

Impact of Nutritional Support Under Comprehensive Nursing on Gastrointestinal Function in Patients With Gastroparesis Syndrome Following Radical Gastrectomy for Gastric Cancer

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AIM: This study aimed to evaluate the effect of nutritional support intervention, implemented within the framework of comprehensive nursing, on gastrointestinal function and primary symptom indices in patients with gastroparesis syndrome following radical gastrectomy for gastric cancer.

METHODS: Based on existing case records, the clinical data of 225 patients who underwent radical gastrectomy (distal gastrectomy + Billroth II anastomosis) for gastric cancer at our hospital between October 2022 and October 2024 were retrospectively analyzed. After propensity score matching (PSM) at a 1:1 ratio, 160 patients were included in the final analysis and among them, 80 cases in the observation group and 80 cases in the control group. The control group received conventional nursing care, while the observation group received nutritional support intervention within a comprehensive nursing model. Levels of gastrointestinal hormones, severity of gastroparesis symptoms, gastrointestinal function, and nursing satisfaction were compared between the two groups before and after the intervention.

RESULTS: Two weeks post-intervention, the levels of motilin (MTL) and gastrin (GAS) in the observation group were significantly lower than in the control group, whereas the pepsinogen I (PG I) level was significantly higher ($p < 0.05$). Following two weeks of treatment, the observation group demonstrated significantly lower Gastroparesis Cardinal Symptom Index (GCSI) scores than the control group ($p < 0.05$). Additionally, the observation group had shorter gastric drainage duration, earlier first flatus, quicker resumption of normal eating, and faster symptom resolution compared to the control group ($p < 0.05$). Nursing satisfaction was significantly higher in the observation group ($p < 0.05$).

CONCLUSIONS: Nutritional support intervention delivered through comprehensive nursing for patients with gastroparesis syndrome after radical gastrectomy for gastric cancer enhances gastric function, modulates gastrointestinal hormone levels, alleviates gastroparesis symptoms, and improves nursing satisfaction.

Keywords: comprehensive nursing; nutritional support; gastroparesis syndrome

Introduction

Gastric cancer is one of the most common malignant tumors, with a high global incidence. Radical gastrectomy is a standard surgical approach for treating gastric cancer, aiming to excise the tumor tissue within the stomach and eliminate the cancerous region. Postoperatively, an anastomosis is typically constructed to restore continuity between the esophagus and the small intestine [1]. Radical gastrectomy is considered highly effective and widely adopted in the clinical management of gastric cancer patients [2]. However, some individuals are prone to postoperative complications, including anastomotic leakage, infection, and gastroparesis syndrome [3].

Gastroparesis syndrome is a significant complication that

may arise following gastric cancer surgery, with an incidence ranging from 2% to 4% [4]. Also referred to as gastric motility disorder, it is a gastrointestinal condition that impairs motility and the ability to empty stomach contents. Clinically, it presents as nausea, vomiting, upper abdominal discomfort, bloating, epigastric pain, and poor appetite, which significantly impacts standardized treatment and negatively affects survival outcomes in patients with gastroparesis syndrome [5]. Moreover, gastroparesis can lead to additional challenges such as weight loss, malnutrition, and anemia [6]. Research suggests that postoperative nutritional support improves patient's nutritional intake by providing essential energy and nutrients, playing a crucial role in enhancing patient recovery [7]. Based on these observations, the study investigated the impact of nutritional support intervention under comprehensive nursing on gastrointestinal function and core symptom indices in patients with gastroparesis syndrome following radical gastrectomy for gastric cancer.

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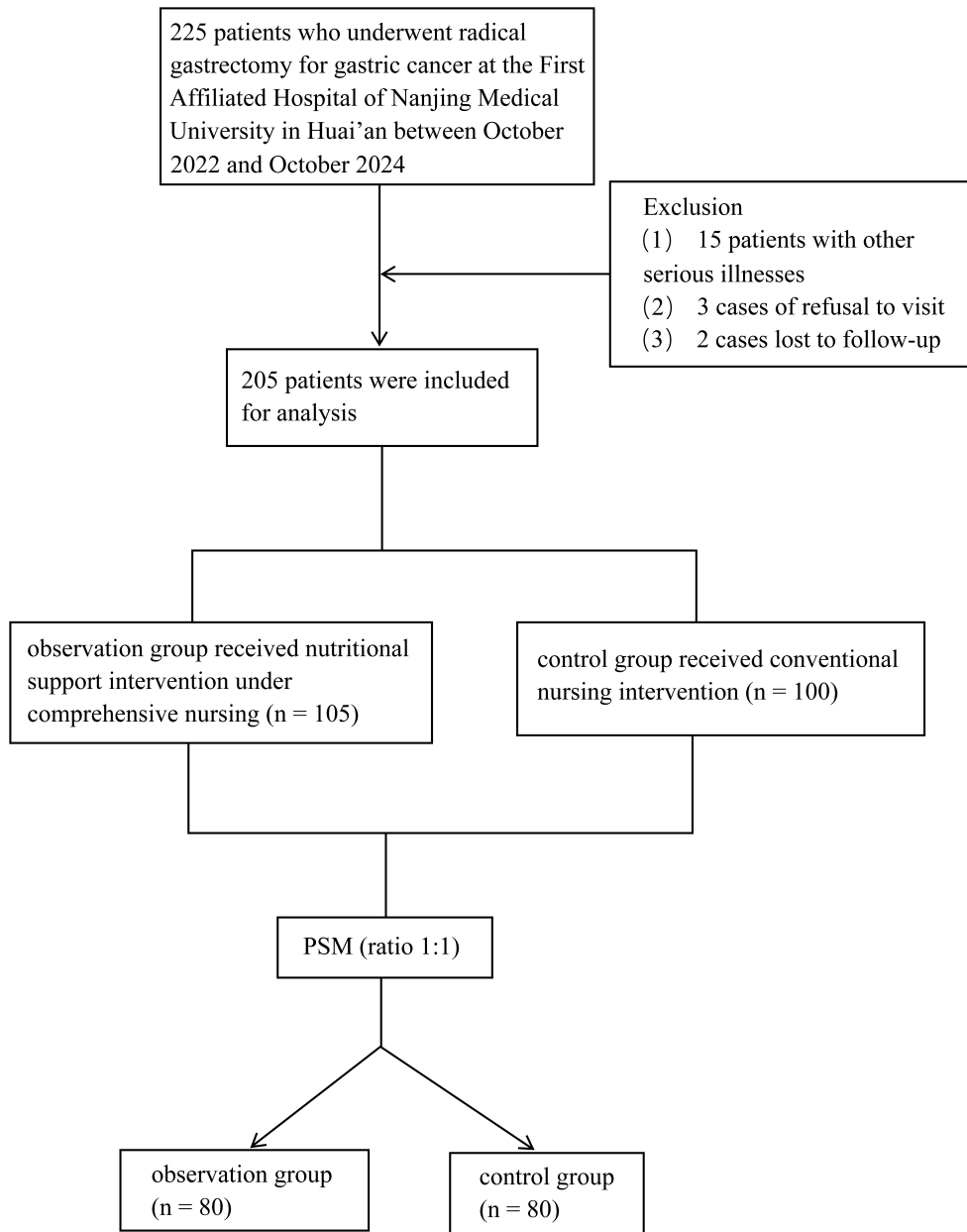


Fig. 1. Flow chart of study design and group allocation. PSM, propensity score matching.

