Original Article

Effects of Mechanical Bowel Preparation on Physiological Parameters of Patients Undergoing Elective Colorectal Surgery: A Quasi-Experimental Hospital-Based Study

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Abstract

Background: Mechanical bowel preparation has many negative side effects such as electrolytes imbalance and blood values changes. Patients vital signs should be monitor during mechanical bowel preparation.
Objective: The aim of this study was to determine the effects of mechanical bowel preparation on physiological parameters of patients undergoing elective colorectal surgery.
Methodology: This quasi-experimental study was conducted at General Surgery Clinic at the West of Turkey. Study was carried out on a total of 64 patients who were scheduled to undergo elective colorectal surgery. Patients were placed in left lateral position and fleet enema was applied. Patients mobilized for bowel contents evacuation after 8-10 minutes and then were placed in semi-fowler's position. Patients physiological parameters were measured at specified times.
Results: Just right at the end of mechanical bowel preparation, systolic and diastolic blood pressure, pulse and respiratory rate increased, however, body temperature and aO_2Sat decreased compare 1 hour before mechanical bowel preparation ($P<0.05$). 20, 40, and 60 minutes after at the end of mechanical bowel preparation, body temperature, systolic, diastolic blood pressure, pulse and respiratory rates decreased compare just right at the end of mechanical bowel preparation ($P<0.05$).
Conclusion: Mechanical bowel preparation was followed by significant changes in physislogical parameters. The study results will be provide in developing evidence-base practice related on MBP in preoperative period and patients outcomes in postoperative period.

Keywords: Mechanical bowel preparation, physiological parameters, colorectal Surgery.

Introduction

Nowadays, mechanical bowel preparation (MBP) is performed routinely before elective colorectal surgeries, minimally invasive surgeries (laparoscopic or robotic), radical cystectomy and ect. (McDougall, 2003; Rex, Imperiale, Latinovich, & Bratcher, 2002; Stein, & Skinner, 2003; Wells, Plante, & McAlpine, 2011). The goal of MBP is to clear the large bowel of feces and therefore reduce the number of bacteria in the lumen of the bowel to minimize the rate of infective and anastamotic complications (Frizelle, & Colls, 2005; Matsuda, Colvin, & Adachi, 2018). The utility of MBP to minimize infectious complications in elective colorectal surgery is contentious (Ares et al., 2018). Still some researchers believe that MBP can reduce the bacterial load in the bowel, but the large number of microorganisms in the digestive tract makes this almost impossible (Fa-Si-Oen et al., 2005). The studies results showed that there were no differences in the rate of postoperative complications in patients with MBP versus no MBP in abdominal surgeris (Bucher, Mermillod, Gervaz, & Morel, 2004; Contant et al., 2007; Emir, Kavlakoglu, Sozen, Yazar, & Ozkan, 2012; Jung, Pahlman, Nystrom, & Nilsson, 2007; Zmora et al., 2006). However, a study results showed that to provide better bowel cleansing effective bowel preparation is required for the patients with diabetes, renal diseases and chronic obstructive pulmonary disease (Reilly & Walker, 2004). Besides MBP has many negative side effects like water and electrolyte imbalance and also is not safe for elderly patients and those having underlying cardiac, renal or pulmonary disease (Askarpour, Peyvasteh, Dastyar, & Javaherizadeh, 2013; Bucher, Mermillod, Gervaz, & Morel, 2004; Curran & Plosker, 2004; Jung, Pahlman, Nystrom, & Nilsson, 2007; Severge, 2009; Wells, Plante, & McAlpine, 2011; Yeh et al., 2005). Despite these drawbacks MBP is still practiced world wide before elective colorectal surgery (Ell et al., 2003; Frizelle, & Colls, 2005; Hookey, Depew, & Vanner,

2004; Platell, Barwood, & Makin, 2006). The aim of this study was to investigate the effects of MBP on body temperature, systolic/diastolic blood pressure, pulse rate, respiratory rate and arterial oxygen saturation of patients undergoing elective colorectal surgery in preoperative period.

