6,00	0,048

SD: standart deviation

TABLE III - *Distribution of characteristics by groups.*

	BMI-1<24,9 (n=95)	BMI-2 25-29,9 (n=133)	BMI- 3 ≥30 (n=118)	p value
Age				
Mean±SD	52,02±15,6	52,26±13,39	52,85±11,85	0,896
GENDER				
Female	22 (%23,2)	99 (%74,4)	78 (%66,1)	
Male	73 (%26,8)	34(%25,6)	40 (%33,9)	
CIT (minutes)	10,46±3,67	10,55±6,87	7,77±2,76	<0,001
Female	10,40±3,89	10,62±7,72	6,83±1,97	<0,001
Male	10,47±3,63	10,35±3,41	9,60±3,16	0,421

SD: standart deviation

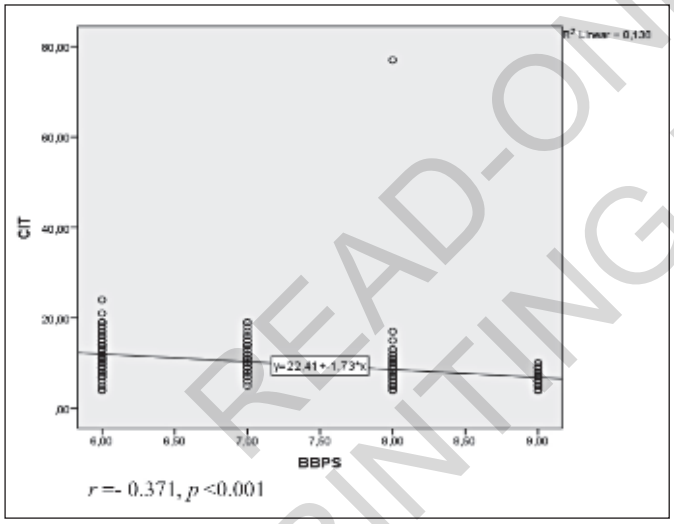

Fig. 1: Negative correlation between BBPS and CIT.

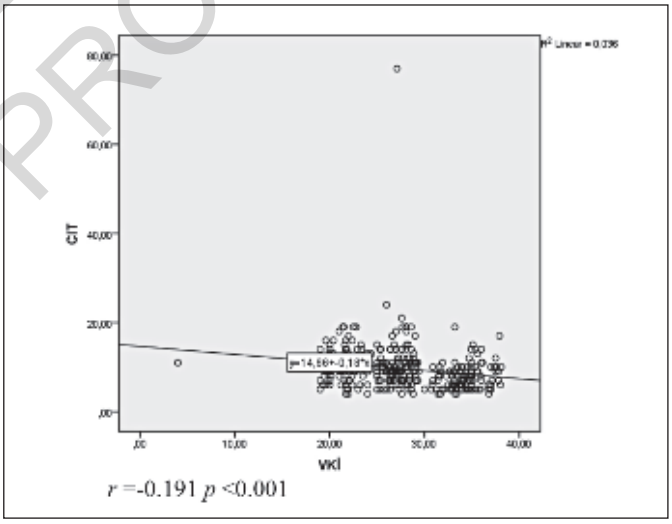

Fig. 2: Negative correlation between body mass index and CIT.

The distribution of data is showed into (Table III). CIT were 10.4±3,67, 10.5±6,87, 7.72, 76 minutes for BMI-1, BMI-2 with BMI-3, respectively (p<0.001). There was no difference of CIT in male gender in terms of BMI. (p= 0.421), but women in BMI-3 has shorter CIT compared to women in BMI-1 and BMI-2 (p= 0001). There was no significant difference in CIT between BMI-1 and BMI-2 (p=0.989).

When all patients BMI-1 and BMI-2 group were analyzed by gender, women and male has similar CIT times (p=0...-842) Same analyses in BMI-3 group revealed that women have statistically significant lower CIT compared to men p<0.-001).

