

Mechanical bowel preparation prior to gynaecological laparoscopy enables better operative field visualization, lower pneumoperitoneum pressure and Trendelenburg angle during the surgery: a perspective that may add to patient safety

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Background: To find the effects of mechanical bowel preparation (MBP) on operative field visualization, and to measure pneumoperitoneum pressure (PP) and Trendelenburg inclination angle (TIA) values. **Methods:** In this two-centred, randomised, single-blind and controlled study, 90 patients who underwent laparoscopic gynaecological surgery for benign conditions were included. After the exclusions, 44 patients received MBP with oral sodium phosphate enema (study group) and 42 did not receive bowel preparation or underwent diet restrictions (control group). An objective visual index, PP and TIA were measured in a stepwise design of assessments. **Results:** The Visual Index at first inspection right after establishing a 12 mmHg PP and a standard 30° TIA was found to be significantly in favour of the study group ($p = 0.015$). The lowest reached TIA in standard 12 mmHg PP following stepwise decrease was observed as 15.2° and 25° in the study and control groups, respectively ($p < 0.001$). The lowest reached PP was 8.9 mmHg and 11.9 mmHg in the study and control groups, respectively ($p < 0.001$). Patients who received MBP reported significantly higher levels of negative discomfort measures ($p < 0.032$), however 80% of those reported MBP as acceptable. **Conclusion:** Significantly better operative field visualization, lower TIA and PP was achieved with MBP. MBP enabled a decrement of either 10° in TIA or 3 mmHg in PP with an adequate operative field to proceed safely for the benign gynaecological laparoscopic operations in exchange for acceptable discomfort for the patients.

Keywords

Laparoscopy; Mechanical bowel preparation; Pneumoperitoneum pressure; Trendelenburg angle

1. Introduction

Preoperative mechanical bowel preparation (MBP) has been routinely used for gynaecological laparoscopy, hypothetically to improve intraoperative bowel handling and visualization of the operative field [1–5]. The studies investigating the effect of MBP on gynaecological laparoscopy [1, 3, 6–

11] indicate that MBP has little or no benefit on improving the operative field visualization and intraoperative bowel handling. The methods used for the evaluation of those outcomes were subjective in the literature including 4/5/10-point Likert scales rated verbally as excellent to poor by the operating surgeons [1, 3, 6, 11–14].

Interestingly, a vast majority of the studies investigating the effects of MBP did not report the details of their anaesthesia method (e.g., agent used for neuromuscular block (NMB), depth of NMB, whether continuous infusion or intermittent bolus of neuromuscular blocking agent administration) and set values for pneumoperitoneum pressure (PP) and Trendelenburg inclination angle (TIA) clearly, which are independent factors that may alter the visualization of the operative field [3, 7, 9–11].

The main focus during the pneumoperitoneum insufflation should be to reach the adequate operative field at the lowest possible PP. High PP during laparoscopic operations has been associated with perioperative morbidity, and increase in PP is not correlated with better volume of operative field [15–18]. However, the use of a standard PP at between 12–15 mmHg throughout the surgical procedure remains as a common practice in the literature. On the other hand, a significant increase in pneumoperitoneum volume at a lower PP has been reported following preoperative use of MBP by reducing the bowel content in a porcine model.

Placing patients in Trendelenburg position is essential for laparoscopic procedures to free the pelvis from descending bowel loops and to improve the operative field. Trendelenburg positioning in combination with a pneumoperitoneum can substantially deteriorate cardiorespiratory function of the patient [19, 20]. Therefore, the degree of Trendelenburg should be well-adjusted to the minimum where the operative field is adequate to proceed safely. As similar to PP, using a

standard TIA throughout the surgical procedure has been a common practice in the literature [1, 8, 21–24]. The TIAs in those studies were usually between 25° and 40° and sometimes even steeper depending on the surgical condition that reflects the general practice for adjustments of PP values

This study aimed to test the null hypothesis that preoperative MBP does not affect the visualization of the operative field and does not enable lower TIA and PP values at a standardized method of anaesthesia.