Materials and Methods

General Data

Sample size estimation process:

(1) Estimation of effect size: Based on previous literature or prior experimental data, the effect size was estimated (e.g., the expected difference between the two groups) [8]. An assumed effect size of 0.5 was adopted, representing a moderate effect.

(2) Setting significance level and power: A commonly accepted significance level ($\alpha = 0.05$) and statistical power (Power = 80% or 0.8) were selected.

(3) Sample size calculation formula:

The sample size (n) was calculated using the following standard formula: $n = 2 (Z_{\alpha/2} + Z_{\beta})^2 \sigma^2 / d^2$

Where, $Z_{\alpha/2}$ is the critical value from the standard normal distribution at $\alpha/2$, usually 1.96 (for $\alpha = 0.05$);

Z_{β} is the critical value from the standard normal distribution corresponding to the desired power, generally 0.84 (for 80% power);

σ^2 is the estimated population variance;

d is the effect size (the expected mean difference between the two groups).

(4) Sample size calculation: Based on the observed standard deviation and mean difference, the study has 80% to detect the expected difference at a significance level of 0.05 according to the following formula:

$$Z_{\alpha/2} = 1.96, Z_{\beta} = 0.84, \sigma = 1, d = 0.5.$$

Substituting into the formula:

$$n = 2 (1.96 + 0.84)^2 \times 1^2 / 0.5^2 = 2 \times (2.8)^2 / 0.25 = 2 \times 7.84 / 0.25 = 62.72$$

Sample size calculations indicated that approximately 63 participants were required in each group to achieve 80% at $\alpha = 0.05$. Considering the possibility of incomplete records and matching failures during the propensity score matching (PSM), a safety margin of approximately 25% was used, resulting in a target sample size of 80–88 participants per group. In this retrospective study, all eligible cases during the study period were enrolled, and the final matched sample size met this requirement.

Based on the above calculations, at $\alpha = 0.05$, at least 63 patients are required in each group to achieve 80% efficacy. Taking into account a safety margin of approximately 25% to account for potential data loss and unmatched cases during propensity score matching, the final target sample size was set at 80 patients per group. In this retrospective study, 80 patients were included in the post-PSM observation group and the control group.

From existing clinical records, the data of 225 patients who underwent radical gastrectomy for gastric cancer at the First Affiliated Hospital of Nanjing Medical University in Huai'an between October 2022 and October 2024 were retrospectively reviewed. After applying 1:1 propensity score matching, 160 patients were selected for final analysis. These were divided into two groups: the observation group ($n = 80$) and the control group ($n = 80$). The patient inclusion process is shown in Fig. 1. This study was approved by the Ethics Committee of the First Affiliated Hospital of Nanjing Medical University in Huai'an (Approval no.KY-2024-224-01).

Propensity score matching (PSM) process:

(1) Definition of research variables: First, potential confounding variables that could influence patient nursing outcomes were identified. These variables included the patient's age, gender, comorbidities, gastroparesis grade, surgical duration, and overall physical condition.

(2) Calculation of propensity scores: Logistic regression or other appropriate statistical models were applied to calculate the probability (i.e., the propensity score) of each patient receiving treatment in either the observation or the control group. In this step, the treatment group (observation or control) was used as the dependent variable, while confounding variables mentioned in (1) served as independent variables.

(3) Matching the patients:

Selection of the matching method: A 1:1 matching ratio was adopted in this study. For each patient in the observation group, a corresponding patient from the control group with a similar propensity score was identified.

Matching process: Nearest neighbor matching or caliper matching methods were employed. In nearest neighbor matching, the patient with the closest propensity score was

selected. In caliper matching, a caliper width of 0.1 was applied to ensure the quality of the matched sample.

(4) Evaluation of the matching effect: After matching, the balance of major confounding variables between the two groups was assessed. Standardized mean differences were used to evaluate the balance and confirm that no significant differences existed in baseline characteristics between groups.

(5) Final analysis: Once balance in confounding variables between the groups was confirmed, further statistical analyses were performed to compare the nursing outcomes of the observation and control groups.

Inclusion criteria: (1) Patients who met diagnostic criteria for primary gastric cancer and were at stage I at the time of treatment. (2) Age >18 years. (3) Patients who underwent radical gastrectomy for gastric cancer and developed gastroparesis syndrome postoperatively.

Exclusion criteria: (1) Patients with severe cardiovascular or renal disease. (2) Patients with distant metastases. (3) Patients with poor treatment compliance. (4) Patients diagnosed with mental illness.

Methods

As a retrospective study, the nursing methods were derived from existing patient records. All patients included in this study underwent distal gastrectomy as a radical surgical treatment for gastric cancer, with Billroth II anastomosis (gastrojejunostomy) used for reconstruction. The rationale for selecting this surgical technique and anastomotic method was as follows:

(1) Clinical universality: Distal gastrectomy combined with Billroth II anastomosis is the most commonly performed procedure for advanced gastric cancer in China, ensuring a sufficient sample size.

(2) Risk comparability for gastroparesis: The incidence of gastroparesis after Billroth II anastomosis (approximately 5%–15%) is moderate. Compared with total gastrectomy (with Roux-en-Y anastomosis, associated with a higher gastroparesis risk) or proximal gastrectomy, the pathophysiological basis of postoperative gastroparesis (e.g., impaired gastric emptying or anastomotic edema) is more consistent, allowing better control of non-interventional variables influencing study results.

(3) PSM matching consistency: All patients received the same surgical approach and anastomotic method, fundamentally eliminating variability in surgical type and technique, and ensuring comparable baseline surgical risks between the observation and the control groups.

The control group received conventional nursing intervention, which mainly included: (1) Health education: Standardized manuals were distributed on postoperative days 1, 3, and 7, covering gastroparesis symptom recognition, liquid food transition timelines, and medication guidelines.

