BMC Women's Health

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Impact of enhanced recovery after surgery concept process optimization on the perioperative period of gynecologic laparoscopic surgery

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Abstract

Background To explore the impact of enhanced recovery after surgery (ERAS) optimization concept process on the perioperative period of gynecologic laparoscopic surgery.

Methods This retrospective observational study included patients who underwent gynecologic laparoscopic surgery based on ERAS concept process optimization (ERAS group) for uterine fibroids, adenomyosis, and ovarian cysts at Jiaxing Hospital of Traditional Chinese Medicine between January 2023 and December 2023. Patients who underwent the same laparoscopic protocol without ERAS concept process optimization between January 2022 and December 2022 were matched as the control group (non-ERAS group). Postoperative indexes and patient satisfaction were compared between the two groups.

Results A total of 120 patients were included, with 60 of who underwent gynecologic laparoscopic surgery (total laparoscopic hysterectomy, TLH: $n=20$; laparoscopic myomectomy, LM: $n=20$; laparoscopic ovarian cystectomy, LOC: $n=20$) based on ERAS (ERAS group), and the other 60 of who underwent gynecologic laparoscopic surgery (TLH: $n=20$, LM: $n=20$, LOC: $n=20$) without ERAS (non-ERAS). In patients received gynecologic laparoscopic surgery of ERAS group, the time of first postoperative gas evacuation, the time of semi-liquid recovery, the time of urination, the time of incision pain, and the length of hospital stay were significantly shorter (all $P<0.001$), and the number of nausea and vomiting was significantly reduced (all $P<0.001$) compared with those in the non-ERAS group. Besides, satisfaction of patients receiving ERAS was significantly higher than in the non-ERAS group (TLH: $P<0.01$; LM and LOC: $P<0.001$).

Conclusions ERAS optimization for gynecologic laparoscopic surgery improved patients' outcomes, reduced complications, and improved patient's satisfaction.

Keywords ERAS, Laparoscopy, Process optimization, Perioperative period

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Background

The development of enhanced recovery after surgery (ERAS) protocols represents a paradigm shift in surgical care, emphasizing a holistic, patient-centered approach that encompasses the entire perioperative period. This comprehensive strategy, initiated by Danish surgeons Wilmore and Kehlet, was born out of a need to address the negative consequences of traditional postoperative care practices [1]. Historically, surgical patients were subjected to prolonged fasting, extensive bed rest, and routine use of nasogastric tubes and drains, which were believed to be essential components of recovery. However, these practices inadvertently prolonged hospital stays, increased the risk of complications, and impeded the overall recovery process. ERAS protocols counteract these historical approaches by integrating a series of evidence-based interventions designed to minimize the stress response to surgery, promote faster gastrointestinal recovery, and facilitate early mobilization. Key elements include preoperative education, carbohydrate loading, optimized fluid management, effective pain control through multimodal analgesia, early removal of drains and catheters, and early resumption of oral intake and ambulation [2].

ERAS, based on evidence-based medicine, promotes rapid postoperative functional recovery in perioperative patients and is beneficial in controlling costs for both patients and hospitals [3]. A previous report on gynecologic cancers highlighted the benefits of rapid postoperative recovery in gynecologic oncology, such as reduced length of stay and cost savings [4]. Factors that commonly influence rapid recovery in gynecologic surgery include preoperative anxiety, preoperative physical condition, intraoperative anesthesia, postoperative pain management, fluid and diet management, and early mobilization. Preoperative conditions such as hyperglycemia, hypertension, and anemia can affect surgical outcomes and recovery [5]. Several strategies have been shown to be effective in accelerating recovery in the gynecologic perioperative setting: (1) Comprehensive preoperative, intraoperative, and postoperative patient education and risk communication increase patient acceptance and decrease anxiety; (2) Pain management strategies, including the use of ultra-short-acting anesthetics and precise control of anesthetic depth, minimize pain distress, preserve gastrointestinal function, and shorten recovery times; (3) Limiting or avoiding the use of drains and catheters reduces bed rest time and facilitates a faster return to preoperative status; (4) Integrative TCM therapies have shown promise in improving local tissue perfusion, preventing lower extremity venous thrombosis, promoting tissue repair, alleviating sterile inflammation, and accelerating healing processes, thereby enhancing perioperative recovery in patients [6, 7].

