Correlation between Pain and Anal Defecation Function in Postoperative Patients with Colorectal Cancer and Related Factors Affecting Patients' Prognosis

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Background: The degree of postoperative pain and defecation function in colorectal cancer will affect patients' prognosis. Therefore, exploring the correlation between postoperative pain and defecation function, and analyzing the related factors, will help to improve the quality of patients' prognosis.

Methods: A total of 94 patients with colorectal cancer admitted to our hospital from March 2022 to June 2023 were retrospectively selected for study. The visual analog scale (VAS) was used to evaluate the pain level of the patients. The low anterior resection syndrome (LARS) scale was used to evaluate bowel function of the patients, and the incidence of LARS was recorded. The patients were grouped according to whether or not they had the complications of LARS, and they were divided into the groups of concurrent LARS and non-concurrent LARS. The patients' anorectal pressure was measured, and the measurements included maximum tolerated volume (MTV), anorectal resting pressure (ARP), and maximum squeeze pressure (MSP). Pearson's correlation coefficient was used to test associations between anal defecation function and postoperative pain and anorectal manometry. Logistic regression was used to test predictors of concurrent LARS, and the value of each of the indices for prediction of LARS was examined using the receiver operating characteristic (ROC).

Results: Patients' VAS scores were positively correlated with LARS scores ($p < 0.05$). A total of 22 patients with VAS score $\geq$20 points were found to have a LARS incidence of 23.40% based on the LARS score. The VAS score was higher in the concurrent LARS group than in the non-concurrent LARS group ($p < 0.05$). The concurrent LARS group had a higher percentage of patients with age $\geq$60 years, body mass index $\geq$24 kg/m^2, anastomotic position $<$5 cm from the anal verge, preoperative radiotherapy, and anastomotic fistula than the non-current LARS group ($p < 0.05$). The levels of MTV, ARP, and MSP were lower in patients in the concurrent LARS group than in the non-current LARS group ($p < 0.05$). Patients' LARS scores were negatively correlated with MTV ($r = –0.420$), ARP ($r = –0.300$) and MSP ($r = –0.220$) levels ($p < 0.05$). Logistic regression analysis showed that anastomotic position $<$5 cm from the anal verge, preoperative radiotherapy, anastomotic fistula, high VAS level, and low MTV level were all significant predictors of concurrent LARS. Anastomotic position, whether or not radiotherapy was administered preoperatively, anastomotic fistula, VAS score, and MSP level all had high sensitivity and specificity for prediction of concurrent LARS, and the combined area under the curve (AUC) of each index was 0.921, sensitivity was 0.818, and specificity was 0.944.

Conclusion: LARS is strongly associated with the patient's pain level, and factors such as anastomotic position $<$5 cm from the anal verge, preoperative radiotherapy, anastomotic fistula, high VAS level, and low MTV level will increase the risk of concurrent LARS in patients.

Keywords: colorectal cancer; postoperative; pain; anal defecation function; correlation; influencing factors

Introduction

Surgical treatment is one of the most common methods for treating colorectal cancer in clinical practice, but it often leads to postoperative pain and alteration of anal defecation function, so understanding the relationship between postoperative pain and anal defecation function of patients is crucial for improving their prognosis. In addition, some studies in recent years have shown that surgical treatment may cause damage to patients' intestinal function, resulting in patients being susceptible to complication of low anterior resection syndrome (LARS), and the incidence of LARS is as high as 70% [1, 2]. LARS is associated with defecation dysfunction, which will seriously affect patients' social activities and daily life [3]. Finding the relevant factors that may affect the complication of LARS will help to improve the quality of life and rehabilitation of patients after colorectal cancer surgery. Therefore, the aim of this study is to deeply investigate the correlation between pain and anal defecation function in patients after surgical treatment, and

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also to improve the quality of postoperative rehabilitation of colorectal cancer patients by identifying the relevant factors that may affect their prognosis.