(2) Monitoring frequency: Vital signs, Body Mass Index

(BMI), and symptoms (e.g., abdominal distention, vomiting episodes) were recorded every 72 hours. (3) Nutritional regimen: Phase 1 (postoperative days 1–3): clear liquid (e.g., rice soup, lotus root powder), <500 mL/day. Phase 2 (postoperative days 4–7): semi-liquid foods (e.g., thin porridge, egg custard), 800–1200 mL/day, protein intake <30 g/day. (4) Caloric target: Total caloric intake via oral and parenteral routes aimed at 25 kcal/kg/day. (5) Medication management: Metoclopramide 10 mg intramuscularly as needed for vomiting; Parecoxib sodium 40 mg IV every 12 hours (up to 3 days for analgesia).

The observation group received nutritional support intervention under a comprehensive nursing framework:

(1) Multidisciplinary team collaboration framework: ① Team establishment: The team included a leader, three attending physicians, six nurses, three dietitians, two clinical pharmacists, two rehabilitation therapists, and one psychologist. The team formulated individualized care plans for patients based on current research evidence, clinical experience, and patient needs. The head nurse led the team, reviewed literature on gastroparesis, and referred to advanced national nursing practices. The attending physicians completed the radical gastrectomy and monitored perioperative gastrointestinal function recovery. Nurses carried out nursing tasks, monitored vital signs, reminded patients about medication adherence, managed enteral and parenteral nutritional support, and conducted health education. Dietitians used screening tools for nutritional risk assessment and developed personalized meal plans to ensure nutritional balance. Clinical pharmacists monitored postoperative pain, ensured rational medication use, and issued prescriptions. Rehabilitation therapists facilitated postoperative recovery through full-body massage and postoperative exercises. Psychologists provided emotional and psychological support for patients and their families, addressing postoperative anxiety and depression. ② Operational mechanism: Daily morning meetings (08:00–08:30) were conducted, led by the team leader. Each specialty gave updates and adjusted care plans (e.g., nutritionist identified low intake → rehabilitation therapist reduced exercise intensity accordingly). ③ Evidence-based decision-making: Literature evidence was assessed using the Joanna Briggs Institute (JBI) evidence grading system. Patient-reported outcomes were recorded using daily symptom diaries, including a visual analog scale (VAS) to assess abdominal bloating.

(2) Evidence-based intervention for early diagnosis of gastroparesis: ① Standardized symptom monitoring: Vomiting records included content (bile/food residue), volume (>200 mL/episode as warning), and odor (sour or not). Gastrointestinal decompression fluid was monitored every 4 hours. If drainage >100 mL/h and appeared green and bile-like, multidisciplinary consultation was initiated. ② Intervention and outcome correlation: Early identification of bile-like vomiting and abnormal drainage allowed plan adjustment within 24 hours (e.g., suspending enteral nutrition), signifi-

cantly reducing symptom resolution time in the observation group (outcome measure).

(3) Structured psychological care plan: Implementation details: Cognitive behavioral therapy (CBT): Daily 15 minutes daily sessions (postoperative days 1–7) to challenge catastrophic thoughts (e.g., “vomiting = surgery failure”). Relaxation training: Initiated 6 hours postoperatively using guided abdominal breathing (inhale 4 s, hold 7 s, exhale 8 s; 5 cycles/session, 3 sessions/day). Environmental control: Patients stayed in private rooms with noise level maintained <35 decibels (monitor alarms set to minimal level).

(4) Precision tube care management: Specific implementation details: Nasal cavity care: Administered compound menthol nasal drops every 6 hours (non-erythromycin based) to prevent mucosal injury. Nutritional tube fixation: Nutritional tubes were secured using 3M™ Silicone Tape (Y-type fixation method), and skin compression sites were checked every 8 hours. Central venous catheter care: Chlorhexidine gluconate swabs were used every 48 hours. Catheter tip cultures were performed during dressing changes to monitor infection risk.

(5) Stratified nutritional support plan: ① Nutritional risk screening: Conducted 24 hours postoperatively using the nutritional risk screening (NRS)-2002 scoring system. Criteria include: age ≥70 years (+1 point), BMI <18.5 (+1 point), serum albumin <30 g/L (+1 point), intake <60% of nutritional requirement (+2 points). ② Nutritional formula and implementation are detailed in Table 1 below. ③ Dynamic adjustment rules: Patients presenting with diarrhea (Bristol scale ≥6) had their enteral infusion rate reduced by 10 mL/h, and soluble fiber (guar gum 2 g/500 mL) was added. In cases of gastric retention (drainage volume >200 mL/4 hours), enteral nutrition was suspended and replaced with parenteral nutrition, maintaining a 50:50 sugar-to-fat ratio.

(6) Multimodal intervention for gastric motility recovery: ① Specific implementation details: Sham feeding therapy: Patients began chewing sugar-free gum (Wrigley®, 100062264215, Mars Arrow Candy (China) Co., Ltd., Guangzhou, China) 6 hours post-surgery for 30 minutes per session, five times daily, with concurrent monitoring of salivary amylase activity. Medication regimen: Erythromycin 250 mg + 0.9% Normal Saline (NS) (100 mL) was administered via intravenous (IV) drip every 12 hours for 48 hours, followed by oral domperidone 10 mg three times daily, 30 minutes before meals. Traditional Chinese Medicine integration: Acupuncture was applied at Zusanli (ST36) and Neiguan (PC6) starting 12 hours postoperatively, with needles retained for 20 minutes, twice daily. Abdominal massage (clockwise circular pressure around the navel) was performed for 10 minutes per session, three times daily. ② Intervention and outcome correlation: Erythromycin stimulated motilin receptors, and acupuncture at Zusanli enhanced vagal excitability, synergistically reducing compensatory motilin elevation. Sham feeding induced

Table 1. Nutritional formula and implementation.

Risk level	Energy target	Protein source	Infusion method
No risk (NRS <3)	30 kcal/kg/day	Whole protein enteral nutrition formula (Ruisu®)	Oral drinking starting 24 hours post-surgery, 50 mL/h
High risk (NRS ≥3)	35 kcal/kg/day	Short peptide formula (Bailipuli®) + Glutamine (10 g/day)	Continuous infusion via jejunal nutrition pump, starting at 20 mL/h

NRS, nutritional risk screening.

cephalic-phase digestive secretions, contributing to earlier dietary resumption.

Methods for controlling potential influencing factors in gastrointestinal outcomes:

(1) Standardized medication usage: Medication guidelines were established based on best clinical practices, specifying indications, dosages, and administration timing for prokinetic agents (e.g., metoclopramide, domperidone, erythromycin), antibiotics, and analgesics.

(2) Monitoring and recording:

Data collection forms: Standardized forms were developed to document type, dose, frequency, and timing of postoperative medication use. Regular review: Routine audits ensured adherence to established medication protocols, with deviations corrected promptly.

