# A Full Enhanced Recovery After Surgery Program in Gynaecologic Laparoscopic Procedures: A Randomized Controlled Trial

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**Abstract**

Objective To assess whether a full enhanced recovery after surgery (ERAS) program can further reduce perioperative outcomes among patients undergoing gynaecologic laparoscopic procedures relative to those undergoing limited ERAS management. Design Single-center, open-label, randomized trial. Setting A tertiary hospital, China: December 2018 to October 2019. Population One hundred and forty-four women scheduled for an elective simple gynaecologic laparoscopic surgery. Methods Patients were randomized into two groups: full ERAS intervention or limited ERAS management. Primary outcome Postoperative length of stay (LOS). Results Postoperative LOS for the full ERAS program showed a 1-day reduction in comparison to the limited ERAS group (median of 1.0 day versus 2.0 days, respectively; P = .002). Multivariate regression analysis identified preoperative carbohydrate loading and opioid-sparing analgesia as the independent factors for discharging on postoperative day (POD) 1. Patients in the full ERAS program reported less postoperative pain within 72 hours postoperatively and had a lower narcotic consumption rate compared with those in the limited ERAS management. They also enjoyed better and faster recovery as demonstrated by the QoR-15 scale on POD 3: median of 137.0 for full ERAS program versus 130.0 for limited ERAS management, respectively (P = .020). There were no significant differences between groups regarding postoperative complication rate, readmission rate, or in-hospital cost. Conclusion The addition of full ERAS management can further reduce postoperative length of stay and improve patients' quality of life after laparoscopic surgery for gynaecologic diseases. Keywords enhanced recovery after surgery, perioperative management, gynaecologic laparoscopic surgery, length of stay.

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*The authors report no conflicts of interest.*

**Running head:** ERAS in Gynaecologic Laparoscopic Surgery

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**Objective**To assess whether a full enhanced recovery after surgery (ERAS) program can further reduce perioperative outcomes among patients undergoing gynaecologic laparoscopic procedures relative to those undergoing limited ERAS management.

**Design** Single-center, open-label, randomized trial.

**Setting** A tertiary hospital, China: December 2018 to October 2019.

**Population** One hundred and forty-four women scheduled for an elective simple gynaecologic laparoscopic surgery.

**Methods** Patients were randomized into two groups: full ERAS intervention or limited ERAS management.

**Primary outcome** Postoperative length of stay (LOS).

**Results** Postoperative LOS for the full ERAS program showed a 1-day reduction in comparison to the limited ERAS group (median of 1.0 day versus 2.0 days, respectively; $P = .002$). Multivariate regression analysis identified preoperative carbohydrate loading and opioid-sparing analgesia as the independent factors for discharging on postoperative day (POD) 1. Patients in the full ERAS program reported less postoperative pain within 72 hours postoperatively and had a lower narcotic consumption rate compared with those in the limited ERAS management. They also enjoyed better and faster recovery as demonstrated by the QoR-15 scale on POD 3: median of 137.0 for full ERAS program versus 130.0 for limited ERAS management, respectively ($P = .020$). There were no significant differences between groups regarding postoperative complication rate, readmission rate, or in-hospital cost.

**Conclusion** The addition of full ERAS management can further reduce postoperative length of stay and improve patients' quality of life after laparoscopic surgery for gynaecologic diseases.

**Funding Statement** This was a self-financing study and there are no financial interests to report.

**Keywords** enhanced recovery after surgery, perioperative management, gynaecologic laparoscopic surgery, length of stay.

**Tweetable abstract** A full enhanced recovery program can further improve perioperative outcomes in gynaecologic laparoscopic procedures compared with limited enhanced recovery management.