2. Patients and methods

This two-centred randomised, single-blind and controlled study included a total of 90 eligible patients who underwent laparoscopic surgery for benign conditions. Patients were sequentially enrolled from April 2018 to September 2019 at two tertiary centres specialized in laparoscopic gynaecological surgeries.

Eligible patients were all non-pregnant women scheduled to undergo elective laparoscopy for various benign gynaecological conditions in a specific time period. Exclusion criteria were; inability to perform MBP, suspicion of malignancy, associated non-gynaecological surgical pathologies, severe endometriosis (stage \geq III according to the classification of the American Society for Reproductive Medicine) [25], history of previous abdominal surgery, and psychiatric disorders precluding consent.

Patients were randomized using a computer-generated block randomization sequence with allocation to receive either MBP with oral sodium phosphate (NaP) enema or no bowel preparation without any diet restrictions in a 1 : 1 ratio design performed via a series of sealed opaque envelopes. Patients were blinded to the allocation. Patients in the study group had only clear liquids after a normal breakfast and lunch on the day before surgery and subsequently fasted for 7–9 hours prior to surgery. Patients ingested the first dose of 45 mL NaP at 4 PM and a second dose at 8 PM in the evening before the scheduled surgery. Patients in the control group did not receive bowel preparation or diet restriction. The patients in this group only fasted for 7–9 hours prior to surgery. A priori power analysis was not possible at the time of the design of this RCT due to the novel measurement methods. Effect sizes and post-hoc power was calculated to determine the achieved power. Written informed consents were obtained from all participants. The institutional review board approved the study (No: 10997).

2.1 Surgical and anaesthesia technique

The surgical procedures were performed by a single surgeon under standardized general anaesthesia in both centres (private tertiary (U.K.), public tertiary (K.B.)). Preoperative surgical preparations have been performed by residents or qualified nurses and thus, surgeons were blind to bowel preparation status. Both surgeons are high-volume surgeons specialised in laparoscopic surgeries.

In all cases, the anaesthesia team maintained the degree of clinical relaxation as grade 4 (complete relaxation) all

through the operation by continuous infusion of neuromuscular blocking agent administration. Any shift of neuromuscular blockade from grade 4 was noted during the surgery, if it existed, to note the surgeon's attempt to increase PP or TIA for a better operative field.

The routine surgical techniques of the authors in performing gynaecological laparoscopy were as follows: after the patient was positioned on the operating table, the inclination of the table was ensured to be zero degrees, parallel to the ground. A mobile phone application (Protractor®, ExaMobile, Bielsko-Biala, Poland) was used to digitally measure the changes in the inclination of the operating table by degrees during the adjustments.

A direct entry laparoscopy technique was used. A 10 mm port was inserted through the umbilicus to introduce the laparoscope. The pneumoperitoneum was obtained with carbon dioxide insufflation (Endoflator®, Karl Storz, Tuttlingen, Germany) at an initial 12 mmHg. Additional ports depended on the type of surgery. After the laparoscope was introduced through the umbilical port, a left lateral port was inserted and the specific steps were performed for each patient to obtain an objective 'Visual Indexing' [8] to assess the visibility of the Douglas pouch and adnexa, to determine the lowest PP and TIA adequate to proceed with the planned surgery. The novel stepwise assessment method of the visibility of the operative field, lowest PP and lowest TIA is described in detail in Fig. 1.

Surgeons were free to proceed with the surgery by any combination of individualized PP and TIA values determined to be adequate for surgery in step 2 or 3 depending on which parameter would be more important for the patient's medical condition.

Type of operation, duration of surgery ("skin to skin"), intraoperative complications, shift of NMB to a lower grade and estimated blood loss were noted perioperatively. Blood loss was measured by an estimation of the amount of fluid aspirated during the operation.

2.2 Pre-operative assessment

Patients were interviewed in the preoperative holding area or in the patients' room by an independent researcher who was not related to the study. Patients were asked to evaluate the acceptability of the MBP (would you mind taking the same bowel preparation regimen prior to a future surgery? Point zero was: "I would absolutely refuse the surgery", point 10 was: "I would absolutely retake it") and the adverse pre-operative events (including nausea, insomnia, headache, thirst, weakness, tiredness, discomfort, abdominal cramps or slip disturbances) by using a 10 cm Visual Analogue Scale (VAS).