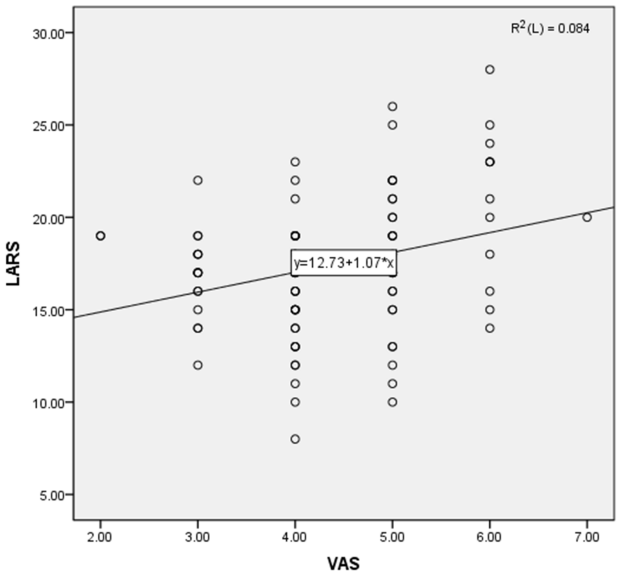

Fig. 1. Correlation analysis chart. Note: LARS, low anterior resection syndrome; VAS, visual analog scale.

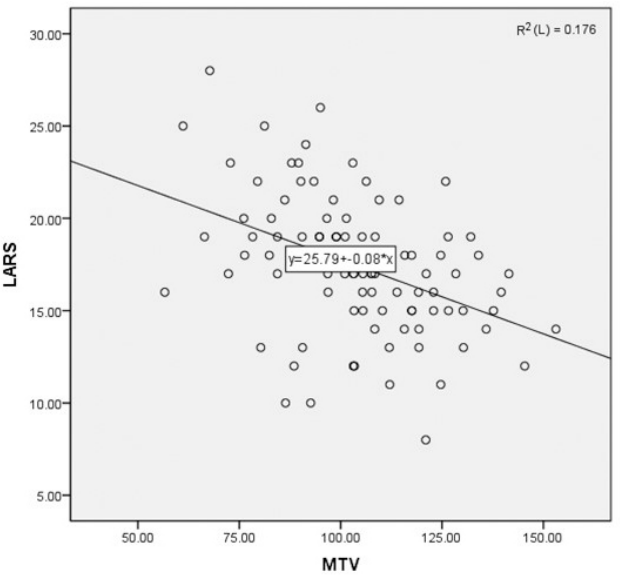

Fig. 2. Correlation analysis chart.

Materials and Methods

Study Design

A total of 94 patients with colorectal cancer admitted to our hospital from March 2022 to June 2023 were retrospectively selected for study. Among the included subjects, 63 cases were male, 31 were female, 34 were aged ≥60 years, 60 were aged <60 years, 30 had body mass index ≥24 kg/m^2, 64 had body mass index <24 kg/m^2, 77 underwent laparoscopic surgery, 17 underwent open surgery, 37 were smokers, 33 reported drinking, 23 had hypertension, and 23 had diabetes mellitus. There were 48 cases with tumor infiltration degree of T0–T2, 46 cases with tumor infiltration degree of T3–T4, 61 cases with anastomotic location ≥5 cm from the anal verge, 33 cases with anastomotic location <5 cm from the anal verge, 53 cases with American Joint Committee on Cancer (AJCC) stage 0–II, 41 cases with AJCC stage III–IV, 9 cases with preoperative radiotherapy, 32 cases with tumor diameter ≥5 cm, 62 cases with tumor diameter <5 cm, and 6 cases with anastomotic fistula. The study was approved by Shengzhou People's