**Clinical trial registration** Chinese Clinical Trial Registry, www.chictr.org.cn, ChiCTR1800019066.

## Introduction

Enhanced recovery after surgery (first introduced by Danish anesthetist Henrik Kehlet in 1997) is a range of optimized, perioperative management approach throughout a patient's stay in the hospital—including extensive preoperative counseling, without bowel preparation, preoperative carbohydrate loading, multimodal analgesia, minimally invasive surgery, adequate perioperative fluid infusion, maintenance of normothermia, early postoperative feeding, and ambulation. These steps aim to mitigate the surgical stress response and accelerate postoperative recovery and not compromise morbidity or the readmission rate. Initially used in colorectal surgery, enhanced recovery after surgery (ERAS) has now been widely adopted for multiple abdominal procedures, including gynaecologic operations.[1] The implementation of ERAS in both benign and malignant gynaecologic services has showed positive results, including a 1- to 2-day reduction in length of stay (LOS) for all approaches, a 20.8% to 97.4% drop in narcotic use, and a 9.25% to 21.7% reduction in the average hospital cost, without compromising mortality or the readmission rate.[2]

Another unprecedented intervention during the last two decades—the laparoscopic approach—has proven its superiority over laparotomy and is considered to be a key element in an ERAS program. ERAS combined with laparoscopic techniques in colorectal surgery was also associated with shorter hospital stay, a lower postoperative complication rate, and reduced hospital costs.[3]

However, a large majority of randomized controlled trials (RCT) on ERAS in the case of gynaecologic surgery have only included patients undergoing an open abdominal approach, and there is a paucity of evidence regarding the potential benefits of an ERAS program in laparoscopic surgery.[4-10] The possible overlap of benefits between an ERAS program and laparoscopy has raised the question of whether the combination of the two interventions further improves the perioperative outcomes, particularly for those patients undergoing simple procedures (i.e. laparoscopic ovarian cystectomy, myomectomy, and hysterectomy, etc.) who might already have achieved a faster recovery.

In addition, a full ERAS program contains more than 20 different items, and implementing those components can be demanding. The gynaecologic service at our hospital has already embraced some of the ERAS concepts, including early catheter removal, feeding, ambulation, and most importantly, a laparoscopic approach—which collectively constitutes the so-called "limited ERAS pathway." This simplified ERAS management has become the standard of care at many medical centers. However, the lack of data with which to evaluate each component of the pathway makes it difficult to determine the critical elements that benefit the outcomes.[11]

In the present single-center, open-label, randomized trial, we aimed to determine which form of perioperative treatment—either a full or limited ERAS program combined with simple laparoscopic procedures—was the optimal approach for patients in gynaecology department; and to identify which elements of ERAS were critical for an improved perioperative outcome.

## Materials and methods

### Ethics approval and registration

The present study was approved by the Institutional Review Board of the Peking Union Medical College Hospital, Chinese Academy of Medical Science (date of approval: 28 August 2018; reference number: ZS-1678), and was conducted in accordance with the principles of the Declaration of Helsinki and the CONSORT statement—as well as the RECOvER Checklist requirement.[12] This trial was registered with the Chinese Clinical Trial Registry (www.chictr.org.cn), before the first patient's enrollment (ChiCTR1800019066).

### Participants and eligibility

The trial Patients who presented to the Peking Union Medical College Hospital between December 2018 and September 2019 were screened by gynecologists and anesthesiologists for recruitment into the trial. Individuals 18–65 years of age were eligible if they met the following criteria: (1) had had an elective gynaecologic laparoscopic surgery in the form of simple procedure (defined as cystectomy or myomectomy or hysterectomies +/-bilateral salpingo-oophorectomy); (2) were designated under ASA classification I–II; and (3) provided signed informed consent. The exclusion criteria included (1) a preoperative albumin blood concentration $< 30$ g/L; (2) weight loss $> 10\%$ during the 6 months preceding surgery; (3) having undergone emergency surgery; (4) and manifesting nonsteroidal anti-inflammatory drug (NSAID) contraindications that included peptic ulcer, a history of allergic reactions to NSAIDs; and aspirin-induced asthma.

