The Impact of Perioperative Comfort Nursing Combined With Targeted Operating Room Nursing on Postoperative Stress Response and Nursing Satisfaction in Colorectal Cancer Patients

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AIM: This study aims to explore the impact of perioperative comfort nursing combined with targeted operating room nursing on the stress response and nursing satisfaction in colorectal cancer patients, emphasizing the importance of precision nursing in enhancing postoperative recovery.

METHODS: This retrospective study analyzed clinical data of colorectal cancer patients (n = 165) who underwent laparoscopic colorectal surgery at our hospital between February 2022 and February 2024. Grouped according to different perioperative nursing methods, and the patients were divided into two groups: the experimental group (n = 85) and the control group (n = 80). The control group received routine operating room nursing, while the experimental group received comfort nursing in addition to targeted operating room care. The differences in the impact of the two nursing models on patients' surgical-related indicators, stress response measured by Serum Amyloid A (SAA), Interleukin-6 (IL-6), and C-reactive protein (CRP) levels, pain scores, as well as nursing satisfaction, postoperative follow-up status, were evaluated and compared between the two groups.

RESULTS: The experimental group demonstrated significantly shorter postoperative times to first flatus, first out-of-bed activity, first oral intake, length of hospital stay, anastomotic healing time, and postoperative infection rate compared to the control group ($p < 0.05$). On days 1 and 2 after surgery, SAA, IL-6, and CRP levels were elevated in both groups compared to their preoperative levels, with the experimental group showing significantly lower levels than the control group ($p < 0.05$). Furthermore, on postoperative days 1, 3, and 7, the Visual Analog Scale (VAS) scores were significantly lower in the experimental group ($p < 0.05$). In contrast, nursing satisfaction was significantly higher in the experimental group than in the control group ($p < 0.05$). Six months and one year after surgery, the experimental group showed significantly higher scores on the Barthel index and the Quality-of-Life Questionnaire Core 30 (QLQ-C30) compared to the control group, while their Hamilton Anxiety Scale (HAMA) and Self-Rating Depression Scale (SDS) scores were significantly lower ($p < 0.05$).

CONCLUSIONS: Integrating comfort nursing with a targeted operating room nursing approach during laparoscopic colorectal cancer surgery helps promote early recovery, alleviate postoperative pain and stress response, improve nursing satisfaction, and promote patient recovery. The effectiveness of nursing interventions may partly depend on the stability of surgical techniques; further verification is needed through multi-center, large-sample studies. The synergistic effect of both factors contributes to the patient's recovery.

Keywords: comfort nursing; targeted operating room nursing; colorectal cancer; laparoscopic colorectal surgery

Introduction

Colorectal cancer is a common malignancy affecting the digestive system. Radical surgery is an effective method for early treatment. The development of laparoscopic approaches has significantly enhanced the landscape of colorectal surgery in China, providing widespread application in clinical settings [1]. Compared with traditional open surgical procedures, laparoscopic surgery offers minimal invasiveness, lower pain, less intraoperative bleeding, and faster recovery time [2]. However, surgical interventions can induce various physiological stress responses in patients, affecting surgical outcomes, delaying postoperative recovery, and increasing the risk of complications. Some patients may experience psychological challenges such as presurgical anxiety, which can exacerbate stress responses, significantly affecting postoperative physical and mental recovery [3,4]. Therefore, effective nursing interventions are crucial to enhancing early recovery.

Routine nursing is a fundamental and widely used strategy in traditional clinical care; however, with continuous advancements in medical technology, the limitations of conventional nursing models are becoming more evident. This is particularly true for patients who require specialized care, where routine nursing practices may not address their individualized needs. Specifically, the routine nursing model presents several key drawbacks:

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(1) Lack of individualized care—routine nursing typically relies on standardized care plans that fail to adjust to the patient's specific condition, psychological state, and postoperative recovery process [5]. For example, colorectal cancer patients often experience significant physiological and psychological stress after surgery. In such cases, conventional nursing practices may not effectively address their physical discomfort or psychological stress, potentially impacting the speed of recovery. (2) Inconsistent quality of care—routine nursing may vary in quality due to differences in nurse experience, workload, and available resources, especially in complex or high-risk surgeries like colorectal cancer [6]. (3) Lack of psychological support and emotional management—the routine nursing model often emphasizes physiological care, such as medication and wound management, while often neglecting the significance of psychological counseling and emotional support [7]. Colorectal cancer patients experience significant physical and psychological stress after surgery, and routine nursing often does not adequately address these emotional and psychological needs [8]. (4) Delayed response to rehabilitation needs—traditional nursing often follows predetermined stages guided by the patient's condition rather than adjusting dynamically to their real-time needs, which may affect recovery. (5) Limited prevention of complications—while routine nursing provides basic postoperative care, its effectiveness in reducing postoperative complications such as wound infections or anastomotic leaks is limited. Especially for high-risk patients, conventional nursing often fails in conducting detailed assessments and interventions to address potential risk factors.

Despite its limitations, routine nursing continues to play a foundational role in clinical care. It provides necessary physiological care and ensures patient safety and comfort to some extent. For patients who do not require highly individualized care, routine nursing remains an effective and vital strategy. However, as patient treatment needs become more diverse, especially for high-risk postoperative patients, the traditional nursing model no longer comprehensively addresses the rehabilitation needs of patients. Therefore, introducing innovative nursing models, such as combining targeted operating room care with comfort-centered nursing, is particularly crucial.

Targeted operating room nursing can address the specific needs of patients undergoing surgery by providing tailored nursing plans to improve care quality, addressing psychological issues, physiological responses, and environmental factors [9,10]. Additionally, perioperatively, patients often experience negative emotions such as irritability and anxiety, and the traumatic nature of surgery can reduce their overall comfort [11,12]. Hence, comfort-focused nursing becomes essential in alleviating negative emotions, enhancing patients' quality of life, and preventing complications such as wound infections and anastomotic leakages. Therefore, this study investigates the application of comfort nursing in combination with targeted operating room nursing during laparoscopic colorectal cancer surgery.

Materials and Methods

Recruitment of Research Subjects

This retrospective study collected clinical data from 165 colorectal cancer patients treated at West China Hospital, Sichuan University, between February 2022 and February 2024. These patients were divided into two groups: 85 in the experimental group and 80 in the control group. Ethical approval was obtained from the Ethics Committee of West China Hospital, Sichuan University (Approval no. 2021-1699). The patient enrollment process is shown in Fig. 1.