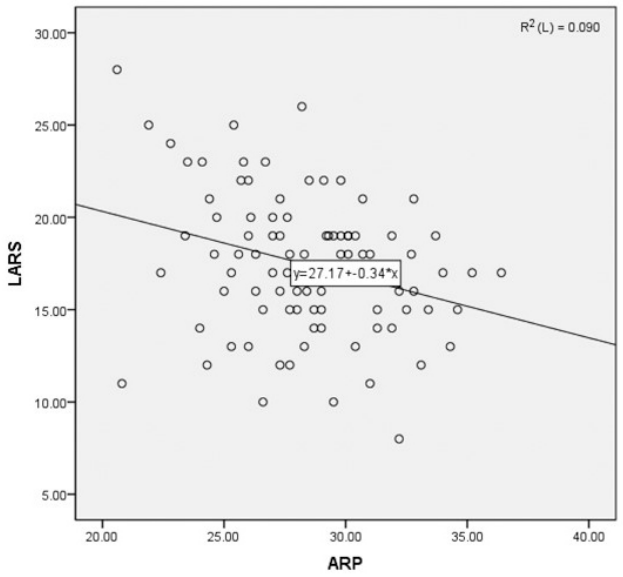

Fig. 3. Correlation analysis chart.

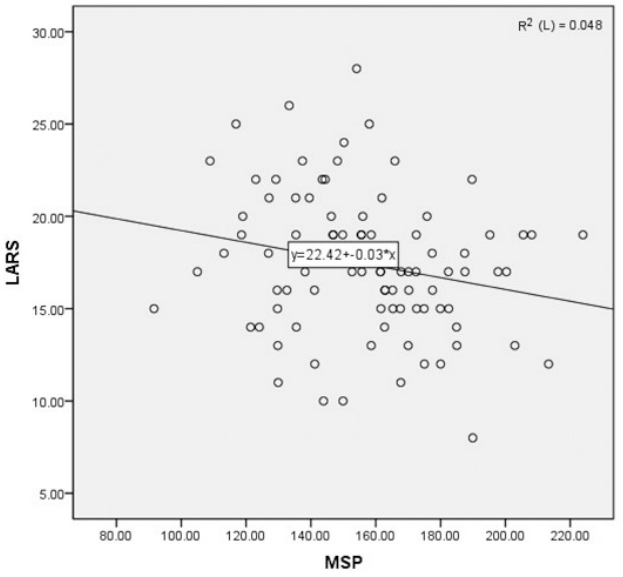

Fig. 4. Correlation analysis chart.

