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Original Article

Enhanced recovery after surgery in the perioperative period promotes recovery of cervical cancer patients undergoing transabdominal radical resection

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Abstract: Objective: To explore the effects of enhanced recovery after surgery (ERAS) during the perioperative period in patients undergoing transabdominal radical resection of cervical cancer. Methods: A total of 114 patients who underwent transabdominal radical resection for cervical cancer at the Red Cross Hospital of Yulin City from January 2020 to December 2023 were retrospectively reviewed. Patients were divided into two groups based on the perioperative intervention method: the ERAS group (n = 51) received ERAS-based management, while the control group (CG, n = 63) received conventional perioperative management. Key outcomes compared included postoperative recovery time, complication rates, hospital stay duration, T lymphocyte levels, and patient satisfaction. Results: Postoperative anal exhaust time, first defecation time, ambulation time, and hospital stay were significantly shorter in the ERAS group compared to the CG group (all $P < 0.05$). The ERAS group also showed earlier catheter removal, faster bladder function recovery, and lower residual urine volume (all $P < 0.05$). Postoperative serum levels of C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-α (TNF-α) increased in both groups but were significantly lower in the ERAS group (all $P < 0.05$). The ERAS group demonstrated improved postoperative quality of life (QLQ-C30 scores), reduced Pittsburgh Sleep Quality Index (PSQI) and Self-Rating Anxiety Scale (SAS) scores, and a significantly lower incidence of postoperative urinary tract infection (7.84% vs. 30.16%, all $P < 0.05$). Treatment satisfaction was higher in the ERAS group (96.08% vs. 76.19%, $P < 0.05$). Conclusion: ERAS effectively promotes gastrointestinal function recovery, reduces hospital stay, accelerates postoperative rehabilitation, and enhances patient satisfaction in cervical cancer patients undergoing transabdominal radical resection. It is safe, economical, and has an efficient approach that supports wider clinical adoption.

Keywords: Cervical cancer, enhanced recovery after surgery, transabdominal radical resection of cervical cancer, perioperative period, complications, hospitalization time

Introduction

Cervical cancer is a prevalent disease among women, particularly those aged 30-55 years, with high morbidity and mortality rates. In 2020, there were 604,000 new cases globally, resulting in 342,000 deaths [1, 2]. In China, cervical cancer remains a significant public health concern, accounting for 18.3% of global cases and 17.6% of related deaths [1]. Notably, the incidence of cervical cancer in China shows a concerning trend toward younger populations [3, 4], posing a severe threat to women's health. The disease is associated with numerous risk factors, including smoking, genetic predisposition, sexual behavior, and the number of deliveries [5]. Early symptoms often include vaginal bleeding and discharge, while advanced stages are marked by constipation, urinary urgency, frequent urination, anemia, cachexia, lower extremity swelling, and pain. The five-year survival rate for late-stage patients remains low, highlighting the urgency for effective clinical interventions [6].

Currently, radiotherapy and surgery are the most effective treatments for cervical cancer. Compared to open surgery, laparoscopic surgery offers several advantages, including smaller incisions, a wider surgical field, better cosmetic outcomes, clearer anatomical views, and reduced intraoperative blood loss. These ben-

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efits have made laparoscopic surgery a widely accepted and recognized option in gynecology [7]. However, surgical trauma may compromise patients' immune systems, increasing the risk of postoperative complications, particularly urinary tract infections, which can impair bladder recovery, affect surgical outcomes, and add to patients' psychological and financial burdens [8, 9].

Addressing these challenges, the perioperative implementation of effective measures is critical to improving treatment outcomes and reducing postoperative complications. Enhanced recovery after surgery (ERAS) is a modern perioperative management approach that has gained prominence in recent years. ERAS aims to minimize the physiological and psychological impact of surgery, enhance surgical outcomes, reduce postoperative complications, shorten hospital stays, and improve patients' quality of life and recovery [10, 11]. Since its introduction in China, ERAS has been widely studied and progressively adopted by medical centers [12]. While ERAS has been extensively applied in gastrointestinal, hepatobiliary, and orthopedic surgeries [13, 14], its use in gynecology, particularly in gynecological oncology, remains underexplored. The lack of standardized ERAS protocols for patients undergoing radical resection of cervical cancer underscores the need for further investigation. This study retrospectively analyzed the application of ERAS during the perioperative period in such patients, aiming to provide evidence-based recommendations for clinical practice.