When the BBPS scores were evaluated, the rate of score 6 was 26.6 % (n=92), score 7 was 25.4% (n=88), score 8 was 26.9% (n=93) and score 9 was 21.1% (n=73). While there is no significant difference in BBPS compared to BMI- 1 and BMI-2 (p=0.668), there was a significant difference in BMI- 3 due to high scores compared to both BMI-1 and BMI-2 (p<0.001). In terms of gender, there was no significant difference in BBPS for either BMI-1 or BMI-2 (p=0.873, p=0.490). In BMI-

3 group, also women had significantly higher scores in terms of BBPS (p=0.006). Regardless of the groups, there was no significant difference in the number of BBPS scores between male and female gender. (p <0.141). While no correlation between age and CIT was detected, a negative correlation between BBPS and BMI with CIT has been found (r = - 0.371, p<0.001 / r= -0.191 p<0.001) (Figs. 1, 2).

Discussion

Colonoscopy is the most accurate and versatile diagnostic test for colorectal carcinoma, localizes lesions in the large intestine and biopsies, detect synchronous neoplasms and remove polyps [7].Identifying risk factors for prolonged CIT is an important first step towards effective colonoscopy, as it will allow endoscopists to pay particular attention to patients at risk and to implement protective measures before the procedure. In our study, we have defined that higher BMI and/or BBPS score has a positive correlation with a lower CIT.

The status of experience of endoscopist, technique, quality of intestinal cleansing, age
and gender of the patient, BMI, intraabdominal adhesions due to previous surgery and the presence, manoeuvres during the procedure and instruments used for colonoscopy [2,4-6,13,14]. It is known that the use of additional maneuvers during colonoscopy prolongs CIT. This is expected because the time required implementing these additional preventions such as abdominal pressure and patient posture change, will definitely prolong the time the cecal intubation [4]. Colonoscopy raises anxiety in some patients. Patient stress can cause sympathetic activation, narcotic drug requirement and be more needed and result in increased intestinal sensitivity, reduction in procedural tolerance [15]. Patients with poor pain tolerance or pre-existing use of narcotic drugs may also have more difficulty with the air insufflations of the colon and the placement of the colonoscopy, which can result prolonged cecal intubation periods [14]. In our study, factors such as pain tolerance, history of the use of narcotic agents, doses of sedoanalgesic drugs used were ignored and CIT was evaluated, although these factors are difficult to measure, although it should be taken into account in future studies.

Older age could be one of the important factors that affect CIT. In a prospective study of 693 patients in which he evaluated factors affecting the duration of cecal intubation, they found that there was a risk factor for CIT prolonged older age [14]. Similarly, in a high volüme retrospective study involving 11812 patients, they reported that older age was a risk factor for incomplete colonoscopy [16]. It has been reported that old age is associated with increased colon length and reduced colon flexibility [17]. In addition, it is claimed that the mesenterics of elderly patients are more elastic and loose, which increases the predisposition to loop formation during colonoscopy [14-16,18]. All these factors can increase CIT in the elderly, but although studies show that advanced age is associated with prolonged CIT, our study there is no correlation between age and CIT. There are publications in the literature that report that colonoscopy is more difficult in women than men, which can result in a decrease in the rate of completing longer CIT and colonoscopy [4,13,14,19]. This can be associated with a deeper and more rounded pelvis that can cause more sigmoid loops during the procedure due to large intra pelvic volume inwomen.

There may also be a longer colon that can contribute to the formation of loop formation in women [4,19]. However, it should be noted that women with larger waist circumference have larger abdominal cavity than normal women, more visceral fat and slightly more fat accumulation in the retroperitoneal region. Fat pillow accumulated in this area, can make CIT shorter by allowing the colonoscopies to move freely during sharp turns during the colonoscopy procedure. During colonoscopy, the relationship between body weightand the technical difficulty of reaching the ceacum base has been a matter of discussion. There is conflicting evidence that both weak and obese people may have difficulty during colonoscopy [4,14,20-22]. Along with publications that observe that low BMI is associated with a prolonged CIT [14,22], there are studies that CIT is reported shorter because patients who are overweight and obese have more visceral fat, which tends to support and minimize loop formation, as well as shorter colon [19,21]. Although BMI is a widely accepted scale for obesity, it is not a real measure of intra-abdominal fat [23]. Another study, they reported that low visceral adipose tissue area and lower subcutaneous adipose tissue area are independently associated with longer CIT, and that high subcutaneous fat accumulation is the best predictive factor for easier passage of colonoscopy [20]. In our study, CIT was found to be noticeably shorter in the BMI-3 group. This may be due to better bowel cleansing, increased visceral adipose tissue and increased amount of subcutaneous fat in patients with BMI more than 30 kg/m^2.