### Randomization

The trial was designed by means of a stratified block randomization (1:1) that was balanced regarding the surgical options: laparoscopic ovarian cystectomy, laparoscopic myomectomy, and total laparoscopic hysterectomy. We performed the randomization using a computer-generated random sequence concealed in opaque envelopes to minimize selection bias. Patients were allocated to receive either full ERAS perioperative intervention or limited ERAS management.

### Intervention

Interventions in both groups are detailed in Table S1. Briefly, patients were randomized into an intervention group that was characterized by education in a full ERAS program, with reduced preoperative fasting (including their last meal 6 hours before surgery and carbohydrate drink intake [300 mL or 5 mL/kg] 2 hours before surgery), omission of mechanical bowel preparation (MBP) unless low anterior resection was planned, avoiding pre-anesthetic medication, preoperative analgesia, total intravenous anesthesia (TIVA),

bispectral index (BIS) monitoring, restricted intraoperative fluid infusion, intravenous infusion of lidocaine, maintenance of normothermia, prophylaxis of postoperative nausea and vomiting (PONV) using ondansetron combined with dexamethasone, opioid-sparing multimodal analgesia prescribed on a scheduled basis, catheter removal and extensive ambulation, and oral intake starting on postoperative day (POD) 0.

Patients allocated to the control group had limited ERAS program counseling, complete preoperative fasting with their last meal by midnight the day before surgery, no strict restrictions on MBP or preanesthetic medication, intravenous-inhalation combined anesthesia, restricted intraoperative fluid infusion, intravenous infusion of lidocaine, maintenance of normothermia, prophylaxis of PONV using ondansetron combined with dexamethasone, catheter removal and progressive ambulation, oral intake starting on POD 1, necessary NSAID prescription, and opioids used for rescue or breakthrough pain.

The design and implementation of the ERAS program at our center was begun nearly a year before trial initiation. Meetings were held every 2 weeks among the multiple disciplines involved to guarantee compliance to the protocol. The influence of the surgeon was minimized by limiting the performance of all surgical cases to two operating surgeons.

**Outcome measures**

The primary outcome was postoperative LOS defined as whole days from the day of surgery until discharge. According to China's medical insurance policy, reimbursement can only be made if the LOS is more than one day, therefore, same day discharge has not yet become routine practice in our hospital. To adjust for the potential impact of the insurance policy and other nonmedical variables (i.e. social problem, patients' concern, etc.) on LOS, a theoretical LOS was introduced, using the theoretical day of discharge, defined as the postoperative day when patients met the following predefined criteria: adequate pain control with oral analgesics, absence of vomiting or severe nausea, absence of body temperature [?] 37.5degC, tolerance of solid food, and ambulation as preoperative.

Secondary outcomes included a numerical rating scale (NRS) score for postoperative pain, time to first flatus, simplified PONV impact scale score as previously described,[13] postoperative 30-day complication (defined as any postoperative 30-day or in-hospital complication, according to the Clavien-Dindo classification)[14], quality of life, readmission rate, and in-hospital cost. Quality of life was assessed on POD 3 with a Chinese-validated version of the Quality of Life-15 (QoR-15) questionnaire.[15]

We collected data via a secure dedicated website, and during hospitalization medical and nursing staff reported daily on patient status. The predefined discharge criteria were scored daily by an independent doctor blinded to group. Patients were systematically followed at an outpatient clinic and were evaluated for any complications or readmission occurring after discharge within 30 days of the operation.

**Sample size calculation**

Using a 5% significance level, a sample size of 64 for each group was calculated to ensure a power of 90% and to detect a difference of 1 day in postoperative LOS between the two groups. Taking a 20% drop-out rate into account, we ultimately determined 72 cases per arm of our study. Intention-to-treat analysis was conducted for all of the included patients after randomization. The per-protocol analysis was also performed.