Background: The benefit of mechanical bowel preparation (MBP) before colorectal surgery has been debated over the last decade. Nevertheless, MBP is routinely done before colorectal surgeries (Fanning, & Valea, 2011; Platell, & Hall,1998). MBP has many negative side effects such as water, electrolytes imbalance, blood values changes. Patients general condition and vital signs should be monitor during MBP. MBP has adverse physiological effects attributed to dehydration, is distressing for the patient and postoperative complications can be occur in associated with spillage of bowel contents (Askarpour, Peyvasteh, Dastyar, & Javaherizadeh, 2013; Gustafsson et al., 2013). In Hu et al. study (2017) patients undergoing elective surgeries for colon cancer, preoperative MBP was associated with increased postoperative complications, delayed recovery of intestinal motility and poorer nutrition status early after the operation (Hu et al., 2017). Rollins et al. (2018) meta-analysis study has showed that the use of MBP does not affect the incidence of postoperative complications when compared with no bowel preparation. They stated that MBP should not be administered routinely prior to elective colorectal surgery (Rollins, Javanmard-Emamghissi, & Lobo, 2018). Studies results showed that no mean in surgical site infection (Bucher, Mermillod, Gervaz, & Morel, 2004; Contant et al., 2007; Emir, Kavlakoglu, Sozen, Yazar, & Ozkan, 2012; Gustafsson et al., 2013; Jung, Pahlman, Nystrom, & Nilsson, 2007), lenght of stay in hospital (Akcan, Sozuer, Akyildiz, Kucuk, & Cetin, 2007; Contant et al., 2007), anastomic leakage (Contant et al., 2007; Emir, Kavlakoglu, Sozen, Yazar, & Ozkan, 2012; Gustafsson et al., 2013), fascia layer evisseration, and time beginning of oral feeding patients with MBP versus no MBP (Contant et al., 2007). In Koller et al. (2018) study to determine the relationship between bowel preparation and surgical site infections, and also other postoperative complications after elective colorectal surgery, bowel preparation was not associated with increased risk of cardiac/renal complications compared with no bowel preparation (Koller et al., 2018). In a randomized prospective study by Severge to compare effects of soydum fosfat and senna sorbitol on colon cleaning before colonoscopy, no important difference observed in vital paramteres, however, senna sorbitol provides better colon cleaning specially in left colon and changes in the electrolytes were less (Severge, 2009). In Askarpour et al. study an increase in body temperature, leucocytosis, hypernatremia, hypokalemia and bowel sonuds were observed. They suggested the use of normal saline instead of manittol in bowel preparation (Askarpour, Peyvasteh, Dastyar, & Javaherizadeh, 2013). Study results showed that beside patients complaints associated with MBP such as palpitation, nausea, cramp, vomiting, anal irritation and swelling, changes of electrolyte, creatinine and hematocrit levels, dehydratation, cardiac and renal dysfunction can be occur (Askarpour, Peyvasteh, Dastyar, & Javaherizadeh, 2013; Cohen, 2008; Jung, Pahlman, Nystrom, & Nilsson, 2007). For this reasons, patients general condition and vital signs should be monitor during MBP. If changes in vital signs or any abnormal situtation and the rhythm disorders occur, the procedure should be finished. The studies related on the effects of the MBP on physiological parameters are limited (Cohen, 2008; Hendry, Jenkins, & Diament, 2007). Perioperative nurses play a key role in developing and implementing a plan of care that incorporates preoperative assessment. The goals of the preoperative assessment are to improve quality of care and restore the patient to the desired level of function (Asgar Pour, 2017; Malley, Kenner, Kim, & Blakeney, 2015). This study results may be provide in developing evidence-base practice in preoperative period and patients outcomes by improving patient assessment before, during and after MBP. The aim of this study was to investigate the effects of MBP on body temperature, systolic/diastolic blood pressure, pulse rate, respiratory rate and arterial oxygen saturation of patients undergoing elective colorectal surgery in preoperative period.