The potential benefit of colonoscopy can be achieved when safely completed in minimal time by good visualization of the mucosa. The effectiveness of the procedure depends largely on the quality of intestinal cleansing [24]. Unsurprisingly, poor bowel cleansing has been found to be associated with prolonged CIT due to the visualization of the colon by feces.

BBPS is considered to be reliable and the most relevant intestinal preparation scale. It is also a simple scoring system that can be used in clinical routine applications [8-10,25]. Another study, obesity was independently associated with poor bowel cleansing, which could lead to a difficult and prolonged colonoscopy, but in our study, the quality of intestinal cleansing in the women with high BMI group was significantly higher [26].The result of

our study also confirms the previous studies where the average cecal intubation time is shorter parallel to a higher BBPS score.
One of the limitations of our study is that colonoscopy was performed by three different endoscopists, so the difference in experience and technical duration can contribute to CIT. However, we tried to minimize this confusion by selecting all three endoscopist as similar and balanced experience duration. The fact that the patient's pain tolerance before colonoscopy can contribute to the rate of colonoscopy can be considered as another limitation.
We preferred to use different doses of sedation and analgesia for each patient before each colonoscopy to minimize this difference in the pain threshold.

Conclusion

In our study we concluded that CIT was effected by BMI. Also women usually get more proper colon cleansing. Interestingly, age was not found to be a factor on CIT.

Riassunto

Obiettivo: Lo scopo di questo studio è valutare i fattori che hanno un effetto sul tempo di intubazione cecale (CIT) e definire la relazione tra la qualità della preparazione intestinale e l'indice di massa corporea (BMI).
Metodi Dei Pazienti: Per la valutazione della pulizia dell'intestino è stata utilizzata la Boston Bowel Preparation Scale (BBPS). Sono stati inclusi un totale di 346 pazienti. Il tempo dall'ano al cieco è stato registrato come tempo di intubazione cecale. I pazienti sono stati definiti sotto 3 sottogruppi BMI-1; ≤ 24,9, BMI-2; 25-29,9, BMI-3; ≥30.
Risultati: Il BMI medio delle donne era 29,30 ± 4,25 e gli uomini 26,19 ± 6,14 (p <0,001). Il tempo medio di intubazione cecale era di 9,11 ± 6,00 e 10,21 ± 3,45 minuti per donne e uomini (p = 0,012). Le donne con BMI elevato (≥30) hanno un tempo di intubazione cecale più breve rispetto alle donne con BMI inferiore a 30 (p = 0001). Quando BBPS ha valutato, c'era una differenza significativa nell'IMC-3 a causa dei punteggi più alti rispetto a entrambi BMI-1 e BMI-2 (p <0,001). Nel gruppo BMI-3, anche le donne avevano punteggi significativamente più alti in termini di BBPS (p = 0,006). È stata trovata anche una correlazione negativa tra BBPS e BMI con CIT (r = – 0,371, p <0,001 / r = – 0,191 p <0,001).
Conclusione: Nel nostro studio, il sesso delle donne e l'aumento dell'IMC hanno un impatto positivo sulla qualità della pulizia intestinale che è associata alla riduzione del tempo di intubazione cecale.

References

1. Ozsoy M, Celep B, Ersen O, et al.: *Our results of lower gastrointestinal endoscopy: Evaluation of 700 patients*. Ulus Cerrahi Derg, 2014; 30:71-75.

2. Jia H, Wang L, Luo H, et al.: *Difficult colonoscopy score identifies the difficult patients undergoing unsedated colonoscopy.* BMC Gastroenterol, 2015; 9:15:46.

3. *Can body mass index predict the difficulty of colonoscopy?* Clin Endosc, 2016; 49:106-07.

