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Original Article

Effects of comprehensive nursing intervention on the postoperative gastrointestinal function and complications in patients undergoing endoscopic polypectomy

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Abstract: Objective: This study aimed to investigate the effect of comprehensive nursing intervention on postoperative gastrointestinal function and complications in patients undergoing endoscopic polypectomy. Methods: This study was a prospective randomized controlled trial (The name of the registry of clinical trial: the impact of comprehensive nursing intervention on the postoperative gastrointestinal function and complications in patients undergoing endoscopic polypectomy; clinical triathe trial number: ChiCTR2000034984; the trial URL: https://www.chictr.org.cn/index.html). 77 patients were randomly divided into a control group (*n*=38, traditional conventional nursing) and an experimental group (*n*=39, comprehensive nursing intervention). The following outcome measures were compared: general baseline data, total compliance rate, laboratory biomarkers (inflammatory factors, nutritional indicators, gastrointestinal hormone levels), gastrointestinal symptom scores, postoperative recovery indicators, clinical risks (venous thromboembolism [VTE] and falls), adverse event rates (total adverse reactions, polyp recurrence, postoperative complications), and patient-centered outcomes (life comfort, quality of life, and nursing quality, and nursing satisfaction). Results: After nursing interventions, the experimental group showed significant improvements across multiple metrics compared to the control group (all P<0.05). Key findings included reductions in inflammatory markers (procalcitonin, C-reactive protein, interleukin-17), faster postoperative recovery (shorter times to bowel sound recovery, first exhaust, and first bowel movement, and hospitalization), and lower clinical risks (VTE and fall scores, total incidence rate of adverse reactions and postoperative complications, and recurrence rate of polyps). Concurrently, the experimental group exhibited enhanced nutritional status (higher albumin and hemoglobin levels), improved gastric physiology (elevated pepsinogen I [PGI], PGI/PGII ratio, and lower PGII and gastrin-17), and superior patient-reported outcomes (general comfort questionnaire and gastrointestinal quality of life index scores), and nursing evaluations (quality and satisfaction). Conclusions: Comprehensive nursing intervention could promote the recovery of gastrointestinal function in patients undergoing endoscopic polypectomy, and reduce the occurrence rate of postoperative complications.

Keywords: Comprehensive nursing intervention, gastrointestinal polyps, endoscopy, gastrointestinal function, complications

Introduction

Gastrointestinal polyps are a common condition in the digestive system, characterized by prominent tumor-like growth in the gastrointestinal tract [1]. The histologic types include adenomatous polyps, hyperplastic polyps, misshapen polyps, and others [2]. This disease can occur in various parts such as the stomach, duodenum, and colon. Size ranges from a few millimeters to several centimeters [3]. They can be single or multiple in occurrence. Most patients have no obvious symptoms in the early stage [4]. Some patients may experience abdominal distension, abdominal pain, bloody stool, or mucus stool [5]. If not treated in time, gastrointestinal polyps may develop into colorectal cancer, seriously threatening the patient's health [6].

With the rapid development of endoscopic techniques, endoscopic polypectomy has become

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the preferred method for treating gastrointestinal polyps [7]. This technique, with its advantages such as minimal invasiveness, clear field of vision, and quick postoperative recovery, has largely replaced traditional open surgeries and significantly reduced patients' suffering [8]. However, the endoscopic operation itself, as an invasive treatment, still has certain risks. Postoperatively, complications such as bleeding, perforation, and infection may occur [9, 10]. Therefore, finding ways to reduce postoperative complications in patients with gastrointestinal polyps and promote early recovery through effective nursing interventions has become a priority in clinical nursing research.

The conventional nursing model focuses mainly on the disease itself and the execution of medical instructions, while neglecting the overall condition of the patient, paying insufficient attention to the patient's psychological state, long-term lifestyle management, and the prevention of disease recurrence [11]. In recent years, the patient-centered comprehensive nursing intervention has garnered increasing attention [12]. The comprehensive nursing intervention integrates multiple aspects, including preoperative assessment and preparation, health education, psychological counseling, precise intraoperative cooperation, individualized postoperative diet and activity guidance, and predictive care for complications [10]. This nursing model has shown good effects in improving the prognosis of gastrointestinal polyps [13, 14]

Based on this, this study adopted a comprehensive nursing intervention to provide care for patients with gastrointestinal polyps treated by digestive endoscopy. The aim was to explore the impact of comprehensive nursing interventions on the postoperative gastrointestinal function and complications in patients, and to provide a reference for selecting the nursing model for patients with gastrointestinal polyps treated by digestive endoscopy.

Materials and methods

Sample size calculation

Based on the initial clinical trial hypothesis, we conducted a sample size estimation using the PASS 15.0 software. The postoperative complication rate was set at approximately 35% for the conventional care group and 5% for the comprehensive nursing intervention group. The significance level α was 0.05 (two-sided), and the power of the test (1-β) was 0.90. A chi-square test was used for analysis, and it was calculated that each group needed at least 33 patients. Considering a 10% dropout rate, the final plan was to include 37 patients in each group, and the study required a total of 74 patients to be included.