2.3 Post-operative assessment

The intensity of the postoperative pain was measured by an independent researcher at the 24th hour with a 10 cm VAS. Length of postoperative ileus was evaluated by asking the patient when they had recovered the ability to pass gas.

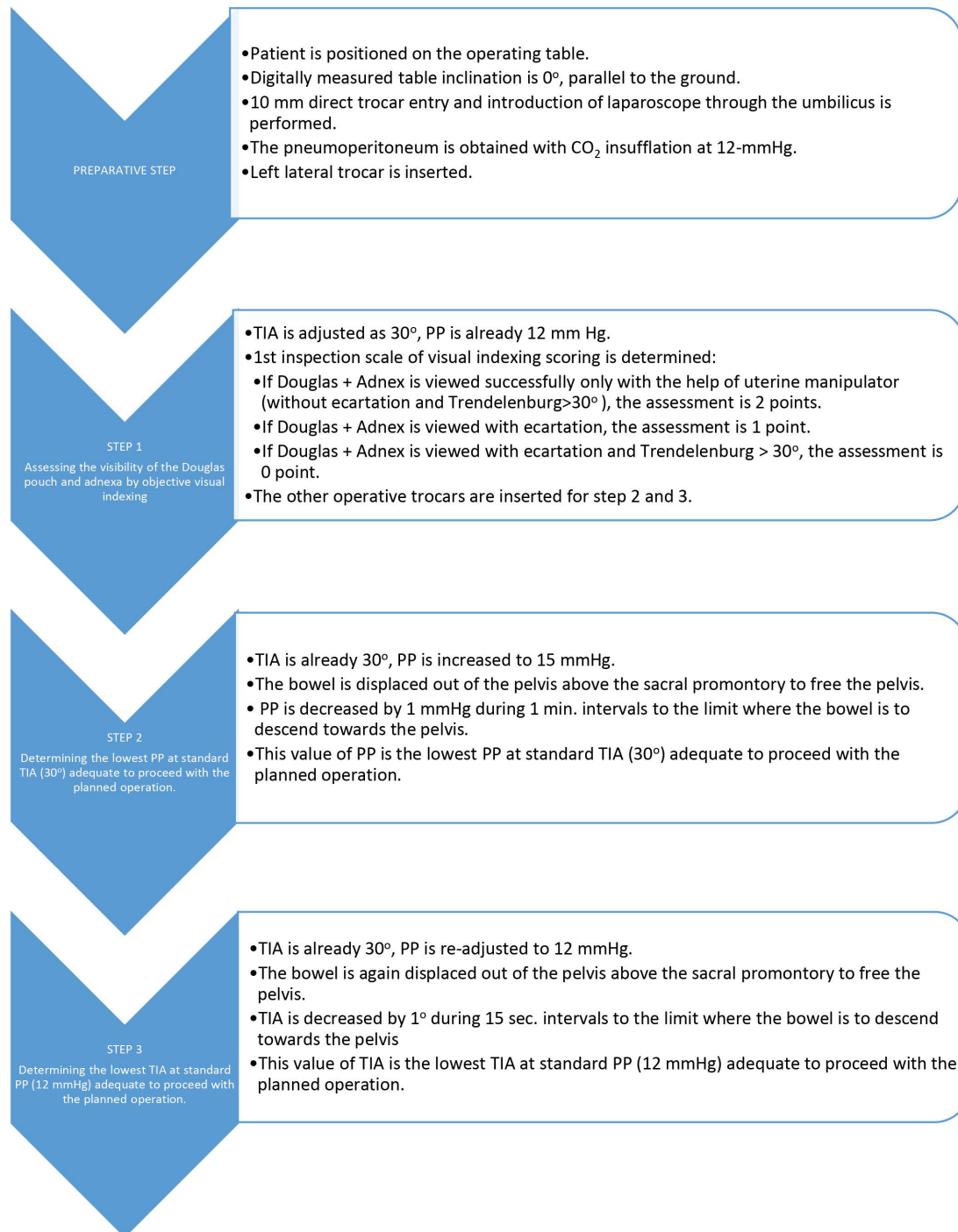


Fig. 1. The novel stepwise assessment method of the visibility of the operative field, lowest pneumoperitoneum pressure and lowest Trendelenburg inclination angle.