Methodology: This quasi-experimental hospital-based repeated measure study was conducted at General Surgery Clinic of Aydın Adnan Menderes University Training-Research Hospital, Turkey between 01 March-27 July 2017. Study was carried out on a total of 64 patients who were scheduled to undergo elective colorectal surgery. For sample size, the results of advanced repeated measures ANOVA power analysis with power set as 0,85, effect size 0.74 and standard deviation 4.95, a selection of 32 patients were sufficient for this study. The total research sample comprised of 64 patients without control group. The inclusion criteria were as follows: voluntary and aged ≥18, consious, oriented, mobilized and no global or recieve aphasia. The exclusion criteria were as follows: fever (core body temperature ≥ 38,3°C) in preoperative period, recieve any inotropic or cardiac agents in preoperative period. Written approvals were obtained from the Ethics Board of Adnan Menderes University Faculty of Medicine E. 124125, Adnan Menderes University Hospital Chief Physician, General Surgery Head of Department and Directorate of Nursing Services. Informed consent was obtained from all patients after explaining the objectives of the research after admission. Patients were assessed for pain, fatigue and sleep quality 1 hour before MBP. After preparing of devices and providing of patients privacy, anal region were assessed for any irritation, wound, infection or etc. Patients were placed in left lateral position and the fleet enema solution was applied rectally slowly for 2-3 minutes. Patients mobilized for bowel contents evacuation after 8-10 minutes at the end of procedure and then patients were placed in semi-fowler's position (30°) after taking the bed. Patients body temperature, systolic /diastolic blood pressure, pulse rate, respiratory rate, arterial O2Sat were measured and recorded 1 hour before, just before, just right at the end, 20, 40 and 60th minutes after MBP.

For data collection, a “Socio-demoFigure Form”, “Patients Follow-up Form” and “Physiological

Parameters Changes Associated With MBP Form" were used. The forms were developed based on the literature. Additionally, NRS-V (Asgar Pour, 2017), Visual Analogue Scale for Fatigue (Daglar, Pinar, Sabanciogullari, & Kav, 2014), and Pittsburgh Sleep Quality Index (PSQI) (Daglar, Pinar, Sabanciogullari, & Kav, 2014; Landry, Best, & Liu-Ambrose, 2015) were used. MBP, is commonly used to prepare patients before colorectal surgery (Bucher, Mermillod, Gervaz, & Morel, 2004). MBP involves the preoperative administration of substances to induce voiding of the intestinal and colonic contents (Acog, 2018). At present study for MBP fleet enema 133 solution (Sodium phosphate 19 g, Sodium phosphate 7 g) was used. Monitoring and evaluating physiological parameters are essential nursing assessment activities. The diagnostic value of standard monitoring parameters is high when these values are abnormal because they are considered sensitive indicators of the overall health of patients (Kiekkas et al., 2007). In this study, we defined physiological parameters as BT, SBP, DBP, PR, RR and aO2Sat; we measured these parameters 1 hour before, just before, just right at the end, 20, 40 and 60th minutes after MBP. To measure body temperature infrared tympanic thermometer (Covidien Genius2), haemodynamic parameters non-invasive monitoring system (Nihon Kohden BSM 2301K) were used. Calibrartion of devices were performed before the study by the relevant company.For statistical analysis, SPSS version 21 (SPSS Inc., Chicago, IL, USA) was used. The Shapiro-Wilk test was employed to test the normality of the distribution of data. The descriptive characteristics were expressed as percentages in the categorical variables and as means, standard deviation and medians. As the data did not display normal distribution, the Wilcoxon T-test was employed in the comparison of variables means in admission and 1 hour before MBP. To compare mean variables at all times One-way ANOVA with repeated measures test was used. Statistical significance was set at $p < 0.05$, as appropriate.

Results

The mean age of patients was 64.12±11.48. Regarding disease diagnosis 25.0% of patients had colon cancer, and 32.8% had diabetes mellitus and the nutrition risk screening-2002 score in 70.3% was 1. Before MBP 62.5% had pain and mean (median) pain score were 3.69±3.20 (4.0). Additionally, mean (median) fatigue score were 4.28± 3.6 (4.0) and mean PSQI were 6.69±3.2. Between admission and 1 hour before MBP, body temperature and aO2Sat demonstrated a significant difference (p<0,05), whilst systolic/diastolic blood pressure, repiratory and pulse rate demonstrated a non-significant difference (p>0,05). Mean body temperature right after, 20, 40, and 60th minutes after MBP decreased 0.03, 0.08, 0.10 and 0.16°C compared just before MBP, respectively. (Figure 1) Mean systolic blood pressure just before and right after MBP increased 3.07 and 4.65 mmHg compared 1 hour before MBP. Likewise, mean SBP right after MBP increased 1.57 mmHg compare just before MBP. However, mean SBP 20, 40, and 60th minutes after MBP decreased 1.09, 3.48 and 4.85 mmHg compared just before MBP. (Figure 2) Mean diastolic blood pressure just before and right after MBP increased 1.93 and 2.87 mmHg compared 1 hour before MBP. Likewise, mean DBP right after MBP increased 0.93 mmHg compare just before MBP. However, meanDBP 20, 40, and 60th minutes after MBP decreased 0.34, 1.51 and 2.68 mmHg compared just before MBP. (Figure 3) Mean pulse rate just before and right after MBP increased 1.96 and 4.71 beats/per minutes compared 1 hour before MBP.