**Statistical analysis**

Quantitative data were described as means +- 1 standard deviation or as medians and interquartile ranges (IQR), where appropriate. Normally distributed quantitative data were analyzed using the Student's $t$ -test; otherwise we used a Mann–Whitney U test. We presented qualitative data as numbers (percentages) and analyzed them by $\chi^2$ test or Fisher's exact-probability test. Multivariate logistic regression analysis was used to assess the effect of the full ERAS-program elements both on primary and secondary outcomes. A two-sided $P$ value $< .05$ was considered to be statistically significant. All of the analyses were performed using SPSS for Windows version 16.0 (SPSS Inc., Chicago, IL, USA).

**RESULTS**

**Recruitment**

Between December 2018 and October 2019, a total of 397 women referred to the Peking Union Medical College Hospital were screened for eligibility. 243 women did not meet the inclusion criteria, and 10 women declined to participate in the trial. Of the 144 eligible women, 72 were randomly assigned to the intervention group and 72 to the control group (Fig. 1). Baseline characteristics of the two groups did not differ significantly (Table 1). Three patients withdrew their informed consent and 5 patients did not undergo eligible surgery. One patient with endometrial carcinoma allocated to control group had laparoscopic surgical staging instead of laparoscopic hysterectomy given the suspected myometrial invasion indicated by MR imaging. In addition, one laparoscopic myomectomy in the controlled group was converted to transabdominal hysterectomy due to intraoperative hemorrhage. After randomization, 67 women in the intervention group and 69 women in the control group completed their surgical procedures and received corresponding perioperative management (per-protocol analysis, Appendix S1).

Protocol compliance in both the groups is presented in Table 2. The compliance regarding key elements of the full ERAS program was significantly higher in the intervention group than in the control group.

**Primary outcome**

Postoperative LOS in the intervention arm was significantly shorter than in the control group (practical postoperative LOS, median, 1.0 day for the full ERAS group versus 2.0 days for the limited ERAS group; $P$= .002; theoretical postoperative LOS, median, 0.0 day for the full ERAS group versus 1.0 day for the limited ERAS group; $P$ = .024) (Table 3). Multivariate regression analysis identified absence of opioid consumption (B =8.96; 95% CI,1.23–65.19; $P$ = .030) and preoperative carbohydrate loading (B = 5.99; 95% CI, 0.98–36.83;$P$ = .010) as independent factors with respect to discharge on POD 1.

Of note, regarding the subgroup of myomectomy and hysterectomy procedures, practical LOS was significantly shorter in the full ERAS group, than in the limited ERAS group [myomectomy: 1.0 day (1.0–1.75) versus 2.0 days (1.0–3.0), respectively ($P$ = .040); hysterectomy: 1.0 day (1.0–1.0) versus 2.0 days (1.0–2.0), respectively ($P$ = .021)], but no difference was observed regarding theoretical LOS (Table S2).

**Secondary outcomes**

We observed no significant differences between the two groups regarding duration of the operation (defined as the time from intubation to extubation), diminution in hemoglobin, fentanyl dosage, overall or severe morbidity, readmission rate, or in-hospital costs (Table 3).

Patients in the intervention group exhibited a lower narcotic consumption rate (1.4% in the full ERAS program compared with 17.4% receiving limited ERAS management, $P$ = .001), and reported that improved postoperative pain management as denoted by NRS scores within 72 hours after surgery was significantly lower in the intervention group than in the control arm. In both the groups, the NRS score was the highest at 2 hours postoperatively and gradually diminished over time (Table 3). Multivariate analysis showed that the use of preoperative analgesics (B = 12.95; 95% CI, 4.28–39.17; $P$ < .001) was the only independent factor associated with better pain control (defined as an NRS score [?] 3 points) at 24 hours postoperatively.

There was no statistical difference in the overall PONV incidence (38.6% in the intervention group versus 44.9% in the control arm,$P$ = .447), or severe PONV incidence (defined as a PONV score [?] 5 points; 8.6% versus 15.9%, respectively; $P$ = .185). Multivariate regression analysis identified the absence of previous PONV history (B = 14.86; 95% CI, 1.50–146.85; $P$ = .021), operation duration < 3 hours (B = 5.85; 95% CI, 1.07–31.98; $P$ = .041), absence of narcotics (B = 4.23; 95% CI,1.11–16.15; $P$ = .035), and utilization of TIVA (B = 3.37; 95% CI, 0.85–13.40; $P$= .084) as the independent factors for improved PONV management.

