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Article

Analysis of the Influencing Factors of Postoperative Constipation in Patients Undergoing Cardiovascular Surgery: A Cross-Sectional and Prospective Study

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Abstract

Background: The aim of this study was to estimate the potential influencing factors of postoperative constipation in patients undergoing cardiovascular surgery. **Methods**: This study included a cohort of 379 patients who underwent cardiovascular surgery at Nanjing Drum Tower Hospital. The patient cohort was stratified into two groups based on the presence or absence of postoperative constipation. Utilizing logistic regression analysis, both univariate and multivariate analyses were conducted to elucidate the factors influencing defecation problems. The predictive accuracy of the findings was subsequently evaluated through the receiver operating characteristic (ROC) curve. **Results**: Among the cohort of 379 patients subjected to cardiovascular surgery, a noteworthy 20.8% (n = 79) reported incidences of postoperative defecation issues. A multivariate logistic regression analysis showed that age (odds ratio (OR) = 1.063, 95% confidence interval (CI) 1.034–1.097, $p < 0.001$), operation time (OR = 1.004, 95% CI: 1.000–1.008, $p = 0.028$), ventilator usage time (OR = 1.032, 95% CI: 1.010–1.055, $p = 0.004$), polypharmacy (OR = 2.134, 95% CI: 1.069–4.321, $p = 0.032$), use of cough medicine (OR = 2.981, 95% CI: 1.271–6.942, $p = 0.011$) and psychological or behavioral barriers to defecation in the hospital environment (OR = 31.039, 95% CI: 14.313–73.179, $p < 0.001$) were independent risk factors for postoperative constipation in patients undergoing cardiovascular surgery. The area under the curve (AUC) for predicting postoperative constipation was 0.885. **Conclusion**: In the pursuit of optimizing postoperative recovery and mitigating postoperative constipation incidence, a targeted approach is imperative. Specifically, a focused intervention directed towards elderly patients, extended operation and prolonged ventilator durations, polypharmacy regimens, use of cough medicine, and those with psychological or behavioral barriers to defecation within the hospital milieu emerges as pivotal.

Keywords

postoperative constipation; cardiovascular surgery; influencing factors

Introduction

Cardiovascular diseases (CVD) pose a significant global health challenge, ranking among the leading causes of patient mortality, with an annual toll of 17.5 million lives [1,2]. Surgical intervention stands as a crucial method in the treatment of CVD, and an estimated one-third of individuals with cardiovascular conditions will undergo surgical or interventional procedures at least once in their lifetime. According to a survey, China had a total of 263,292 cardiac and major vascular surgeries in 2022 [3]. The nature of cardiovascular surgery, characterized by its complexity and trauma, subjects patients to various discomforts and complications during the postoperative recovery period. Among the common gastrointestinal complications encountered, constipation emerges as a prevalent issue, with research indicating an incidence ranging from 39.2% to 50% following heart surgery [4,5].

In clinical practice, constipation is often overlooked until it becomes a severe problem for the patient. Compared with other diseases, constipation after cardiovascular surgery has a more serious impact on the prognosis [6]. Forced defecation can lead to the instability of the circulatory system, increasing the risk of cardiovascular adverse events such as congestive heart failure, arrhythmia, acute coronary disease, and aortic dissection [4,7]. Patients with aortic valve stenosis may struggle to maintain cardiac output during strained defecation, potentially triggering chest pain, syncope, or heart failure. In addition to physiological problems, constipation can prolong hospital stays, increase financial costs, and demand more nursing care time. Factors such as analgesics, diet changes, immobilization, and concerns about privacy or shame contribute to changes in defecation patterns during the early postoperative period [8–10].

To prevent postoperative constipation, clinicians often use laxatives before surgery, like lactulose and enema. However, despite these preventive measures, some patients still develop constipation during the transfer from the intensive care unit to the ward. Current research on constipation in patients after cardiovascular surgery is limited, with a focus on isolated factors, including exploring the effects of magnesium supplements and opioid medications on postoperative constipation in cardiac patients [11,12]. More comprehensive studies are needed to understand the multifaceted aspects of constipation in this specific patient population and to develop effective preventive and management strategies. Prevention of constipation is more important than early diagnosis and treatment of constipation. In particular, information about which patients are at risk will increase the efficiency of pre-emptive measures.

Overall, the study aimed to investigate the prevalence of constipation among patients undergoing cardiovascular surgery and explored its associated factors, to prevent constipation or improve its status.

Methods

Study Design and Participants

From October to December 2022, 473 patients received cardiac surgery in the Department of Cardiothoracic Surgery at Nanjing Drum Tower Hospital, China. Inclusion criteria included the following: (1) volunteer to participate in the study; (2) 18 years or older; (3) undergoing cardiovascular surgery for the first time (coronary artery bypass graft surgery, cardiac valve surgery and aortic dissection); (4) no communication problems. Exclusion criteria included the following: (1) no history of gastrointestinal disease; (2) no postoperative gastrointestinal complications. Three hundred seventy-nine patients were eligible for this study, as shown in Fig. 1.

There was no standardized constipation prevention procedure in the study site. The time of oral feeding after cardiovascular surgery depends on the individual condition. In general, the Kubota drinking test was performed 2 hours after surgery, and if there was no choking, eating could be started. According to the patient's tolerance, water was given first, then semi-liquid and soft food, such as rice porridge, soft noodles, *etc*.