Materials and methods

Case selection

This study was approved by the Ethics Committee of Red Cross Hospital of Yulin City. Clinical data from 114 patients who underwent transabdominal radical resection for cervical cancer at the Red Cross Hospital of Yulin City from January 2020 to December 2023 were retrospectively analyzed. Patients were divided into two groups based on the perioperative intervention method: the ERAS group (n = 51) received ERAS-based management, while the control group (CG, n = 63) received conventional perioperative management.

Inclusion criteria: (1) Age > 18 years. (2) Clinically diagnosed with cervical cancer. (3) Eligible for radical resection of cervical cancer. (4) No hearing or language impairments. (5) No prior history of abdominal surgery. (6) Complete data available for analysis.

Exclusion criteria: (1) Severe organ dysfunction (heart, liver, or kidney). (2) Conversion to laparotomy during surgery. (3) History of cardiovascular or cerebrovascular diseases, diabetes, or other systemic illnesses. (4) Presence of other malignant tumors. (5) Immune system or hematologic disorders. (6) Poor patient compliance.

Intervention methods

Patients in both groups underwent radical cervical cancer resection under general anesthesia. In the CG, patients received conventional perioperative management, including preoperative health education via manuals, oral hygiene instruction, maintaining body warmth, and strict fasting on the day of surgery. During surgery, body temperature was maintained at 34.7°C±0.6°C. Postoperatively, pain was managed with either an analgesic pump or diclofenac sodium (Guangdong Huanan Pharmaceutical Group Co., Ltd., Guoyao Zhunzi H44024989). Patients were permitted oral intake only after anal exhaust. Symptomatic treatment was provided in cases of nausea or vomiting, and early ambulation was encouraged. The drainage tube and urinary catheter (Shandong Weigao Group Medical Polymer Products Co., Ltd., DNB-A) were removed at least 48 hours after surgery.

The ERAS group received perioperative care guided by a rapid rehabilitation surgery model. A multidisciplinary management team, including gynecologists, anesthesiologists, respiratory specialists, dietitians, nurses, and an acute pain management team, was established. Following multiple discussions, a standardized rapid rehabilitation surgical protocol and implementation rules were developed for patients undergoing transabdominal radical resection for cervical cancer. The specific interventions were as follows.

Preoperative measures

Education and counseling: Patients were provided with information about the surgical procedure and successful case examples. Nurses strengthened communication with patients, conducted psychological counseling tailored to

individual needs, alleviated negative emotions, and improved compliance.

Nutritional preparation: Nutritional infusion was administered up to 4 hours before anesthesia. Solid food was restricted, and no mechanical enema was performed. Patients were given Kaisailu (Hubei Kangzheng Pharmaceutical Co., Ltd., Sinopharm Approval No. H420-20134).

Pelvic floor exercises: Patients were guided in preoperative pelvic floor muscle exercises.

Carbohydrate loading: Two hours before surgery, patients received 400 mL of 10% glucose solution (Jichuan Pharmaceutical Group Co., Ltd., Guoyao Zhunzi H32024826).

Intraoperative management

Temperature regulation: Central body temperature was maintained at 36°C±0.5°C during surgery.

Antiemetic administration: Antiemetic drugs were administered before discontinuation of anesthesia.

Postoperative measures

Hydration and nutrition: Patients were allowed to drink 10-15 mL of water per session post-surgery. Six hours post-surgery, patients without choking or coughing began a gradual transition to liquid diets and were instructed to chew xylitol gum.

Blood sugar control: Blood glucose levels were monitored and managed.