Figure 1: Distribution of BT 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

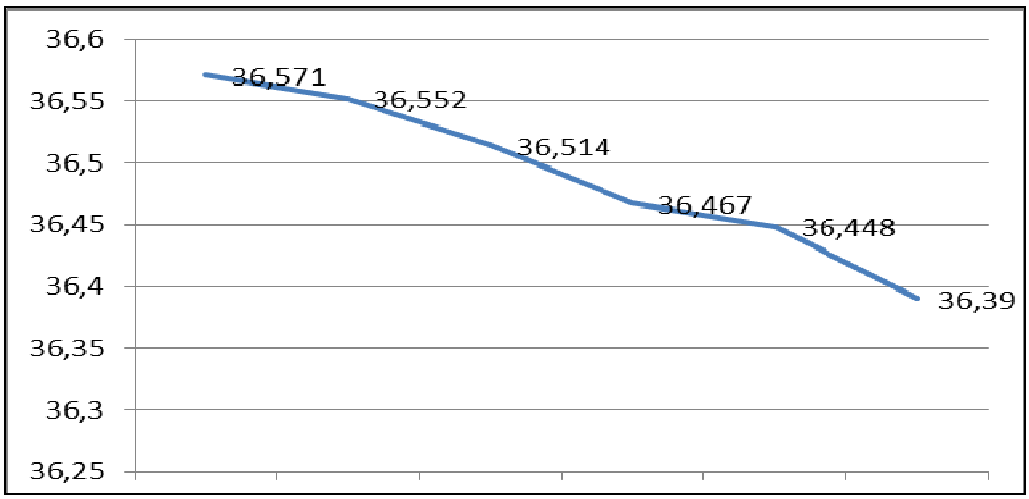

Figure 2: Distribution of SBP 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

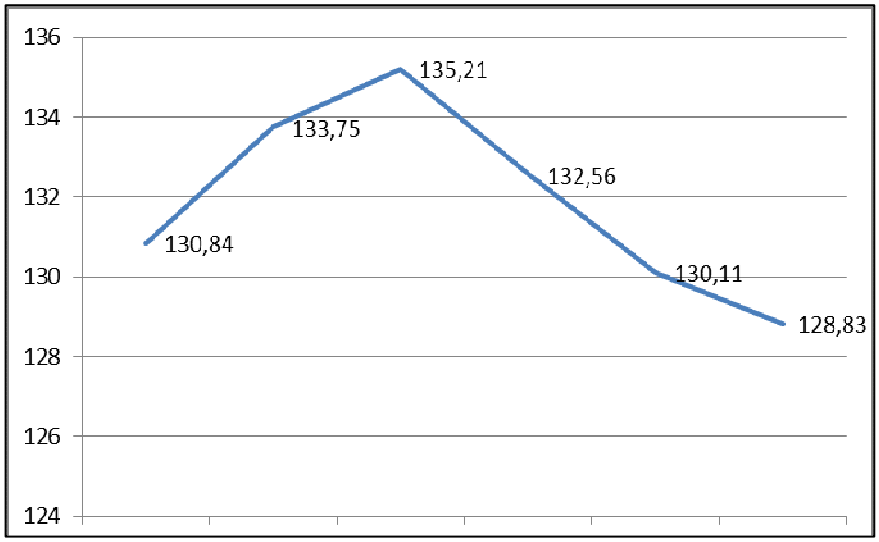

Figure 3: Distribution of DBP 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