Study population

This was a prospective randomized controlled study. A total of 80 inpatients, who received endoscopic treatment of gastrointestinal polyps in the Department of Gastroenterology, The Affiliated Suzhou Hospital of Nanjing University Medical School, from December 22, 2020 to December 17, 2023, were prospectively included as the research subjects. They were randomly grouped using a computer-generated random number sequence. To ensure the confidentiality of the grouping, the random sequence was generated by independent researchers who were not involved in the patient inclusion and assessment process. Subsequently, this random sequence was sealed in sequentially numbered opaque envelopes. After the eligible subjects completed the enrollment assessment, the researchers opened the envelopes in sequence to determine their groupings. All patients were randomly divided into a control group (n=40) and an experimental group (n=40). The control group received conventional nursing, while the experimental group received a comprehensive nursing intervention. However, during the follow-up study, 2 patients in the control group and 1 patient in the experimental group chose to discontinue participation in the intervention. Thus, 77 patients were ultimately included in the statistical analysis of this study: 38 in the control group and 39 in the experimental group. This study strictly followed the principle of blinding: all participants were unaware of their group assignment and the treatment they received. Due to the nature of the intervention measures, although the responsible nurses were aware of the actual nursing allocation, they strictly kept it confidential and did not participate in the result assessment; all indicator data were collected and evaluated by research assistants who were completely unaware of the group

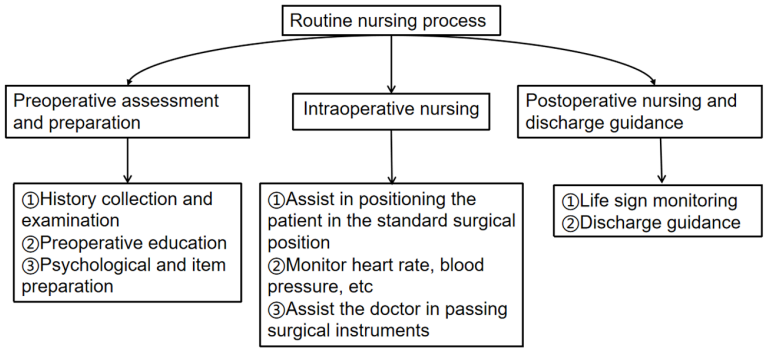

Figure 1. Routine nursing process.

assignment, thus ensuring objectivity of the assessment process. This blinded setting continued from the start of the intervention until the collection and analysis of all data were completed. All participants signed written informed consent, and the study protocol was approved by the Medical Ethics Committee of Suzhou Science and Technology City (No. IRB202012003RI).

Diagnostic criteria of gastrointestinal polyps

The patient met the diagnostic criteria for gastrointestinal polyps as outlined by the European Society of Gastrointestinal Endoscopy [15]: Patients were found to have gastrointestinal polyps by endoscopy, which showed granular, non-granular elevations, nodules, lobules, smooth surface, and visible erosion, congestion, grayish color of the nearby mucosal tissues, and visible atrophic lesions.

Diagnostic criteria for recurrence of gastrointestinal polyps

According to the guidelines of the European Society of Gastrointestinal Endoscopy [15], recurrence was defined as the appearance of new lesions or residual tissue at the original resection site, which needed to be confirmed through endoscopic observation combined with pathologic biopsy. The assessment was usually conducted during the first follow-up examination, which took place 3 to 6 months after the surgery. If suspicious lesions were found, further enhanced examinations such as narrow-band imaging or staining endoscopy should be conducted to determine their nature. Regular use of endoscopy for monitoring (e.g., at intervals of 6-12 months) was used for the early identification of recurrence.

Inclusion, exclusion, discontinuation criteria

(1) Inclusion criteria: ① Age between 18 and 75 years. ② Diagnosis of endoscopic gastrointestinal polyps. ③ Hospitalization for recovery after endoscopic polypectomy. ④ Informed consent from the patient or a family member. ⑤ Good communication skills and high compliance.

(2) Exclusion criteria: ① Pregnant or gestating women. ② Serious organ diseases and malignant tumors. ③ Mental diseases, communication disorders, and cognitive disorders.

(3) Discontinuation criteria: ① Loss to follow-up. ② Voluntary withdrawal by the patient or legal representative. ③ Administration of alternative or concomitant interventions. ④ Occurrence of an adverse event.

Nursing intervention

To ensure the consistency of intervention measures, all nursing interventions were carried out by a fixed nursing team. This team consisted of 3 responsible nurses with more than 5 years of experience in the endoscopy center and with a nurse practitioner or higher professional title. Before the start of the study, they received a 2-week unified training. The training content covered all the standardized procedures of this research plan, communication skills, and data recording norms. They passed an assessment to ensure complete consistency in understanding and implementation of the intervention plan.

Control group: The control group was given routine nursing measures (**Figure 1**). The main nursing process was as follows: (1) Preoperative assessment and preparation: ① History collection and examination: After the patient was admitted to the hospital, the responsible nurse conducted a one-time history inquiry and record, with a focus on surgical contraindications. Subsequently, the patient was led to complete the preoperative examination items as prescribed by the doctor, including: blood routine, coagulation function, and electrocardiogram. ② Preoperative education: On the

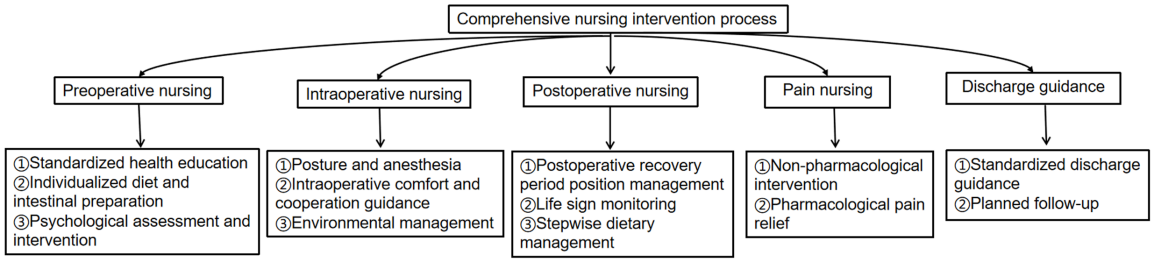

Figure 2. Comprehensive nursing process.

afternoon before the surgery, the responsible nurse conducted a collective oral education for the patients, lasting approximately 5 minutes. They were uniformly informed: "You need to fast for 8 hours and refrain from drinking water for 4 hours before the surgery". ③ Psychological and item preparation: For patients expressing anxiety, basic verbal reassurance was provided, such as "Please rest assured, don't be nervous". At the same time, the necessary drugs and basic instruments for the surgery were prepared according to the doctor's instructions.