Pain and nausea management: Pain relief was provided using an analgesic pump combined with diclofenac sodium. Ondansetron hydrochloride tablets (Shanghai Shangyao Xixi Pharmaceutical Co., Ltd., Guoyao Zhunzi H1998-0118) were administered for postoperative nausea and vomiting.

Early mobilization: Passive rehabilitation exercises began 2 hours post-surgery using massage devices. Activities gradually transitioned to autonomous movements, with patients encouraged to ambulate within 24 hours.

Catheter and drain removal: The drainage tube and urinary catheter were removed 24 hours or later post-surgery.

Data collection

Main indicators: Postoperative recovery: Key metrics included postoperative anal exhaust time, first defecation time, ambulation time, and hospital stay duration, which were compared between the two groups.

Catheter indwelling time, bladder function recovery time, and residual urinary volume were recorded and analyzed.

Inflammatory markers: Fasting venous blood samples (5 mL) were collected at three time points: 1 day before surgery (T0), 1 day after surgery (T1), and 12 days after surgery (T2).

Serum C-reactive protein (CRP) levels were measured using immunoturbidimetry, while tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6) levels were detected via enzyme-linked immunosorbent assay (ELISA).

Secondary indicators: Quality of life: Assessed using the Core Quality of Life Scale (QLQC30), which evaluates five dimensions: physical, cognitive, role, emotional, and social. The total score ranges from 0 to 100, with higher scores indicating better quality of life.

Sleep quality: Evaluated with the Pittsburgh Sleep Quality Index (PSQI), which includes 18 items across 7 components, scored on a scale of 0-3 for each component, yielding a total score of 0-21. Higher scores indicate poorer sleep quality.

Anxiety: Assessed using the Self-Rating Anxiety Scale (SAS). Scores of 50-59 indicate mild anxiety, 60-69 moderate anxiety, and > 69 severe anxiety.

Complications: The incidence of postoperative urinary tract infections was recorded and compared between the two groups.

Treatment satisfaction: Satisfaction was evaluated using the “Satisfaction Survey Scale for Cervical Cancer Patients with Radical Surgery”, developed by the hospital. This scale assesses service attitude, treatment technology, imple-

Table 1. Comparison of general data between the two groups of patients

Items		ERAS group (n = 51)	CG group (n = 63)	t/χ^2	P
Pathological type [n (%)]	Squamous cell carcinoma	29 (56.86)	36 (57.14)	0.371	0.831
	Adenocarcinoma	20 (39.22)	23 (36.51)		
	Adenosquamous carcinoma	2 (3.92)	4 (6.35)	0.90	0.929
Age ($\bar{x}$ ±s, years)		44.49±6.02	44.40±5.08		
Education degree [n (%)]	Primary and junior high school	22 (43.14)	23 (36.51)		
	High School and University	29 (56.86)	40 (63.49)	0.518	0.472
BMI ($\bar{x}$ ±s, kg/m^2)		27.83±2.46	28.06±2.21	-0.516	0.607
Neoplasm staging [n (%)]	Ia	26 (50.98)	30 (47.62)	2.338	0.311
	Ib	21 (41.18)	22 (34.92)		
	IIa	4 (7.84)	11 (17.46)		

Note: ERAS: Enhanced recovery after surgery; CG group: routine treatment.