The inclusion criteria for patient selection were as follows: (1) patients who were eligible for laparoscopic colorectal cancer radical surgery; (2) patients who had not received any invasive treatment, radiotherapy, or chemotherapy in the past 3 months; (3) patients with normal cognition and clear consciousness; (4) those with complete clinical data.

The exclusion criteria included: (1) patients with severe infections, coagulopathy, or other gastrointestinal diseases; (2) those with abnormal liver or kidney function, or with other malignant tumors; (3) patients with poorly controlled blood pressure, blood sugar, or heart rate; (4) those with cognitive abnormalities, mental disorders, or communication barriers; (5) patients with contraindications for surgery.

Treatment Protocols

As a retrospective study, the surgical procedures and nursing methods were documented from the existing case records. All patients in both groups underwent laparoscopic radical resection of colorectal cancer, following the steps below: (1) The patient was placed in the lithotomy position, with the legs elevated and the head lowered. (2) General anesthesia was administered using continuous endotracheal intubation and epidural anesthesia. Pneumoperitoneum pressure was maintained at 12–14 mmHg, and a four-port laparoscopic technique was employed. (3) For female patients with mid- to low-lying colorectal cancer complications, a purse-string needle was inserted into the abdominal cavity and suspended on the ligaments at both ends of the uterus through the abdominal wall to enhance the surgical field of view. (4) For intestinal segments with tumors located more than 2 cm from the resection margin, an enlarged left abdominal port was used. A plastic bag was applied to protect the surgical wound during specimen retrieval. After extracting the tumor and the corresponding intestinal segment, the proximal cecum and tumor were excised. An anastomosis device was placed at the proximal end of the colon, the incision was sutured, and a drainage tube was placed.

The control group received routine operating room nursing, which included preoperative, intraoperative, and postoperative care: (1) During preoperative care, patients were given basic education. They were verbally informed about

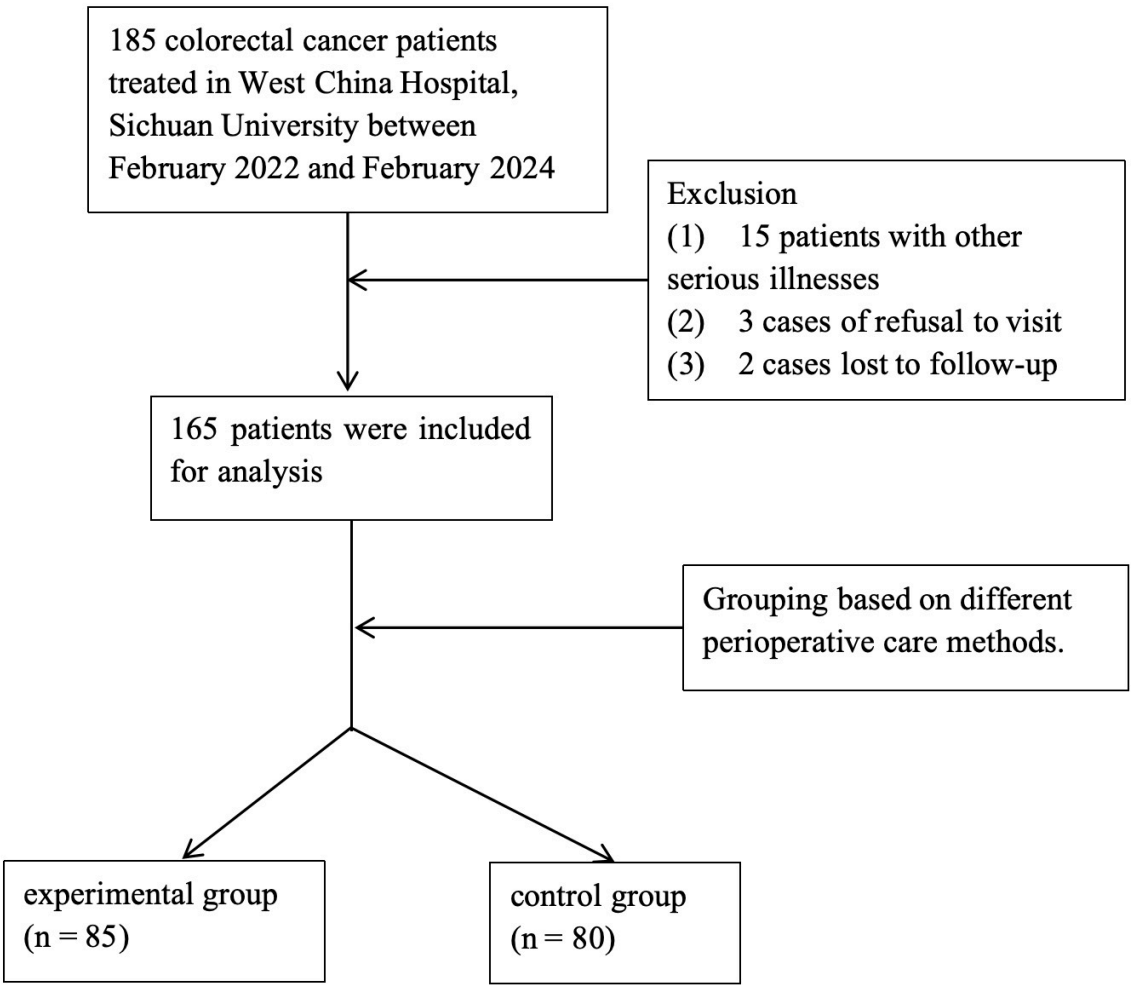

Fig. 1. A flow chart of the study design and patient grouping.

the surgery process, postoperative dietary transition (clear liquids → liquids → soft foods → regular diet), and the requirements for smoking and drinking cessation. A broad-spectrum antibiotic was intravenously administered 30 minutes before surgery (covering aerobic and anaerobic bacteria). If the blood loss was expected to be ≥500 mL or the surgery lasted for ≥3 hours, an additional dose was given during the procedure. Routine shaving and skin preparation were conducted at the surgical site, followed by alcohol disinfection. Furthermore, patients received preoperative gastrointestinal care, where measures were taken to minimize intraoperative contamination and postoperative bloating, and to reduce the risk of wound infection. Patients are instructed to fast for 12 hours before surgery and refrain from drinking water for 6 hours. Three days before surgery, patients were advised to take poorly absorbed antibacterial drugs to prevent gastrointestinal infections. One day before surgery, two rounds of soap water enema were performed to reduce the risk of contamination during the procedure. Postoperatively, certain measures were taken to prevent incision infections and abdominal cavity complications, promoting better anastomosis healing. (2) Intraoperative care included anesthesia management, environmental control, and instrumental management. General anesthesia with tracheal intubation was administered, with the depth of anesthesia routinely adjusted by the anesthesiologist. The operating room temperature was maintained at 24–26 °C, and the abdominal cavity was irrigated with room temperature saline. Furthermore, instruments were passed according to standard procedures, and items were counted after surgery. (3) Postoperative care includes various crucial measures. On the first day after surgery, patients are encouraged to move in bed. On days 2 and 3, after the removal of the urinary catheter, patients were encouraged to get out of bed. Furthermore, Abdominal drainage tubes (23 tubes), gastric tubes, and urinary catheters were routinely fixed. These tubes were regularly monitored and were removed on postoperative days 4–5. Similarly, postoperative pain was managed through oral or intravenous analgesics as required. Additionally, patients received nutritional support starting on postoperative days 4–6, and continuous postoperative electrocardiogram (ECG) monitoring was conducted to observe the patient's heart function.