Compared with patients in the control group, those in the full ERAS program were more likely to produce early flatus: 775.0 min (563.8–1004.8 min) versus 1022.5min (833.8–1248.8 min), respectively ($P$ < .001); they also enjoyed a better and faster recovery as demonstrated by the QoR-15 scale on POD 3: 137.0 (127.3–141.0) in the intervention group compared with 130.0 (124.0–138.8) in the control group ($P$ = .020).

## DISCUSSION

### Main findings

This randomized, single-center, open-label trial was launched to explore whether full ERAS perioperative management would improve surgical outcomes in patients undergoing simple gynaecologic laparoscopic procedures compared with a limited ERAS program. Our study showed that the full ERAS pathway further improved patient outcome by shortening the length of stay, reducing postoperative pain, reducing narcotics consumption, and improving the quality of life—while not compromising morbidity or the readmission rate within 30 days after surgery.

### Strengths and limitations

The perioperative data in this study reinforced the evidence for a full ERAS program providing additional benefits for patients after simple gynaecologic laparoscopic surgery. Furthermore, we identified the key elements associated with an improved perioperative outcome, which may require additional focus when introducing an ERAS program.

Our study has several limitations. First, this study was an open-label trial, and it was therefore difficult to blind the clinical practitioners or the patients to interventions such as preoperative carbohydrate loading, multimodal analgesia, early postoperative diet, or ambulation. Unblinded treatment might theoretically introduce observer bias and the Hawthorne effect. Nonetheless, those possible biases have been minimized by several measures: an independent doctor who decided discharge time-points using preestablished criteria and separated ward sections to avoid contamination between the two groups. Second, this study was a single-center, randomized clinical trial. Thus, the external validity of the study might have been compromised, particularly when extending our results to other patient populations. However, a single-center trial might also be beneficial in several respects: compliance with an ERAS program is better controlled in a single center than in multiple centers, and the Department of Gynecology of Peking Union Medical College Hospital is one of the leading and largest gynecology centers in China, accepting patients from all over the country, such that the sample population in this trial was truly representative of the larger patient population.

### Interpretation

There have been seven RCTs in which the investigators evaluated ERAS implementation in gynaecologic surgery, and they have proven its benefits with respect to the length of stay and postoperative pain control[4-10]; however, a majority of the aforementioned studies focused on an open approach, and high-quality evidence supporting the combination of ERAS and laparoscopy is still lacking. This is especially true for patients undergoing an simple and efficient laparoscopic procedures, and those who have already experienced a fast postoperative recovery may therefore not benefit as greatly from the implementation of an ERAS pathway.

Previous systematic reviews have set a threshold of at least four items to identify a qualified ERAS program.[2] For the control group in our study, we adopted more than four interventions—including minimally invasive surgery, multimodal PONV prophylaxis, intraoperative fluid restriction, maintenance of normothermia, early postoperative diet, and ambulation—and it is reasonable to assume that the perioperative managements outlined above constituted the limited ERAS pathway. As for the intervention group, we introduced additional components comprising a full ERAS protocol that were unconventional or difficult to carry out in daily practice.

In our study we demonstrated a 1-day reduction in postoperative LOS in the intervention group, indicating that patients enrolled in a full ERAS program met the discharge criteria more quickly. Preoperative carbohydrate loading and opioid-sparing analgesia were found to be associated with an increased odds of discharge on POD 1. Fortunately, these beneficial items are relatively easier and more cost effective to implement.