(3) Adherence monitoring: Patient interviews: Periodic interviews were conducted to assess understanding and adherence to the medication regimen, and collect feedback on their understanding of the treatment plan. Healthcare provider records: Nurses documented responses to prokinetic and analgesic treatments in care logs, enabling analysis. Retrospective analysis: Post-study evaluation compared medication adherence and its impact on gastric motility recovery across groups.

(4) Education and training: Healthcare staff training: Personnel were trained on medication standards and the clinical importance of adherence to clinical practices. Patient education: Patients were educated on postoperative recovery and treatment protocols to enhance compliance.

Quality control and blinding implementation:

(1) In this retrospective study, we extracted Gastroparesis Cardinal Symptom Index (GCSI) scores, patient satisfaction, gastrointestinal parameters, and laboratory measurement data (GAS, pepsinogen I (PG I)) from existing medical records and laboratory databases. Data extraction was performed by two independent researchers using a standardized form, and the analysts were masked to group assignment until statistical analysis was completed. Laboratory results were generated by routine clinical testing, and sample identifiers were replaced with anonymous codes before analysis.

(2) Standardized data collection tools and procedures:

GCSI scoring: A validated Chinese version of the GCSI was used in structured interviews by blinded, uniformly trained nurses. Interviews followed a standardized script

to avoid leading questions, and patient responses were recorded verbatim for scoring.

Gastrointestinal function indicators: Gastric drainage volume, time to first flatus, first bowel movement, eating resumption, and symptom resolution were recorded by ward nurses following standard operating procedures (SOPs). Objective observations, such as nurse-signed records for first flatus and bowel movements, physician-approved dietary orders, and clinical documentation of symptom resolution, were used instead of subjective patient reports or nurse assumptions.

(3) Blinded data management: Data entry personnel worked independently and accessed only anonymized data. Final statistical analysis was performed by a biostatistician blinded to group allocations, with only Group A and B labels used.

(4) Training for data collection personnel: All staff involved in data collection (assessors, recording nurses, laboratory staff) completed specialized SOP training and passed competency evaluations before participating in the study.

Observation Indicators

As a retrospective study, the results of the outcome indicators were already recorded in the existing case files.

(1) Gastrointestinal hormone levels: Blood samples (5 mL fasting venous blood) were collected before and two weeks after the intervention. Samples were centrifuged at 3000 rpm for 15 minutes to obtain serum. Enzyme-linked immunosorbent assay was used to measure serum motilin, gastrin (GAS), and pepsinogen I concentrations.

(2) Severity of gastroparesis symptoms: The Gastroparesis Cardinal Symptom Index [9] was employed to evaluate the severity of gastroparesis symptoms in both groups before and two weeks post-intervention. The index includes three subscales: postprandial fullness/early satiety (4 items), nausea/vomiting (3 items), and abdominal distention (2 items). Each item is rated on a 0–5 scale: none, very mild, mild, moderate, severe, or very severe. Higher scores indicate greater severity of gastroparesis.

(3) Gastrointestinal function: Parameters including gastric drainage volume, time to first flatus, time to resume normal eating, and symptom resolution time were recorded and used to assess gastrointestinal recovery.

(4) Patient satisfaction with nursing care: Before discharge, patient satisfaction was assessed using a self-designed hos-

pital survey scale ranging from 0 to 100 points. A score ≥ 89 indicated “very satisfied”, 70–89 indicated “generally satisfied”, and < 70 indicated “unsatisfied”. The total satisfaction rate was calculated as:

$$\text{Total Satisfaction Rate (\%)} = (\text{Very Satisfied} + \text{Generally Satisfied}) / \text{Total Cases} \times 100\%.$$

The standardized process for questionnaire distribution and collection is detailed in **Supplementary Material**.

Personnel blinding statement: The satisfaction questionnaire survey was conducted by a full-time research assistant who had received standardized training, did not participate in clinical care, and remained blinded to group allocation.

Process validity statement: To minimize reporting biases (e.g., social desirability bias), questionnaires were distributed in a private setting, with standardized instructions provided. Patients sealed their completed questionnaires, which were anonymized before analysis.

Statistical Methods

Data were analyzed using SPSS version 22.0 (IBM, Armonk, NY, USA) and GraphPad Prism version 8.0.2 (GraphPad Software, Inc., San Diego, CA, USA). The normality of data was tested using the Shapiro-Wilk test. The Bartlett test was used to evaluate homogeneity of variance. Normally distributed continuous variables were expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$), and inter-group comparisons were made using independent sample *t*-tests. Non-normally distributed data or unequal variances were reported as median (M) and interquartile range (M [P₂₅, P₇₅]), and analyzed using the Mann-Whitney U test. Categorical (count) data were expressed as percentages (%) and compared using chi-square tests. A *p*-value < 0.05 was considered statistically significant.

Data quality assurance procedures included cleaning. Raw data were reviewed for missing values and outliers, which were flagged for further analysis.

For limited missing data, mean imputation methods were applied; for more substantial missingness, multiple imputation methods were used to reduce bias. All imputation approaches were chosen based on the data type and distribution characteristics. A Sensitivity analysis was performed to evaluate the impact of different missing data handling methods on study results, ensuring robustness of the findings. The data collection process was reviewed for accuracy and consistency. When necessary, original data sources and recording methods were re-evaluated to confirm data integrity. Before inferential analyses, appropriate normality and variance homogeneity tests were performed to ensure the suitability of the statistical methods applied.

Results

General Information

To minimize confounding bias and more accurately assess the effect of the intervention, PSM was applied to control

for covariates potentially influencing treatment outcomes between the two patient groups. By calculating a propensity score for each patient, individuals in the treatment group were matched with those in the control group, yielding comparable characteristics after matching.

The general characteristics of both groups are shown in Table 2. No significant differences were observed between the two groups ($p > 0.05$).

Gastrointestinal Hormone Levels

Two weeks after the intervention, the observation group exhibited significantly lower serum MTL and GAS levels compared to the control group, while serum PG I levels were higher in the observation group. Specifically, MTL (82.51 ± 9.83) pg/mL vs. (95.25 ± 9.10) pg/mL; 95% CI = (-15.7069 , -9.7906); GAS, (67.80 ± 9.54) pg/mL vs. (81.70 ± 8.55) pg/mL; 95% CI = (-16.7264 , -11.0711); PG I, (86.10 ± 7.50) ng/mL vs. (77.50 ± 7.20) ng/mL; 95% CI = (6.3032 , 10.8943). All differences were statistically significant ($p < 0.05$; Table 3).

Severity of Gastroparesis Symptoms

GCSI score data were collected through interviews conducted by trained independent evaluators blinded to group allocation. Two weeks after treatment, the observation group showed significantly lower GCSI scores than the control group (14.10 ± 7.05) vs. (23.60 ± 10.08); 95% CI = (-12.218 , -6.782), $p < 0.05$, Table 4).