(2) Intraoperative nursing: Patients were positioned in accordance with standard surgical protocols (such as the left lateral position for endoscopic examination). During the operation, vital signs including heart rate and blood pressure were monitored in compliance with hospital protocols. The surgeon was assisted with the passage of surgical instruments as required.

(3) Postoperative nursing and discharge guidance: ① Life sign monitoring: After the patient returned to the ward, regular monitoring of heart rate and blood pressure was conducted. Records were made every 60 minutes until the patient regained consciousness. ② Discharge guidance: On the day of discharge, the nurse provided routine discharge education to the patient. The content will be: "rest well, have a light diet, take your medication on time, and have regular follow-up check-ups".

Experimental group: The experimental group was given comprehensive nursing measures (**Figure 2**). The main nursing process was as follows: (1) Preoperative nursing: ① Standardized health education: On the day of the surgery, the responsible nurse immediately provided a one-time standardized health education. Using the unified "Endoscopic Surgery Knowledge Manual" [16], a one-on-one explanation was given, lasting approximately 15 minutes. The content covered polyp knowledge, surgical procedures, anesthesia methods, cooperation points, and expected outcomes. ② Individualized diet and intestinal preparation: For patients undergoing colonoscopy, the responsible nurse would distribute a uniformly printed "low-fiber diet list" 3 days before the procedure, instructing the patients to consume foods that are low in fiber and easy to digest. One day before the procedure, starting after lunch, they would switch to a liquid diet (such as rice soup) and would be prohibited from eating at dinner. At 7 p.m., they would uniformly take 2000 ml of compound polyethylene glycol electrolyte powder, and finish it within 2 hours until clear water-like stools were passed. For patients undergoing gastroscopy, they would be strictly instructed to fast and refrain from drinking water for at least 8 hours on the day of the procedure. ③ Psychological assessment and intervention: At the time of admission, the Hospital Anxiety and Depression Scale was used for a rapid assessment [17]. For patients with a score of ≥8, indicating a risk of anxiety/depression, a one-time, approximately 20-minute targeted psychological counseling session was conducted by a trained responsible nurse on the day before the surgery. The focus was on listening, explaining the safety of the surgery, and teaching deep breathing relaxation techniques.

(2) Intraoperative nursing: ① Posture and anesthesia: The responsible nurse assisted the patient in assuming the standard left lateral position with the legs bent. The anesthesiologist calculated and administered the anesthesia based on the patient's weight (for example, propofol 1.5-2.5 mg/kg). ② Comfort and cooperation guidance: During the operation, the nurse provided the patient with verbal encour-

agement every 10 minutes using standardized language (such as "well done, please stay relaxed"). For patients undergoing gastroscopy, the nurse instructed them to tightly bite the mouth pad and sprayed lidocaine gel into their throat to alleviate discomfort. ③ Environmental management: The operating room temperature was maintained at 22-24°C and humidity was at 50-60%. Ultraviolet disinfection was performed for 30 minutes before the operation, and the environment was kept quiet during the operation.

(3) Postoperative nursing: ① Position management: After the patient returned to the ward, the nursing staff immediately assisted the patient in assuming a supine position without a pillow and tilted the head to one side at an angle of 15-30 degrees. This position needed to be maintained until the patient was fully conscious (Steward score ≥4 points) [18]. The responsible nurse needed to check the position every 15 minutes and observe and record the secretion situation. ② Life sign monitoring: Before the patient regained consciousness from anesthesia, the nurse monitored and recorded vital signs such as heart rate, blood pressure, and blood oxygen saturation every 15 minutes. After regaining consciousness, the patient's consciousness was immediately assessed, and any symptoms such as abdominal distension, abdominal pain, or bloody stool were documented. ③ Stepwise dietary management: During the patient's recovery period, they were prohibited from drinking alcohol, consuming spicy and irritating foods, and pickled foods. The graded diet plan had to be strictly followed, and a unified "Postoperative Diet Guidance Card" was distributed to the patient and their family members: 1 hour after surgery, warm water could be consumed; 4-6 hours after surgery, if there are no discomforts, liquid food can be taken; 24 hours after surgery, semi-liquid food was introduced; 3 days after surgery, patients can gradually transit to soft food based on the recovery condition. If the patient recovers well and has no complications, the diet can return to normal.

(4) Pain nursing: ① Non-pharmacological intervention: After the patient returned to the ward, the responsible nurse continuously encouraged the patient to divert his attention by listening to soft music and chatting with family members. ② Pharmacological pain relief: The pain assessment was conducted using the Numerical Rating Scale [19]. A standardized analgesic protocol was implemented: when a patient reported a pain score of 4 or higher, an intramuscular injection of 5 mg dezocine was administered as the initial analgesic. If the pain persisted (Numerical Rating Scale ≥4) 1 hour after the first dose, a second dose could be given following the physician's assessment. The maximum allowable dose within 24 hours was 10 mg.

(5) Discharge guidance: ① Standardized discharge guidance: On the day of discharge, a unified "Discharge Guidance Manual" was distributed, and a 15-minute one-on-one explanation was given, covering dietary restrictions, activity intensity, medication methods, and the importance of follow-up visits [20]. ② Planned follow-up: To continuously monitor the patient's condition and enhance guidance, we established a planned telephone follow-up system. The follow-up time points were fixed at the 7th day, the 1st month, the 3rd month, and the 12th month after discharge. Each follow-up was conducted by the same trained nurse, and a unified follow-up record form with standardized content was used. The main purpose was to understand the patient's symptom recovery, diet, activity, medication compliance, and presence of complications, and to provide immediate and personalized guidance based on the patient's feedback.

Post-nursing follow-up

One year after the patient's discharge, outpatient examinations were conducted for both groups of patients. The total incidence rate of adverse reactions (nausea, regurgitation, constipation, abdominal pain, and diarrhea), the total recurrence rate of polyps, and the total incidence rate of postoperative complications (abdominal pain, bleeding, wound infection, and perforation) were collected for both groups.