Data Collection Instruments

The study was conducted in two stages. In the first stage, sociodemographic characteristics of the patients were determined within 48 hours of admission. In the second stage, preoperative, intraoperative, and postoperative clinical data were determined upon discharge.

Since the hospital stay of heart surgery patients generally does not exceed 20 days, therefore we adopted the North America Nursing Diagnosis Association general definition of constipation, which is the state in which an individual experiences or is at high risk of experiencing stasis of the large intestine, resulting in infrequent elimination and/or the inability to achieve a soft bowel movement, a feeling of incomplete rectal emptying, the need for manual evacuation of the rectal region [13]. A re-established defecation pattern was defined as the absence of defecation for 3 days or longer, without the use of any laxative or specific methods to facilitate evacuation [14]. Patients' constipation risk was evaluated from the second postoperative day and upon discharge in this study.

Demographic data, clinical assessments, imaging and laboratory examination were collected by two trained researchers following standard protocols [15]. The baseline data was collected at the admission to the hospital.

(1) Baseline demographics: age, gender, body mass index (BMI), occupation, marital status, place of residence, medical insurance, smoke history, alcohol history. (2) Preoperative data: prehospital diet and exercise (irregular diet habits, probiotics intake, roughage intake, vegetable intake, make exercise, barthel score), past history (constipation, hemorrhoids, hypertension, diabetes Mellitus, hyperthyroidism, hypothyroidism, stroke, cancer, anemia, hypoproteinemia), drug use (polypharmacy (the types of long-term drug use were $\geq$5), antidepressant, antihypertensive), New York Heart Association (NYHA) stage, stool routine (latent occult blood test, stool characteristics, color of stool), preoperative constipation, laxatives were used before surgery, gastric tube was used before surgery, restricted to bed before surgery, sleep duration during hospitalization $\geq$7 h. (3) Related to cardiovascular surgery: preoperative ultrasound (heart rate, ejection fractions (EF) value), surgical classification, surgical incision location, operation time, duration of anesthesia, cardiopulmonary bypass, intraoperative blood loss, intraoperative blood transfusion. (4) Postoperative data: fever in intensive care unit (ICU), ventilator usage time, preoperative ultrasound (EF value), drainage volume within 24 hours after surgery, total volume in postoperative day, postoperative water intake, medication use during hospitalization (hypnotics, cough medicine, sedative, painkillers), reduced food intake, psychological or behavioral barriers to defecation in the hospital environment (contains either item: decreased appetite, decreased mobility, stress, hospital environment, and embarrassment) [14].

Statistical Analysis

The demographic and clinical data were expressed as the means $\pm$ standard deviations for continuous variables and numbers (percentages) for categorical variables. *T*-tests or Wilcoxon rank sum test were carried out for continuous variables and chi-square tests or Fisher's exact analysis for categorical variables. All variables in univariate analysis were included as independent variables. The incidence of postoperative constipation was used as the depen-