It is worth noting that the length of stay in our intervention group was in accordance with the literature but longer in the control group than that reported in previous studies.[2] The length of stay in our trial was standardized by predefined, objectively quantified discharge criteria, which were stricter than those used

in previous studies. These criteria included adequate pain control with oral analgesics and the absence of vomiting or severe nausea; thus our study might more accurately reflect daily practice. The incidence of overall PONV and severe PONV in the control group was higher than in the intervention group (although not to a statistically significant degree), which may have contributed to the delayed discharge. Patients on the gynaecologic service possess nearly all the risk factors for PONV—including being female, exhibiting younger age and nonsmoking status, experiencing motion sickness, and undergoing laparoscopic or pelvic surgery.[16] We found that the introduction of TIVA may reduce the chance of severe PONV; yet even in the full ERAS group, compliance with respect to TIVA was only 75.0%. This percentage was not as high as for the other elements, which may be attributable to the anesthetists' concerns with TIVA since it has not become a routine anesthesia approach in our center. It is thus predictable that the occurrence and severity of PONV would be further reduced by promoting TIVA implementation in gynaecologic surgery.

The multimodal analgesic regimen that we used in our study proved to markedly improve the postoperative NRS score at all of the time-points and also reduced narcotics consumption. Satisfactory pain control on POD 1 (NRS [?] 3 points) is one of the key factors allowing patients to be discharged on time. A standard multimodal analgesic strategy consists of the concurrent use of nonopioid analgesics and various techniques throughout the entire perioperative period. Interestingly, we found that preoperative analgesia was the only independent factor associated with better pain control on POD 1, which is consistent with the hypothesis that analgesics given before a nociceptive stimulus are more effective than after the stimulus.[17] Therefore, it appears to be extremely important to strengthen compliance with the preoperative analgesia in simple laparoscopic gynaecologic surgery.

In our study, the hospitalization expenditures for the full ERAS program slightly exceeded that of the control group, but this was not statistically significant. The higher cost of medication in the full ERAS program—particularly the extra expenses produced by the multimodal analgesic protocol—were most likely counterbalanced by a shorter hospital stay.

Length of hospital stay is certainly an important indicator but not the only one that is a measure of the effect of ERAS, the primary goal of which is to accelerate the patient's recovery instead of discharging patients earlier. It is additionally important to include the patient's personal concerns, and we therefore introduced the QoR-15 scale to evaluate the patient's quality of life on POD 3. Patients in both of the groups recovered well as demonstrated by the QoR-15 score; however, we still observed a statistically significant improvement in the full ERAS group. As differences in the quality of life are expected to be the most prominent in the first week after surgery, we did not investigate time-course further.

## Conclusion

The addition of full ERAS management with preoperative carbohydrate loading, total intravenous anesthesia, and opioid-sparing analgesia reduced postoperative length of stay and improved the patients' quality of life after simple gynaecologic laparoscopic procedures.

## Disclosure of interests

The authors report no conflicts of interest. Completed disclosure of interests forms are available to view online as supporting information.

## Contribution to authorship

YR and HL contributed to the concept and design of the study. XL and YL ran the study and collected the data. DS and LP performed the primary data analyses. YR and HY conducted the data interpretation and co-drafted the manuscript. All authors have approved the final version of this manuscript.

## Details of ethics approval

Ethics approval was obtained from the Institutional Review Board of the Peking Union Medical College Hospital, Chinese Academy of Medical Science (date of approval: 28 August 2018; reference number: ZS-

1678), and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consents were obtained from all participants.

**Funding**

This was a self-financing study and there are no financial interests to report.

**Data sharing statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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**Supporting information**

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Table S1.** Full and Limited Enhanced Recovery after Surgery Programs.