Observation indicators

(1) General baseline indicators: Baseline data of the patients at the time of admission were collected, including age, gender, polyp type, polyp diameter, and surgical procedure.

(2) The compliance of patients: The patient's compliance after the entire nursing process was collected. The patient compliance was

evaluated through the questionnaire survey [21], with a total score ranging from 0 to 15. A score of 9 to 15 indicated good compliance. A score of 6 to 9 was defined as partial compliance, representing an average level of adherence. Scores from 0 to 5 indicated poor compliance, constituting complete non-compliance. The total compliance rate = (complete compliance + partial compliance)/total number of patients × 100%.

(3) The inflammatory markers, nutritional indicators, and gastrointestinal hormone levels: These were collected before and after the nursing. Inflammatory markers included procalcitonin (PCT), C-reactive protein (CRP), and interleukin-17 (IL-17); Nutritional indicators included albumin (ALB) and hemoglobin (Hb); Gastrointestinal hormone indicators included pepsinogen I (PGI), pepsinogen II (PGII), and gastrin-17 (G-17). 15 mL of peripheral venous blood from patients (before and after nursing) in a fasting state was collected, and left to stand at room temperature for 1 h. Then, it was centrifuged at 3000 r/min for 15 min. The upper serum and lower cells were separately collected. The levels of serum PCT, CRP, and IL-17 were determined using the enzyme-linked immunosorbent assay. The levels of ALB and Hb in serum were detected using an automatic biochemical analyzer. The levels of PGI, PGII, and G-17 in serum were measured using the HIT-91A fluorescence immunoassay analyzer, and the ratio of PGI to PGII was calculated.

(4) Gastrointestinal symptom indicator: The gastrointestinal symptoms of the patients before and after the nursing were evaluated using the Gastrointestinal Symptom Rating Scale (GSRS) [22]. The GSRS consisted of 15 items, and the total score ranged from 0 to 60. It used the Likert 4-point rating method, with positive scoring. The higher the score, the worse the gastrointestinal function.

(5) Postoperative gastrointestinal function recovery indicators: Indicators for the recovery of the patient's postoperative gastrointestinal function were collected, mainly including bowel sound recovery time, first exhaust time, first bowel movement time, and hospitalization time.

(6) Venous thromboembolism (VTE) and fall risk assessment indicators: After nursing, the Caprini risk assessment scale was used to evaluate the patient's risk of VTE [23]. 1-2 scores were considered low risk, 3-4 scores were medium risk, and 5 scores or above were high risk. The higher the score, the higher the risk of VTE. The Morse fall risk scale was used to evaluate the patient's fall risk [24]. The maximum score was 125, and the higher the score, the higher the risk of falls.

(7) Total incidence rate of gastrointestinal adverse reactions: During the postoperative hospital stay, the adverse reactions in the two groups of patients were observed. The adverse reactions included nausea, regurgitation, constipation, abdominal pain, and diarrhea. The total incidence rate of adverse reactions = (number of patients who experienced at least one adverse reaction/total number of patients) × 100%.

(8) The recurrence rate of polyps: One year after the patient's discharge, a gastroscopy was conducted to assess for polyp recurrence, based on the patient's clinical symptoms and signs. The recurrence rate was calculated for both groups, with the recurrence rate = (number of recurrences/total number of patients) × 100%.

(9) Postoperative complications: The complications included abdominal pain, bleeding, wound infection, and perforation. One year after the patient's discharge, the occurrence of complications was examined, and the total incidence of complications in the two groups was compared. The total incidence rate = (number of patients with complications)/total number of patients × 100%.

(10) Evaluation indicators for comfort level and quality of life: Following the nursing intervention, the Kolcaba General Comfort Questionnaire (GCQ) was used to assess the comfort of patients [25]. GCQ consists of 4 dimensions: psychological, physiological, socio-cultural, and environmental. The score ranged from 28 to 112, and was directly proportional to the level of comfort. The Gastrointestinal Quality of Life Index (GIQLI) was used to assess the patients' quality of life [26]. The total score was 144 points, and the higher the score, the better the quality of life.

(11) Nursing quality: Upon completion of the nursing, the self-developed nursing quality assessment scale was used for evaluation

Table 1. Comparison of general baseline data [n (%)] ($\bar{x}$±s)

Item	Experimental group (n=39)	Control group (n=38)	t/χ^2	*P*
Gender			1.063	0.303
Male	18 (46.1)	22 (57.9)		
Female	21 (53.9)	16 (42.1)		
Age (years)	41.91±5.20	42.33±4.35	-0.385	0.702
Type of polyps			0.330	0.565
Intestinal polyps	19 (48.7)	21 (55.3)		
Gastric polyps	20 (51.9)	17 (44.7)		
Diameter of polyp (cm)	1.97±0.33	1.86±0.59	1.008	0.313
Surgical Procedure			0.630	0.427
Endoscopic mucosal resection	17(43.6)	20 (52.6)		
Endoscopic submucosal dissection	22 (56.4)	18 (47.4)		
Nutritional risk score	1.94±0.48	1.99±0.52	-0.433	0.667

[27]. There were three items, each scored from 0 to 100. The higher the score, the better the nursing quality.

(12) Nursing satisfaction: After the nursing, the self-developed satisfaction questionnaires were used to evaluate the satisfaction of patients in both groups [28]. The questionnaire contained 20 questions, each worth 5 points, with a maximum total score of 100 points. A total score lower than 60 indicated dissatisfaction, 60-69 scores indicated basic satisfaction, 70-85 scores indicated satisfaction, and 85 scores or above represented a state of being very satisfied. Nursing satisfaction rate = (number of very satisfied, satisfied, and basically satisfied patients)/total number of patients × 100%.

