



Retrospective Study

Identification of multiple risk factors for colorectal cancer relapse after laparoscopic radical resection

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Abstract

BACKGROUND

Colorectal cancer (CRC) is a common life-threatening disease that often requires surgical intervention, such as laparoscopic radical resection. However, despite successful surgeries, some patients experience disease relapse. Identifying the risk factors for CRC relapse can help guide clinical interventions and improve patient outcomes.

AIM

To determine the risk factors that may lead to CRC relapse after laparoscopic radical resection.

METHODS

We performed a retrospective analysis using the baseline data of 140 patients with CRC admitted to our hospital between January 2018 and January 2020. All included participants were followed up until death or for 3 years. The baseline data and laboratory indicators were compared between the patients who experienced relapse and those who did not experienced relapse.

RESULTS

Among the 140 patients with CRC, 30 experienced relapse within 3 years after laparoscopic radical resection and 110 did not experience relapse. The relapse group had a higher frequency of rectal tumors with low differentiation and

lymphatic vessel invasion than that of the non-relapse group. The expression of serum markers and the prognostic nutritional index were lower, whereas the neutrophil-to-lymphocyte ratio, expression of cytokeratin 19 fragment antigen 21-1, vascular endothelial growth factor, and Chitinase-3-like protein 1 were significantly higher in the relapse group than those in the non-relapse group. The groups did not differ significantly based on other parameters. Logistic regression analysis revealed that all the above significantly altered factors were independent risk factors for CRC relapse.

CONCLUSION

We identified multiple risk factors for CRC relapse following surgery, which can be considered for the clinical monitoring of patients to reduce disease recurrence and improve patient survival.

Key Words: Colorectal cancer; Laparoscopic surgery; Relapse; Risk factors

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Core Tip: This study aimed to identify the risk factors for colorectal cancer (CRC) relapse after laparoscopic radical resection by comparing the baseline data and laboratory indicators of 140 patients with CRC, of whom 30 patients experienced relapse within 3 years. Rectal tumors with low differentiation and lymphatic vessel invasion were associated with higher relapse rates. Lower CD4⁺/CD8⁺ ratio, immunoglobulins (Ig) IgA, IgG, IgM, albumin-globulin ratio, and prognostic nutritional index and higher neutrophils to lymphocytes ratio, cytokeratin 19 fragment antigen 21-1, vascular endothelial growth factor, and Chitinase-3-like protein 1 were also identified as independent risk factors for CRC relapse following surgery. These findings suggested that monitoring these factors could reduce the risk of disease recurrence and improve patient outcomes.

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INTRODUCTION

Colorectal cancer (CRC) is a prevalent digestive tract cancer associated with lifestyle and living conditions. The lack of specific symptoms at the early stage of the disease leads to a low early detection rate. Thus, many patients are diagnosed at an advanced stage, and their prognoses are often unsatisfactory[1,2]. Treatments for CRC have progressed rapidly, and the overall principle is to adopt surgical intervention supplemented by comprehensive standardized treatments, such as radiotherapy and targeted therapy. Endoscopic technology has gradually replaced traditional laparotomy and is the first choice and main intervention for the treatment of CRC[3,4]. Although patients with CRC receive timely consolidation treatment with adjuvant therapies, such as chemoradiotherapy and molecular targeted therapy after surgery, the risk of postoperative relapse remains high, leading to a high mortality rate[5,6]. Approximately 30% of patients with CRC who have undergone laparoscopic radical surgery show a risk of metastasis or relapse after surgery, and the 5-year survival rate of such patients is only approximately 19%. Liver metastasis presents a major clinical challenge. Therefore, exploring the factors that may lead to postoperative relapse is necessary to enhance the vigilance of patients at high risk of relapse and guide more appropriate clinical interventions, ultimately reducing the risk of postoperative relapse and enhancing patient prognosis[7,8]. A search for clinical literature related to the exploration of factors that may affect relapse after laparoscopic radical resection in patients with CRC revealed varying factors, such as patient age, tumor stage, and tumor size, with no firm consensus[9-11]. Therefore, in this study, we compared and analyzed the baseline data of included participants to identify the influencing factors that may lead to relapse in patients with CRC after laparoscopic radical resection to guide future interventions and reduce the risk of relapse in patients with CRC after surgery.