**Table S2.** Subgroup Perioperative Outcomes (Intention-to-Treat Analysis).

**Appendix S1.** Per-protocol Analysis for primary and secondary outcomes.

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**Table 1. Baseline Characteristics of Patients Included in Each Group (Intention-to-Treat Analysis)**

| **Baseline Characteristics** | **Intervention Group (n = 72)** | **Control Group (n = 72)** | P |
|---|---|---|---|
| Age, mean ± SD, years | 39.9 ± 8.9 | 40.3 ± 9.2 | .814* |
| Body mass index, mean ± SD, kg/m$^2$ | 22.7 ± 4.0 | 22.9 ± 3.3 | .774* |
| ASA classification, Number (%) | | | .886+ |
| ASA I | 31 (43.1) | 30 (41.7) | |
| ASA II | 41 (56.9) | 42 (58.3) | |
| Previous abdominal surgery, Number (%) | | | |
| Uterus and Adnexa | 27 (37.5) | 19 (26.4) | .153+ |
| Appendectomy | 5 (7.1) | 3 (4.2) | .719++ |
| Other | 2 (2.8) | 0 (0) | .497++ |
| Patients with [?] 2 previous abdominal surgeries | 7 (9.7) | 1 (1.4) | .063++ |
| Dysmenorrhea (NRS [?] 4), Number (%) | 28 (38.9) | 20 (27.8) | .157+ |
| PONV history, Number (%) | 3 (4.2) | 1 (1.4) | .620++ |
| Motion sickness, Number (%) | 8 (11.1) | 11 (15.3) | .460+ |
| Smoking history, Number (%) | 1 (1.4) | 0 (0) | 1.000+ |
| Operation approach, Number (%) | | | .966++ |
| Laparoscopic cystectomy | 24 (33.3) | 24 (33.3) | |
| Laparoscopic myomectomy | 24 (33.4) | 24 (33.3) | |

| **Baseline Characteristics** | **Intervention Group (n = 72)** | **Control Group (n = 72)** | P |
|---|---|---|---|
| Laparoscopic hysterectomy | 24 (33.3) | 22 (30.6) | |
| Laparoscopic EC surgical staging | 0 (0) | 1 (1.4) | |
| Trans-abdominal hysterectomy | 0 (0) | 1 (1.4) | |
| Postoperative diagnosis | | | .549++ |
| Benign Ovarian Cysts | 25 (34.7) | 24 (33.3) | |
| Uterine leiomyoma | 33 (45.8) | 33 (45.8) | |
| Adenomyosis | 6 (8.3) | 2 (2.8) | |
| Endometrial intraepithelial neoplasia | 1 (1.4) | 2 (2.8) | |
| Cervical intraepithelial neoplasia | 6 (8.3) | 7 (9.7) | |
| Endometrial carcinoma | 1 (1.4) | 4 (5.6) | |

SD, standard deviation; ASA, American Society of Anesthesiologists; NRS, numerical rating scale; PONV, postoperative nausea and vomiting; EC, endometrial carcinoma.

Data are means ± 1 standard deviation or medians (interquartile ranges) for quantitative data and n (%) for quantitative data.

*$t$ test.

+Chi-squared test.

++Fisher's exact test.

**Table 2. Protocol Compliance (Intention-to-Treat Analysis)**

| **ERAS Elements** | **Intervention Group (n = 72)** | **Control Group (n = 72)** | P |
|---|---|---|---|
| Avoiding unnecessary MBP, Number (%) | 48 (80.0) | 38 (60.3) | .017* |
| Intake of CHL, Number (%) | 62 (88.6) | 0 (0) | < .001 |
| Preoperative analgesics, Number (%) | 68 (94.4) | 0 (0) | < .001 |
| Total intravenous anesthesia, Number (%) | 54 (75.0) | 9 (12.5) | < .001 |
| Intraoperative fluid infusion, mean ± SD, mL/h | 580.5 ± 280.6 | 665.5 ± 352.7 | .112+ |
| Lidocaine infusion, Number (%) | 72 (100) | 72 (100) | 1.000+ |
| Ondansetron & dexamethasone, Number (%) | 72 (100) | 72 (100) | 1.000+ |
| Avoiding drainage, Number (%) | 71 (98.6) | 68 (94.4) | .366++ |
| Multimodal analgesia, Number (%) | 67 (93.1) | 3 (4.2) | < .001 |
| Catheter retention duration, median (IQR), min | 527.5 (140.0–762.5) | 802.5 (686.3–1048.8) | < .001 |
| Time to oral intake, median (IQR), min | 485.0 (290.0–794.0) | 940.0 (793.8–1195.0) | < .001 |
| Time to ambulation, mean ± SD, min | 578.9 ± 332.8 | 961.3 ± 250.4 | < .001 |
| Gum chewing, Number (%) | 66 (91.7) | 1 (1.4) | < .001 |
| Laxatives, Number (%) | 51 (70.8) | 1(1.4) | < .001 |

ERAS, enhanced recovery after surgery; MBP, mechanical bowel preparation; CHL, carbohydrate loading; SD, standard deviation; IQR, interquartile range.