Statistical methods

Data analysis was conducted using SPSS 27.0 software. Graphs were plotted using GraphPad Prism 8.0 statistical software. The Shapiro-Wilk test was employed to check the normality of the data. Measured data that followed a normal distribution were presented in the form of mean ± standard deviation (x±s). Independent sample *t*-tests were used for the comparison between the two groups, and a paired *t*-test was used to within-group measurements before and after nursing. Non-normally distributed data were represented in the form of *M* (Q_{25}, Q_{75}), and the generalized linear model was adopted for the comparison between groups. Counted data were presented in the form of n (%), and the χ^2 test was used for comparisons between count data groups. To control the inflation of Type I errors caused by multiple statistical tests, when conducting comparisons among multiple groups or testing multiple primary outcome indicators, we employed the Bonferroni correction method to adjust the significance level (α). Uncorrected tests considered differences statistically significant at $P<0.05$; for tests corrected with Bonferroni adjustment, differences were considered significant at the adjusted $P<0.05$.

Results

Comparison of general baseline data

The comparison of general baseline data between the two groups of patients is shown in **Table 1**. There was no significant difference in gender, age, polyp type, polyp diameter, and surgical procedure between the two groups (all $P>0.05$), so they were comparable.

Comparison of total compliance rate

The comparison of compliance between the two groups of patients is shown in **Table 2**. There was no significant difference in the total compliance rate between the experimental group and the control group ($P>0.05$).

Comparison of inflammatory markers, nutritional indicators, and gastrointestinal hormone levels

The comparison results of inflammatory factor levels, nutritional indicators, and gastrointestinal hormone levels between the two groups are shown in **Table 3**. Before the nursing interven-

Table 2. Comparison of total compliance rate [n (%)]

Item	Experimental group (n=39)	Control group (n=38)	χ^2	*P*
Complete non-compliance	1 (2.6)	3 (7.9)		
Partial compliance	3 (7.7)	4 (10.5)		
Complete compliance	35 (89.7)	31 (81.6)		
Total compliance	38 (97.4)	34 (89.5)	1.110	0.358

Table 3. Comparison of inflammatory markers, nutritional indicators and gastrointestinal hormone levels ($\bar{x}\pm s$)

Item	Experimental group (n=39)	Control group (n=38)	*MD*	95% *CI*	*t*	*P*
PCT (ng/mL)						
Before nursing	0.65±0.14	0.68±0.17	-0.030	-0.102-0.041	-0.846	0.400
After nursing	0.32±0.11*	0.48±0.19*	-0.160	-0.231--0.089	-4.537	<0.001
CRP (mg/L)						
Before nursing	42.17±9.15	44.32±8.93	-2.149	-6.310-2.011	-1.043	0.300
After nursing	22.16±6.27*	37.28±9.36*	-15.120	-18.777--11.464	-8.348	<0.001
IL-17 (ug/L)						
Before nursing	6.32±0.64	6.41±0.67	-0.091	-0.392-0.211	-0.603	0.548
After nursing	3.13±0.86*	5.37±1.13*	-2.239	-2.700--1.778	-9.804	<0.001
ALB (g/L)						
Before nursing	30.21±2.17	30.62±2.25	-0.410	-1.427-0.607	-0.814	0.418
After nursing	43.19±3.53*	36.94±3.38*	6.250	4.659-7.841	7.932	<0.001
Hb (g/L)						
Before nursing	95.27±8.19	94.37±7.83	0.900	-2.788-4.587	0.493	0.623
After nursing	115.27±11.23*	101.14±9.86*	14.130	9.264-18.996	5.861	<0.001
PGI (ng/mL)						
Before nursing	62.32±6.08	63.15±6.34	-0.831	-3.688-2.027	-0.586	0.560
After nursing	118.28±8.15*	94.37±8.24*	23.910	20.140-27.680	12.801	<0.001
PGII (ng/mL)						
Before nursing	23.57±2.17	24.18±2.19	-0.610	-1.613-0.393	-1.228	0.223
After nursing	11.58±2.05*	18.53±2.31*	-6.950	-7.954--5.946	-13.973	<0.001
G-17 (pmol/L)						
Before nursing	19.36±2.51	19.12±2.33	0.241	-0.874-1.356	0.435	0.665
After nursing	9.08±1.62*	14.74±2.21*	-5.660	-6.549--4.770	-12.841	<0.001
PGI/PGII						
Before nursing	5.81±1.07	5.65±1.13	0.159	-0.347-0.666	0.638	0.525
After nursing	16.27±2.25*	7.27±1.82*	8.999	8.057-9.942	19.268	<0.001

Note: PCT, procalcitonin; CRP, C-reactive protein; IL-17, interleukin-17; ALB, albumin; Hb, hemoglobin; PGI, pepsinogen I; PGII, pepsinogen II; G-17, gastrin-17; MD, mean difference; CI, confidence interval; * indicates *P*<0.05 compared to pre-nursing.

tion, there was no significant difference in the levels of PCT, CRP, IL-17, ALB, Hb, PGI, PGII, G-17, or PGI/PGII between the two groups (all *P*>0.05). After the nursing intervention, the levels of PCT, CRP, IL-17, PGII, and G-17 in both groups decreased (all *P*<0.05), while ALB, Hb, PGI, and PGI/PGII levels increased (all *P*<0.05). The post-nursing levels of PCT (mean difference [*MD*]: -0.160; 95% confidence interval [*CI*]: -0.231, -0.089; *P*<0.001), CRP (*MD*: -15.120; 95% *CI*: -18.777, -11.464; *P*<0.001), IL-17 (*MD*: -2.239; 95% *CI*: -2.700, -1.778; *P*<0.001), PGII (*MD*: -6.950; 95% *CI*: -7.954, -5.946; *P*<0.001), and G-17 (*MD*: -5.660; 95% *CI*: -6.549, -4.770; *P*<0.001) in the experimental group were lower than those of the control group; while the levels of ALB (*MD*: 6.250; 95% *CI*: 4.659, 7.841; *P*<0.001), Hb (*MD*: 14.130;

Table 4. Comparison of gastrointestinal symptom scores ($\bar{x}\pm s$)

Item	Experimental group (n=39)	Control group (n=38)	*MD*	95% *CI*	*t*	*P*
GSRS (score)						
Before nursing	45.58±5.34	44.32±5.51	1.260	-1.236-3.756	1.019	0.311
After nursing	27.37±2.15*	37.84±4.62*	-10.469	-12.120–8.819	-12.803	<0.001

Note: GSRS, gastrointestinal symptom rating scale; MD, mean difference; CI, confidence interval; * indicates *P*<0.05 compared to pre-nursing.