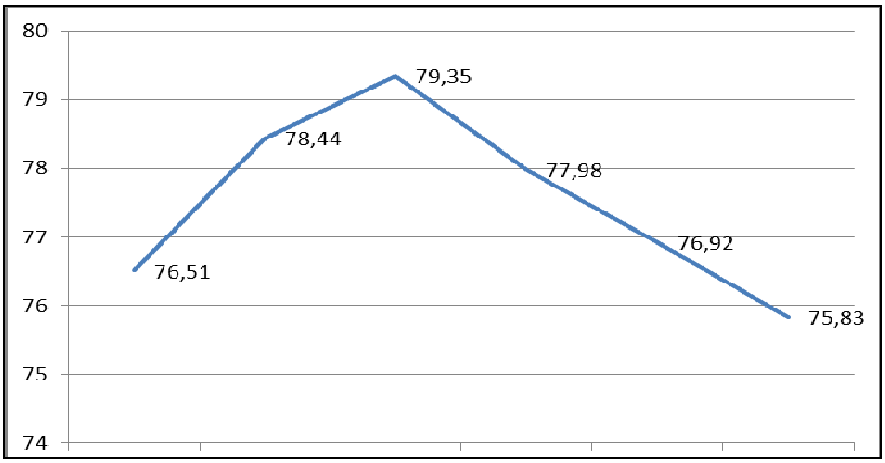

Figure 4: Distribution of PR 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

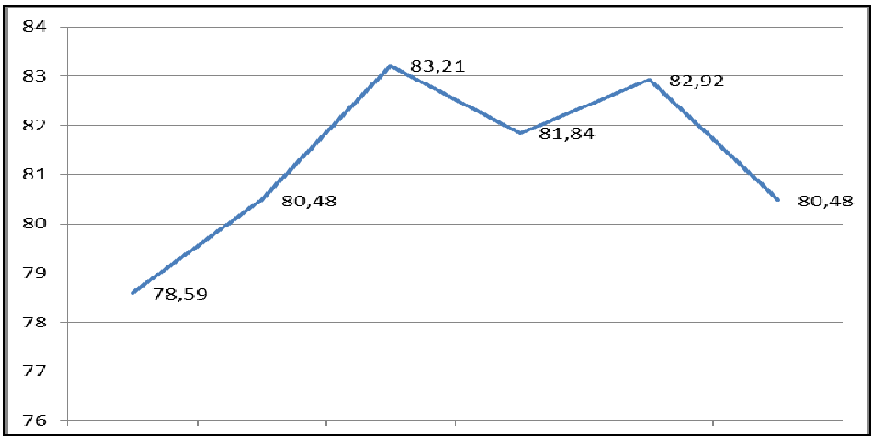

Figure 5: Distribution of RR 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

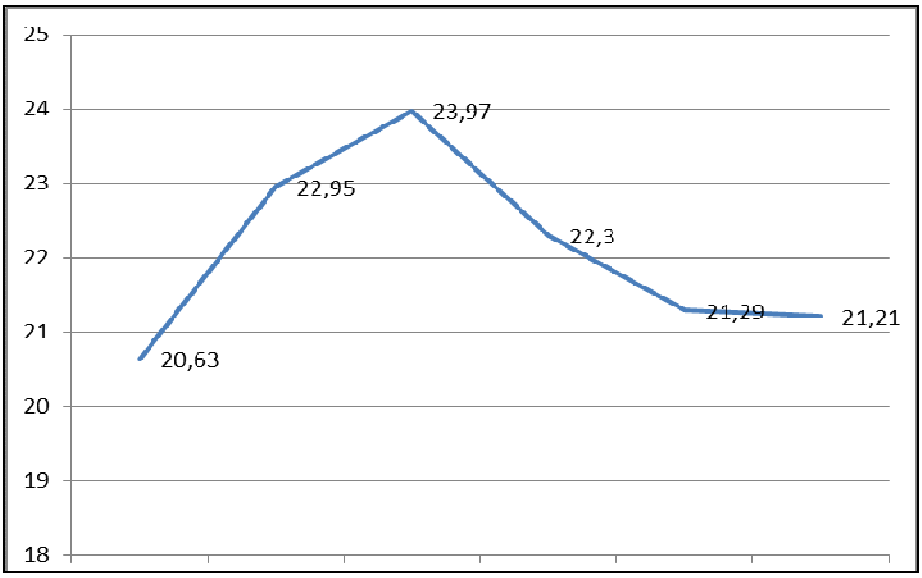

Figure 6: Distribution of aO_2Sat 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