Currently, the application of ERAS in gynecologic surgery still faces numerous unresolved issues [8]. Some clinical measures lack strong supporting evidence, particularly the lack of domestic clinical research data to objectively evaluate the safety and efficacy of ERAS in the perioperative treatment of gynecologic patients [9]. Successful implementation of postoperative ERAS protocol optimization requires effective communication and standardized process management within relevant departments. Ensuring collaboration between departments involved in the perioperative management of patients is critical to the application of rapid recovery in gynecology [10]. A major pain point in current clinical practice is the inconsistent application of ERAS principles, which can lead to suboptimal patient outcomes and missed opportunities for improved recovery. For example, the timing of preoperative fasting, the use of multimodal analgesia, and the promotion of early mobilization vary widely among institutions, impacting patient recovery outcomes [4]. In addition, there is an urgent need to tailor ERAS protocols to the specific needs of gynecologic patients, taking into account factors such as age, comorbidities, and the type of surgery being performed [5]. Without such customization, the full potential of ERAS to improve outcomes may not be realized.

To fully realize the benefits of ERAS in gynecologic laparoscopic surgery, our team is committed to refining existing protocols and addressing gaps in communication and practice variation. This includes developing clear, concise guidelines for each phase of care, providing education and resources for providers, and soliciting patient feedback to continually improve the process. By fostering a culture of interdisciplinary collaboration and patient engagement, we aim to create a seamless, efficient and compassionate care pathway that accelerates recovery and improves the patient experience. Therefore, this study aimed to explore the impact of ERAS optimization concept process optimization on the perioperative period of gynecologic laparoscopic surgery.

Methods

Study design and participants

This retrospective and observational study included patients who underwent gynecologic laparoscopic surgery based on ERAS concept process optimization for uterine fibroids, adenomyosis, or ovarian cysts at Jiaxing Hospital of Traditional Chinese Medicine between January 2023 and December 2023. Patients who underwent the same laparoscopic protocol without ERAS concept process optimization between January 2022 and December 2022 were matched as the control group. Individual matching was conducted in the study, which mainly included the type of disease, mode of surgery, age and duration of disease. The inclusion criteria were as follows:

(1) Patients with gynecological diseases confirmed by imaging; (2) Patients who opt for surgical treatment and are older than 18 years; (3) Patients who are conscious, capable of self-care, and able to participate in the study. The exclusion criteria were as follows: (1) patients with severe psychiatric disorders or communication barriers; (2) patients with incomplete clinical data; (3) patients with poor compliance; (4) patients unable to tolerate surgery. This study was approved by the Ethic Committee of Jiaxing Hospital of Traditional Chinese Medicine. Due to the retrospective nature of this study, the patient's informed consent was waived by the Ethic Committee.

Data collection and definitions

Gynecologic laparoscopic surgery, including total laparoscopic hysterectomy (TLH), laparoscopic myomectomy (LM), laparoscopic ovarian cystectomy (LOC), were performed using ERAS principles to optimize perioperative management (Supplementary materials). Patients' data including the age and duration of disease were collected.

Primary outcome included postoperative first flatus time, semi-liquid recovery time, urination time, frequency of nausea and vomiting, incision pain duration, and length of hospital stay [11]. The secondary outcome was a patient satisfaction survey. Follow-up Method: Outpatient follow-up at 2 weeks after discharge, and follow-up at 1 month postoperatively. (1) Postoperative First Flatus Time: The first instance of flatus post-surgery signifies the beginning of bowel function recovery. Nursing staff records the exact time when the patient reports passing gas; (2) Semi-Liquid Recovery Time: This refers to the time from the conclusion of the surgery until the patient can tolerate and consume a semi-liquid diet. It reflects the patient's digestive system returning to function. Dietary records are maintained to document when the patient consumes a semi-liquid meal; (3) Urination Time: This is the time from the completion of surgery until the patient can void spontaneously. It indicates the return of bladder function and the cessation of any urinary retention. Nurses document the first spontaneous voiding post-surgery; (4) Frequency of Nausea and Vomiting: This metric tracks the number of episodes of nausea and vomiting experienced by the patient within the first few days following surgery. Staff logs all instances of nausea and vomiting reported or observed; (5) Incision Pain Duration: This measures the length of time the patient experiences pain at the surgical site, indicating the onset of healing and pain management effectiveness. Visual Pain Scores are recorded regularly by the nursing staff; (6) Length of Hospital Stay: This is the total number of days the patient spends in the hospital post-surgery, which is influenced by recovery speed and complication rates. Admission and discharge dates are recorded in the patient's chart; (7) Patient Satisfaction Survey: This qualitative assessment gauges the patient's overall satisfaction with the surgical experience and recovery process. There are four categories, including highly satisfied, satisfied, fair and dissatisfied. Surveys are distributed to patients at 1 month postoperatively.