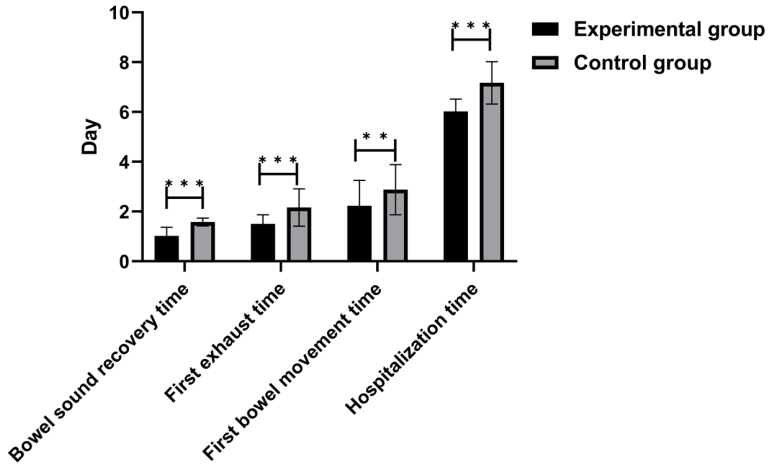

Figure 3. Comparison of postoperative gastrointestinal function recovery indicators. Note: **P<0.01, ***P<0.001.

95% *CI*: 9.264, 18.996; *P*<0.001), PGI (*MD*: 23.910; 95% *CI*: 20.140, 27.680; *P*<0.001), and PGI/PGII (*MD*: 8.999; 95% *CI*: 8.057, 9.942; *P*<0.001) were higher than those of the control group.

Comparison of gastrointestinal symptom scores

The comparison of gastrointestinal symptom scores between the two groups of patients is shown in **Table 4**. Before the nursing intervention, there was no significant difference in the GSRS scores between the two groups (*P*>0.05). After the nursing intervention, the GSRS scores of both groups decreased (both *P*<0.05), and the score of the experimental group was lower than that of the control group (*MD*: -10.469; 95% *CI*: -12.120, -8.819; *P*<0.001).

Comparison of postoperative gastrointestinal function recovery indicators

The comparison of postoperative gastrointestinal function recovery indicators between the two groups of patients is shown in **Figure 3**. The bowel sound recovery time, first exhaust time, first bowel movement time, and hospitalization time of the patients in the experimental group were considerably shorter than those of the control group (all *P*<0.05).

Comparison of risk indicators for VTE and falls

The comparison of VTE and fall risk indicators between the two groups of patients is shown in **Figure 4**. The VTE score and Morse falls score of the experimental group were both lower than those of the control group (both *P*<0.05).

Comparison of the total incidence of gastrointestinal adverse reactions

The comparison of the total incidence of gastrointestinal adverse reactions between the two groups of patients is shown in **Table 5**. The total incidence rate of gastrointestinal adverse reactions in the experimental group was 7.7%, while that of the control group was 26.3%. The total incidence rate in the experimental group was lower than in the control group (*odds ratio*: 0.210; 95% *CI*: 0.059, 0.929; *P*<0.05).

Comparison of the total recurrence rate of polyps

The comparison of polyp recurrence rates between the two groups of patients is shown in **Figure 5**. The recurrence rate of polyps in the experimental group was lower than that of the control group (*P*<0.05).

Comparison of the total incidence rate of postoperative complications

The comparison of the total incidence of complications between the two groups of patients

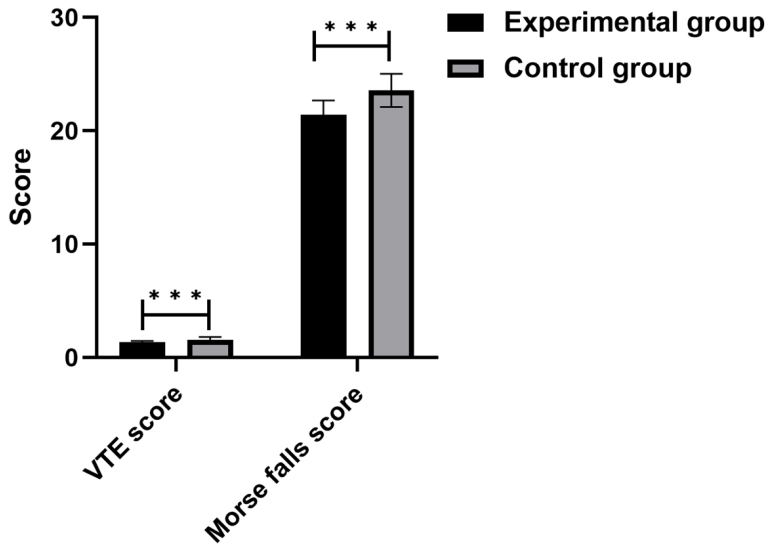

Figure 4. Comparison of risk indicators for VTE and falls. Note: VTE, venous thromboembolism; ***P<0.001.

is shown in **Table 6**. The total incidence of complications in the experimental group was 5.13%, while that in the control group was 34.21%. The total incidence of complications in the experimental group was lower than that of the control group (*odds ratio*: 0.104; 95% *CI*: 0.022, 0.501; P<0.05).

Comparison of nursing comfort and quality of life

The scores for nursing comfort and quality of life between the two groups of patients are shown in **Table 7**. The GCQ score (*MD*: 9.521; 95% *CI*: 6.082, 12.960; P<0.001) and GIQLI score (*MD*: 13.130; 95% *CI*: 10.757, 15.503; P<0.001) of the experimental group were higher than those of the control group.