The experimental group received a combination of targeted operating room nursing and comfort nursing. The targeted operating room nursing approach consisted of the following measures.

(1) Preoperative visit: The lack of the patient's knowledge regarding laparoscopic colorectal cancer surgery often results in fear and negative emotions. Therefore, the surgical nursing staff visited the patient one day before surgery, where they introduced themselves, reviewed medical records, explained the surgical environment, and described the anesthesia method. Emphasis was placed on the significant advantages of laparoscopic surgery, such as shorter hospital stays, fewer complications, no impact on immune function, quicker recovery, minimal postoperative pain, early resumption of eating, less bleeding, and minimal tissue damage. Additionally, the surgical method and key cooperation points were explained, successful cases were shared, and psychological counseling was provided to alleviate patient anxiety and encourage active participation in the surgery.

(2) Structured psychological intervention: Patients were provided with cognitive behavioral intervention. On the day before surgery, a nurse provided a 30-minute bedside visit, explaining the advantages of laparoscopic surgery (such as less trauma and faster recovery) with visual aids like pictorial handouts and videos, along with three successful case studies. Furthermore, patients were provided with individualized education based on their literacy levels. For example, using dialects if required, and anxiety score for patients with a self-rating anxiety scale (SAS) score $\geq$50, and daily psychological counseling was also provided.

(3) Optimized skin and gastrointestinal preparation: Hair at the surgical site was trimmed using an electric hair trimmer (1 mm) rather than a blade, followed by iodine disinfection (0.5% solution) in a spiral motion (alcohol in the control group). Moreover, for gastrointestinal preparation, oral Rifaximin (200 mg tid) was administered three days before surgery to inhibit intestinal flora. On the day before surgery, patients received polyethylene glycol electrolyte solution (2000 mL/4 h) in multiple doses. Additionally, enema solution pre-heated at 37–38 °C was also used, while the control group used room-temperature soap water.

(4) Surgical instrument preparation: Laparoscopic equipment function was thoroughly monitored. Two hours before surgery, a specialized nurse examined the insufflation machine's pressure calibration, lens anti-fogging performance (pre-heating to 40 °C), and applied medical lubricant to the instruments to prevent jamming. Additionally, to set a sterile field, instruments were arranged in a specific order: "camera system $\rightarrow$ separating forceps $\rightarrow$ ultrasonic knife $\rightarrow$ anastomosis device", with wires fixed in a tension-free, arc-shaped pattern.

(5) Instrument care team cooperation: Twenty minutes before surgery, the nursing staff organized and examined surgical instruments to avoid any procedural failure. Instruments were placed on the sterile table in order of use and adjusted to ensure timely and accurate delivery during surgery. The surgical team was advised to actively assist with the surgical tasks, and the nursing staff was instructed to frequently wipe the lens with iodine gauze to avoid fogging and ensure optimal visibility.

(6) Circulating nurse cooperation: Upon entry to the operating room, the circulating nurse greeted the patient, provided psychological comfort, and helped position them gently.

However, comfort nursing included the following measures.

(1) Preoperative care: On the day before surgery, the nursing staff conducted a comprehensive assessment of the patient's psychological state. Based on the patient's cognitive level, gender, age, and education, information about colorectal cancer was provided. The patients were encouraged to familiarize themselves with the hospital environment and understand the importance of early ambulation. They were encouraged to practice bed-bound bowel movements and limited limb movements. Sedative medications were administered to patients with poor sleep quality. The anesthetist, the responsibility nurse, and the circulating nurse reviewed anesthesia methods, key surgical points, and provided preoperative guidance to alleviate surgical anxiety. Patients were guided to drink glucose-sodium chloride solution and magnesium sulfate solution to aid in bowel movements, and a warm enema was performed on the day of surgery.

(2) Intraoperative care: Various measures were taken during the procedure, including temperature control, privacy protection, patient handling, instrument collaboration, sensory intervention, and comfortable positioning. The operating room temperature and humidity were adjusted before the patient entered, and a 38 °C warming blanket was applied. The abdominal cavity irrigation fluid was heated to 37 °C. Core body temperature was monitored in real-time (maintained at $\geq$36 °C). Patient privacy was ensured by covering non-surgical areas with sterile drapes, and a silicone hip pad was placed after anesthesia induction to relieve pressure from the lithotomy position. Furthermore, patients were carefully handled, particularly when moving them to avoid bumps and injuries. Laparoscopic lenses were cleaned with iodine-soaked gauze every 15 minutes, and the smoke evacuation system was activated if the insufflation pressure exceeded 14 mmHg. For sensory intervention, noise-reducing headphones were used to play alpha wave music (60 dB, 812 Hz) during surgery, and lemon-scented wet cotton swabs were applied to moisten the patient's lips every 30 minutes. For comfortable positioning of the patients, a gel positioning pad was used to distribute pressure ($<$32 mmHg), and non-slip silicone shoulder pads were used when the patient is in a head-down, foot-up position (tilt angle $\leq$20°). Upon entering the operating room, the patient should be comforted with soft touch and reassuring words.

(3) Postoperative care: Vital signs were monitored every half hour, reducing to every 1–2 hours when stabilized. Biochemical and routine blood analysis were performed for patients with electrolyte imbalances or hypokalemia. Continuous oxygen therapy was administered at 3–5 hours, with careful monitoring of oxygen saturation and respiratory status. Upon shifting the patient to the ward, tubes such as the urinary catheter, abdominal drainage, gastric tube, and intravenous catheter were carefully checked to prevent twisting or kinking, and patients and their families were instructed about the importance of these tubes. The drainage output was monitored for color, quantity, and quality, and regular oral hygiene was applied. During the 4–8 days postsurgery, careful observation of abdominal signs, drainage output, and color is required to prevent complications such as anastomotic leaks. The patients were encouraged to attain a supine position and avoid abrupt posture changes, with gradual position changing every 2 hours.