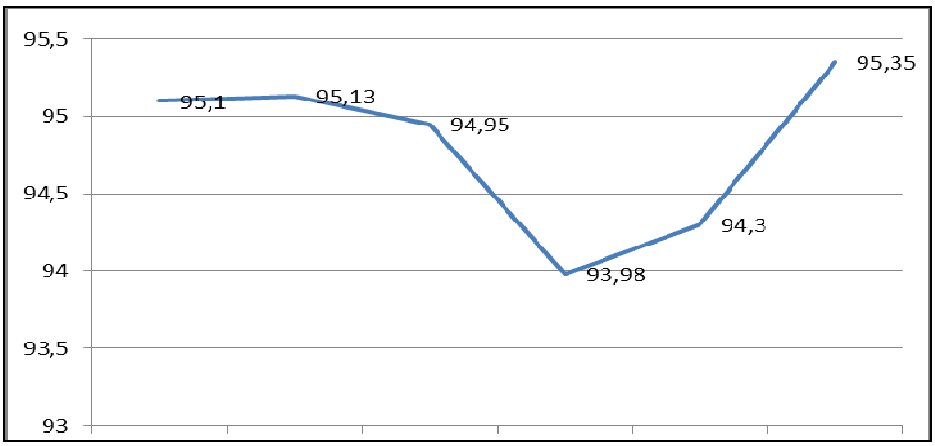

Table 1. Compare Physiological Parameters 1 hour before, right before, just right at the end, 20, 40 and 60th minutes after the end of MBP

Variables	1hour before	Just Before	Just Right At the end	20th min	40th min	60th min	P value One-way ANOVA
BT*	36.57±.46	36.55±.48	36.51±.44	36.46±.42	36.44±.41	36.39±.44	p <0.001
SBP**	130.84±23.13	133.75±21.80	135.21±23.02	132.56±21.08	130.11±21.13	128.83±24.10	p <0.001
DBP**	76.51±12.01	78.44±12.11	79.35±14.36	77.98±12.90	76.92±12.75	75.83±13.86	p <0.001
PR***	78.59±14.68	80.48±14.97	83.21±15.69	81.84±14.72	82.92±16.61	80.48±16.01	p <0.001
RR****	20.63±3.81	22.95±4.97	23.97±5.53	22.30±4.73	21.29±4.10	21.21±5.46	p <0.001
aO_2Sat*****	95.10±2.42	95.13±2.26	94.95±2.25	93.98±11.13	94.30±7.89	95.35±2.17	p <0.001

* °C ** mmHg *** beats/min **** breaths/min ***** %

Futhermore, mean PR right after MBP increased 2.75 beats/per minutes compare just before MBP. Likewise, mean PR 20 and 40th minutes after MBP increased 1.28 and 2.23 beats/per minutes and 60th minute after MBP decreasd 0.21 beats/per minutes compared just before MBP. (Figure 4) Mean respiratory rate just before and right after MBP increased 2.42 and 3.40 breaths/minutes compared 1 hour before MBP. Likewise, mean RR right after MBP increased 0.98 breaths/minutes compare just before MBP. However, mean RR 20, 40, and 60th minutes after MBP decreased 0.76, 1.79 and 1.85 breaths/minutes compared just before MBP. (Figure 5) Mean aO2Sat right after MBP decreased 0.14 and 0.15 % compared 1 hour before and just before MBP. Likewise, mean aO2Sat 20 and 40th minutes after MBP decreased 1.14 and 0.78 % compared just before MBP. Mean aO2Sat 60th minute after MBP increased 0.23 % compared just before MBP.(Figure 6) According to the results of One-way ANOVA with repeated measures test all of the physiological parameters changed significantly when comparing measurements over time, from 1 hour before MBP to 60th minute after the MBP in preoperative period ($p<0,05$). (Table 1)