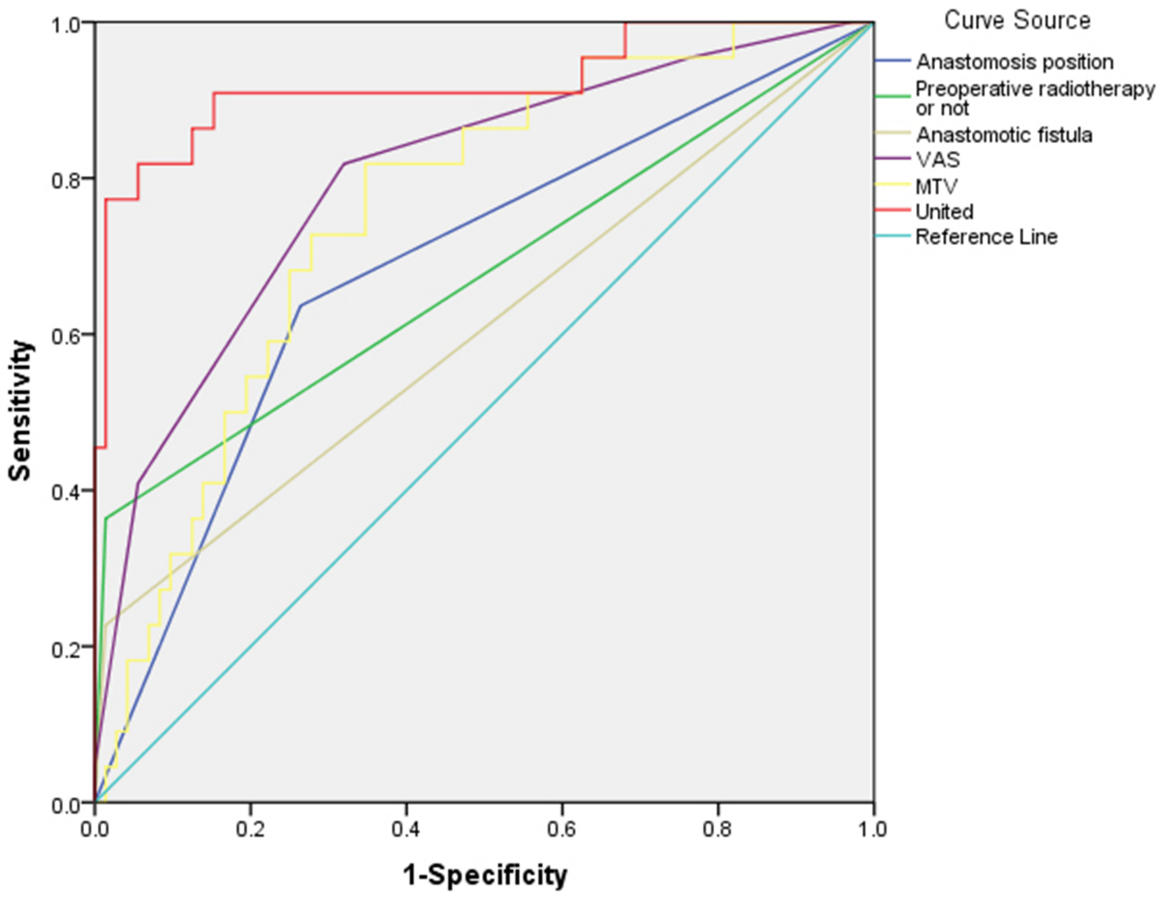

Fig. 5. ROC graph. Note: ROC, receiver operating characteristic; MTV, maximum tolerated volume.

Hospital Ethics Committee (2024-001) and all patients provided informed consent. All procedures of this study were in accordance with relevant ethical standards including the Declaration of Helsinki.

Participants

Inclusion: Patients who provided informed consent; patients who were diagnosed with colorectal cancer by preoperative or postoperative pathologic testing; patients that had good adherence to treatment (strict adherence to the doctor's instructions for completing the surgery and other related treatments) and complete clinical data (baseline data, data related to all tests and assessments were not missing); patients that were ≥18 years of age; telephone contact was used for follow-up and all patients completed follow-up within 6 months; patients that underwent radical surgery for colorectal cancer. Exclusions: Patients with cognitive dysfunction or inability to communicate properly; those with preoperative defecation dysfunction; those with other anal or pelvic diseases; those taking medications that affect anal function after surgery; those with distal metastases or postoperative recurrence; those with local excision or permanent fistulas only.

Methods and Assessments

All evaluations were performed by specialized physicians with many years of experience. All healthcare professionals received training in pain management and provided comprehensive services during the perioperative period. This included health guidance, tailored analgesic treatment, maintaining quiet wards, and psychological counseling. All patients underwent abdominal examination for observation of wound healing and for the presence of masses or bowel movements, and the patients were observed for pain response using light pressure on the abdomen to assess possible complications.

Postoperative pain: The patients' pain was evaluated using the visual analog scale (VAS), which is rated on a scale of 0–10, with higher scores indicating more intense pain [4].

Anal defecation function: The LARS scale was used to evaluate the patients' defecation function. The scale has a total score of 42 points, and the higher the patients' score, the worse their anal defecation function; according to the score, if the patients' score is <20 points, it means that LARS has not occurred, and if the patients' score is ≥20 points, it suggests that the patients have complications of LARS [5].

Table 1. Comparison of baseline data for patients with different prognoses [n(%)].