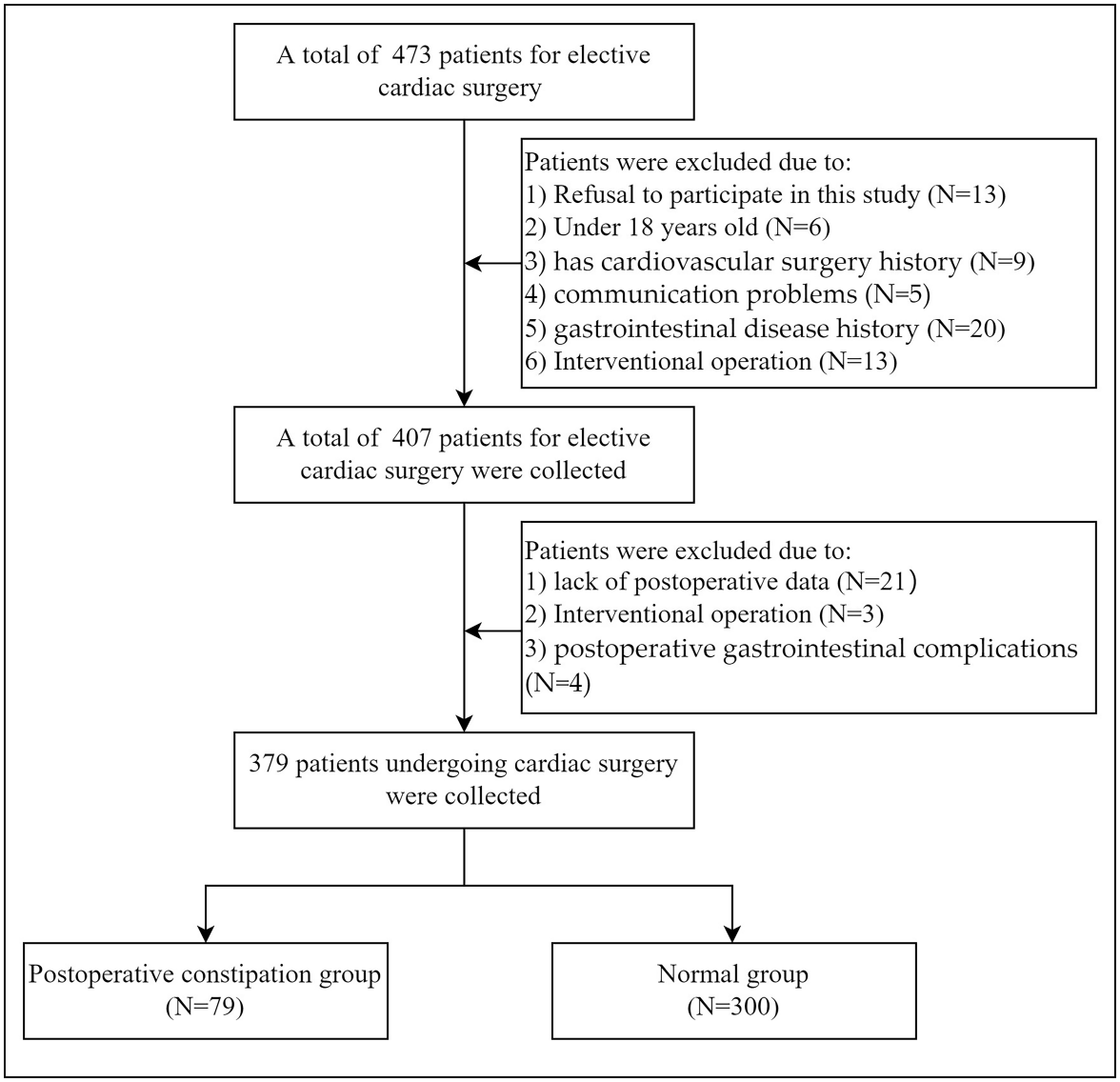

Fig. 1. Flowchart of participant selection.

dent variable. In the univariate Logistic regression analysis, variables with a $p < 0.05$ were included in the multivariable logistic regression analysis. The odds ratio (OR) and 95% confidence interval (CI) were examined as part of the statistical analysis. Data were analyzed using R, version 4.0.2 (The R Foundation, Vienna, Austria). All of the tests were two-tailed, and $p < 0.05$ was thought to be statistically significant.

Results

Baseline

Of 379 patients undergoing cardiovascular surgery, 79 patients developed constipation (20.48%). The mean age of the patients was 59.17 ± 13.93 years. Two hundred and thirteen (56.20%) were male, and the mean BMI was 23.68 ± 3.55 kg/m^2. Three hundred and forty-three (90.77%) were medical insurance, one hundred and ninety-two (50.66%) were manual labour, three hundred and fifty-nine (94.72%) were urban, three hundred and forty-four (90.7%) were married. The demographic and baseline data, intraoperative data, and postoperative data are illustrated in Table 1 and Table 2.

Univariate Analysis of Factors Affecting Postoperative Constipation in Patients Undergoing Cardiovascular Surgery

The difference of postoperative constipation in patients with different characteristics of cardiovascular surgery is statistically significant ($p < 0.05$). The univariate analysis revealed that gender (OR = 1.719, 95% CI: 1.045–2.842, $p = 0.033$), age (OR = 1.038, 95% CI: 1.017–1.062, $p < 0.001$), barthel score (OR = 0.973, 95% CI: 0.952–0.996, $p = 0.017$), diabetes mellitus history (OR = 2.035, 95% CI: 1.070–3.766, $p = 0.026$), stroke history (OR = 2.265, 95%

Table 1. Baseline characteristics in patients undergoing cardiovascular surgery based on postoperative constipation.

	Normal	Constipation	*p*
	(n = 300)	(n = 79)	
Age (mean standard deviation (SD))	57.87 (14.11)	64.11 (12.11)	<0.001
Body mass index (mean (SD))	23.69 (3.39)	23.65 (4.13)	0.923
Gender (%)			0.044
Male	177 (59.0)	36 (45.6)	
Female	123 (41.0)	43 (54.4)	
Occupation (%)			0.253
Manual labour	157 (52.3)	35 (44.3)	
Non-manual work	143 (47.7)	44 (55.7)	
Marital status (%)			0.309
Single	13 (4.3)	0 (0.0)	
Married	270 (90.0)	74 (93.7)	
Widowed	13 (4.3)	4 (5.1)	
Divorced	4 (1.3)	1 (1.3)	
Place of residence (%)			0.705
Urban	283 (94.3)	76 (96.2)	
Rural	17 (5.7)	3 (3.8)	
Medical insurance (%)	272 (90.7)	72 (91.1)	0.999
Smoke history (%)	62 (20.7)	14 (17.7)	0.672
Alcohol history (%)	44 (14.7)	10 (12.7)	0.784
Prehospital diet and exercise			
Irregular diet habits (%)	18 (6.0)	3 (3.8)	0.628
Probiotics intake (%)			0.957
<3 day/week	64 (21.3)	16 (20.3)	
≥3 day/week	236 (78.7)	63 (79.7)	
Roughage intake (%)			0.667
<3 day/week	130 (43.3)	37 (46.8)	
≥3 day/week	170 (56.7)	42 (53.2)	
Vegetable intake (%)			0.999
<3 day/week	290 (96.7)	76 (96.2)	
≥3 day/week	10 (3.3)	3 (3.8)	
Make exercise (%)			0.616
<3 day/week	140 (46.7)	40 (50.6)	
≥3 day/week	160 (53.3)	39 (49.4)	
Barthel score (mean (SD))	91.48 (9.12)	88.42 (12.02)	0.014
Past history			
Constipation (%)	62 (20.7)	21 (26.6)	0.328
Hemorrhoids (%)	82 (27.3)	19 (24.1)	0.657
Hypertension (%)	127 (42.3)	39 (49.4)	0.32
Diabetes mellitus (%)	38 (12.7)	18 (22.8)	0.038
Hyperthyroidism (%)	2 (0.7)	1 (1.3)	0.999
Hypothyroidism (%)	4 (1.3)	1 (1.3)	0.999
Stroke (%)	20 (6.7)	11 (13.9)	0.062
Cancer (%)	8 (2.7)	3 (3.8)	0.876
Anemia (%)	50 (16.7)	19 (24.1)	0.177
Hypoproteinemia (%)	54 (18.0)	18 (22.8)	0.422
Drug use			
Polypharmacy (%)	83 (27.7)	38 (48.1)	0.001
Antidepressant (%)	3 (1.0)	0 (0.0)	0.858
Antihypertensive (%)	115 (38.3)	30 (38.0)	0.999