Duration of immediate postoperative ambulation, length of postoperative hospital stays (in total hours) and complications in postoperative 1st and 6th weeks were documented. Before hospital discharge, patients had to tolerate a normal diet, be able to dress themselves, be fully mobile, be analgesic free, and be satisfied that they could manage themselves at home.

The primary outcomes were the objective effects of MBP including the differences in; (i) Lowest PP enabling adequate operative field to proceed safely at standard TIA (30°); (ii) Lowest TIA enabling adequate operative field to proceed safely at standard PP (12 mmHg); (iii) The scores of '1st inspection' scale of the visual indexing, between the groups.

The secondary outcomes included the subjective effects of MBP including preoperative disturbances due to MBP, postoperative pain, length of postoperative ileus and hospital stay, duration of immediate postoperative ambulation and complications.

2.4 Statistical analysis

G*Power software version 3.1.9.4 was used to calculate post-hoc power for primary outcomes. Post-hoc statistical power of primary outcomes was assessed using G*Power v. 3.1.9.4 (Heinrich Heine University, Dusseldorf, Germany). The power analysis ($n = 86$) was found to be 89.3%, 100% and 100% at an alpha error of 0.05 with anticipating the difference of one unit (score, degree and mmHg for each related) as significant for Objective Visual Index, lowest degree and lowest pressure, respectively. Effect sizes were 0.38, 3.336 and 3.138 for primary outcomes, respectively. Data was analysed using SPSS (Windows version 16.0, SPSS Inc., Chicago, IL, USA), and all results were presented in mean \pm standard deviation, median (Interquartile range), or n (%). The statistical tests used for analysis are specified within the related tables. Values with $p < 0.05$ were considered to be statistically significant.

3. Results

Out of initial 90 patients, 4 were excluded from the analysis. Two were excluded due to requisite variation from the anaesthetic method, one due to inadequate documentation and one for technical measuring problems. A total of 86 patients were included in the final analysis. Types of endoscopic interventions can be seen in Table 1. Forty-four patients received MBP (study group) and 42 did not (control group). Age, BMI, parity, comorbidities, smoking status and indications for laparoscopic surgeries did not differ significantly between the two groups (Table 1). There were no conversions to laparotomy.

The Visual Index at the first inspection right after establishing a 12 mmHg PP and a standard 30° TIA was found significantly in favour of the study group ($p = 0.015$; Table 2). The visibility of the pouch of Douglas and adnexa without ecartation and Trendelenburg more than 30° (Score of 0) was possible in 38.6% and 16.7% of the patients in the study and control group, respectively.

The lowest reached TIA in standard 12 mmHg PP following stepwise decrease from 30° by 1° with 15 seconds intervals were observed in favour of MBP as mean values of 15.2° and 25° in the study and control groups, respectively ($p < 0.001$; Table 2, Fig. 2).

The lowest reached PP in standard 30° TIA following gradually decrease from 15 mmHg by 1 mmHg with 1 minute intervals were observed in favour of MBP as mean values of 8.9 mmHg and 11.9 mmHg in the study and control groups, respectively ($p < 0.001$; Table 2, Fig. 2).

Majority of the patients completed the bowel preparation regimen ($p = 0.512$; Table 2). Up to 80% of patients in the

study group expressed that they would not mind taking the same bowel preparation regimen prior to a future surgery, however, the rate was significantly lower than the control group ($p = 0.003$; Table 2).

The median VAS scores of the symptoms that can be related with the bowel preparation including nausea, insomnia, headache, thirst, weakness, tiredness, discomfort, abdominal cramps and sleep disturbances were shown in Table 3. Patients who received MBP reported significantly higher levels of negative symptoms in all measures when compared to the control group ($p < 0.032$; Table 3).