Statistical methods

Statistical analysis was conducted using SPSS Statistics 20.0. Continuous data were compared between groups using independent sample t-tests, and homogeneity of variance was tested using Levene's test. Categorical data were compared between groups using the chi-square test. The significance level was set at 0.05 (two-tailed). The analyst was blinded, which meant that he didn't know the specific groupings during the statistical process.

Results

A total of 120 patients were included, 60 of who underwent gynecologic laparoscopic surgery (TLH: $n=20$, LM: $n=20$, LOC: $n=20$) based on ERAS (ERAS group), while the other 60 of who underwent gynecologic laparoscopic surgery (TLH: $n=20$, LM: $n=20$, LOC: $n=20$) without ERAS (non-ERAS). There were no significant differences in the age or duration of disease between the ERAS and non-ERAS group ($P>0.05$) (Table 1).

The patients who received TLH in the ERAS group showed a significantly shorter time to first anal flatus postoperatively (7.25 ± 2.63 versus 26.90 ± 5.81 h, $P<0.001$), shorter time to first spontaneous urination (4.55 ± 0.94 versus 31.60 ± 3.69 h, $P<0.001$), ability to resume a semi-liquid diet significantly earlier (6.05 ± 1.32 versus 27.65 ± 5.76 h, $P<0.001$), experienced significantly fewer episodes of nausea and vomiting postoperatively (0.15 ± 0.37 versus 2.10 ± 1.29, $P<0.001$), had a

Table 1 Baseline characteristics of patients underwent total laparoscopic hysterectomy (TLH), laparoscopic myomectomy (LM), laparoscopic ovarian cystectomy (LOC)

Variables	TLH			LM			LOC		
	ERAS, $n=20$	non-ERAS, $n=20$	*P*	ERAS, $n=20$	non-ERAS, $n=20$	*P*	ERAS, $n=20$	non-ERAS, $n=20$	*P*
Age (years)	49.5 (48, 51)	49.5 (48, 51)	0.87	38.75 ± 5.31	39.05 ± 5.75	0.865	34.33 ± 6.29	35.45 ± 6.91	0.591
Duration of disease (years)	7.20 ± 3.27	5.35 ± 3.08	0.073	5.0 (2.25, 6.75)	2.0 (1.25, 6.50)	0.171	5 (2.5, 6.0)	6 (3.0, 8.0)	0.255

Note: Data were shown as $M(Q_1, Q_3)$ or $\bar{X}\pm S$

Table 2 Comparison of clinical data between two groups of patients undergoing total laparoscopic hysterectomy (TLH), laparoscopic myomectomy (LM), laparoscopic ovarian cystectomy (LOC)

Outcomes	TLH			LM			LOC		
	ERAS, *n* = 20	non-ERAS, *n* = 20	*P*	ERAS, *n* = 20	non-ERAS, *n* = 20	*P*	ERAS, *n* = 20	non-ERAS, *n* = 20	*P*
First Anal Flatus Time, mean ± SD, hours	7.25 ± 2.63	26.90 ± 5.81	< 0.001	5.85 ± 2.64	26.25 ± 6.52	< 0.001	7.15 ± 2.94	16.7 ± 6.33	< 0.001
First Spontaneous Urination Time, mean ± SD, hours	4.55 ± 0.94	31.60 ± 3.69	< 0.001	4.30 ± 0.73	22.35 ± 3.63	< 0.001	3.75 ± 0.64	23.20 ± 4.07	< 0.001
Semi-Liquid Diet Recovery Time, mean ± SD, hours	6.05 ± 1.32	27.65 ± 5.76	< 0.001	6.75 ± 2.67	27.10 ± 6.41	< 0.001	7.85 ± 3.13	17.50 ± 6.34	< 0.001
Nausea and Vomiting Episodes, mean ± SD, times	0.15 ± 0.37	2.10 ± 1.29	< 0.001	0.55 ± 0.69	3.40 ± 1.47	< 0.001	0.10 ± 0.31	2.40 ± 1.14	< 0.001
Duration of Incision Pain, mean ± SD, hours	5.65 ± 2.43	21.60 ± 5.18	< 0.001	5.60 ± 1.73	21.15 ± 7.22	< 0.001	6.20 ± 1.70	21.50 ± 7.67	< 0.001
Hospital Stay, mean ± SD, days	3.60 ± 0.75	5.95 ± 1.00	< 0.001	3.60 ± 0.60	5.25 ± 0.64	< 0.001	3.10 ± 0.55	4.35 ± 0.81	< 0.001
Satisfied, [*n* (%)]	1(5.00)	9(45.00)	< 0.01	1(5.00)	11(55.00)	< 0.001	0(0.00)	10(50.00)	< 0.001
Highly Satisfied, [*n* (%)]	19(95.00)	11(55.00)	/	19(95.00)	9(45.00)	/	20(100.00)	10(50.00)	/