Indicators	Concurrent LARS groups (n = 22)	Non-current LARS group (n = 72)	χ^2	*p*
Gender				
Male	15 (68.18)	48 (66.67)	0.018	0.895
Female	7 (31.82)	24 (33.33)		
Age (years)				
≥60	12 (54.55)	22 (30.56)	4.201	0.040
<60	10 (45.45)	50 (69.44)		
BMI (kg/m^2)				
≥24	13 (59.09)	17 (23.61)	9.762	0.002
<24	9 (40.91)	55 (76.39)		
Surgical procedures				
Lumpectomy	17 (77.27)	60 (83.33)	0.418	0.518
Open surgery	5 (22.73)	12 (16.67)		
Are you a smoker				
Yes	8 (36.36)	29 (40.28)	0.108	0.742
No	14 (63.64)	43 (59.72)		
Whether or not alcohol is consumed				
Yes	6 (27.27)	27 (37.50)	0.774	0.379
No	16 (72.73)	45 (62.50)		
Whether you have high blood pressure				
Yes	5 (22.73)	18 (25.00)	0.047	0.828
No	17 (77.27)	54 (75.00)		
Whether you have diabetes				
Yes	6 (27.27)	17 (23.61)	0.122	0.727
No	16 (72.73)	55 (76.39)		
Degree of tumor infiltration				
T0–T2	9 (40.71)	39 (54.17)	1.185	0.276
T3–T4	13 (59.09)	33 (45.83)		
Anastomosis position (cm)				
≥5 from anal verge	8 (36.36)	53 (73.61)	10.262	0.001
<5 from anal verge	14 (63.64)	19 (26.39)		
AJCC staging				
0–II	11 (50.00)	42 (58.33)	0.476	0.490
III–IV	11 (50.00)	30 (41.67)		
Preoperative radiotherapy or not				
Yes	8 (36.36)	1 (1.39)	23.808	0.000
No	14 (63.64)	71 (98.61)		
Tumor diameter size (cm)				
≥5	7 (31.82)	25 (34.72)	0.063	0.801
<5	15 (68.18)	47 (65.28)		
Anastomotic fistula				
Yes	5 (22.73)	1 (1.39)	12.840	0.000
No	17 (77.27)	71 (98.61)		

Note: BMI, body mass index; AJCC, American Joint Committee on Cancer.

Table 2. Comparison of anorectal manometry levels in two groups of patients ($\bar{x} \pm s$).

Groups	MTV (mL)	ARP (mmHg)	MSP (mmHg)
Concurrent LARS groups (n = 22)	91.38 ± 15.45	26.30 ± 2.91	143.80 ± 19.75
Non-current LARS group (n = 72)	108.06 ± 19.21	29.11 ± 3.13	160.47 ± 26.33
t	3.717	3.744	2.739
p	<0.001	<0.001	0.007

Note: MTV, maximum tolerated volume; ARP, anorectal resting pressure; MSP, maximum squeeze pressure.

Table 3. Analysis of the correlation between anorectal manometry and defecation function.

Indicators	LARS	
	r	*p*
MTV	–0.420	<0.001
ARP	–0.300	0.003
MSP	–0.220	0.033

Baseline information: After the patients were admitted to the hospital, general information was collected and filed, including gender, age, body mass index, surgical procedure, the AJCC stage, the size of the tumor, and presence of an anastomotic fistula, whether they smoked, whether they drank alcohol, whether they suffered from hypertension, whether they suffered from diabetes mellitus, the degree of tumor infiltration, the location of the anastomosis, whether they were treated with radiotherapy prior to the operation.

Anorectal manometry: Anorectal manometry was performed using a post-gastrointestinal dynamics system (Polygram HR, CTD-synectics Medical, Sweden). The patients were placed in the left lateral position during the measurement, the catheter was placed into the anus of the patients at a position of about 7 cm, and then pulled outward at a speed of 0.15 cm/s at a uniform speed after completion. Measurements included maximum tolerance volume (MTV), anorectal resting pressure (ARP), and maximum squeeze pressure (MSP).