The shift of NMB from grade 4 was rare in both groups with 2 (4.5%) patients and 1 (2.4%) patient in the study and control groups, respectively ($p = 0.587$; Table 4). It has been reported that the surgeons encountered with the sudden interruption of their operative field caused by bowel descent fewer number of times in the study group than the control group, however a significant difference was not found between the two groups with 16% and 31%, respectively ($p = 0.101$; Table 4). The mean duration of the surgery was noted as comparable (55.5 versus 52.2 minutes, $p = 0.469$; Table 4). Intraoperative blood loss, the duration of postoperative ambulation, interval from the surgery until the first passage of flatus or stool, the intensity of the postoperative pain measured at the 24th hour and the length of postoperative hospital stay were statistically similar in both groups ($p > 0.05$; Table 4).

There were no postoperative complications in the 1st week in the study group while mild complications were seen in 4 (9.5%) patients who had not received MBP. However, it did not reach a significant difference ($p = 0.053$; Fisher's Exact Test). Those complications were wound infection at midline trocar site, umbilical wound infection, small cuff incision haematoma and cuff cellulitis. All were treated with proper antibiotics and recovered rapidly. There were no complications at postoperative 6th week in all patients.

4. Discussion

The present study provides evidence that MBP increased the visualization of the operative field and enabled a decrement of either 10° in Trendelenburg inclination angle or 3 mmHg in pneumoperitoneum pressure with an adequate operative field to proceed safely for the benign gynaecological laparoscopic operations.

MBP seemed less appealing to surgeons after emerging evidence that it did not reduce the bacterial load and peritoneal contamination [2], and subsequently fell from popular esteem in gynaecological surgeries [26, 27]. However, the major data was extrapolated from colorectal surgeries [2, 14, 21], and robust data specifically for gynaecological laparoscopy are lacking [1, 3–11]. Moreover, visualisation of operative field and intraoperative bowel handling in the existing studies were predominantly measured subjectively by the attending surgeons without using a standardized scale [1, 3, 6, 11–14]. An objective visual indexing based on anatomical landmarks

Table 1. Demographic characteristics and surgical features of the cohort.

	Bowel prep (n = 44)	No prep (n = 42)	p
Age (years)	41 ± 10.66	40.07 ± 10.74	0.688 ^a
BMI (kg/m ²)	26.29 ± 3.66	25.73 ± 3.45	0.472 ^a
Parity (n)	2 (1)	1 (2)	0.179 ^b
Systemic diseases	8 (18.2%)	4 (9.5%)	0.397 ^c
Smoking	7 (15.9%)	10 (23.8%)	0.516 ^c
Type of surgery			
Abdominal intrauterine device extraction	1 (2.3%) [‡]	0 (0%) [‡]	
Cystectomy	5 (11.4%) [‡]	6 (14.3%) [‡]	
Cystectomy + myomectomy	1 (2.3%) [‡]	0 (0%) [‡]	
Diagnostic + ovarian drilling	3 (6.8%) [‡]	2 (4.8%) [‡]	
Myomectomy	7 (15.9%) [‡]	5 (11.9%) [‡]	
Pectopexy	1 (2.3%) [‡]	1 (2.4%) [‡]	
Pectopexy + uterosacral ligamentopexy	1 (2.3%) [‡]	1 (2.4%) [‡]	
Salpingectomy	2 (4.5%) [‡]	4 (9.5%) [‡]	
Salpingo-oophorectomy	1 (2.3%) [‡]	2 (4.8%) [‡]	
Subtotal H.	0 (0%) [‡]	1 (2.4%) [‡]	
Subtotal H. + sacrocolpopexy	1 (2.3%) [‡]	0 (0%) [‡]	
Subtotal H. + BSO	0 (0%) [‡]	1 (2.4%) [‡]	
Subtotal H. Burch	1 (2.3%) [‡]	0 (0%) [‡]	
Subtotal H. pectopexy	1 (2.3%) [‡]	0 (0%) [‡]	
Subtotal H. + sacrocolpopexy	3 (6.8%) [‡]	2 (4.8%) [‡]	
Subtotal H. + uterosacral ligamentopexy	1 (2.3%) [‡]	0 (0%) [‡]	
TLH	1 (2.3%) [‡]	1 (2.4%) [‡]	
TLH + BSO	9 (20.5%) [‡]	11 (26.2%) [‡]	
TLH + sacrocolpopexy	1 (2.3%) [‡]	1 (2.4%) [‡]	
Tubal ligation	4 (9.1%) [‡]	4 (9.5%) [‡]	

Data are shown in mean ± standard deviation, median (Interquartile range), or n (%).