Data are means ± 1 standard deviation or medians (interquartile ranges) for quantitative data and n (%) for quantitative data.

*Chi-squared test.

+$t$ test.

++Fisher's exact test.

[SS]Mann–Whitney U test.

**Table 3. Perioperative Outcomes (Intention-to-Treat Analysis)**

| Outcome Variable | Intervention Group (n = 72) | Control Group (n = |
|---|---|---|
| Practical postoperative LOS, median (IQR), days | 1.0 (1.0–1.0) | 2.0 (1.0–2.0) |
| Theoretical postoperative LOS, median (IQR), days | 0.0 (0.0–1.0) | 1.0 (0.0–2.0) |
| Discharged on practical POD1, Number (%) | 55 (76.4) | 33 (45.8) |
| Operation duration, mean ± SD, min | 100.6 ± 39.8 | 100.3 ± 41.2 |
| Surgery completed by 18:00, Number (%) | 52 (72.2) | 49 (68.1) |
| Hemoglobin decrease, mean ± SD, g/L | 14.6 ± 12.2 | 12.9 ± 8.2 |
| Fentanyl dosage, median (IQR), mg | 250.0 (200.0–293.8) | 235.0 (200.0–300.0) |
| NRS 2 h, mean ± SD | 2.9 ± 2.2 | 4.1 ± 2.1 |
| NRS 6 h, median (IQR) | 2.0 (1.0–3.0) | 3.0 (3.0–5.0) |
| NRS 24 h, median (IQR) | 2.0 (1.0–3.0) | 3.0 (2.0–4.0) |
| NRS 48 h, median (IQR) | 1.0 (0.0–2.0) | 3.0 (2.0–3.0) |
| NRS 72 h, median (IQR) | 1.0 (0.0–2.0) | 2.0 (1.0–3.0) |
| Opioid consumption rate, Number (%) | 1 (1.4) | 12 (16.7) |
| Time to first flatus, median (IQR), min | 775.0 (563.8–1004.8) | 1022.5 (833.8–1248.8) |
| PONV incidence, Number (%) | 27 (37.5) | 31 (43.1) |
| PONV score, median (IQR) | 0.0 (0.0–2.0) | 0.0 (0.0–4.0) |
| PONV score [?] 5, Number (%) | 6 (8.3) | 11 (15.3) |
| Perioperative complication rate within 30 days, Number (%) | 10 (13.9) | 7 (9.7) |
| QoR-15 score, median (IQR) | 137.0 (127.3–141.0) | 130.0 (124.0–138.8) |
| Readmission rate, Number (%) | 1 (1.4) | 0 (0) |
| Hospitalization cost, mean ± SD, ¥ | 14041.0 ± 3295.7 | 13890.9 ± 3210.7 |

LOS, length of stay; IQR, interquartile range; SD, standard deviation; NRS, numerical rating scale; PONV, postoperative nausea and vomiting; QoR-15, quality of life-15 scale.

Data are means ± 1 standard deviation or medians (interquartile ranges) for quantitative data and n (%) for quantitative data.

[*]Mann–Whitney U test.

[+]Chi-squared test.

[++] *t* test.

[SS]Fisher's exact test.

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`Figure 1.pdf` available at https://authorea.com/users/361010/articles/482528-a-full-enhanced-recovery-after-surgery-program-in-gynaecologic-laparoscopic-procedures-a-randomized-controlled-trial