Furthermore, for systematic pain management, patients received multimodal analgesia. Intravenous parecoxib sodium (40 mg) and local anesthesia with 0.25% ropivacaine (10 mL) were administered at the abdominal incision. Moreover, patients received a non-pharmacological intervention initiated 6 hours after surgery. Cold compress bags were applied to the incision site every 2 hours (20 minutes per session), and breathing exercises were taught at a rate of 3 sets per day (10 repetitions each).

Patients also underwent goal-oriented early rehabilitation. On postoperative day 1, the bedhead was elevated to 30° for turning. On day 2, patients were assisted to sit at the bedside (target heart rate increase $\leq$20%). On day 3, patients were assisted to walk 5 m (Borg rating $\leq$3, the Borg rating is a scale used to assess the subjective perception of exercise intensity and physical exertion) and encouraged to perform simple bedside activities such as sitting and standing.

To address the risk associated with the tube, drainage tubes were fixed using the "high platform method", with monitoring of drainage volumes. A warning drainage volume was set for an increase of $\geq$50 mL within 24 hours.

Additionally, to provide continuing support, a patient discharge plan was prepared. A personalized nutrition plan was developed (e.g., a low-residue diet for up to 14 days post-surgery), and rehabilitation videos were shared daily via a WeChat mini-program for 7 days.

Observational Indicators

As this was a retrospective study, the outcome indicators were obtained from existing medical records.

Surgical-related Indicators

These indicators included time to first postoperative flatus, time to first out-of-bed activity, time to first oral intake, length of hospital stay, time to anastomotic healing, and postoperative infection rate. Anastomotic healing time was assessed through the following methods: ① Clinical observations: Physicians monitored clinical signs, such as the return of bowel function (e.g., passage of flatus and stool). ② Imaging examination: Postoperative radiological examinations, such as contrast studies, were used to evaluate the healing of the anastomosis. ③ Surgical records: Intraoperative findings and postoperative evaluations were recorded to track anastomotic recovery.

Stress Response Indicators

Peripheral venous blood samples (5 mL) were collected from both groups before surgery and on postoperative days 1 and 2. Blood was stored in pre-chilled tubes and centrifuged using a Beckman Coulter centrifuge. Enzyme-linked immunosorbent assays were used to measure the serum levels of Interleukin-6 (IL-6), Serum Amyloid A (SAA), and C-reactive protein (CRP) in both groups.

Postoperative Pain Assessment

Postoperative pain was assessed on days 1, 3, and 7 using the Visual Analog Scale (VAS) [13], ranging from 0 to 10, with a higher score indicating more severe postoperative pain.

Patient Satisfaction

Patient satisfaction was assessed using the Newcastle Scale [14], which measures several dimensions, including professionalism and technical competence of healthcare providers, communication abilities, accessibility and responsiveness of nursing care, and patient involvement and information sharing. The total score ranged from 0 to 100 points. A score of $>$80 points was considered satisfied, 60–80 points were considered moderately satisfied, and $<$60 points was considered dissatisfied. Overall satisfaction rate was calculated as: (number of satisfied + moderately satisfied patients/total number of patients) $\times$ 100%.

Postoperative Follow-up

The recovery and quality of life of patients were evaluated at 6 months and 1 year after surgery. Follow-up assessments included:

(1) Functional recovery: The Barthel index [15] was used to assess activities of daily living (ADLs), reflecting self-care ability. The index includes 10 items, with a maximum score of 100. Patient scores were interpreted as follows: 0–20 points indicated complete dependence, 21–60 points represented partial dependence, and 61–100 points reflected essential independence.

(2) Quality of life: Quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC QLQ-C30) [16], a questionnaire specifically designed for cancer patients. It covers functional status, symptom burden, and overall health status. Score for each functional and symptom item ranges from 0 to 100, with higher scores indicating better functioning or fewer symptoms.

(3) Psychological status: Hamilton Anxiety Scale (HAMA) [17] was used to assess postoperative anxiety. It includes 14 items each scored 0 to 4, with a total score ranging from 0 to 56. Patient scores were interpreted as follows: $\leq$7 points indicate no anxiety symptoms, 7–13 points indicate possible anxiety, 14–20 points indicate definitely anxiety, 21–28 points indicate definitely obvious anxiety, and $\geq$29 points indicate severe anxiety. The Self-Rating Depression Scale (SDS) [18] was used to evaluate postoperative depressive symptoms. The scale included 20 items scored from 1 to 4. Total scores were interpreted as follows: below 53 points showed normal, 53–62 points indicated mild depression, 63–72 points represented moderate depression, and 72 points and above indicated severe depression.

Statistical Methods

Statistical analysis was performed using SPSS 21.0 (IBM, Armonk, NY, USA) and GraphPad Prism 8.0.2 (GraphPad Software, Inc., San Diego, CA, USA). The Shapiro-Wilk test was used to examine the normality of the data. Normally distributed continuous variables were expressed as mean $\pm$ SD. Group comparisons were performed using independent sample *t*-tests and repeated measures Analysis of Variance (ANOVA) with post-hoc analysis. Categorical variables were represented as frequency and percentage (%), with group comparisons performed using the chi-square test or Fisher's exact test, as appropriate. The *p*-value of $<$0.05 indicated a statistical significance.

Results

Comparison of Baseline Characteristics Between the Two Groups

The baseline clinical and demographic characteristics of both the experimental and control groups are detailed in Table 1. There were no statistically significant differences in baseline characteristics between the two groups ($p > 0.05$).

Comparison of Surgery-related Indicators Between the Two Groups

The experimental groups showed substantially earlier postoperative recovery, including shorter times of the first flatus, first out-of-bed activity, first oral intake, length of hospital stay, and anastomotic healing, compared to the control group. Furthermore, the postoperative infection rate was significantly lower in the experimental group than the control group ($p < 0.05$, Table 2).

Stress Response Indicators Across the Two Groups

On days 1 and 2 after surgery, SAA, IL-6, and CRP levels were elevated in both groups compared to their preoperative levels, with the experimental group showing significantly lower levels than the control group ($p < 0.05$, Table 3). After Bonferroni corrections, the decrease in SAA, IL-6, and CRP levels remained statistically significant in both groups after intervention, indicating an improvement in postoperative inflammatory response.