Statistical Analysis

SPSS 21.0 software (SPSS Inc., Chicago, IL, USA) was used for data processing and analysis. Continuous variables were expressed as the mean (± s) and differences between groups were analyzed using the *t*-test. Categorical variables were expressed as % and associations were analyzed using the χ^2-test. Pearson's correlation coefficient was used to test associations between anal defecation function and measurements of postoperative pain and anorectal manometry. Logistic regression was used to test predictors of concurrent LARS, and the value of each indicator for prediction of concurrent LARS was examined using the receiver operating characteristic (ROC). p values < 0.05 were considered statistically significant.

Sample Size Calculation

In this study, we gathered a comprehensive sample size, initially enrolling 102 colorectal cancer patients at our hospital. However, 3 individuals declined to participate, and 5 were lost to follow-up, leading to a final cohort of 94 participants.

Results

Correlation Analysis of Pain and Bowel Function in Patients

The patients' mean pain VAS score was 4.37 ± 1.02, and the mean LARS score was 17.43 ± 3.76. Patients' VAS scores were positively correlated with LARS scores ($r = 0.290$, $p < 0.05$). A total of 22 patients with VAS score ≥20 points were found to have a LARS incidence of 23.40% based on the LARS score. The mean VAS score in the concurrent LARS group (5.23 ± 0.92) was higher than that of the non-current LARS group (4.11 ± 0.90), and the difference was statistically significant ($t = 5.082$, $p < 0.05$). See Fig. 1.

Comparison of Baseline Data for Patients with Different Prognoses

The concurrent LARS group had a higher percentage of patients with age ≥60 years, body mass index ≥24 kg/m^2, anastomotic position <5 cm from the anal verge, preoperative radiotherapy, and anastomotic fistula compared to non-current LARS group, and the differences were statistically significant ($p < 0.05$). See Table 1.

Comparison of Anorectal Manometry Levels in Two Groups of Patients

The levels of MTV, ARP, and MSP were lower in the patients in the concurrent LARS group than in the non-current LARS group, and the differences were statistically significant ($p < 0.05$). See Table 2.

Analysis of the Correlation between Anorectal Manometry and Defecation Function

Patients' LARS scores were negatively correlated with the levels of MTV, ARP, and MSP ($p < 0.05$). See Table 3 and Figs. 2,3,4.

Multifactorial Analysis

Whether the patient had concurrent LARS was used as the dependent variable. Age, body mass index, anastomotic position, whether or not the patient had preoperative radiotherapy, anastomotic fistula, VAS score, MTV, ARP, and MSP level were included as covariates, with VAS score, MTV, ARP, and MSP included as continuous predictors. The other dichotomous predictors were coded as follows: concurrent LARS was 1, non-current LARS was 0; age ≥60 years was 1, age <60 years was 0; body mass index ≥24 kg/m^2 was 1, body mass index <24 kg/m^2 was 0; anastomotic position <5 cm from the anal verge was 1, anastomotic position ≥5 cm from the anal verge was 0; preoperative radiotherapy was 1, preoperative nonradiotherapy was 0; anastomotic fistula was 1, and no anastomotic fistula was 0. Logistic regression analysis showed that anastomotic position <5 cm from the anal verge, preoperative radiotherapy, anastomotic fistula, higher VAS level, and lower MTV level were all significant predictors of concurrent LARS. See Table 4.

Table 4. Logistic regression analysis for predictors of concurrent LARS.

Influencing Factors	β value	SE value	Wald value	p value	OR value	95% CI
Anastomosis position	1.979	0.802	6.086	0.014	7.237	(1.502, 34.867)
Preoperative radiotherapy or not	3.483	1.411	6.091	0.014	32.567	(2.048, 517.758)
Anastomotic fistula	3.052	1.415	4.653	0.031	21.163	(1.322, 338.803)
VAS	1.309	0.499	6.872	0.009	3.702	(1.391, 9.850)
MTV	–0.046	0.022	4.384	0.036	0.955	(0.914, 0.997)
Constants	–4.240	3.234	1.718	0.190	0.014	

Table 5. Predictive value of indicators for LARS.