Gastrointestinal Function

Gastrointestinal function time indicators were recorded by nurses who were blinded to the study groups following standardized procedures using objective timestamps. The observation group exhibited a lower gastric drainage volume, earlier first flatus, shorter time to resume normal eating, and faster symptom resolution compared to the control group (Gastric drainage volume: (952.10 ± 19.40) mL/day vs. (1121.33 ± 27.65) mL/d, 95% CI = (-176.6950 , -161.7650); time to first flatus: (35.10 ± 6.05) hours vs. (45.50 ± 6.35) hours, 95% CI = (-12.3274 , -8.4551); time to resume normal eating: (5.10 ± 0.65) days vs. (6.45 ± 1.32) days, 95% CI = (-1.6772 , -1.0253); time to symptom resolution: (13.50 ± 2.68) days vs. (18.05 ± 2.35) days, 95% CI = (-5.3382 , -3.7618)). All differences were statistically significant ($p < 0.05$, Table 5).

Nursing Satisfaction

Nursing satisfaction data were obtained through interviews conducted by trained independent evaluators who were blinded to group allocation. The satisfaction rate in the observation group was significantly higher than in the control group ($p < 0.05$, Table 6).

Table 2. Baseline characteristics of the two groups before and after PSM.

Observation indicators	Pre-PSM				Post-PSM			
	Observation group (n = 105)	Control group (n = 100)	t	χ^2/p	Observation group (n = 80)	Control group (n = 80)	t	χ^2/p
Age (years)	63.70 ± 8.34	60.21 ± 7.50	3.145	0.002	55.78 ± 5.13	54.96 ± 4.87	1.034	0.303
Gender (male/female)	55/50	55/45	0.141	0.707	46/34	51/29	0.655	0.418
Classification of gastroparesis, n (%)								
A	26 (24.76)	33 (33.00)			17 (21.25)	26 (32.50)		
B	52 (49.52)	45 (45.00)	1.725	0.422	40 (50.00)	32 (40.00)	2.795	0.247
C	27 (25.71)	22 (22.00)			23 (28.75)	22 (27.50)		
BMI (kg/m ²)	23.51 ± 2.50	23.11 ± 2.25	1.202	0.231	24.08 ± 2.97	24.77 ± 2.65	1.572	0.118
Smoking history, n (%)	38 (36.19)	31 (31.00)	0.618	0.432	26 (32.50)	21 (26.25)	0.695	0.404
Complications, n (%)								
Comorbid diabetes	28 (26.67)	21 (21.00)	0.904	0.342	17 (21.25)	16 (20.00)	0.038	0.845
Hypertension	21 (20.00)	18 (18.00)	0.133	0.715	7 (8.75)	12 (15.00)	1.493	0.222
Hyperlipidemia	35 (33.33)	20 (20.00)	4.638	0.031	15 (18.75)	13 (16.25)	0.173	0.677
Obesity	26 (24.76)	21 (21.00)	0.410	0.522	16 (20.00)	20 (25.00)	0.573	0.449
Operative time (h)	5.05 ± 0.73	4.96 ± 0.65	1.032	0.303	4.36 ± 0.58	4.40 ± 0.60	0.429	0.668

PSM, propensity score matching; BMI, Body Mass Index.

Table 3. Comparison of gastrointestinal hormone levels between the two groups ($\bar{x} \pm s$).

Group	n	MTL (pg/mL)		GAS (pg/mL)		PG I (ng/mL)	
		Before intervention	Two weeks after intervention	Before intervention	Two weeks after intervention	Before intervention	Two weeks after intervention
Observation group	80	136.30 ± 15.10	82.51 ± 9.83	131.25 ± 15.70	67.80 ± 9.54	55.21 ± 6.35	86.10 ± 7.50
Control group	80	136.65 ± 16.05	95.25 ± 9.10	130.20 ± 13.95	81.70 ± 8.55	54.95 ± 5.45	77.50 ± 7.20
t-value		0.146	8.512	0.447	9.708	0.269	7.398
p-value		0.884	<0.001	0.655	<0.001	0.789	<0.001

MTL, motilin; GAS, gastrin; PG I, pepsinogen I.

Discussion

Gastroparesis syndrome following radical gastric cancer surgery is a non-mechanical obstructive condition primarily characterized by delayed gastric emptying and impaired gastric outlet function. The core clinical symptoms include impaired gastric motility, postprandial fullness, bloating, nausea, vomiting, abdominal distention, and upper abdominal pain. Several studies have indicated that nutritional support can provide essential nutrients to meet the body's energy and nutritional demands, thus mitigating malnutrition caused by reduced oral food intake [10,11]. For patients undergoing surgery for malignant tumors, comprehensive nutritional support is crucial for maintaining body weight and preventing malnutrition [12]. In patients with gastroparesis syndrome, providing effective nutritional support is especially challenging due to frequent symptoms such as nausea, vomiting, and anorexia, which significantly limit dietary intake. In such cases, nutritional strategies must be tailored more precisely to the needs of the patient [13].

Previous research has shown that nutritional interventions guided by a multidisciplinary team can facilitate the development of personalized dietary and nutrition plans based on the specific condition of the patient [14]. Through coordi-

nated efforts, a multidisciplinary team can optimize dietary modifications, assess and stratify nutritional risks, and implement timely enteral or parenteral nutrition. These interventions help alleviate gastrointestinal symptoms, reduce gastric workload, and enhance patient tolerance to feeding regimens [15].

This study observed that after two weeks of intervention, levels of MTL and GAS in both patient groups had significantly decreased compared to preoperative levels, while PG I levels increased. These changes were more pronounced in the observation group, which received comprehensive care combined with nutritional support, than in the control group, which received routine care. These findings provide direct biochemical support for the hypothesis that comprehensive interventions can improve gastric function.

A potential mechanistic explanation for the observed decrease in MTL/GAS involves the concept of compensation and overcompensation in gastroparesis. At the core of gastroparesis lies delayed gastric emptying. Under pathological conditions, the body often attempts to compensate by increasing the secretion of gastric motility-related hormones, such as MTL, which promotes gastric motility, and GAS, which stimulates gastric acid secretion and

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

Group	n	Before intervention	Two weeks after intervention
Observation group	80	33.10 $\pm$ 8.50	14.10 $\pm$ 7.05
Control group	80	34.20 $\pm$ 7.45	23.60 $\pm$ 10.08
<i>t</i> -value	-	0.870	6.909
<i>p</i> -value	-	0.385	<0.001

GCSI, Gastroparesis Cardinal Symptom Index.

Table 5. Comparison of gastrointestinal function indicators between the two groups ($\bar{x} \pm s$).