CI: 1.005–4.875, $p = 0.040$), polypharmacy (OR = 2.423, 95% CI: 1.456–4.036, $p < 0.001$), preoperative heart rate (OR=1.020, 95% CI: 1.004–1.036, $p = 0.012$), operation time (OR = 1.005, 95% CI: 1.003–1.007, $p < 0.001$), duration of anesthesia (OR = 1.005, 95% CI: 1.002–1.007, $p < 0.001$), intraoperative blood loss (OR = 1.001, 95% CI: 1.000–1.001, $p = 0.018$), intraoperative blood transfusion (OR = 2.978, 95% CI: 1.792–5.027, $p < 0.001$), Ventilator

Table 1. Continued.

	Normal (n = 300)	Constipation (n = 79)	*p*
New York Heart Association (NYHA) stage (%)			0.127
I	70 (23.3)	19 (24.1)	
II	95 (31.7)	21 (26.6)	
III	130 (43.3)	34 (43.0)	
IV	5 (1.7)	5 (6.3)	
Routine stool test			
Latent occult blood test (%)			0.43
Negative	257 (85.7)	71 (89.9)	
Positive	43 (14.3)	8 (10.1)	
Stool characteristics (%)			0.621
Soft stool	284 (94.7)	73 (92.4)	
Other	16 (5.3)	6 (7.6)	
Color of stool (%)			0.206
Yellow	297 (99.0)	76 (96.2)	
Other	3 (1.0)	3 (3.8)	
Preoperative constipation (%)	35 (11.7)	13 (16.5)	0.343
Laxatives were used before surgery (%)	12 (4.0)	7 (8.9)	0.141
Gastric tube was used before surgery (%)	5 (1.7)	4 (5.1)	0.177
Restricted to bed before surgery	50 (16.7)	19 (24.1)	0.177
Sleep duration during hospitalization $\geq$7 h (%)	119 (39.7)	39 (49.4)	0.153

usage time (OR = 1.038, 95% CI: 1.021–1.059, $p < 0.001$), total volume in postoperative day (OR = 1.000, 95% CI: 0.999–1.000, $p = 0.007$), cough medicine (OR = 2.141, 95% CI: 1.154–3.887, $p = 0.014$), sedative (OR = 2.119, 95% CI: 1.162–4.105, $p = 0.019$), psychological or behavioral barriers to defecation in the hospital environment (OR = 14.250, 95% CI: 8.045–25.888, $p < 0.001$) were associated with postoperative constipation, as shown in Table 3.

Multivariate Analysis of Factors Affecting Postoperative Constipation in Patients Undergoing Cardiovascular Surgery

The results showed that age (odds ratio (OR) = 1.063, 95% confidence interval (CI): 1.034–1.097, $p < 0.001$), operation time (OR = 1.004, 95% CI: 1.000–1.008, $p = 0.028$), ventilator usage time (OR = 1.032, 95% CI: 1.010–1.055, $p = 0.004$), polypharmacy (OR = 2.134, 95% CI: 1.069–4.321, $p = 0.032$), use of cough medicine (OR = 2.981, 95% CI: 1.271–6.942, $p = 0.011$) and psychological or behavioral barriers to defecation in the hospital environment (OR = 31.039, 95% CI: 14.313–73.179, $p < 0.001$) were independent risk factors for postoperative constipation in patients undergoing cardiovascular surgery, as shown in Table 4. The area under the curve (AUC) for predicting postoperative constipation was 0.885, as shown in Fig. 2.

Discussion

Patients with cardiovascular disease require a longer period of bed rest after constipation compared to other conditions [16,17]. In this study, we found that older age, longer operation time, longer ventilator time, polypharmacy, use of cough medicine and psychological or behavioral barriers to defecation in the hospital environment were independent risk factors for postoperative constipation in patients undergoing cardiovascular surgery. This suggests that we should pay attention to these patients, and prevention will reduce the incidence of postoperative constipation.