MATERIALS AND METHODS

Participants

Baseline data were collected from 140 patients (80 male and 60 female) with CRC admitted to Peking University Shenzhen Hospital between January 2018 and January 2020. The inclusion criteria were as follows: (1) Patients with CRC who met the diagnostic requirements of the "Clinical Guideline for Diagnosis and Treatment of Tumor"[12] and were confirmed using biopsy; (2) those who underwent successful laparoscopic radical resection; and (3) those with baseline data and complete laboratory test results.

The exclusion criteria were as follows: (1) Patients with other cancerous lesions; (2) those with metastasis diagnosed before or during the surgery; (3) those who received targeted therapy, chemoradiotherapy, and other adjuvant treatments before the surgery; (4) those with reduced compliance due to psychological disorders; and (5) presence of acute or chronic diseases, such as impaired liver and kidney function, pulmonary, cardiovascular, cerebrovascular, and hematological diseases, or coagulation disorders, intestinal diseases including intestinal obstruction and intestinal perforation, and acute and chronic infections or active inflammation that may affect the prognosis of the patient.

Methods

We retrospectively analyzed the baseline data of the enrolled patient cohort.

Diagnostic criteria for relapse

The diagnostic criteria included patients followed up effectively until death or up to 3 years (until January 31, 2023). Relapse was determined as the detection of pathological lesions similar to the primary lesions regrowing around the sites of the primary lesion, intestinal anastomosis, peri-intestinal tissue, mesentery, and lymph node regions through clinical imaging (B-scan ultrasonography, abdominal radiography, computed tomography) and further confirmation by tissue biopsy for patients suspected of relapse.

Baseline data collection

The following baseline data were collected: Sex; age (≥ 60 years); tumor node metastasis (TNM)[13] stage (stage I–II, stage III–IV); degree of differentiation (with reference to the Edmondson-Stener classification of tumor pathological grade[14] (stage I: Highly differentiated carcinoma, stage II: Moderately differentiated carcinoma; stage III and IV: Poorly differentiated carcinoma); maximum tumor diameter (≥ 5 cm); location of the lesion (rectum, left/right hemicolon); lymphovascular invasion (present, absent); pathological type (glandular cancer, mucinous adenocarcinoma, Indian cell carcinoma); depth of invasion (T1 + T2, T3 + T4); serum tumor and immune indicators including lymphocytes (CD4⁺/CD8⁺), immunoglobulins (Ig) IgA, IgG, IgM, neutrophils to lymphocytes ratio (NLR), albumin-globulin ratio (AGR), cytokeratin 19 fragment antigen 21-1 (CYFRA 21-1), vascular endothelial growth factor (VEGF), prognostic nutritional index (PNI), and the inflammatory biomarker Chitinase-3-like protein 1 (YKL-40).

Detection of serum indicators

Fasting peripheral blood was collected in anticoagulation tubes and used for the following assays: Absolute neutrophil count and absolute lymphocyte count (ALC) using the XE-2100 blood cell analyzer (SYSMEX Corporation, Japan; NLR = PLT/ALC); enzyme-linked immunosorbent assay detection of immunoglobulins, VEGF and YKL-40, Huamei, and Zhenke Biotechnology, China, respectively); total serum protein and albumin detection by an auto chemistry analyzer (BK-400, Jinan Olebo Electronic Commerce, China; globulin = total protein-albumin, AGR = albumin/globulin); CYFRA 21-1 detection by electrochemical luminescence; PNI determination by calculating the albumin concentration and lymphocyte counts using the AU680 automatic biochemical analyzer [Beckman Coulter, United States; PNI = albumin (mg/L) + 5 \times lymphocyte counts ($\times 10^9$ /L)].

Statistical analysis

Data analysis was conducted using SPSS 25.0 software. The Shapiro-Wilk test was used to determine the normality of the measurement data. Measurement data conforming to a normal distribution were expressed as mean \pm SD. The independent sample *t*-test was used for inter-group comparison; count data were presented as *n* (%) and analyzed using the χ^2 test was used. Logistic regression analysis was used to analyze the risk factors for relapse in patients with CRC after laparoscopic radical resection, maintaining an inspection level of $\alpha = 0.05$.

RESULTS

Relapse status of patients after radical resection of CRC

Among the 140 patients with CRC included in the study, 30 experienced relapse within 3 years after laparoscopic radical resection, whereas 110 did not experience relapse, resulting in the relapse rate being 21.43% (30/140) and non-relapse rate being 78.57% (110/140). We analyzed baseline data of the relapsed and non-relapsed groups.