Group	n	Gastric drainage volume (mL/day)	Time to first flatus (h)	Time to resume normal eating (days)	Time to symptom resolution (days)
Observation group	80	952.10 $\pm$ 19.40	35.10 $\pm$ 6.05	5.10 $\pm$ 0.65	13.50 $\pm$ 2.68
Control group	80	1121.33 $\pm$ 27.65	45.50 $\pm$ 6.35	6.45 $\pm$ 1.32	18.05 $\pm$ 2.35
<i>t</i> -value	-	44.815	10.600	8.211	11.401
<i>p</i> -value	-	<0.001	<0.001	<0.001	<0.001

antral contractions, to overcome the emptying dysfunction [16]. However, this compensatory response is often ineffective or excessive, leading to persistently elevated levels of MTL and GAS. These heightened levels can exacerbate gastric spasms, increase patient discomfort, and contribute to symptoms of indigestion [17]. This may explain why, under routine care, hormone levels in the control group declined slightly but remained relatively high. In contrast, the observation group exhibited a more significant decrease in MTL and GAS levels, indicating more effective resolution of gastric motility disorders. This improvement can be attributed to several factors. One is the reduction of physiological stress and improved neurological regulation. Multidisciplinary collaboration, including psychological support and analgesia, helps to alleviate postoperative pain and reduce anxiety-induced sympathetic nervous system activation. By attenuating the “fight or flight” stress response, which is a well-documented inhibitor of gastrointestinal motility, comprehensive care facilitated the restoration of vagal tone. This, in turn, promoted more physiological gastric motility and reduced the need for compensatory hormonal elevation. Another contributing factor is the optimization of nutritional substrates and physiological stimuli. Early, evidence-based, and individualized nutritional support, especially via the enteral route, supplied not only essential energy and nutrients but also influenced gastric function through the physical and chemical properties of the feeding solution. Variables such as osmolality, temperature, and infusion rate of the nutritional solution, as well as specific nutrients such as select amino acids and short-chain fatty acids, served as physiological signals to the enteric nervous system and endocrine cells. Such stimuli enhanced the coordinated contraction and emptying of gastric smooth muscle, thereby reducing reliance on elevated MTL and GAS levels. Lastly, improvement of the gastric environment played a crucial role. A well-structured nutritional plan, emphasizing low-fat, easily digestible, small, and frequent meals, reduces mechanical and chemical stress on the

stomach. This approach minimized gastric overloading and irritation, preventing reflexive over-secretion of MTL and GAS, often triggered by food retention [18,19].

Compared to the routine care, the control group may have lacked systematic stress management and detailed nutritional adjustments, which limited the ability to effectively interrupt the vicious cycle of gastroparesis and compensatory hormone overproduction. As a result, improvements in hormone levels were less pronounced.

Pepsinogen I serves as a key biomarker of gastric acid secretion. Secreted primarily by the chief cells in the gastric fundus, its serum concentration reflects the acid-producing capacity and the functional status of the fundic glands [20]. In gastroparesis, the retention of gastric contents, gastric dilation, and associated inflammation or autonomic dysfunction inhibit gastric acid secretion [21]. Furthermore, the stress response also suppresses gastric acid secretion, leading to lower PG I levels.

Patients receiving comprehensive intervention showed significantly higher PG I levels compared to the control group, suggesting better recovery of gastric secretory function. Several mechanisms may explain this effect. One is the improvement in neuroendocrine regulation. As previously discussed, the reduction of physiological stress and restoration of vagal tone through multidisciplinary care promote the physiological control of gastric acid secretion. Another factor is the dual effect of nutritional support. Adequate nutritional substrates, especially protein, provide raw material for gastric acid synthesis. Furthermore, the passage of enteral nutrition through the duodenum stimulates the release of hormones such as gastric inhibitory polypeptide (GIP) and cholecystokinin (CCK), which modulate gastric secretory activity. Although these hormones initially inhibit acid secretion, they promote coordinated long-term secretory function under physiological conditions [22,23].

Improved gastric emptying also plays a key role. By reducing the mechanical distention and chemical feedback that impair fundic function, comprehensive care creates a fa-

Table 6. Comparison of nursing satisfaction between the two groups n (%).

Group	n	Very satisfied, n (%)	Generally satisfied, n (%)	Unsatisfied, n (%)	Overall satisfaction rate (%)
Observation group	80	44 (55.00)	31 (38.75)	5 (6.25)	75 (93.75)
Control group	80	27 (33.75)	32 (40.00)	21 (26.25)	59 (73.75)
χ^2 -value	-				11.757
<i>p</i> -value	-				0.001

avorable local environment for gastric acid secretion. The restoration of PG I levels may also indicate improved gastric mucosal health, especially in the functional recovery of chief cells. In contrast, the control group, receiving routine care, may have experienced slower improvement in gastric emptying and inadequate stress management, resulting in a continuous unfavorable gastric environment and delayed restoration of secretory function, as indicated by the smaller increase in PG I levels.

Changes in gastrointestinal hormone levels may influence long-term patient outcomes in multiple ways. Restoration of hormone balance contributes to the recovery of normal gastrointestinal function, alleviating symptoms of gastroparesis. Improved gastric emptying and digestive capacity reduce complication risks and improve the patient's quality of life. As gastrointestinal function recovers, nutrient absorption efficiency improves, which supports postoperative recovery, strengthens immune function and reduces the risk of postoperative complications or delayed recovery. Improvements in gastroparesis symptoms contribute to enhanced quality of life, reduced levels of anxiety and depression, and foster a more positive care experience [24]. Relief of symptoms may also strengthen psychological resilience, exerting a beneficial influence on long-term mental health outcomes [25]. In addition to the psychological well-being, normalization of gastrointestinal hormone levels may help reduce the risk of gastric cancer recurrence, especially when combined with appropriate postoperative monitoring and timely intervention. Efficient gastrointestinal function further contributes to a lower incidence of postoperative complications, including infection and malnutrition.

The interpretation of confidence intervals is essential in evaluating the significance and robustness of findings. A confidence interval provides a range for the estimated effect, offering insights into the precision and reliability of the results. In this study, presenting confidence intervals for key indicators such as MTL, GAS, and PG I, is crucial for assessing their clinical significance. For example, a 95% confidence interval for PG I ranging from 6.3032 to 10.8943 suggests that the true change in PG I lies within this interval with 95% certainty, supporting the observed benefit of the intervention in the observation group. The clinical significance of PG I elevation, from 77.50 ng/mL in the control group to 86.10 ng/mL in the observation group, can be considered from several perspectives. As a precursor to pepsin, PG I is typically associated with the func-

tional status of the gastric glands. An increase in its level may reflect improved gastric secretory function, which is crucial in supporting gastrointestinal recovery after radical gastrectomy for cancer. Literature also suggests that PG I dynamics may be related to clinical prognosis in gastric cancer patients. Elevated levels may indicate better mucosal restoration, potentially lowering the likelihood of recurrence or postoperative complications.