The results of this study showed that polypharmacy was one of the independent risk factors for constipation after cardiovascular surgery, and the risk was 2.134 times that of patients with fewer than 5 types of long-term medications. Currently, most relevant studies primarily discuss the relationship between single drugs and constipation, such as opioids, calcium tablets, and constipation after cardiovascular surgery. Fewer studies have explored the relationship between multiple drugs and constipation. Silveira *et al.* [18] analyzed 150 adults with obesity class II and III; the results showed that constipation was associated with the simultaneous use of five or more medications. Some studies found that polypharmacy was linked to a high risk of constipation in children and elderly patients [19,20]. The more types of medication, the greater the drug intake, corresponding to more gastrointestinal (GI) symptoms. In this study, patients had at least 5 kinds of long-term medication, including calcium tablets, antihypertensive drugs, hypoglycemic drugs, iron, anticoagulants, *etc*. Some drugs themselves impact the gastrointestinal mucosa or cause constipation. Coupled with the long operation time of patients undergoing cardiovascular surgery, it is more likely to lead to the occurrence of constipation [21,22].

Table 2. Intraoperative and postoperative data in patients undergoing cardiovascular surgery based on postoperative constipation.

	Normal (n = 300)	Constipation (n = 79)	*p*
Preoperative ultrasound			
Heart rate (mean (SD))	75.51 (14.61)	80.39 (16.37)	0.01
Ejection Fractions (EF) value (mean (SD))	56.27 (7.66)	54.83 (9.93)	0.163
Surgical classification (%)			0.118
Aortic dissection surgery	43 (14.3)	13 (16.5)	
Cardiac valve surgery	182 (60.7)	43 (54.4)	
Coronary artery bypass graft surgery	52 (17.3)	21 (26.6)	
Other surgery	23 (7.7)	2 (2.5)	
Surgical incision location (%)			0.206
Median sternal incision	259 (86.3)	73 (92.4)	
Other	41 (13.7)	6 (7.6)	
Operative time (mean (SD))	262.99 (89.60)	317.70 (120.25)	<0.001
Duration of anesthesia (mean (SD))	317.99 (93.19)	370.28 (114.24)	<0.001
Cardiopulmonary bypass (%)	260 (86.7)	67 (84.8)	0.808
Intraoperative blood loss (mean (SD))	821.30 (496.12)	983.29 (601.51)	0.014
Intraoperative blood transfusion (%)	110 (36.7)	50 (63.3)	<0.001
Fever in intensive care unit (ICU) (%)	226 (75.3)	62 (78.5)	0.664
Ventilator usage time (mean (SD))	9.89 (12.78)	26.39 (48.06)	<0.001
Preoperative ultrasound			
EF value (mean (SD))	55.00 (7.02)	54.54 (7.83)	0.612
Drainage volume within 24 hours after surgery (mean (SD))	360.15 (238.64)	394.84 (254.77)	0.258
Total volume in postoperative day (mean (SD))	3125.76 (956.65)	2798.61 (909.32)	0.007
Postoperative water intake (mean (SD))	1294.57 (623.51)	1215.16 (671.59)	0.322
Medication use during hospitalization			
Hypnotics (%)	40 (13.3)	17 (21.5)	0.102
Cough medicine (%)	41 (13.7)	20 (25.3)	0.020
Sedative (%)	206 (68.7)	65 (82.3)	0.025
Painkillers (%)	143 (47.7)	45 (57.0)	0.179
Reduced food intake (%)	37 (12.3)	11 (13.9)	0.851
Psychological or behavioral barriers to defecation in the hospital environment (%)	34 (11.3)	51 (64.6)	<0.001

This suggests that we need to pay attention to patients with polypharmacy and conduct a holistic assessment of the patient's drug intake to minimize unnecessary drug use. Additionally, health education for patients should be prioritized, teaching them the correct methods of medication administration to reduce the occurrence of constipation.

The results of this study showed that the use of cough medicine during hospitalization was an independent risk factor for postoperative constipation in patients undergoing cardiovascular surgery, which was 2.981 times that of not using cough medicine. The cough medicine included codeine and compound glycyrrhiza oral solution. Codeine belongs to opioids, and its side effects include gastrointestinal reactions such as constipation. Many studies have shown that opioids are related to constipation after cardiovascular surgery due to their action on receptors in the gastrointestinal tract [12,23]. In addition, compound glycyrrhiza oral solution is a Chinese medicine containing compound camphor tincture, which has adverse reactions of constipation [24]. Thus, the use of antitussive drugs during hospitalization was associated with postoperative constipation.

The results of this study also showed that psychological or behavioral barriers to defecation in the hospital environment were a risk factor for postoperative constipation in patients undergoing cardiovascular surgery. It included decreased appetite, decreased mobility, increased stress, and not being adapted to the hospital environment [14]. Defecation requires a private and comfortable environment. Patients undergoing cardiovascular surgery have a high risk of postoperative constipation due to pressure, early bed defecation, and decreased appetite. This suggests that we should pay attention to the preoperative psychology of patients, provide a conducive environment for patients to defecate, and pay attention to the patient's appetite, so as to reduce or improve the occurrence of postoperative constipation.

Table 3. Univariate logistic regression analysis of postoperative constipation in patients undergoing cardiovascular surgery.