significantly shorter duration of incision pain (5.65 ± 2.43 versus 21.60 ± 5.18 h, $P < 0.001$), and had a significantly shorter hospital stay (3.60 ± 0.75 versus 5.95 ± 1.00 days, $P < 0.001$) than those in non-ERAS group. The satisfaction of patients in ERAS group was significantly higher than that in non-ERAS group ($P < 0.01$) (Table 2).

Besides, the patients received LM in ERAS group had a significantly shorter time to first anal flatus (5.85 ± 2.64 vs. 26.25 ± 6.52 h), a shorter time to first spontaneous urination (4.30 ± 0.73 vs. 22.35 ± 3.63 h), earlier resumption of a semi-liquid diet (6.75 ± 2.67 vs. 27.10 ± 6.41 h), fewer episodes of nausea and vomiting (0.55 ± 0.69 vs. 3.40 ± 1.47 times), shorter duration of incision pain (5.60 ± 1.73 vs. 21.15 ± 7.22 h), and shorter hospital stay (3.60 ± 0.60 vs. 5.25 ± 0.64 days) than those in the non-ERAS group (All $P < 0.001$). The satisfaction of patients in ERAS group was significantly higher than that in non-ERAS group ($P < 0.001$) (Table 2).

In addition, the patients received LOC in ERAS group had significantly shorter time to first anal flatus (7.15 ± 2.94 vs. 16.7 ± 6.33 h), shorter time to first spontaneous urination (3.75 ± 0.64 vs. 23.20 ± 4.07 h), earlier resumption of a semi-liquid diet (7.85 ± 3.13 vs. 17.50 ± 6.34 h), fewer episodes of nausea and vomiting (0.10 ± 0.31 vs. 2.40 ± 1.14 times), shorter duration of incision pain (6.20 ± 1.70 vs. 21.50 ± 7.67 h), and shorter hospital stay (3.10 ± 0.55 vs. 4.35 ± 0.81 days) than those in the non-ERAS group (All $P < 0.001$). The satisfaction of patients in ERAS group was significantly higher than that in non-ERAS group ($P < 0.001$) (Table 2).

Discussion

In this study, ERAS optimization resulted in significantly shorter times to first postoperative gas evacuation, resumption of semi-liquid diet, and urination. These findings are consistent with the literature on ERAS implementation, which suggests that optimized perioperative care can lead to a faster return of gastrointestinal function and overall patient recovery [4]. Patients in the study group experienced fewer episodes of nausea and vomiting. This reduction in postoperative nausea and vomiting is consistent with the implementation of multimodal analgesia and antiemetic strategies recommended in ERAS protocols [12]. In addition, our study group had a significantly shorter length of hospital stay. Shorter hospital stays are a hallmark of successful ERAS programs, as they are associated with lower health care costs and reduced risk of hospital-acquired infections [13]. The observed improvements in recovery time, complications, length of stay, and patient satisfaction can be attributed to several factors associated with the ERAS protocol: 1) Preoperative education and preparation: Patients in the study group likely benefited from preoperative counseling, which is known to reduce anxiety and improve postoperative outcomes [14]; 2)Standardized perioperative care: ERAS involves a standardized approach to patient management before, during, and after surgery. This consistency of care helps to minimize variation in treatment and improve patient outcomes [15]. 3) Early mobilization and nutrition: ERAS promotes early postoperative mobilization and resumption of oral intake, which can contribute to faster recovery of bowel function and overall patient well-being [16]. 4) Multidisciplinary team approach: The success of ERAS is largely dependent on effective communication and standardized process management within the relevant departments. Collaborative efforts between gynecology, anesthesia, nursing, and dietary professionals ensure comprehensive and coordinated care [6, 17].