Comparison of nursing quality

The comparison of nursing quality scores between the two groups of patients is shown in **Figure 6**. The scores for the patients in the experimental group in terms of responsibility, service attitude, and professional skills were all higher than those of the control group (all P<0.05).

Comparison of nursing satisfaction

The comparison of nursing satisfaction between the two groups of patients is shown in **Table 8**. The nursing satisfaction rate of the experimental group was 97.44%, while that of the control group was 71.05%. The nursing satisfaction rate of the experimental group was higher than that of the control group (P<0.05).

Discussion

With the improvement in people's living standards, their dietary structure and living habits have changed dramatically. High-fat, high-salt, and high-sugar diets, along with long-term smoking, drinking, and other unhealthful habits, are exacerbating gastrointestinal mucosal damage, resulting in an annually increasing incidence of gastrointestinal polyps [29]. Currently, endoscopic treatment of gastrointestinal polyps is mostly used in clinical practice. However, a lack of surgical knowledge and fear of the procedure among patients can easily lead to mood swings before surgery, increasing the difficulty of surgery and leading to severe stress reactions, thereby resulting in less favorable surgical and therapeutic outcomes [30]. Therefore, it is necessary to provide patients with rational nursing interventions that increase their awareness of the disease and motivation for treatment, aiming to improve surgical outcomes and accelerate postoperative recovery. Research has shown that scientific and rational nursing interventions can alleviate patients' anxiety, facilitate smoother procedures, and reduce complications [31]. In addition, the involvement of nursing interventions in endoscopic treatment has been shown to help improve the detection rate and ensure the quality of the procedure [32].

This study found that after nursing intervention, the levels of PCT, CRP, IL-17, PGII, and G-17 in the experimental group were lower than those of the control group, and the levels of ALB, Hb, PGI, and PGI/PGII in the experimental group were higher than those of the control group. This may have been because the comprehensive nursing intervention increases the intake of fresh vegetables and fruits for the patients. These foods are rich in natural anti-inflammatory and antioxidant substances (such as poly-

Table 5. Comparison of the total incidence rate of gastrointestinal adverse reactions [n (%)]

Item	Experimental group (n=39)	Control group (n=38)	*OR*	95% *CI*	χ^2	*P*
Nausea	1 (2.6)	3 (7.9)				
Regurgitation	1 (2.6)	2 (5.3)				
Constipation	0 (0.0)	1 (2.6)				
Abdominal Pain	1 (2.6)	2 (5.3)				
Diarrhea	0 (0.0)	2 (5.3)				
Total occurrence	3 (7.7)	10 (26.3)	0.210	0.059~0.929	4.757	0.029

Note: OR, odds ratio; CI, confidence interval.

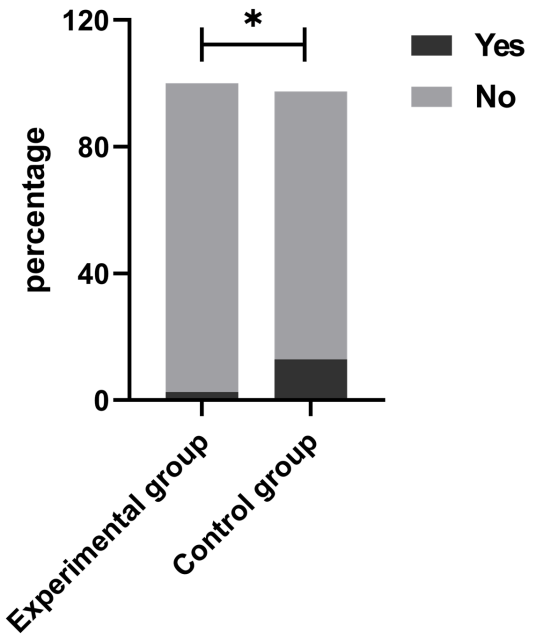

Figure 5. Comparison of polyp recurrence rate. Note: *P<0.05.

phenols, vitamin C) [33], which can inhibit the release of pro-inflammatory cytokines (such as IL-17) and reduce the level of oxidative stress, thereby indirectly leading to the decrease of PCT and CRP [34]. In addition, the dietary adjustments (avoiding spicy and pickled foods) and the management of medication compliance in the comprehensive nursing intervention can effectively alleviate the inflammatory stimulation and damage of the gastric mucosa [35]. As the inflammation of the mucosa subsides and heals, the functions of chief cells and gastric antrum G cells may tend to return to normal, resulting in a decrease in PGII and G-17 levels [36]. Moreover, the nursing staff formulates the diet plan based on the patient's recovery stage, gradually transiting from liquid and semi-liquid foods to soft and regular foods. This directly provides sufficient raw materials for the synthesis of ALB and Hb [37]. The research results are similar to those of previous studies [38, 39], indicating that the application of the comprehensive nursing intervention in the clinical treatment of patients undergoing endoscopic resection of digestive tract polyps can reduce the levels of inflammatory factors in patients, improve nutritional levels, and gastrointestinal hormone levels.

Furthermore, this study found that the bowel sound recovery time, first exhaust time, first bowel movement time, hospitalization time, VTE score, and Morse fall score of the experimental group after nursing were lower than those of the control group. In promoting the recovery of gastrointestinal function, preoperative low-fiber diet and standardized bowel preparation create favorable conditions for the surgery; after the operation, following the progressive dietary guidance of "liquid food - semi-liquid food - regular food" and avoiding early eating to avoid increasing the burden on the intestines enable a safe and rapid recovery of gastrointestinal function [40]. In reducing the risk of VTE, early guidance for patients to rest in bed can avoid the bleeding risk caused by excessive activity, and appropriate exercise, based on the recovery situation, can effectively promote blood circulation; in addition, the entire dietary management (from liquid food, semi-liquid food to regular food) ensures adequate blood volume and avoids increased blood viscosity [41]. In preventing falls, during the anesthesia recovery period, the lateral positioning of the head can prevent sudden body displacement from choking; continuous monitoring of vital signs ensure that patients only start to move after being fully awake and in

Table 6. Comparison of the total incidence rate of postoperative complications [n (%)]

Item	Experimental group (n=39)	Control group (n=38)	*OR*	95% *CI*	χ^2	*P*
Abdominal pain	1 (2.56)	5 (13.16)				
Bleeding	1 (2.56)	2 (5.26)				
Wound infection	0 (0)	3 (7.89)				
Perforation	0 (0)	3 (7.89)				
Total incidence	2 (5.13)	13 (34.21)	0.104	0.022-0.501	10.378	0.001

Note: OR, odds ratio; CI, confidence interval.