Var	OR	2.50%	97.50%	B	Wald	*p*
Gender	1.719	1.045	2.842	0.542	4.527	0.033
Age	1.038	1.017	1.062	0.038	12.029	<0.001
Body mass index	0.997	0.929	1.068	–0.003	0.009	0.923
Smoke history	0.827	0.421	1.534	–0.190	0.338	0.561
Alcohol history	0.843	0.384	1.699	–0.171	0.206	0.650
Irregular Diet habits	0.618	0.142	1.887	–0.481	0.569	0.450
Probiotics intake	1.068	0.589	2.026	0.066	0.044	0.834
Roughage intake	0.868	0.528	1.431	–0.142	0.311	0.577
Vegetable intake	1.145	0.252	3.850	0.135	0.041	0.840
Make exercise	0.853	0.519	1.402	–0.159	0.394	0.530
Barthel score	0.973	0.952	0.996	–0.027	5.711	0.017
Constipation history	1.390	0.772	2.436	0.329	1.272	0.259
Hemorrhoids history	0.842	0.464	1.474	–0.172	0.344	0.557
Hypertension history	1.328	0.807	2.186	0.284	1.253	0.263
Diabetes mellitus history	2.035	1.070	3.766	0.710	4.942	0.026
Hyperthyroidism history	1.910	0.088	20.191	0.647	0.276	0.599
Hypothyroidism history	0.949	0.048	6.526	–0.053	0.002	0.963
Stroke history	2.265	1.005	4.875	0.817	4.198	0.040
Cancer history	1.441	0.310	5.115	0.365	0.281	0.596
Polypharmacy	2.423	1.456	4.036	0.885	11.629	<0.001
Antidepressant	0.000			–14.242	0.000	0.986
Antihypertensive	0.985	0.587	1.633	–0.015	0.003	0.953
NYHA stage	1.125	0.838	1.520	0.118	0.607	0.436
Anemia	1.583	0.855	2.847	0.460	2.263	0.132
Hypoproteinemia	1.344	0.721	2.421	0.296	0.926	0.336
Latent occult blood test	0.673	0.283	1.427	–0.395	0.940	0.332
Stool characteristics	1.459	0.509	3.687	0.378	0.579	0.447
Color of stool	3.908	0.711	21.479	1.363	2.719	0.099
Preoperative constipation	1.491	0.724	2.917	0.400	1.284	0.257
Laxative were used before surgery	2.333	0.842	6.017	0.847	2.948	0.086
Gastric tube was used before surgery	3.147	0.763	12.171	1.146	2.816	0.093
Restricted to bed before surgery	1.583	0.855	2.847	0.460	2.263	0.132
Sleep duration during hospitalization ≥7 h	1.483	0.900	2.444	0.394	2.405	0.121
Preoperative heart rate	1.020	1.004	1.036	0.020	6.375	0.012
Preoperative EF value	0.980	0.953	1.009	–0.020	1.933	0.164
Surgical classification	0.946	0.676	1.310	–0.055	0.108	0.743
Surgical incision location	1.926	0.843	5.211	0.655	2.059	0.151
Operation time	1.005	1.003	1.007	0.005	16.601	<0.001
Duration of anesthesia	1.005	1.002	1.007	0.005	14.986	<0.001
Cardiopulmonary bypass	0.859	0.438	1.792	–0.152	0.182	0.670
Intraoperative blood loss	1.001	1.000	1.001	0.001	5.584	0.018
Intraoperative blood transfusion	2.978	1.792	5.027	1.091	17.300	<0.001
Fever in ICU	1.194	0.669	2.224	0.177	0.339	0.560
Ventilator usage time	1.038	1.021	1.059	0.037	15.973	<0.001
Preoperative EF value	0.991	0.959	1.027	–0.009	0.259	0.611
Drainage volume within 24 hours after surgery	1.001	1.000	1.001	0.001	1.266	0.261
Total volume in postoperative day	1.000	0.999	1.000	0.000	7.219	0.007
Postoperative water intake	1.000	0.999	1.000	0.000	0.981	0.322
Hypnotics	1.782	0.929	3.309	0.578	3.217	0.073
Cough medicine	2.141	1.154	3.887	0.761	6.090	0.014
Sedative	2.119	1.162	4.105	0.751	5.509	0.019
Painkillers	1.453	0.884	2.407	0.374	2.149	0.143
Reduced food intake	1.150	0.535	2.305	0.140	0.143	0.705
Psychological or behavioral barriers to defecation in the hospital environment	14.250	8.045	25.888	2.657	79.771	<0.001