^aIndependent Samples Test; ^bMann-Whitney U Test, Monte Carlo simulation; ^cPearson Chi-square test, continuity correction; [‡]Each denotes a subset of group (Bowel or No preparation) categories whose column proportions do not differ significantly from each other at the 0.05 level.

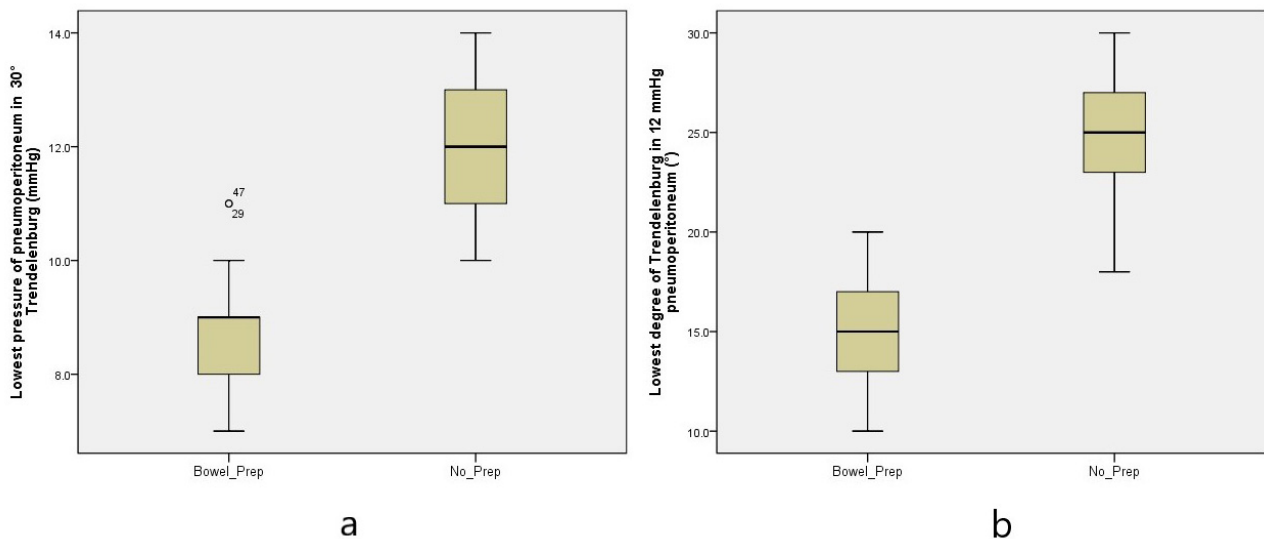


Fig. 2. The obtained lowest pressure of PP in a standard TIA and lowest degree of TIA in a standard PP. (a) The obtained lowest pressure of pneumoperitoneum in a standard Trendelenburg inclination angle. (b) The obtained lowest degree of Trendelenburg inclination angle in a standard pneumoperitoneum pressure. Patients who had preoperative mechanical bowel preparation are presented at left.

Table 2. Primary outcomes of the study.

	Bowel prep (n = 44)	No prep (n = 42)	p
The Visual Index at first inspection (Bakay <i>et al.</i> 2017 [8])	2: 17 (38.6%) [‡] 1: 20 (45.5%) [‡] 0: 7 (15.9%) [‡]	2: 7 (16.7%) [‡] 1: 18 (42.9%) [‡] 0: 17 (40.5%) [‡]	0.015 ^{a,*}
Lowest degree of Trendelenburg in 12 mmHg pneumoperitoneum (degree)	15.23 ± 2.76	25.02 ± 3.10	<0.001 ^{b,*} Mean difference: -9.80 (95% CI: -11.05-8.54)
Lowest pressure of pneumoperitoneum in 30° Trendelenburg (mmHg)	8.86 ± 0.85	11.91 ± 1.08	<0.001 ^{b,*} Mean difference: -3.04 (95% CI: -3.46-2.63)
Could you complete the regimen? (yes/no)	Yes: 43 (97.7%)	Yes: 42 (100%)	0.512 ^c
Willingness to retake the same preparation method prior to a future surgery (yes/no)	Yes: 35 (79.5%)	Yes: 42 (100%)	0.003 ^{c,*}