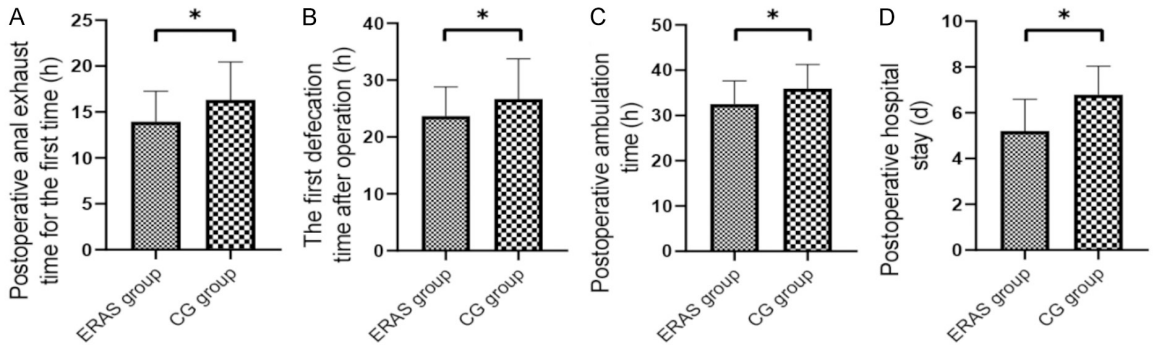

Figure 1. Postoperative recovery. Note: *P < 0.05; (A) Postoperative anal exhaust time; (B) The first defecation time; (C) Postoperative ambulation time; (D) Postoperative hospital stay. Bladder function recovery; ERAS: Enhanced recovery after surgery; CG group: routine treatment.

mentation, and health education, using a 5-point scoring system for each item.

Total scores (out of 100) were categorized as complete satisfaction (> 90 points), partial satisfaction (70-90 points), and dissatisfaction (< 70 points). Complete and partial satisfaction scores were combined to calculate total satisfaction.

The Cronbach's α coefficient of the scale was 0.893, indicating good reliability and validity.

Statistical methods

SPSS 22.0 statistical software was used for data analysis. Measurement data following a normal distribution were expressed as mean ± standard deviation ($\bar{x}$ ± s) and analyzed using the t-test. Count data were expressed as numbers and percentages and analyzed using the χ^2 test. A significance threshold of P < 0.05 was applied.

Results

Comparison of general information

The 114 patients were divided into two groups based on perioperative intervention methods, as shown in **Table 1**. There were no significant differences between the two groups in age, education level, or pathological type (all P > 0.05).

Comparison of postoperative recovery

The ERAS group demonstrated significantly shorter times for postoperative anal exhaust, first defecation, ambulation, and hospital stay compared to the CG group (all P < 0.05). See **Figure 1**. The catheter indwelling time and bladder function recovery time were also earlier in the ERAS group, and the residual urine volume was significantly lower than that in the CG group (P < 0.05). See **Figure 2**.

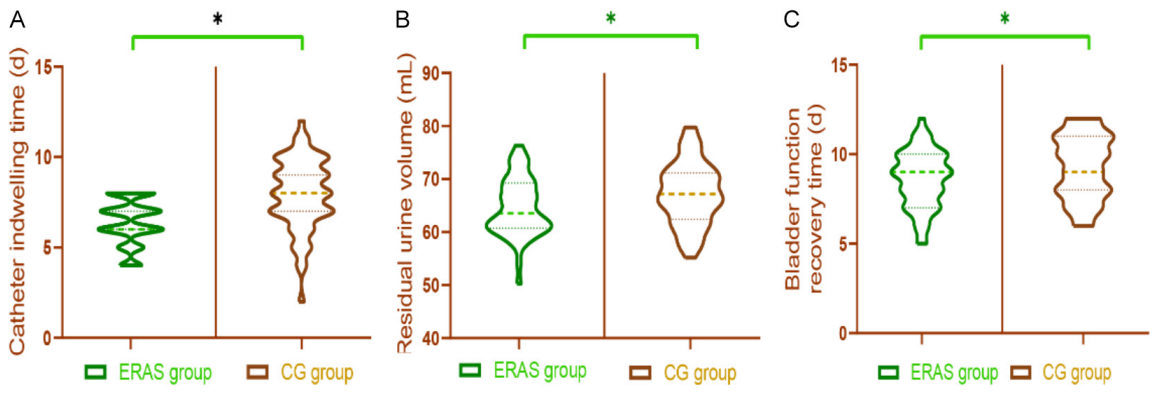

Figure 2. Comparison of bladder function recovery between the two groups. Note: (A) Catheter indwelling time; (B) Residual urine volume; (C) Bladder function recovery time; *P < 0.05; ERAS: Enhanced recovery after surgery; CG group: routine treatment.