Moreover, higher PG I levels are likely associated with symptom relief. Through comprehensive nursing care and targeted nutritional support, the observed rise in PG I may contribute to the alleviation of bloating, nausea, and other manifestations of gastroparesis, improving overall quality of life. In statistical reporting, it is essential to look beyond *p*-values by including effect sizes and confidence intervals. These additional indicators offer a clearer understanding of the statistical and clinical significance of the findings, and they strengthen the validity of evidence-based conclusions. A study conducted by Li *et al.* [26] highlights that traditional Chinese acupuncture therapy for gastrointestinal diseases has a history spanning thousands of years. A meta-analysis included randomized controlled trials in which the treatment groups received traditional Chinese acupuncture, while the control groups received standard medical treatment, routine nursing, or rehabilitation. Using RevMan 5.3 software (RevMan 5.3, Cochrane Collaboration, London, UK), the relative risks and weighted mean differences with 95% confidence intervals were calculated for total effectiveness, gastrin levels, gastric emptying time, fasting blood glucose, 2-hour postprandial blood glucose, and HbA1c levels. The Cochrane risk of bias tool was applied for quality assessment, and a total of 59 studies were included in the final analysis. Compared to the control group, the acupuncture group demonstrated significantly higher total effectiveness, enhanced gastric emptying, and reduced HbA1c levels. These findings suggest that traditional Chinese acupuncture has notable benefits in managing diabetic gastroparesis compared to Western or traditional pharmacological treatments. However, due to the generally low methodological quality and high risk of bias in the included studies, further high-quality randomized controlled trials are needed to validate these conclusions.

Following two weeks of intervention, GCSI scores for gastroparesis decreased in both patient groups. However, the decline was significantly greater in the observation group than in the control group. This trend was highly consistent with the greater decline in MTL and GAS levels and

the greater increase in PG I, supporting a direct association between improvements in biochemical indicators and the alleviation of clinical symptoms. The primary driver of the decrease in GCSI scores appears to be the restoration of gastric motility and acceleration of gastric emptying. The more significant reduction in MTL and GAS levels in the observation group reflects reduced compensatory hormonal stimulation and enhanced coordination of gastric motility. The elevated PG I levels indirectly signal improvements in the gastric environment and reduced resistance to gastric outflow. Accelerated gastric emptying alleviates core symptoms such as postprandial bloating, early satiety, nausea, and vomiting, which are central to GCSI scoring.

Recovery of gastric acid secretion also plays a crucial role. The increase in PG I in the observation group indicates enhanced gastric acid secretion, which is crucial for the initial digestion of proteins, microbial defense, and promotion of intestinal digestion and absorption. Insufficient gastric acid secretion can lead to symptoms such as indigestion, upper abdominal discomfort, and belching, all components of the GCSI scale. Therefore, improved gastric acid secretion likely contributed to the more significant symptom relief observed. The broad-spectrum benefits of the comprehensive intervention strategy also contribute to symptom improvement. Personalized dietary management, tailoring food properties, caloric density, and meal timing, minimized gastric burden and discomfort. Multidisciplinary collaboration optimized the use of prokinetic and antiemetic agents, enhancing their efficacy under the support of nutritional therapy. Regulation of the brain-gut axis through psychological counseling and health education significantly reduced patient anxiety and uncertainty about the disease, both of which can amplify symptom perception and impair gastrointestinal function [27]. The alleviation of psychological stress, therefore, likely contributed meaningfully to the improvement of subjective GCSI scores. Furthermore, encouragement of early postoperative activity helped stimulate the enteric neural pathways and improve abdominal blood flow, indirectly promoting gastric emptying and alleviating discomfort such as bloating.

In contrast, symptom improvement in the control group was likely attributable to conventional treatment, routine nutritional advice, and natural postoperative recovery. However, in the absence of a systematic, multi-targeted intervention, the effects on gastric motility (as indicated by inadequate reduction in MTL and GAS), gastric environment improvement (as reflected by minimal PG I increase), and the lack of targeted psychological support were limited. Consequently, the degree and speed of symptom relief in the control group were inferior to those observed in the comprehensively managed observation group. These findings highlight the advantages of an individualized, multidisciplinary, and collaborative nursing approach in managing the complex symptoms associated with postoperative gastroparesis.

In a related study by Hu *et al.* [28], 90 patients diagnosed with spleen and stomach deficiency-type gastroparesis were randomly selected for analysis. Participants were divided into two groups through digital randomization: a control group receiving routine nursing care, and an observation group receiving comprehensive Traditional Chinese Medicine (TCM) nursing in addition to the care provided to the control group. The results showed that, following the intervention, the observation group experienced more significant improvements in gastric pain and clinical symptoms compared to the control group. Pain scores recorded on days four and eight were lower in the observation group. Additionally, nursing satisfaction was significantly higher among patients in the observation group. In the clinical care of patients with spleen and stomach deficiency-type gastroparesis, the application of a comprehensive TCM nursing model effectively improved treatment outcomes, enhanced physical recovery, relieved gastric discomfort, and significantly increased patient satisfaction with nursing services. These findings are consistent with the results of this study, reinforcing the conclusion that comprehensive interventions significantly alleviate clinical symptoms and enhance postoperative quality of life in gastroparesis patients, while also improving patient satisfaction with nursing care.

The observation group demonstrated significantly lower gastric juice drainage volume, earlier time to first flatus, shorter time to resume normal eating, and quicker symptom resolution compared to the control group. These differences can be attributed to several mechanisms underlying enhanced gastrointestinal function recovery in the observation group.

Physiological mechanisms contributing to reduced gastric drainage volume include optimized neuroendocrine regulation. The multidisciplinary care approach, including pain management and psychological interventions, significantly mitigated the postoperative stress response. Under stress, sympathetic nervous system activation suppresses vagal tone, leading to disrupted gastric acid secretion and weakened gastric antrum motility, resulting in gastric retention. The comprehensive nursing provided reduced circulating cortisol and other stress hormones, restored autonomic nervous system balance, and suppressed excessive gastric acid secretion, thus lowering the drainage volume. An additional contributor was the targeted effect of nutritional support. An individualized enteral nutrition strategy, based on a thorough nutritional risk assessment and employing low-fat, isotonic formulations, helped reduce gastric acid stimulation. Early initiation of enteral nutrition also stimulated the duodenum, releasing peptide YY (PYY) and glucagon-like peptide-1 (GLP-1), which inhibit gastric acid secretion and accelerate gastric emptying. In contrast, conventional dietary practices in the control group lacked such targeted precision. The synergistic effect of prokinetic medications further enhanced outcomes. The multidisciplinary team systematically monitored for gastroparesis symptoms and

administered agents such as erythromycin and mosapride in a timely fashion. These agents enhanced gastric antral contractions, improved emptying, and further reduced gastric fluid accumulation.