^aPearson Chi-Square test; ^bIndependent Samples Test; ^cFisher's Exact Test; [‡]Each denotes a subset of group (Bowel or No preparation) categories whose column proportions do not differ significantly from each other at the 0.05 level.

*Statistically significant at 0.05 level.

Table 3. Postoperative VAS Scores of discomfort.

	Bowel prep	No prep (Control)	p ^a	U	Z
Nausea	3 (1)	1 (2)	<0.001*	106.5	-7.21
Insomnia	3 (1.8)	2 (1)	0.002*	584	-3.04
Headache	1.5 (2.8)	1 (2)	0.032*	684.5	-2.14
Thirst	2 (2)	1 (2)	0.001*	543	-3.40
Weakness	3 (1)	1 (2)	<0.001*	304	-5.51
Tiredness	3 (1)	1 (2)	<0.001*	286	-5.66
Discomfort	3 (1.8)	1 (2)	<0.001*	223.5	-6.16
Abdominal cramps	3 (2)	0 (2)	<0.001*	205.5	-6.39
Sleep disturbances	1 (2)	0 (0)	<0.001*	498.5	-4.12

Data are shown in median (Interquartile range).

^aMann-Whitney U test.

*Statistically significant at 0.05 level.

[8] was used in the present study to assess the effect of MBP on operative field visualization.

Our results were found to be in favour of MBP in terms of significantly better operative field visualization, lower TIA and PP. Mechanical bowel preparation did not negatively influence the perioperative and postoperative surgical outcomes and did not cause the need of alteration in the anaesthesia method during the surgery.

For the gynaecological laparoscopy, optimal visualization of the operative field is the primary matter for the safety of the operation as the bony pelvis is small and relatively not expandable. Thus, any intervention improving operative field visualization contributes to the safety of the operation. Among the studies assessing the effect of MBP before gynaecological laparoscopy [1, 3, 5-11], only Won *et al.* [1] reported a less but significant improvement in operative field visualization in the group receiving MBP. We believe that their clinical significance could have been prominent with more objective assessment methods. An animal study by Vlot *et al.* [28], reported a significant increase in pneumoperitoneum volume at lower PP following the use of preoperative MBP.

In the current study, MBP was found to be associated with poor preoperative patients' complaints when compared to the patients without preoperative MBP, however the overall VAS scores ranged between 1 and 3. We believe that it has no or little clinical relevance since VAS scores below 4 were attributed as mild in the literature [29]. Moreover, the majority of the patients (98%) reported to complete the regimen and most of them (80%) expressed that they would not mind to take the same bowel preparation regimen prior to a future surgery.

The effect of TIA and PP on the safety of laparoscopic procedures is an important issue. The setting of 25°-40° of TIA and 12-15 mmHg of PP is stated in the vast majority of the literature referred in this study [1, 8, 21-24, 30, 31] and it is very rare to see any implication other than those values, however, we believe that this approach may cause morbidities especially for patients with obesity and/or chronic systemic diseases. It was reported that high PP during the laparoscopic procedures was associated with perioperative morbidity [15-18]. Moreover, steep TIA in combination with a high PP deteriorates cardiorespiratory function and can lead to a decrease in functional residual capacity and respiratory compli-

Table 4. Peri- and post-operative outcomes.