Indicators	AUC	Standard error	p	95% CI	Yoden Index	Truncation value	Sensitivity	Specificity
Anastomosis position	0.686	0.067	0.008	(0.555, 0.818)	0.372	-	0.636	0.736
Preoperative radiotherapy or not	0.675	0.074	0.013	(0.529, 0.821)	0.350	-	0.364	0.986
Anastomotic fistula	0.607	0.075	0.131	(0.460, 0.754)	0.213	-	0.227	0.986
VAS	0.800	0.056	0.000	(0.691, 0.909)	0.499	4.500 (points)	0.818	0.681
MTV	0.758	0.055	0.000	(0.650, 0.865)	0.471	103.050 (mL)	0.818	0.653
United	0.921	0.041	0.000	(0.841, 1.000)	0.762	-	0.818	0.944

Note: AUC, area under the curve.

ROC Analysis

Anastomotic position, whether or not radiotherapy was administered preoperatively, anastomotic fistula, VAS score, and MSP level all had high sensitivity and specificity for the prediction of concurrent LARS, and the combined area under the curve (AUC) of each index was 0.921, sensitivity was 0.818, and specificity was 0.944. See Table 5 and Fig. 5.

Discussion

Colorectal cancer, the third most common cancer in the world, is a malignant tumor that originates from the mucosal cells of the colon or rectum. Its pathogenesis is not yet fully understood but involves a number of factors, including genetics, environment, and lifestyle [6, 7]. Surgery is the most common treatment, and resection can completely remove the tumor, improving the therapeutic effect and reducing the recurrence rate; however, the surgical incision is large, which will cause substantial pain, and although the operation retains the function of the anus as much as possible, it may still cause the patients to have defecation dysfunction problems such as increased frequency of defecation, difficulty in passing stools, and defecation incontinence [8, 9].

The occurrence of LARS in postoperative colorectal cancer significantly impacted the patient's bowel function. Triggered fecal incontinence adversely affected the patient's psychological, physical, and emotional well-being [10]. The mechanism of LARS is not fully understood, but it may be related to physiological and anatomical changes after colorectal resection; for example, after surgical treatment, there may be changes in colorectal volume and wall tension, which may lead to defecation dysfunction and LARS complications in patients [11, 12]. Therefore, screening and preventive measures should be taken to avoid the occurrence of LARS, and patients should be followed up and evaluated regularly for early detection and management of possible defecation dysfunction in order to improve the prognosis.

Boström *et al*. [13] showed that intense postoperative pain in patients with colorectal cancer suggests the possibility of an anastomotic fistula, which would be detrimental to the patient's prognosis, and also that the degree of postoperative pain is closely related to a variety of postoperative complications. In the present study, we found that the degree of postoperative pain of patients was positively correlated with the LARS score. In addition, logistic regression analysis revealed that higher VAS score was a significant predictor of concurrent LARS. The reason for this association may be that the patient's intense postoperative pain can lead to anal sphincter tension and impaired function, which will reduce bowel control and affect the quality and frequency of bowel movements, thereby increasing the risk of complicating LARS. Therefore, the results have important guiding significance for clinical practice: clinicians should pay more attention to postoperative pain management, need to strengthen the observation of the condition, and take timely and effective measures to alleviate the patients' pain, so as to reduce the risk of patients' concurrent LARS. Several studies have shown that after surgical treatment of colorectal cancer patients, if the anastomotic position is closer to the anal verge, preoperative radiotherapy and anastomotic fistula will increase the risk of postoperative complication of LARS in patients, which is consistent with the results of the current study [14, 15, 16]. The reason may be that, when the anastomosis position is closer to the anal verge, the function of the anal sphincter muscle may be affected. This is an important muscle for maintaining defecation control, and if it is damaged or dysfunctional, thus it may lead to the occurrence of LARS symptoms such as difficulty in defe-