Table 7. Comparison of nursing comfort and quality of life ($\bar{x}\pm s$)

Item	Experimental group (n=39)	Control group (n=38)	*MD*	95% *CI*	*t*	*P*
GCQ (score)	94.81±7.27	85.29±7.68	9.521	6.082-12.960	5.587	<0.001
GIQLI (score)	96.62±5.45	83.49±4.84	13.130	10.757-15.503	11.167	<0.001

Note: GCQ, general comfort questionnaire; GIQLI, gastrointestinal quality of life index; MD, mean difference; CI, confidence interval.

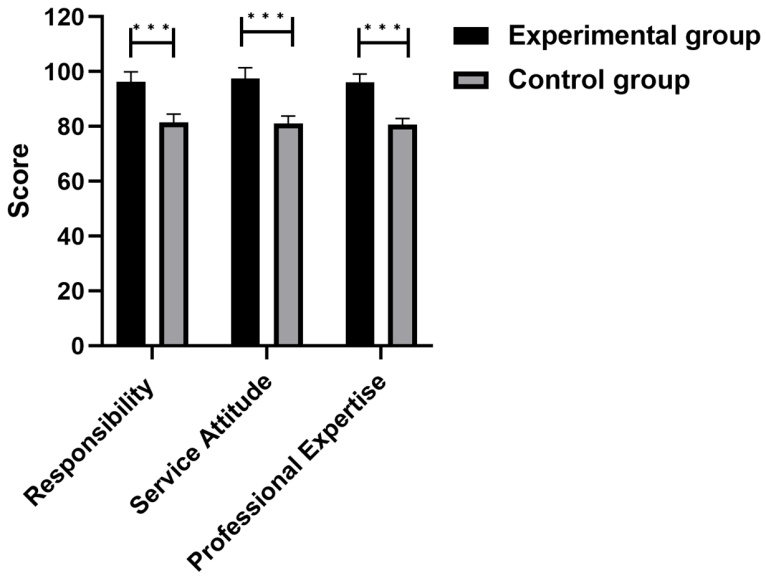

Figure 6. Comparison of nursing quality. Note: ***P<0.001.

a stable state; and before discharge, comprehensive guidance on exercise, diet, and medication fundamentally prevents falls caused by weakness, dizziness, or orthostatic hypotension, ensuring the safety of the patients [42]. This result is similar to previous studies [43, 44]. This indicates that the comprehensive nursing intervention can effectively promote the recovery of postoperative gastrointestinal function and accelerate the patient's rehabilitation process.

In addition, the total incidence of adverse reactions, the recurrence of polyps, and the total incidence of postoperative complications in the experimental group were all lower than those in the control group. Moreover, the risk of adverse reactions and postoperative complications in the experimental group was significantly lower than that in the control group. The GCQ score, GIQLI score, nursing quality, and nursing satisfaction were all higher than those in the control group. This is because postoperative comprehensive nursing intervention instructs family members to tilt the patient's head to one side to allow oral secretions to flow naturally, which helps reduce the occurrence of postoperative respiratory complications [45]; monitoring of vital signs and symptom inquiries after awakening from anesthesia help detect and promptly handle complications such as abdominal distension and bleeding in an early stage [46]; dietary management and guidance help promote gastrointestinal recovery and reduce symptoms of indigestion and discomfort [47]; rehabilitation exercises and detailed life guidance help reduce the occur-

Table 8. Comparison of nursing satisfaction [n (%)]

Item	Experimental group (n=39)	Control group (n=38)	χ^2	*P*
Greatly satisfied	12 (30.77)	6 (15.79)		
Satisfied	14 (35.90)	8 (21.05)		
Basically satisfied	12 (30.77)	13 (34.21)		
Dissatisfied	1 (2.56)	11 (28.95)		
Nursing satisfaction	38 (97.44)	27 (71.05)	10.184	0.001

rence of complications and the disease [48]. Moreover, comprehensive nursing prioritizes the health and comfort of patients and provides overall services before, during, and after the surgery, which is beneficial for accelerating the rehabilitation process of patients with gastrointestinal polyps and reducing the risk of complications, thereby ultimately improving nursing quality and satisfaction [49]. The research results are similar to those of previous scholars' studies [50, 51]. This indicates that the application of comprehensive nursing to the clinical care of patients undergoing endoscopic resection of digestive tract polyps can not only reduce the recurrence of gastrointestinal polyps, the incidence of adverse reactions, and the total incidence of complications, but also can improve nursing quality and satisfaction.

In conclusion, the comprehensive nursing intervention in this study can improve the nutritional and gastrointestinal hormone levels of patients, reduce the level of inflammatory factors, the risk of VTE and falls, the recurrence of polyps, and the total incidence of postoperative complications, shorten the recovery time of gastrointestinal function after surgery, and improve the gastrointestinal symptoms of patients. It also has high comfort, quality of life, nursing quality, and nursing satisfaction. This nursing intervention can be widely applied in clinical practice. However, this study has some limitations. For example, the sample size was small; the data came from a single center; and the follow-up period was short. The results need to be further verified through a multi-center study with a larger sample size, and the follow-up period should be extended to ensure the stability of the results. In addition, emotional changes in patients after comprehensive nursing intervention were not evaluated. Further research in this field can be conducted in the future.

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Disclosure of conflict of interest

None.

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