Bonferroni correction for SAA, IL-6, and CRP was as follows:

1. Number of comparisons (m): 3 (before surgery, 1 day after surgery, 2 days after surgery).
2. Significance level (α): Usually set to 0.05.

The Bonferroni-adjusted significance level (α') was calculated as:

$\alpha' = \alpha/m = 0.05/3 = 0.017$.

When comparing the pre- and post-intervention values, the original *p*-values were all $<$0.001, which is below the threshold of 0.017.

Comparison of Postoperative Pain Between the Two Groups

On postoperative days 1, 3, and 7, the VAS pain scores were substantially lower in the experimental group than the control group ($p < 0.05$, Table 4). However, after applying Bonferroni correction, the decrease in VAS scores remained statistically significant in both groups after the intervention, suggesting effective postoperative pain relief.

Nursing Satisfaction

The nursing satisfaction scores were significantly higher in the experimental group than in the control group ($p < 0.05$, Table 5).

Comparison of Postoperative Follow-up Outcomes Between the Two Groups

During both 6 months and 1 year after surgery, the experimental group showed significantly higher scores on the Barthel index and the QLQ-C30 questionnaire across various dimensions compared to the control group. Additionally, the experimental group demonstrated significantly lower HAMA and SDS scores ($p < 0.05$, Tables 6,7,8). After the intervention, the differences between the two groups in Barthel index, QLQ-C30, HAMA and SDS scores were statistically significant, and this conclusion still holds after Bonferroni correction.

Discussion

The primary treatment options for colorectal cancer include chemotherapy and surgical intervention. The laparoscopic colorectal cancer resection is the most widely adopted treatment strategy due to its favorable therapeutic outcomes, significantly reducing postoperative pain [19]. Beyond achieving effective therapeutic outcomes, it is crucial to optimize perioperative nursing care through comprehensive patient support and education. The combination of comfort nursing combined with targeted operating room nursing models has proven to be crucial in the context of laparoscopic colorectal cancer resection [20]. The targeted operating room nursing model provides comprehensive care throughout the preoperative, intraoperative, and postoper-

Table 1. Comparison of baseline characteristics between the two groups.

Variable	Experimental group (n = 85)	Control group (n = 80)	χ^2/t	*p*-value
Age (years)	46.35 ± 5.65	45.46 ± 5.32	1.030	0.305
Gender (male/female)	45/40	40/40	0.143	0.706
Dukes staging				
Phase A	22 (25.88)	24 (30.00)		
Phase B	40 (47.06)	43 (53.75)	2.824	0.244
Phase C	23 (27.06)	13 (16.25)		
Disease type				
Colon cancer	50 (58.82)	35 (43.75)	3.749	0.053
Rectal cancer	35 (41.18)	45 (56.25)		
Disease duration (months)	7.05 ± 1.50	7.30 ± 1.45	1.082	0.281
BMI (kg/m^2)	22.98 ± 1.50	23.05 ± 1.43	0.307	0.759
Smoking history (%)	27 (31.76)	21 (26.25)	0.608	0.436
Underlying disease (%)				
Diabetes	26 (30.59)	21 (26.25)	0.381	0.537
Hypertension	22 (25.88)	18 (22.50)	0.257	0.612
Hyperlipidemia	37 (43.53)	32 (40.00)	0.211	0.646
Obesity	28 (32.94)	21 (26.25)	0.884	0.347
Family history of colorectal cancer	5 (5.88)	8 (10.00)	0.963	0.327
Operative time (min)	133.51 ± 16.85	128.91 ± 18.50	1.672	0.097
Tumor markers CEA (ng/mL)	15.11 ± 3.40	14.85 ± 3.80	0.446	0.656

Abbreviations: BMI, Body Mass Index; CEA, Carcinoembryonic Antigen.

Table 2. Comparison of surgery related indicators ($\bar{x}$ ± s, d).

Group	n	Postoperative time to the first flatus	Time to first out-of-bed activity	Time to first oral intake	Length of hospital stay
Experimental group	85	2.10 ± 0.35	1.83 ± 0.57	4.07 ± 0.28	13.10 ± 2.05
Control group	80	2.41 ± 0.19	3.35 ± 0.68	4.82 ± 0.45	16.21 ± 2.86
t	-	7.240	15.621	12.723	8.010
p-value	-	<0.001	<0.001	<0.001	<0.001

ative stages, effectively addressing the limitations of conventional nursing strategy and improving the quality of minimally invasive procedures [21]. Meanwhile, comfort nursing emphasizes the environmental, psychological, and physiological dimensions, aiming to enhance patient well-being, improve treatment adherence, and promote postoperative recovery [22].

Our study reveals that the experimental group experienced significantly better postoperative recovery outcomes compared to the control group. This suggests that comfort nursing combined with targeted operating room nursing can significantly improve postoperative recovery speed and reduce postoperative stress responses, thereby promoting faster patient recovery. However, while these positive clinical outcomes are notable, it is important to delve deeper into the underlying mechanisms for this nursing intervention and explore possible alternative explanations.

This study can be interpreted through comfort theory and the biopsychosocial model. Comfort theory emphasizes the need for patients across physiological, psychological, social, and environmental domains to enhance overall well-being. In contrast, the biopsychosocial model highlights the importance of physiological, psychological, and social factors in affecting health outcomes and recovery.

This study involves two intervention mechanisms, comfort nursing and the targeted operating room nursing model. Comfort nursing aims at improving the overall well-being of the patient by addressing both physical and emotional needs through a series of supportive approaches, such as environmental optimization, emotional support, pain management, and psychological intervention [23]. In the experimental group of this study, comfort care significantly promoted postoperative recovery, which can be attributed to the following mechanisms. Environmental adaptation: By adjusting factors like lighting, temperature, and noise levels, the operating environment can substantially reduce stress and enhance psychological comfort, contributing to reduced postoperative anxiety and improved postoperative outcomes. Pain management: Structured pain assessment and multimodal pain relief protocols reduce postoperative pain, enabling early mobilization and oral intake [24]. Psychological support: Emotional reassurance and empathetic

Table 2. Continued.

Group	n	Anastomotic healing time (d)	Postoperative infection rate (%)
Experimental group	85	6.35 ± 1.50	5 (5.88)
Control group	80	9.35 ± 2.10	15 (18.75)
χ^2/t		10.604	6.406
p-value		<0.001	0.011

Table 3. Comparison of stress response indicators ($\bar{x} \pm s$).