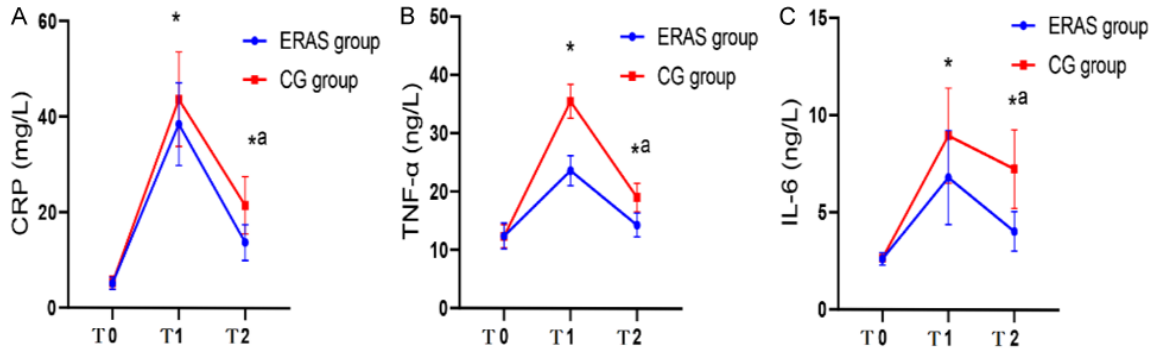

Figure 3. Comparison of inflammatory indicators. Note: (A) CRP; (B) TNF-α; (C) IL-6; ERAS: Enhanced recovery after surgery; CG group: routine treatment; *P < 0.05; CRP: C-reactive protein; TNF-α: tumour necrosis factor-α; IL-6: interleukin-6.

Comparison of inflammatory indicators

Postoperative serum levels of CRP, IL-6, and TNF-α were elevated in both groups compared to preoperative levels (all P < 0.05). However, the levels in the CG group were significantly higher than those in the ERAS group (all P < 0.05). See **Figure 3**.

Comparison of quality of life, sleep and anxiety

Postoperatively, the QLQC30 score in the ERAS group was significantly higher compared to T0, and higher than that in the CG group (P < 0.05). In contrast, PSQI and SAS scores were significantly lower in the ERAS group than in the CG group (both P < 0.05). See **Figure 4**.

Comparison of postoperative complications

The incidence of postoperative urinary tract infection was significantly lower in the ERAS group (7.84%) compared to the CG group (30.16%) (P < 0.05). See **Table 2**.

Comparison of treatment satisfaction

The treatment satisfactionwas significantly higher in the ERAS group (96.08%) than in the CG group (76.19%) (P < 0.05). See **Table 3**.

Discussion

Cervical cancer is one of the four major malignant tumors affecting women worldwide. Radical surgery remains the primary treatment for early-stage cervical cancer; however, surgical trauma often induces stress responses in the body, leading to increased postoperative complications. Optimizing preoperative, intraoperative, and postoperative interventions is essential to achieve the best surgical outcomes [15]. The traditional perioperative care model has