4. Akere A, Otegbayo JA: *Complete colonoscopy: Impact of patients' demographics and anthropometry on caecal intubation time.* BMJ Open Gastroenterol, 2016; 7:3(1).

5. Liang CM, Chiu YC, Wu KL, et al.: *Impact factors for difficult cecal intubation during colonoscopy.* Surg Laparosc Endosc Percutan Tech, 2012; 22:443-46.

6. Chung GE, Lim SH, Yang SY, et al.: *Factors that determine prolonged cecal intubation time during colonoscopy: Impact of visceral adipose tissue*. Saudi J Gastroenterol, 2014; 49(10):1261-267.

7. Jain D, Goyal A, Uribe J: *Obesity and Cecal Intubation Time*. Clin Endosc, 2016; 49(2):187-90.

8. Lai EJ, Calderwood AH, Doros G, et al.: *The Boston bowel preparation scale: A valid and reliable instrument for colonoscopy-oriented research.* Gastrointest Endosc, 2009; 69(3):620-25.

9. Kim EJ, Park YI, Kim YS, et al.: *A Korean experience of the use of Boston bowel preparation scale: A valid and reliable instrument for colonoscopyoriented research*. Saudi J Gastroenterol, 2014; 20(4):219-24.

10. Calderwood AH, Jacobson BC: *Comprehensive validation of the Boston bowel preparation scale*. Gastrointest Endosc, 2016; 72(4):686-92.

11. Rex DK: *Effect of variable stiffness colonoscopes on cecal intubation times for routine colonoscopy by an experienced examiner in sedated patients.* Endoscopy, 2001; 33:60-64.

12. Kim WH, Cho YJ, Park JY: *Factors affecting insertion time and patient discomfort during colonoscopy*. Gastrointest Endosc, 2000; 52:600-05.

13. Jaruvongvanich V, Sempokuya T, Laoveeravat P, et al.: *Risk factors associated with longer cecal intubation time: A systematic review and meta-analysis*. Int J Colorectal Dis, 2018; 33:359-65.

14. Bernstein C, Thorn M, Monsees K, et al.: *A prospective study of factors that determine cecal intubation time at colonoscopy.* Gastrointest Endosc, 2005; 61:72-75.

15. Williams OA: *Patient knowledge of operative care*. J R Soc Med, 1993; 86:328-31.

16. Koido S, Ohkusa T, Nakae K, et al.: *Factors associated with incomplete colonoscopy at a Japanese academic hospital.* World J Gastroenterol, 2014; 20:6961-67.

17. Sadahiro S, Ohmura T, Yamada Y, et al.: *Analysis of length and surface area of each segment of the large intestine according to age, sex and physique*. Surg Radiol Anat, 1992; 14:251-57.

18. Waye JD: *Difficult colonoscopy*. Gastroenterol Hepatol, 2013; 9:676-78.

19. Khashab MA, Pickhardt PJ, Kim DH: *Colorectal anatomy in*

adults at computed tomography colonography: Normal distribution and the effect of age, sex, and body mass index. Endoscopy, 2009; 41(8):67478.

20. 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; 57:1213-19.

21. Waye JD. *Completing colonoscopy*. Am J Gastroenterol, 2000; 95:2681-82.

22. Anderson JC, Gonzalez JD, Messina CR, et al.: *Factors that predict incomplete colonoscopy: Thinner is not always better*. Am J Gastroenterol, 2000; 95:2784-87.

23. Kobayashi M, Ogawa S, Tayama J: *Intra-abdominal fat accumulation is an important predictor of metabolic syndrome in young adults.* Medicine (Baltimore), 2020; 99(37):e22202.

24. *High quality colonoscopy in a low volume unit; is it achievable*? Arab J of Gastroenterol, 2010; 11:161-64.

25. Chaves Marques S: *The Boston bowel preparation scale: is it already being used?* 2018; 25(5):219-21.

26. Borg BB, Gupta NK, Zuckerman GR, et al.: *Impact of obesity on bowel preparation for colonoscopy*. Clin Gastroenterol Hepatol, 2009; 7(6):670-75.