Group	n	IL-6 (pg/mL)			*F* (time × group)	*p*-value
		Before surgery	1 day after surgery	2 days after surgery		
Experimental group	85	24.50 ± 6.75	34.85 ± 7.54	42.61 ± 8.25	22.577	<0.001
Control group	80	25.01 ± 6.53	45.16 ± 8.04	53.75 ± 9.86		
F (time)			364.849			
p-value			<0.001			
Group	n	SAA (mg/L)			*F* (time × group)	*p*-value
		Before surgery	1 day after surgery	2 days after surgery		
Experimental group	85	46.30 ± 6.83	56.71 ± 7.35	60.95 ± 7.52	25.878	<0.001
Control group	80	47.11 ± 6.83	67.05 ± 8.15	73.21 ± 8.85		
F (time)			308.834			
p-value			<0.001			
Group	n	CRP (mg/L)			*F* (time × group)	*p*-value
		Before surgery	1 day after surgery	2 days after surgery		
Experimental group	85	35.75 ± 5.95	43.50 ± 7.54	50.65 ± 8.10	42.524	<0.001
Control group	80	36.10 ± 6.10	58.32 ± 9.68	65.37 ± 10.25		
F (time)			312.355			
p-value			<0.001			

IL-6, Interleukin-6; SAA, Serum Amyloid A; CRP, C-reactive protein.

communication from the healthcare providers boost patient confidence and engagement in the recovery process, resulting in enhanced cooperation and reduced emotional distress.

Furthermore, the targeted operating room nursing approach delivers targeted perioperative care that focuses on the patient's individual characteristics and clinical condition. During personalized care plans, nursing protocols are customized to address individualized specific medical and psychosocial needs, ensuring that interventions are timely and effective, thereby optimizing the recovery processes [25]. Information sharing and communication are also crucial in targeted operating room nursing. Providing adequate explanations about the surgical procedure, postoperative expectations, and potential risks reduces preoperative anxiety and improves patient preparedness and cooperation during the surgical process [26]. Additionally, patients are physiologically monitored during targeted operating room care. Continuous observation and timely management of physiological parameters (such as heart rate and blood pressure) enables early detection of complications, improving postoperative safety and outcomes.

Our study indicates that the application of comfort nursing combined with targeted operating room nursing during the perioperative period significantly reduces postoperative stress responses in patients undergoing colorectal cancer surgery. The observed improvements in stress-related indicators in the experimental group align with existing literature, which underscores the importance of psychological support and comprehensive nursing care in improving postoperative recovery outcomes in surgical patients [27]. To better understand the underlying mechanisms and clinical significance of these findings, we applied contemporary theoretical frameworks as follows:

(1) Role of psychological intervention: The core of comfort care lies in improving the patient's psychological well-being to reduce physiological stress responses. Psychological factors play a significant role in the recovery of surgical patients [28]. Preoperative anxiety and fear lead to enhanced stress responses, releasing more stress hormones (such as cortisol), which in turn affects immune system function. By providing psychological support, informational education, and emotional care, patients' psychological burdens are alleviated, thereby reducing postoperative stress responses.

(2) Efficacy of attentive, targeted nursing: Targeted nursing emphasizes individualized and patient-centered care strategies that address the unique physiological and psychological needs of each patient [29]. Strategies such as detailed preoperative education, personalized surgical guid-

Table 4. Comparison of VAS scores between two groups ($\bar{x} \pm s$, scores).

Group	n	1 day after surgery	3 days after surgery	7 days after surgery	F (time × group)	p-value
Experimental group	85	6.29 ± 1.20	3.49 ± 0.95	1.33 ± 0.59	3.374	0.038
Control group	80	7.84 ± 1.46	5.36 ± 1.48	3.50 ± 0.73		
F (time)			746.183			
p-value			<0.001			

VAS, Visual Analog Scale.

Table 5. Comparison of nursing satisfaction (n (%)).

Group	n	Satisfied	Moderately satisfied	Dissatisfied	Degree of satisfaction
Experimental group	85	48 (56.47)	33 (38.82)	4 (4.71)	81 (95.29)
Control group	80	34 (42.50)	29 (36.25)	17 (21.25)	63 (78.75)
χ^2	-				10.155
p-value	-				0.001

ance, early mobilization, and proactive pain management enhance patients' confidence and a sense of safety. This tailored care promotes greater cooperation during the postoperative recovery process, resulting in reduced physiological stress and a lower incidence of postoperative complications.

(3) Impacts on biomarkers: Inflammatory biomarkers such as IL-6 and CRP are key indicators of inflammation and physiological stress. Research has shown that improvements in psychological states directly influence the levels of these biomarkers. By reducing anxiety and emotional distress through comfort care and targeted nursing, patients experience a corresponding decline in inflammatory responses. This decrease in biomarker levels indicates a lower physiological stress response, improving tissue healing and immune recovery. Clinically, this mechanism is important because reducing postoperative inflammation not only promotes recovery but also shortens hospital stays and alleviates overall healthcare costs.

(4) Role of social support and environmental factors: Comfort nursing also highlights the role of optimizing the care environment and strengthening social support. A calm, clean, and well-organized operating room combined with empathetic, communicative nursing staff enhances patients' sense of safety and satisfaction, further promotes patient comfort and reduces procedural stress. Furthermore, emotional support from both healthcare providers and family members enhances the patient's psychological resilience, alleviates feelings of loneliness, and increases a sense of security.

In a study by Li *et al.* [30], 100 colorectal cancer patients undergoing laparoscopic surgery were randomly divided into an experimental group and a control group. The experimental group received systematic, standardized, and specialized, precision nursing care during the preoperative, intraoperative, and postoperative periods, while the control group received routine care. Postoperative recovery indicators, stress response biomarkers, and psychological parameters were compared between the two groups. The results showed that the experimental group had a significantly shorter time to first flatus, bowel movement, ambulation, and overall hospital stay compared to the control group. Additionally, postoperative CRP and IL-6 levels were significantly lower in the experimental group than those in the control group. Moreover, there was a significant difference in anxiety and depression scores between the two groups. The study indicates that implementing Enhanced Recovery After Surgery (ERAS)-based precision nursing effectively promotes postoperative recovery, reduces physiological stress, and alleviates psychological distress. These findings align with our study results, reinforcing the significance of providing comprehensive, meticulous perioperative care to promote both physical and psychological outcomes in cancer surgery.