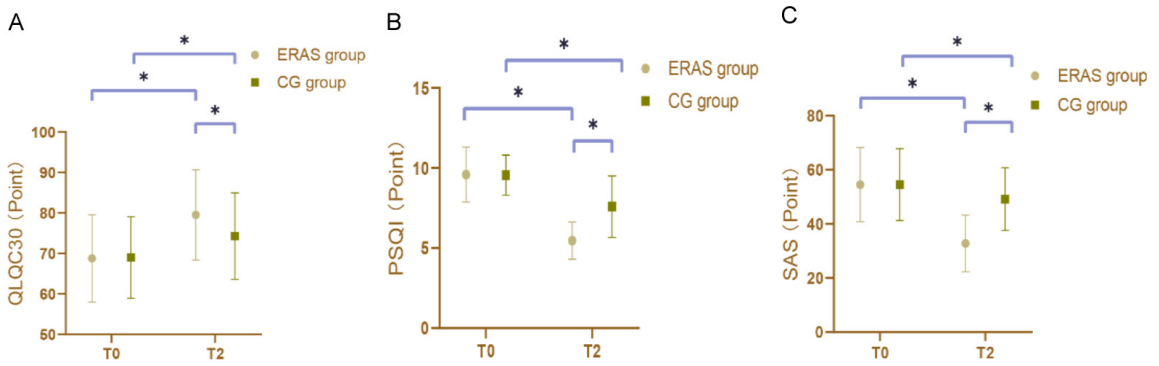

Figure 4. Comparison of quality of life, sleep and anxiety between the two groups. Note: *P < 0.05; (A) QLQC30; (B) PSQI; (C) SAS; ERAS: Enhanced recovery after surgery; CG group: routine treatment; QLQC30: quality of life questionnaire-C30; PSQI: Pittsburgh sleep quality index; SAS: Self-rating Anxiety Scale.

Table 2. Comparison of urinary tract infection between the two groups at 12 days after operation [n (%)]

Urinary tract infection	ERAS group (n = 51)	CG group (n = 63)	χ^2	*P*
Infection	5 (9.80)	18 (28.57)		
uninfected	46 (90.19)	45 (71.43)	6.164	0.013

Note: ERAS: Enhanced recovery after surgery; CG group: routine treatment.

Table 3. Comparison of treatment satisfaction between the two groups [n (%)]

Treatment satisfaction	ERAS group (n = 51)	CG group (n = 63)	χ^2	*P*
Full satisfaction	29 (56.86)	22 (34.92)		
Partially satisfied	20 (39.22)	26 (41.27)		
Dissatisfied	2 (3.92)	15 (23.81)		
satisfaction	49 (96.08)	48 (76.19)	8.786	0.003

Note: ERAS: Enhanced recovery after surgery; CG group: routine treatment.

several drawbacks. For instance, prolonged fasting and excessive bowel preparation before surgery may cause thirst, hunger, gut flora imbalance, and heightened stress responses. Open fluid resuscitation during and after surgery increases cardiac load and tissue edema, raising the risk of perioperative complications and mortality. Intraoperative hypothermia may trigger stress responses during rewarming, impair coagulation and leukocyte function, and heighten the risk of cardiovascular events. Prolonged drainage tube placement after surgery can cause pain, infections, and an exacerbated stress response, stimulating the neuroendocrine system and leading to insulin resistance and multiple organ dysfunction. Incomplete intraoperative and postoperative analgesia further amplifies stress responses. Delayed postoperative mobilization results in muscle strength reduction, muscle mass loss, impaired lung function, diminished antioxidant capacity, venous stasis, and thrombus formation, all of which negatively impact recovery [16, 17]. Therefore, adopting appropriate and efficient perioperative strategies is crucial.

ERAS, also known as fast-track surgery, emphasizes a multidisciplinary approach and evidence-based optimization of perioperative measures. The goal is to minimize patients' physiological and psychological stress responses, thereby accelerating recovery. ERAS has been widely applied in various surgical fields, yielding favorable outcomes [18]. In this study, the ERAS model was applied to the perioperative care of patients undergoing radical abdominal surgery for cervical cancer. Results demonstrated significantly shorter times for postoperative anal exhaust, first defecation, ambulation, and hospital stay in the ERAS group compared to the CG. Moreover, the incidence of postoperative complications was reduced. The ERAS model facilitates postoperative recovery through perioperative measures, including preventive antithrombotic therapy, analgesia, and antibiotic use, as well as early catheter removal and mobilization. These measures improve prognosis, accelerate recovery, and reduce hospitalization time.

Sánchez-Iglesias et al. [19] assessed the impact of fast-track surgery on hospital stay duration in ovarian cancer patients and found that preoperative, intraoperative, and postoperative optimization measures effectively reduced hospital stays. Similarly, Bernard et al. [20] evaluated the application of ERAS in gynecologic cancer patients undergoing laparotomy, reporting a reduction in average hospitalization time. These findings align with this study. Prolonged postoperative intestinal inactivity can lead to complications such as intestinal obstruction, posing significant risks to patient safety. In the ERAS group, early mobilization and gum chewing within 24 hours post-surgery effectively shortened exhaust time. Ertas et al. [21] reported similar findings, indicating that gum chewing during the perioperative period in gynecologic cancer patients shortens postoperative exhaust time. Early mobilization also helps maintain physical function, lowers the risk of complications and infections, and supports recovery, effectively preventing related complications.