cation and defecation incontinence. Preoperative radiotherapy is a commonly used adjuvant therapy in the treatment of colorectal cancer, and is effective in shrinking the tumor and reducing the risk of metastasis. However, preoperative radiotherapy may cause certain damage to colorectal tissues or surrounding structures, which may lead to postoperative intestinal dysfunction and increase the risk of postoperative LARS complications. Anastomotic fistula is a complication of colorectal resection, and refers to the failure of the anastomosis to heal completely. It can form an abnormal channel, which leads to leakage of intestinal contents to the abdominal cavity or pelvis, and may not only lead to infection, inflammation, and the impairment of the function of the anal sphincter muscle, but also affect the function of the patient's defecation. The results indicate that a closer anastomotic position to the anal verge, preoperative radiotherapy, and anastomotic fistulas increase the risk of concurrent LARS postoperatively. Clinicians should carefully consider the anastomotic position to minimize proximity to the anal verge, thereby preserving anal sphincter function and reducing the risk of LARS. Secondly, for patients who need to receive radiotherapy or have an anastomotic fistula, the assessment and monitoring of anal sphincter function should be strengthened, and timely measures should be taken to protect its function and reduce the occurrence of LARS. In addition, in the postoperative period, nurses and healthcare workers need to pay attention to the recovery of patients after surgery, closely observe the patients' defecation and LARS symptoms, report to the doctor in time and take corresponding nursing measures, such as instructing the patients to carry out pelvic floor exercises, dietary modifications, etc., in order to help the patients to recover as soon as possible. Min *et al*. [17] showed that the use of anorectal manometry can objectively evaluate the anal contractility and sensitivity of patients and facilitate the objective evaluation of bowel function. In the present study, it was found that when the MTV level was low, patients had a higher risk of postoperative complications of LARS. The reason for this may be that low MTV levels imply a lesser extent of surgical resection or a reduced ability to stretch the rectum postoperatively, which will result in reduced colorectal volume and altered wall tension, etc., leading to anal sphincter tightness and cause difficulty in defecation. Therefore, clinicians should adequately assess patients' MTV levels before surgery, formulate surgical plans according to specific conditions, and avoid overly conservative surgical resection ranges to reduce the risk of LARS. Meanwhile, for patients with low postoperative MTV levels, postoperative rehabilitation care should be strengthened, including promoting the recovery of rectal function, dietary modifications, and pelvic floor exercises, in order to minimize the occurrence of LARS and improve the quality of life of patients.

The current study still has several limitations. The limited sample size in this study could have introduced bias in the findings, suggesting the need for a larger, future study to address these issues. No formal sample size calculation was conducted in this study; however, future studies will set appropriate benchmarks for sample size determination. The baseline data gathered in this study may not comprehensively reflect the effects of various factors on individuals with concurrent LARS. To enhance result reliability, future studies will seek comparable references to widen the scope of influencing factors considered. There may be many factors affecting patients' prognosis, and in retrospective studies, it is difficult to completely control all confounding factors, which may lead to misinterpretation of the results. Moreover, such studies can only describe the correlation between the variables, but cannot prove causality, which makes it difficult to establish a causal relationship between pain and defecation function and patients' prognosis. Therefore, in subsequent studies, the possible confounding factors can be taken into account at the beginning of the study and control measures, such as randomized grouping and paired design, can be taken to reduce the interference of the confounding factors. In addition, causation can be considered in the study design, and the causal relationship between pain and bowel function and patient prognosis can be verified through intervention experiments or survey studies.

Conclusion

In conclusion, LARS is strongly associated with the patient's pain level, and factors such as anastomotic position <5 cm from the anal verge, preoperative radiotherapy, anastomotic fistula, high VAS level, and low MTV level will increase the risk of concurrent LARS in patients.

Availability of Data and Materials

The data used to support the findings of this study are available from the corresponding author upon request.

Author Contributions

YWZ and JHL designed the research study. YWZ and CJX analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was approved by Shengzhou People's Hospital Ethics Committee (2024-001) and all patients provided informed consent. All procedures of this study were in accordance with relevant ethical standards including the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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