Discussion

The benefit of MBP before colorectal surgery has been debated over the last decade. Nevertheless, MBP is routinely done before colorectal surgeries. The concept of MBP prior to surgery has many attractions such as decrease intraoperative contamination of the peritoneum and wound by reducing total number of intestinal bacteria, may prevent mechanical disruption of the anastomosis and improve handling of the bowel during surgery by reducing the amount of solid faeces (Fanning, & Valea, 2011; Platell, & Hall,1998). Enhanced Recovery After Surgery (ERAS) pathways were developed with the goal of maintaining normal physiology in the perioperative period, thus optimizing patient outcomes without increasing postoperative complications or readmissions. Evidence that preoperative mechanical cleansing of the bowel improves surgical outcomes is limited (Acog, 2018).As a result of MBP, peristaltism of the smooth muscles in the intestine and increase of mesentric blood circulation in gastrointestinal system due to stimulation of parasympathetic nervous system (Babaoglu, 2008; Ilgi, & Konan, 2013). MBP has adverse physiological effects attributed to dehydration, is distressing for the patient and postoperative complications can be occur in associated with spillage of bowel contents (Gustafsson et al., 2013). At present study, increase of systolic/dastolic blood pressure, pulse and respiratory rate and decrease of aO2Sat just right after MBP can be depended on increase of left ventricular workload activity of sympathetic system in left-lateral position and maybe patients anxiety. Gravity affects oxygen transport 40 and might exert an increased workload on cardiac function when the left lateral position is assumed. A larger workload required in the left lateral position will produce more sympathetic and less vagal activity (Chen, & Kuo, 1997; Ryan, Larsen, & Galletly, 2003). The results of a study to evaluate oxygen saturation values in different body positions showed that the mean oxygen saturation value an upright position was higher than supine or lying on the right/left side position (Ceylan, Khorshid, Gunes, & Zaybak, 2016), but Jones & Dean (2004) study results showed that oxygen saturation did not change with changes in position (Jones, & Dean, 2004).

Decrease in body temperature just right after MBP could be related to the factors such as patients eld and the blood circulation tend to gastrointestinal system. It is thought decrease in body temperature, systolic/diastolic blood pressure, pulse and respiratory rate and aO2Sat 20th minute after the end of MBP depended on parasympathetic nervous system stimulation and tend of blood circulation to gastrointestinal system. In 40 and 60th minutes after the MBP, decrease in systolic/diastolic blood pressure is related to the dehydration depended on bowel contents evacuation following 8-10 minute after MBP, but pulse and respiratory rate and aO2Sat similarity or close to the rates before the MBP could be depended on semi-fowler's position after MBP and body compensation mechanism versus parasympathetic nervous system. The results of a study showed the hazardous physiological effects of bowel preparartion preparates depend on dehydration (Holte, Nielsen, Madsen, & Kehlet, 2004). In Severge randomized prospective study to compare effects of soydum fosfat and senna sorbitol on colon cleaning before colonoscopy, no important difference observed in vital paramteres, however, senna sorbitol provides better colon cleaning specially in left colon and changes in the electrolytes were less (Severge, 2009). In Askarpour et al. study an increase in body temperature, leucocytosis, hypernatremia, hypokalemia and bowel sonuds were observed. They suggested the use of normal saline instead of manittol in bowel preparation (Askarpour, Peyvasteh, Dastyar, & Javaherizadeh, 2013).At present study significant changes in physiological parameters did occur associated with MBP. Study results proved that disadvantage is gained by MBP before elective colorectal surgery in preoperative period.

Study Limitations: An important limitation of this study was the only one type bowel preparartion solution has been evaluated at present study. Another limitation was not inclusion of patients with use of inotropic/cardiotonic agents.

Recommendations for Clinical Practice: Carefully patients assessment before, during and after MBP will be of a benefit to clinicians in terms of quality of care, patients follow-up and surgical outcomes. The study results will be provide in develop evidence-base practice related on MBP in preoperative period.

Conclusion: MBP was followed by significant changes in physislogical parameters. Consequently, carefully monitoring of physiological parameters associated with MBP will be of a benefit to clinicians in terms of quality of care and patients follow-up. The study results will be provide in developing evidence-base practice related on MBP in preoperative period and patients outcomes in postoperative period. Future studies about patients outcomes in postoperative period depend on

physiological changes in term of MBP will be provided in the literarure.

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