Comparison of baseline data between the two groups

The relapse and non-relapse groups were comparable in terms of their baseline characteristics. However, significant differences between the two groups were observed in the degree of tumor differentiation, lesion location, lymphatic vessel invasion, and several serum indicators. Most patients in the relapse group exhibited rectal tumors characterized by low differentiation and lymphatic vessel invasion. However, patients in the non-relapse group predominantly presented tumors in the left/right hemicolon, with higher differentiation and lack of lymphatic invasion (Table 1). The CD4⁺/CD8⁺ ratio and levels of IgG, IgA, IgM, AGR, and PNI were lower, whereas the expression of NLR, CYFRA21-1, VEGF, and YKL-40 was higher in the relapse group than those in the non-relapse group, and the differences were statistically significant ($P < 0.05$).

Table 1 Comparison of baseline data, *n* (%)

Criteria	Relapse group (<i>n</i> = 30)	Non-relapse group (<i>n</i> = 110)	Statistical values (χ^2/t)	<i>P</i> value
Gender				
Male	20 (66.67)	60 (54.55)	0.414	0.234
Female	10 (33.33)	50 (45.45)		
Age (year)				
≥ 60	18 (60.00)	70 (63.64)	0.134	0.715
< 60	12 (40.00)	40 (36.36)		
TNM stage				
I-II	15 (50.00)	65 (59.09)	0.796	0.372
III-IV	15 (50.00)	45 (40.91)		
Differentiation				
Low	25 (83.33)	23 (20.91)	40.768	< 0.001
Medium/high	5 (16.67)	87 (79.09)		
Tumor maximum diameter (cm)				
≥ 5	20 (66.67)	65 (59.09)	0.567	0.451
> 5	10 (33.33)	45 (40.91)		
Lesion location				
Rectum	24 (80.00)	25 (22.73)	33.986	< 0.001
left/right hemicolon	6 (20.00)	85 (77.27)		
Lymphatic vascular invasion				
Present	22 (73.33)	20 (18.18)	34.141	< 0.001
Absent	8 (26.67)	90 (81.82)		
Postoperative adjuvant therapy				
Not done or incomplete	15 (50.00)	60 (54.55)	$\chi^2 = 0.196$	0.658
Complete	15 (50.00)	50 (45.45)		
Pathological type				
Glandular cancer	10 (33.33)	30 (27.27)	0.951	0.622
Mucinous adenocarcinoma	8 (26.67)	25 (22.73)		
Indian cell carcinoma	12 (40.00)	55 (50.00)		
Infiltration depth				
T1 + T2	18 (60.00)	70 (63.64)	0.134	0.715
T3 + T4	12 (40.00)	40 (36.36)		
Immune indicators				
CD4 ⁺ /CD8 ⁺	1.02 ± 0.26	1.48 ± 0.38	6.236	< 0.001
IgG (g/L)	4.14 ± 0.60	5.72 ± 0.94	8.722	< 0.001
IgA (g/L)	0.50 ± 0.08	0.69 ± 0.14	7.111	< 0.001
IgM (g/L)	0.68 ± 0.22	0.95 ± 0.32	4.344	< 0.001
NLR	4.18 ± 0.95	3.42 ± 0.55	5.636	< 0.001
AGR	1.60 ± 0.40	1.98 ± 0.36	0.003	< 0.001
Tumor indicators				
CYFRA21-1 (ng/mL)	4.78 ± 0.52	3.25 ± 0.35	13.369	< 0.001

VEGF (ng/L)	190.12 ± 50.25	140.12 ± 42.25	4.171	< 0.001
PNI	40.75 ± 2.02	43.21 ± 2.18	4.534	< 0.001
YKL-40 (ng/mL)	104.25 ± 20.52	78.95 ± 15.25	5.420	< 0.001

TNM: Tumor node metastasis; Ig: Immunoglobulins; NLR: Neutrophils to lymphocytes ratio; AGR: Albumin-globulin ratio; CYFRA21-1: Cytokeratin 19 fragment antigen 21-1; VEGF: Vascular endothelial growth factor; PNI: Prognostic nutritional index; YKL-40: Inflammatory biomarker Chitinase-3-like protein 1.