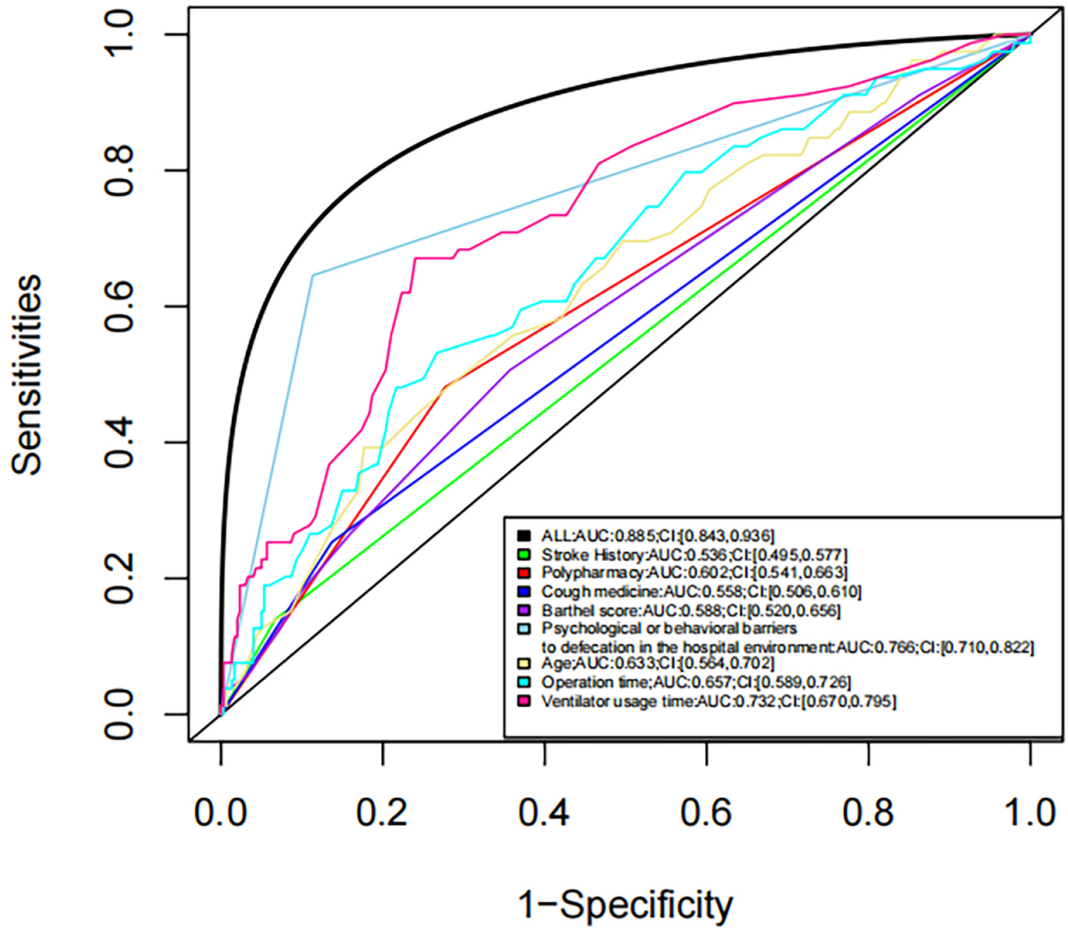

Fig. 2. The area under the curve for predicting postoperative constipation.

Table 4. Multivariate logistic regression analysis of postoperative constipation in patients undergoing cardiovascular surgery.

Var	OR	2.50%	97.50%	B	Wald	*p* value
(Intercept)	0.002	0.000	0.081	–6.204	9.803	0.002
Stroke History	2.677	0.943	7.356	0.985	3.580	0.058
Polypharmacy	2.134	1.069	4.321	0.758	4.577	0.032
Cough medicine	2.981	1.271	6.942	1.092	6.439	0.011
Barthel score	0.975	0.946	1.008	–0.025	2.350	0.125
Psychological or behavioral barriers to defecation in the hospital environment	31.039	14.313	73.179	3.435	68.755	<0.001
Age	1.063	1.034	1.097	0.061	16.857	<0.001
Operation time	1.004	1.000	1.008	0.004	4.799	0.028
Ventilator usage time	1.032	1.010	1.055	0.031	8.202	0.004

In addition, the results of this study indicated that older age, longer operation time, and extended ventilator usage were identified as risk factors for postoperative constipation in patients undergoing cardiovascular surgery, aligning with findings from previous studies [25,26]. Prolonged operative time might signify a more intricate patient condition, while extended postoperative ventilator use could imply an extended period of bed rest, both of which are correlated with a heightened risk of postoperative constipation.

Conclusion

This study will provide evidence and a theoretical basis for the prevention and improvement of postoperative constipation in patients undergoing cardiovascular surgery. Healthcare professionals should focus on patients with older age, prolonged operation time, prolonged ventilator use, polypharmacy, use of cough medicine and psychological or behavioral barriers to defecation in the hospital environment. Healthcare professionals should recog-

nize constipation and associated straining as an important cardiovascular risk and intervene early to prevent it.

Limitations

This study has limitations that remain to be addressed in our future investigations. First, the cross-sectional design of the study explores causality, and various biases may exist that affect the accuracy of the results. Second, our results may reflect the effects of unknown or unmeasured confounders. Last, the sample size of this study is small, and the test efficiency may be insufficient.

Availability of Data and Materials

Avaliability of data and materials can be provided by authors if it is on valid basis.

Author Contributions

PZ, CL, WQ, XX and YS performed the study. PZ and YS designed the study and wrote the manuscript. All authors contributed to editorial changes in the manuscript. All 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

All the patient signed an informed consent form. Ethical approval was obtained from the Ethics Committee of Nanjing Drum Tower Hospital (NO. 2022-216-01).

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Conflict of Interest

The authors declare no conflict of interest.

References

[1] Koenen M, Hill MA, Cohen P, Sowers JR. Obesity, Adipose Tissue and Vascular Dysfunction. Circulation Research. 2021; 128: 951–968.

[2] Vervoort D, Meuris B, Meyns B, Verbrugghe P. Global cardiac surgery: Access to cardiac surgical care around the world. The Journal of Thoracic and Cardiovascular Surgery. 2020; 159: 987–996.e6.

[3] Hao X. White book of Chinese cardiovascular surgery and extracorporeal circulation in 2022. Chinese Journal of Extracorporeal Circulation. 2023; 21: 197–200.

[4] Ishiyama Y, Hoshide S, Mizuno H, Kario K. Constipation-induced pressor effects as triggers for cardiovascular events. Journal of Clinical Hypertension (Greenwich, Conn.). 2019; 21: 421–425.