Mechanisms underlying shortened time to first flatus primarily involve enteric nervous system activation. Early enteral nutrition, a core intervention in the observation group, provided short-chain fatty acids (SCFAs), which stimulated chromaffin cells in the gut to release 5-hydroxytryptamine (5-HT). This, in turn activated the intrinsic enteric nervous plexus and restored gut motility reflexes. Delayed nutritional support in the control group may have missed the optimal window for postoperative enteric nerve function recovery. Restoration of the vagovagal reflex also played a role. Psychological interventions and pain management attenuated sympathetic activation, relieving vagal inhibition. This facilitated earlier restoration of the gastrocolic reflex, enhancing colonic motility in the observation group relative to controls. Inflammation control and improvement of the intestinal microenvironment were also key contributing factors. Individualized nutritional support enhanced protein intake, especially from sources such as whey protein, which reduced postoperative inflammatory markers such as interleukin (IL)-6 and tumor necrosis factor (TNF)- α . This helped alleviate postoperative intestinal edema caused by surgical trauma and improved smooth muscle contraction efficiency [29].

Mechanisms supporting the earlier resumption of normal feeding and symptom resolution are multifactorial. One primary factor is improved gastric emptying, evidenced by reduced gastric drainage volume and earlier gas passage. These indicators suggest a higher gastric emptying rate in the observation group, warranting further validation through objective methods such as gastric scintigraphy. Accelerated gastric emptying mitigates hallmark symptoms of gastroparesis, including early satiety, nausea, and vomiting, thus laying the physiological foundation for earlier oral feeding. Bidirectional regulation of the brain-gut axis also contributed. Psychological support lowered anxiety and suppressed corticotropin-releasing hormone (CRH), which otherwise inhibits gastrointestinal motility. At the same time, improvements in gastrointestinal function produced positive feedback to the central nervous system, creating a positive loop of symptom relief, anxiety reduction, and further function recovery. A cascading effect involving nutrition, physiological function, and symptomatology was also evident. The intervention logic in the observation group followed a coherent trajectory: precise nutritional support facilitated mucosal repair, reduced inflammation, enhanced neuronal transmission, accelerated motility recovery, and led to symptom resolution. This chain of improvements ultimately enabled earlier restoration of oral feeding. In contrast, the control group, lacking systematic interventions, exhibited fragmented recovery at various stages.

The satisfaction level reported by the observation group was significantly higher, with several underlying factors contributing to this difference in nursing satisfaction. One key factor was the direct effect of symptom relief. The observation group experienced faster resolution of core symptoms, such as bloating and vomiting, and an earlier return to oral feeding directly, which directly improved physiological comfort and established a foundation for enhanced patient satisfaction. Patient empowerment and a stronger sense of participation also played a vital role. Personalized health education, particularly diet adjustments guided by nutritionists, allowed patients to develop self-management skills, such as symptom tracking and food texture adjustments, which fostered a sense of control over their condition. Additionally, the visibility and frequency of psychological support interventions made patients feel genuinely cared for, in contrast to the unidirectional and generic educational approach experienced by those in the control group. The experience-related advantages of multidisciplinary collaboration were also notable. The timeliness of team responses, such as early identification and management of complications such as diarrhea through formula adjustments, helped reduce patient discomfort and distress. Continuity in the care experience, achieved through coordinated efforts among physicians, nurses, nutritionists, and psychologists, reduced the fragmentation typical of conventional nursing and allowed patients to perceive a more integrated whole-process approach to recovery. Another influential element was the effectiveness of expectation management. Comprehensive nursing strategies set clear, phase-based recovery goals, such as initiating enteral nutrition by the third postoperative day or transitioning to liquid food after one week. This approach helped patients form realistic expectations. When actual recovery progresses better than expectations, patients have reported significantly higher satisfaction.

Despite the positive findings, several limitations must be acknowledged, which may influence the generalizability of the results and the depth of the mechanistic interpretation. One major limitation is the study design. This research was conducted as a retrospective cohort study, with patients allocated into groups based on pre-existing medical records (observation vs. control). The absence of randomization raises the possibility of baseline differences between the two groups in variables such as preoperative nutritional status, tumor staging, surgical techniques, preoperative anxiety levels, or comorbid conditions. These potential confounding factors may have contributed to the observed effects of the intervention, suggesting that the superiority of the observation group may partially result from more favorable baseline characteristics, rather than solely from the nursing intervention.

Another limitation was the short-term observation window. The study evaluated outcomes only within the first two weeks post-intervention. Since recovery from postopera-

tive gastroparesis is often a prolonged process, it remains unclear whether the early advantages in the observation group are sustained over time. The study does not address whether the two groups differ in terms of long-term symptom resolution, duration to resume full feeding nutritional status, quality of life, or readmission rates. Therefore, short-term improvements do not necessarily translate into an optimized long-term prognosis.

Additionally, the retrospective design of the study limits the ability to rigorously control all potential confounding variables. For example, variations in perioperative medication use, such as the types and dosages of administered prokinetic agents, could have influenced the interpretation of the results.

While the nursing satisfaction survey was designed to be as objective as possible, patient perceptions may have been influenced by the visible differences in nursing care intensity, for example, more frequent nutritional consultations, which may have biased satisfaction scores. This reflects an inherent limitation of non-blinded study designs.

Due to the nature of the interventions, conventional care vs. comprehensive nutritional support, it was not possible to blind either the patients or care providers, which may have influenced subjective reports such as GCSI scores and satisfaction ratings. To address this bias, the study employed blinded evaluators who were unaware of group assignments, standardized data collection protocols, and emphasized confidentiality to encourage honest feedback. Furthermore, the consistency between subjective outcomes and objective indicators, such as gastrointestinal hormone levels and gastrointestinal function time points, provided additional support for the reliability of the findings, minimizing the impact of potential bias related to group allocation knowledge in measuring outcomes, especially subjective outcomes.

Conclusions

Comprehensive nursing combined with nutritional support improves gastric function in patients with gastroparesis syndrome following radical gastrectomy for gastric cancer. It contributes to the regulation of gastrointestinal hormone levels, alleviates the severity of gastroparesis symptoms, and significantly improves patient satisfaction with nursing care.

Availability of Data and Materials

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

Author Contributions

YRQ and CXX designed the study and carried it out. YRQ and CXX supervised the data collection. YRQ analyzed and

interpreted the data. YRQ and CXX drafted the manuscript and revised it critically for important intellectual content. Both authors gave final approval of the version to be published. Both authors have participated sufficiently 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 the First Affiliated Hospital of Nanjing Medical University in Huai'an (Approval no.KY-2024-224-01). Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article. This study adhered to the principles outlined in the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.62713/ai.c.4173>.

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