The results of this study indicate that patients in the experimental group experienced lower levels of postoperative pain, suggesting that the comfort nursing combined with targeted operating room nursing was effective in pain relief. This outcome is likely due to the combined impact of the targeted nursing model and psychological interventions. The analysis can be understood through the following models:

(1) Biopsychosocial model. This model emphasizes that health and disease results from the interaction of biological, psychological, and social factors [31]. In the perioperative period of colorectal cancer patients, physiological factors (such as surgical trauma and individual physiological responses), psychological factors (such as anxiety and fear), and social support (such as family support and care from medical staff) all significantly affect the patient's stress response and pain perception. Surgical-induced physiological trauma leads to inflammation, causing an increase in biological markers (such as IL-6 and CRP), which in turn triggers pain. In this study, comfort care provided to the experimental group likely reduced inflammation by creating a more favorable recovery environment, contributing to pain reduction. Furthermore, comfort nursing combined with psychological interventions (such as relaxation train-

Table 6. Comparison of Barthel index between two groups of patients ($\bar{x} \pm$ s, scores).

Group	n	Before surgery	6 months after surgery	1 year after surgery	F (time × group)	p-value
Experimental group	85	53.75 ± 3.89	75.15 ± 7.95	91.39 ± 5.07	65.188	<0.001
Control group	80	53.40 ± 4.15	62.50 ± 6.34	80.30 ± 4.50		
F (time)			1515.519			
p-value			<0.001			

Table 7. Comparison of EORTC QLQ-C30 questionnaire scores between two groups ($\bar{x} \pm$ s, scores).

Group	n	Functional dimensions			F (time × group)	p-value
		Before surgery	6 months after surgery	1 year after surgery		
Experimental group	85	62.85 ± 5.11	76.20 ± 5.80	90.02 ± 5.15	53.225	<0.001
Control group	80	62.45 ± 4.80	70.10 ± 5.50	78.15 ± 3.46		
F (time)			743.008			
p-value			<0.001			
Group	n	Symptom dimensions			F (time × group)	p-value
		Before surgery	6 months after surgery	1 year after surgery		
Experimental group	85	61.80 ± 5.10	81.25 ± 5.01	91.59 ± 4.06	38.099	<0.001
Control group	80	61.20 ± 5.50	73.20 ± 5.30	82.80 ± 3.10		
F (time)			1246.909			
p-value			<0.001			
Group	n	Overall health status			F (time × group)	p-value
		Before surgery	6 months after surgery	1 year after surgery		
Experimental group	85	64.85 ± 4.85	80.20 ± 5.75	93.85 ± 2.45	72.393	<0.001
Control group	80	64.20 ± 5.55	72.45 ± 4.50	81.30 ± 2.40		
F (time)			1073.220			
p-value			<0.001			

EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30.

ing and music therapy) effectively alleviates anxiety and fear, reduces psychological stress levels, and thereby improves pain perception. Research shows that psychological factors significantly affect patients' pain perception, and increased feelings of safety and control contribute to effective pain management [32]. Similarly, strong communication between patients and healthcare providers, along with family support enhances the sense of trust and satisfaction. The targeted nursing model emphasized this social support through personalized care, further reducing pain levels.

(2) Pain management theory. This theory emphasizes that a multi-dimensional intervention strategy is most effective for controlling pain. The nursing interventions applied in the experimental group reflect several aspects: ① Individualized care: Personalized care plans based on each patient's specific needs and pain responses ensure more precise and effective interventions [33]. ② Non-pharmacological interventions: Using non-pharmacological therapies such as warm compresses, gentle massage, and distraction techniques like music or sensory stimuli provides effective pain relief, reduces dependence on analgesics, and minimizes drug-related side effects [34]. ③ Preoperative education and psychological preparation: Providing sufficient preoperative information about the surgical procedure and recovery expectations helps alleviate fear and anxiety, thereby reducing pain perception postoperatively.

In the study conducted by Li *et al*. [35], the medical records of 100 cancer patients were retrospectively analyzed and divided into the control and observation groups. The control group received routine pain care, whereas the observation group received pain education care based on mind mapping. The study compared the impact of these nursing models on quality of life, pain intensity, emotional well-being, and overall comfort. The findings indicated that after nursing intervention, the quality-of-life scores and psychological comfort scores were significantly higher in the observation group compared to the control group. Furthermore, the observation group demonstrated significantly lower VAS scores at different postoperative time points, along with lower levels of anxiety and depression. These findings indicate that mind mapping-based pain education care can effectively improve the quality of life and alleviate pain, offering valuable reference for postoperative care approaches. These observations are consistent with the results of our study, reinforcing that targeted pain interventions significantly alleviate postoperative discomfort, improve psychological well-being, and enhance overall patients' quality of life.

Table 8. Comparison of psychological state scores between two groups ($\bar{x} \pm s$, scores).

Group	n	HAMA			F (time × group)	p-value
		Before surgery	6 months after surgery	1 year after surgery		
Experimental group	85	40.85 ± 6.65	19.49 ± 5.40	11.89 ± 3.20	36.681	<0.001
Control group	80	41.37 ± 6.55	30.65 ± 7.63	20.10 ± 4.50		
F (time)			788.282			
p-value			<0.001			
Group	n	SDS			F (time × group)	p-value
		Before surgery	6 months after surgery	1 year after surgery		
Experimental group	85	64.45 ± 8.45	41.20 ± 6.30	24.51 ± 2.32	45.529	<0.001
Control group	80	64.82 ± 8.75	50.20 ± 7.27	39.10 ± 5.49		
F (time)			964.462			
p-value			<0.001			

HAMA, Hamilton Anxiety Scale; SDS, Self-Rating Depression Scale.

In this study, we also observed that nursing satisfaction in the experimental group was significantly higher than in the control group. This result suggests that combined nursing can effectively enhance patient satisfaction. Several attributes may explain this result as follows:

First, individuals undergoing surgical intervention for malignant tumors often experience significant psychological distress, including anxiety, fear, and uncertainty. These psychological responses can adversely affect both mental well-being and postoperative recovery. In our study, the nursing approach for the experimental group specifically addressed these psychological needs through targeted emotional support and psychological counseling. This not only helped patients feel secure but also enhanced a sense of trust in the healthcare team. As a result, patients cooperated well and engaged in their treatments, leading to a significant improvement in nursing satisfaction. Second, the nursing strategy in the experimental group emphasized personalized communication, where nurses used adaptive communication methods based on patients' individual characteristics. This customized approach helped reduce psychological burden and enhance the intimacy between patients and caregivers. Research has shown that effective nurse-patient communication improves patient satisfaction, increases patients' understanding of the care process, and encourages adherence to the treatment plan, factors which are crucial for better clinical outcomes [36]. Furthermore, comprehensive preoperative education played a vital role in enhancing patient satisfaction. By clearly explaining the hospitalization and nursing procedures, patients developed a clear understanding of what to expect, thereby reducing anxiety associated with uncertainty. Studies have indicated that when patients are well-informed, they are more likely to develop positive psychological expectations, which enhances their recognition and satisfaction with nursing care. In the postoperative phase, encouraging early ambulation in the experimental group not only promoted faster physiological recovery but also increased their confidence regarding the healing process. This sense of active participation empowered patients, improved their postoperative psychological state, and further enhanced their satisfaction levels. Lastly, consistent feedback and timely communication from the nursing staff after implementing the care plan improved transparency of nursing work and strengthened patient engagement. This ongoing interaction also motivated the nursing team, developing a culture of responsiveness and continuous improvement. By aligning nursing care more closely with patients' unique needs and expectations, a positive feedback loop was created, further increasing the overall patient experience and satisfaction.