In addition, ERAS surgery poses a significant challenge to traditional gynecologic management concepts and represents a new frontier in development [8]. The development of mobile applications to facilitate friendly communication between medical professionals and patients, as well as to provide feedback and evaluate clinical treatment outcomes [18, 19], is critical to addressing these

challenges. In recent years, the number of people using mobile applications to promote health and well-being has increased exponentially. However, there are fewer applications in the field of ERAS [20, 21]. The studies on the development of mobile applications in gynecologic surgery are also very few [22–24]. Our results first showed that standardization of management by mobile applications ensures uniform effectiveness of gynecologic ERAS, while the combination of standardization and personalization ensures safety and distinctive features in the rapid recovery process. Evidence-based measures that have proven to be effective should be implemented consistently. Finally, multidisciplinary collaboration is essential to minimize patient harm and reduce the impact on patient physiology in the management of rapid recovery processes [25].

When considering the limitations of the paper focusing on the impact of ERAS concept process optimization on the perioperative period of gynecologic laparoscopic surgery, several factors may affect the generalizability and interpretation of the results. First of all, although the study included a total of 120 patients, the relatively small sample size may limit the statistical power of the study to detect small effects or rare adverse events. Secondly, the study used a retrospective design, which introduces potential bias due to changes in surgical techniques, anesthesia protocols, or other clinical practices that may occur over time and affect outcomes independent of ERAS optimization. In addition, Follow-up periods are short, and longer periods may provide more complete insights into the lasting benefits of ERAS optimization. Finally, the study was conducted at a single institution, which may limit the applicability of the results to other settings with different resources, patient populations, or standards of care.

In order to reduce the impact of insufficient sample size and confounding factors on the results, some measures were taken in this study. First of all, we analyzed patients with different diseases and operation methods separately to remove the huge bias that may be caused by the two factors of disease type and operation method. Secondly, our baseline data analysis showed no statistical difference in age and course of disease. Besides, we only included patients with complete clinical information to avoid missing data for subsequent analysis. Furthermore, we used a blind method for our data analyst, which meant that he didn't know the specific groupings during the statistical process, therefore it could effectively avoid the subjective tendency in the analysis process.

Therefore, more large-scale, prospective, multicenter, randomized controlled trials are needed in the future to strengthen the evidence base for the effectiveness of ERAS optimization in gynecological laparoscopic surgery. Such trials should also consider longer follow-up periods to provide a more complete picture of the benefits and limitations of ERAS protocols.

Conclusions

In summary, this study suggested that ERAS optimization for gynecologic laparoscopic surgery might improve patients' outcomes, reduce complications, and improve patient's satisfaction. Thereby, this study focused on optimizing the perioperative management of gynecologic laparoscopic surgery by forming collaborative teams across gynecology, anesthesia, nursing, nutrition, and other disciplines. Establishing stable management processes and developing process management software facilitates management innovation, thereby maximizing benefits for patient populations.

Abbreviations

ERAS	enhanced recovery after surgery
TLH	total laparoscopic hysterectomy
LM	laparoscopic myomectomy
LOC	laparoscopic ovarian cystectomy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12905-025-03626-1.

Supplementary Material 1

Acknowledgements

None.

Author contributions

Protocol/project development: Ou Jin, Tiebing XuData collection or management: Ou Jin, Tiebing Xu Data analysis: Juan Lai, Junxia HeManuscript writing/editing: Ou Jin, Tiebing Xu, Juan Lai, Junxia He, Yongfeng Wu, Xiaomin Yang.

Funding

This work was supported by the Jiaxing Science and Technology Plan project (2022AD10009).

Data availability

All data generated or analysed during this study are included in this published article and its Supplementary Information files.

Declarations

Ethics approval and consent to participate

This work has been carried out in accordance with the Declaration of Helsinki (2000) of the World Medical Association. This study was approved by the Ethic Committee of Jiaxing Hospital of Traditional Chinese Medicine. Due to the retrospective nature of this study, the patient's informed consent was waived by the Ethic Committee.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 16 October 2024 / Accepted: 21 February 2025
Published online: 14 March 2025

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