The results of this study demonstrated that treatment satisfaction among patients in the ERAS group was significantly higher than that in the CG group. This indicates that implementing the ERAS protocol for radical abdominal surgery in cervical cancer patients effectively improves satisfaction levels, consistent with findings from PRABHU's study [22]. In the ERAS group, shorter hospitalization times, faster recovery, reduced medical expenses, and improved comfort and symptom management during hospitalization were key factors contributing to higher patient satisfaction. The ERAS protocol minimizes stress responses, alleviates postoperative pain, nausea, and vomiting, and effectively enhances overall satisfaction.

As part of the ERAS protocol, patients consumed 400 mL of glucose solution within 2 hours before surgery and liquid food 6 hours after surgery. Previous reports suggest that fasting for only 2 hours help prevent aspiration pneumonia during surgery. Additionally, consuming glucose solution 2 hours preoperatively improve surgical tolerance, reduces anxiety, alleviates hunger, and mitigates insulin resistance [23].

This study found that compared to T0, the postoperative QLQ-C30 scores in the ERAS group were significantly higher, while pSQI and SAS scores were notably lower compared to the CG group. The reasons for these findings are as follows: (1) Optimized perioperative measures: The ERAS protocol included preoperative education, reduced fasting periods (2 h-6 h-8 h regimen), and oral administration of 10% carbohydrate solution 2 hours before surgery. Immediate postoperative feeding further mitigated hunger-induced insulin resistance. (2) Focus on mental health: The ERAS protocol emphasized addressing patients' mental health by conducting regular psychological assessments and resolving emotional issues such as anxiety, fear, and depression. Disease education and psychological counseling helped patients better understand their condition and surgical procedures, reducing fear and anxiety and improving their psychological well-being.

CRP, IL-6, and TNF-α are commonly used clinical markers of inflammation, with their levels directly reflecting the severity of various types of inflammatory damage [24]. In this study, inflammatory response indicators at T1 were significantly higher than at T0 in both groups, indicating that surgical trauma induced systemic inflammatory responses. Although some indicators began to decrease at T2, they remained higher than baseline levels (T0). Moreover, the postoperative inflammatory markers in the ERAS group were lower than those in the control group, demonstrating that the ERAS protocol mitigated the inflammatory response more effectively. These findings are consistent with those reported by Wang et al. [25], highlighting that ERAS interventions can reduce the release of inflammatory cytokines, lower inflammation-related complications, and promote faster postoperative recovery.

Despite these benefits, implementing the ERAS protocol for perioperative management in patients undergoing radical cervical cancer surgery poses challenges. Effective execution requires close collaboration among surgical, anesthetic, nursing, and nutritional teams. In practice, poor interdisciplinary coordination can hinder the successful implementation of ERAS protocols [26]. Additionally, the application of ERAS in surgical perioperative management remains in an exploratory stage, with theoretical frameworks often outpacing practical adoption, and no unified expert consensus has been established [27]. Furthermore, there is a notable lack of large-scale, long-term prospective studies evaluating the safety and effi-

cacy of ERAS interventions [28]. Collecting more clinical data on transabdominal radical hysterectomy is essential for continuous refinement and optimization of the ERAS protocol.

In summary, the application of the ERAS protocol in patients undergoing transabdominal radical hysterectomy for cervical cancer significantly reduces surgical trauma and stress responses, lowers inflammatory factor levels, preserves immune function, enhances anti-tumor capacity, improves nutritional status, accelerates postoperative recovery, and enhances quality of life. The ERAS protocol is highly suitable for clinical implementation and promotion.

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Disclosure of conflict of interest

None.

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