After six months and one year of postoperative follow-up, patients in the experimental group showed significantly better recovery outcomes, higher quality of life, and enhanced psychological well-being than the control group. These observations suggest that a combined nursing approach better promotes long-term patient recovery. A closer examination of the underlying mechanisms reveals the following key factors: ① Psychological support and education: Targeted operating room nursing emphasizes preoperative psychological support and patient education with the primary goal of reducing anxiety and fear. Evidence shows that preoperative psychological interventions help reduce surgical-related stress responses (such as anxiety and depression), thereby improving postoperative recovery outcomes. In our study, patients in the experimental group received more detailed preoperative education about the surgical procedure, which enhanced their understanding and confidence. This psychological preparation helped improve patient postoperative satisfaction, emotional stability, and overall quality of life. ② Physiological monitoring and supportive care: One of the key aspects of targeted operating room nursing is the continuous monitoring of vital physiological parameters and the timely implementation of clinical interventions. By promptly addressing potential intraoperative complications, such as bleeding or infection, this approach helps reduce the physiological stress response.

Additionally, comfort-oriented measures (such as effective pain management, positioning, and thermoregulation) significantly reduced discomfort in the early postoperative period. These interventions promoted early mobilization, enhanced functional independence, and resulted in improved Barthel index and quality of life scores. ③ Multidisciplinary collaboration: with the involvement of a multidisciplinary team, including surgeons, anesthesiologists, nurses, nutritionists, and rehabilitation specialists, ensures the formulation of a comprehensive, individualized care plan. This collaborative approach enables the combination of medical, psychological, and functional recovery methods tailored to the needs of each patient. As a result, complications are reduced, continuity of care is maintained, and overall nursing satisfaction is substantially improved.

In the study by Liu *et al*. [37], the impact of integrating psychological care and extended nursing care on colorectal cancer patients with ostomies was assessed in 78 patients. The patients were divided into two groups of 39 each. The control group received routine nursing care, while the observation group was provided with psychological care alongside extended care interventions. Key assessment parameters included levels of anxiety, depression, sleep quality, psychological resilience, and self-care ability. Three months after discharge, the observation group demonstrated significantly lower Hamilton Depression Scale and Pittsburgh Sleep Quality Index scores compared to the control group, and substantially higher scores on the Connor-Davidson Resilience Scale and the Ostomy Self-Care Ability Scale. These findings indicate that combining psychological care with long-term care can significantly improve emotional well-being, sleep quality, resilience, and self-care ability in patients with ostomies. These results are consistent with our study, further validating that comprehensive perioperative nursing care significantly improves postoperative quality of life in colorectal cancer patients.

The strengths and innovations of this study, compared to previous research, are reflected in the following key areas:

(1) Integration of a novel, comprehensive nursing model: This study combines comfort nursing with targeted operating room nursing, creating a comprehensive nursing care model. This model not only addresses the physiological needs of patients but also emphasizes psychological well-being. Through structured and systematic nursing care, it improves the comfort and satisfaction of patients across all surgical stages.

(2) Emphasis of personalized care: This study emphasizes preoperative visits and psychological assessments to personalize care plans to the specific needs and conditions of individual patients. Such customization helps alleviate anxiety and fear, enhances patients' confidence in the surgery.

(3) Focus on psychological health: Compared to traditional nursing methods, this study incorporates psychological care as a crucial component. It highlights the emotional experience of patients by providing psychological support and comfort care throughout the surgical process, which helps to reduce stress responses and leads to better overall recovery.

(4) Quantitative assessment and robust data analysis: With a retrospective analysis of 165 patients, this study provides a sufficient sample size and data set to support its findings. Additionally, using quantitative metrics, such as nursing satisfaction scores, recovery indicators, and biochemical markers, adds credibility and reproducibility to the findings.

(5) Broad clinical applicability: By combining targeted nursing with a comfort care approach, this study offers valuable experiences and potential utility beyond laparoscopic colorectal cancer surgery. Its structure and approach can be applied to other surgical procedures, making it a versatile model with significant potential for wider implementations in clinical nursing practice.

Despite several valuable findings, the study has certain limitations. The relatively small sample size and single-center design may limit the generalizability of the results. Furthermore, patient background variables, such as comorbid conditions and risk factors of postoperative complications, were not comprehensively examined. Future large-scale, multi-center investigations into the role of specific risk factors in postoperative outcomes are needed to enhance clinical decision-making and optimize nursing care approaches.

Conclusions

In summary, the combined application of comfort nursing and targeted operating room nursing in laparoscopic colorectal cancer surgery effectively improves surgical outcomes, reduces postoperative stress responses, alleviates postoperative pain, enhances nursing satisfaction, and promotes patient recovery. The effectiveness of these nursing interventions may partly depend on the stability of surgical techniques. Therefore, further validation through multicenter, extensive studies is warranted. Ultimately, the synergistic interaction between effective nursing care and consistent surgical performance plays a crucial role in improving postoperative recovery.

Availability of Data and Materials

The data analyzed are available from the corresponding author upon reasonable request.

Author Contributions

QZ and JieY designed the study and carried it out. QZ, JieY, LLJ, YPD, XML and JinY supervised the data collection. QZ, JieY, LLJ, YPD, XML and JinY analyzed the data. QZ, JieY, LLJ, YPD, XML and JinY interpreted the data. QZ and JieY drafted and reviewed the manuscript. All authors have been involved in revising it critically for important intellectual content. All authors gave final approval of the version to be published. All authors have participated suf-

ficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Ethics Committee of West China Hospital, Sichuan University (Approval no. 2021-1699). Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article. This study adheres to the relevant principles of the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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