[5] Iyigun E, Ayhan H, Demircapar A, Tastan S. Impact of preoperative defecation pattern on postoperative constipation for patients undergoing cardiac surgery. Journal of Clinical Nursing. 2017; 26: 495–501.

[6] Dong Q, Chen D, Zhang Y, Xu Y, Yan L, Jiang J. Constipation and cardiovascular disease: A two-sample Mendelian randomization analysis. Frontiers in Cardiovascular Medicine. 2023; 10: 1080982.

[7] Omer A, Quigley EMM. An update on prucalopride in the treatment of chronic constipation. Therapeutic Advances in Gastroenterology. 2017; 10: 877–887.

[8] Rong LQ, Shen L, Bartels K. Cardiac surgery's long opioid dependency: time to recalibrate pain therapy? British Journal of Anaesthesia. 2022; 129: 655–658.

[9] Grant MC, Gregory AJ, Ouanes JPP. Regional analgesia for cardiac surgery. Current Opinion in Anaesthesiology. 2022; 35: 605–612.

[10] Lee S, Collins EG. Factors influencing physical activity after cardiac surgery: An integrative review. Heart & Lung: the Journal of Critical Care. 2021; 50: 136–145.

[11] Moradian ST, Ghiasi MS, Mohamadpour A, Siavash Y. Oral magnesium supplementation reduces the incidence of gastrointestinal complications following cardiac surgery: a randomized clinical trial. Magnesium Research. 2017; 30: 28–34.

[12] Rodrigues MA, Lofton T, Tume SC, Lemming KI. Reducing Opioid-Induced Constipation Post-Cardiac Surgery: An Improvement Project in a Pediatric Cardiac Intensive Care Unit. Journal of Nursing Care Quality. 2022; 37: 213–217.

[13] Carpenito-Moyet LJ. Nursing diagnosis: application to clinical practice (pp. 6–10). Wolters Kluwer Health: The Netherlands. 2006.

[14] Celik B, Bilik Ö. Postoperative Constipation Incidence and Effects of Selected Risk Factors on Constipation Development in Elderly Patients With Hip Fracture. Orthopedic Nursing. 2022; 41: 397–405.

[15] Ma X, Lu Q, Lu Y, Yu W, Kang D, Zhao Y, *et al*. Validation of the Constipation Risk Assessment Scale (CRAS) in Chinese cancer patients. European Journal of Oncology Nursing: the Official Journal of European Oncology Nursing Society. 2021; 50: 101895.

[16] Munshi MN, Florez H, Huang ES, Kalyani RR, Mupanomunda M, Pandya N, *et al*. Management of Diabetes in Long-term Care and Skilled Nursing Facilities: A Position Statement of the American Diabetes Association. Diabetes Care. 2016; 39: 308–318.

[17] Rasmussen LS, Pedersen PU. Constipation and defecation pattern the first 30 days after thoracic surgery. Scandinavian Journal of Caring Sciences. 2010; 24: 244–250.

[18] Silveira EA, Santos ASEADC, Ribeiro JN, Noll M, Dos Santos Rodrigues AP, de Oliveira C. Prevalence of constipation in

adults with obesity class II and III and associated factors. BMC Gastroenterology. 2021; 21: 217.

[19] Komiya H, Umegaki H, Asai A, Kanda S, Maeda K, Nomura H, *et al*. Prevalence and risk factors of constipation and pollakisuria among older home-care patients. Geriatrics & Gerontology International. 2019; 19: 277–281.

[20] Wan M, King L, Baugh N, Arslan Z, Snauwaert E, Paglialonga F, *et al*. Gutted: constipation in children with chronic kidney disease and on dialysis. Pediatric Nephrology (Berlin, Germany). 2023; 38: 3581–3596.

[21] Cano-Escalera G, Graña M, Irazusta J, Labayen I, Gonzalez-Pinto A, Besga A. Mortality Risks after Two Years in Frail and Pre-Frail Older Adults Admitted to Hospital. Journal of Clinical Medicine. 2023; 12: 3103.

[22] Arco S, Saldaña E, Serra-Prat M, Palomera E, Ribas Y, Font S, *et al*. Functional Constipation in Older Adults: Prevalence, Clinical Symptoms and Subtypes, Association with Frailty, and Impact on Quality of Life. Gerontology. 2022; 68: 397–406.

[23] Konradsen H, Lundberg V, Florin J, Boström AM. Prevalence of constipation and use of laxatives, and association with risk factors among older patients during hospitalization: a cross sectional study. BMC Gastroenterology. 2022; 22: 110.

[24] Zhao T, Ma PJ, Shu WJ, Lu JW, Dong W, Ju YS. Literature analysis of adverse reactions caused by drugs containing compound camphor tincture. Clinical Research and Practice. 2022; 7: 12–15. (In Chinese)

[25] Al Nou'mani J, Al Alawi AM, Al-Maqbali JS, Al Abri N, Al Sabbri M. Prevalence, Recognition, and Risk Factors of Constipation among Medically Hospitalized Patients: A Cohort Prospective Study. Medicina (Kaunas, Lithuania). 2023; 59: 1347.

[26] G Rler H, Y Ld Z FT, Bekmez F. A Common Complication in Orthopedic Patients: Postoperative Constipation and Related Risk Factors. Journal of Perianesthesia Nursing: Official Journal of the American Society of PeriAnesthesia Nurses. 2023; 38: e15–e20.