	Bowel prep	No prep	<i>p</i>	U	Z
The need of change in neuromuscular blockade during the surgery (times)	0 (0), [0–1]	0 (0), [0–1]	0.587 ^a	904	–0.544
No, n (%)	42 (95.5%)	41 (97.6%)			
One time, n (%)	2 (4.5%)	1 (2.4%)			
The count of interruption by bowel during the operation	0 (0), [0–1]	0 (1), [0–1]	0.101 ^a	785	–1.641
No, n (%)	37 (84.1%)	29 (69%)			
One time, n (%)	7 (15.9%)	13 (31%)			
Operation time, skin to skin (mins)	55.45 ± 23.16	52.24 ± 20.42	0.469 ^b		
Intraoperative blood loss (mL)	128.07 ± 77.01	127.74 ± 78.48	0.668 ^b		
Time of ambulation postoperatively (hours)	5.59 ± 1.11	5.67 ± 0.90	0.578 ^a	864	–0.556
Length of postoperative ileus (hours)	14.5 ± 4.71	13.62 ± 4.84	0.391 ^a	825	–0.858
Postoperative pain (VAS)	3 (1), [2–6]	4 (1), [2–6]	0.263 ^a	799	–1.120
Length of postoperative hospital stay (days)	2 (1), [1–3]	2 (1), [1–3]	0.716 ^a	886	–0.364

Data are shown in n (%) and median (Interquartile range), [minimum–maximum] or mean ± standard deviation.

^aMann-Whitney U test; ^bIndependent Samples Test.

ance, with an increase in respiratory resistance and impairment of arterial oxygenation [19, 20]. It was shown that intraocular pressure increases in steep Trendelenburg resulting in the potential for ocular complications such as corneal abrasion and ischemic optic neuropathy [32–34]. Intraoperative peripheral nerve injuries are rare, but occasionally serious when related to lithotomy positioning with steep Trendelenburg [35–37]. Therefore, instead of using constant steep TIA and high PP pairs in laparoscopic procedures, they should be adjusted individually for each case to an extent where the operative field is adequate to proceed safely with the planned operation. Our results revealed that MBP before benign gynaecological laparoscopy allows significantly lower TIA and PP values to be set, thus may enhance the patient safety especially for the high-risk cases with concomitant obesity, systemic diseases or with a longer surgical time. We believe that this novel perspective is more objective, and provides an objective and standardized understanding for assessing the effects of MBP in surgical convenience and safety of laparoscopic procedures. Selective bowel preparation is recommended in the current Enhanced Recovery After Surgery (ERAS) approach [38]. The surgeries that particularly needs attention for surgical safety may likely benefit from our novel perspective regarding MBP.

We believe that the indication of the surgery may not be directly related to measured parameters since a strict criterion was used for visualisation as displacement of bowels below sacral promontory. However, a larger sample size and standardization may be beneficial with regard to comparing complications between the groups. The use of MBP did not significantly affect the recovery of bowel functions following surgery in this study. Further studies are needed to verify these issues. The role of diet was not entirely investigated in this study. A future randomized controlled trial (NCT: 04400669) is planned to overcome this limitation with an aim

to assess the effect of MBP, regime of 3-day low fibre diet, 3-day low fibre diet plus MBP, and no MBP/regimen on TIA, PP and visualization of operative field in benign gynaecological laparoscopy.

5. Conclusions

We proposed a body of techniques that contributes to patients' safety and enhances the visualization of operative fields during benign gynaecological laparoscopy. Significantly better operative field visualization, lower Trendelenburg inclination angle and pneumoperitoneum pressure was achieved by mechanical bowel preparation before benign gynaecological laparoscopy in exchange for acceptable discomfort for the patients without leading to any potential harm.

Abbreviations

MBP, mechanical bowel preparation; NaP, sodium phosphate; NMB, neuromuscular block; PP, pneumoperitoneum pressure; TIA, Trendelenburg inclination angle; VAS, visual analogue scale.

Author contributions

ÜK and KB conceived and designed the experiments. ÜK and KB performed the experiments. ÜK, MY and ŞH analyzed the data. ÜK, KB, MY and ŞH wrote the paper.

Ethics approval and consent to participate

Written informed consent was obtained from all participants. The institutional review board approved the study (No: 10997).

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Conflict of interest

The authors declare no conflict of interest. ŞH is the Editorial board member of this journal, given his role as Editorial board member, ŞH had no involvement in the peer-review of this article and has no access to information regarding its peer-review.

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