Logistic regression analysis of relapse after laparoscopic radical resection of CRC

To determine whether the factors that were significantly different between patients in the relapse and non-relapse groups were significant risk factors for relapse after laparoscopic radical resection, we performed logistic regression analysis with relapse after surgery being treated as the dependent variable (1 = relapse, 0 = non-relapse) and indicators with significant differences from Table 1 as the independent variables (Table 2 presents the assignment). The results demonstrated that the degree of differentiation (low differentiation); location of the lesion (rectum); lymphatic vessel invasion (present); low expression of serum CD4⁺/CD8⁺, IgG, IgA, IgM, AGR, and PNI; and high expression of serum NLR, CYFRA21-1, VEGF, and YKL-40 were independent risk factors for relapse in patients with CRC after laparoscopic radical surgery (OR > 1, *P* < 0.05; Table 3).

DISCUSSION

Laparoscopic radical resection can significantly improve overall patient outcomes and reduce the impact of open surgery on immune function. However, the risk of relapse remains high in patients with CRC after radical resection. Our present study supports this conclusion, as our results are consistent with the observed relapse rate of 21.43% observed in a cohort of 140 patients. The results negatively impact patients' quality of life and overall survival rate. Therefore, for patients with CRC, early detection of relapse after surgery and exploration of the risk factors that may lead to relapse are particularly crucial for guiding further treatment, prolonging survival time, and improving the quality of life[15,16].

This study demonstrated that patients with rectal tumors with a low degree of differentiation and lymphatic vessel invasion were at higher risk of postsurgical relapse than that of patients with more differentiated tumors located within the colon and without lymphatic vessel invasion. Other immune/tumor-related risk factors for relapse included lower expression of CD4⁺/CD8⁺, IgG, IgA, IgM, AGR, and PNI and higher expression of NLR, CYFRA21-1, VEGF, and YKL-40. Logistic regression analysis indicated that all variables were independent risk factors for CRC relapse after laparoscopic radical resection.

The complex rectal lymphatic drainage system may be a possible reason for the higher relapse rate in patients with rectal tumors. The absence of a serosa in the lower rectal cancer tube may allow lesions to easily adhere to the surrounding tissues, increasing the difficulty of complete surgical removal and the risk of postoperative relapse[17]. The degree of tissue differentiation has a significant effect on the biological behavior of tumors. A lower degree of differentiation indicates that the tumor tissue has strong regenerative ability; a fast growth rate due to rapid cell division and proliferation; and high migration and invasiveness into surrounding tissues, lymphatic vessels, and capillaries, contributing to a high probability of postoperative relapse[18,19].

As an important immune organ, the lymph node is the switch that activates the immune response in the body. Because of the abundant lymphatic and blood vessels in the mesorectum, cancer cells can easily invade these circulatory systems, forming circulating tumor cells that are resistant to apoptosis and attacks from the immune system and many other environmental factors, eventually invading new tissues to form metastases, thereby increasing the relapse rate of patients after surgery[20,21]. The body's immune function is essential for monitoring and inhibiting tumor progression, and T cells and their subsets are particularly associated with the progression of malignant diseases. CD8⁺ T cells can directly act as effector cells to kill tumor cells, whereas CD4⁺ T cells mainly inhibit inflammatory factors, secrete specific cytokines to assist other immune cells, regulate the body's immune function against tumors, and increase the body's immune tolerance to achieve antitumor immunity. Thus, changes in the CD8⁺/CD4⁺ ratio directly affect the ability of the body to resist tumor cells[22-24]. Regulatory T cells contribute to the immune escape mechanisms of cancer lesions. When the CD4⁺/CD8⁺ ratio is high, many regulatory T cells infiltrate the tumor and elicit a significant immunosuppressive effect contributing to tumor occurrence, progression, and metastasis. When the CD4⁺/CD8⁺ ratio is increased for various reasons, it indicates that the immune function is in an inhibitory state with decreased immunity and increased tolerance, and the antitumor immune response is also damaged, leading to the proliferation and progression of cancerous lesions and a directly increase in the risk of postoperative relapse. When a patient experiences relapse after surgery, many soluble immunosuppressive factors are produced during tumor regeneration and progression. These hinder the maturation of CD4⁺ cells, inhibit the immune system, and promote disease progression. This vicious cycle leads to poor patient prognosis[25-27]. Immunoglobulins, such as IgG, IgA, and IgM, are important immune system components. They mainly activate the complement system by specifically binding to antigens, accelerating cell lysis, and enhancing antibody regulation to achieve antitumor immune effects. Abnormal immunoglobulin expression is a manifestation of impaired humoral immune function. Decreased IgG, IgA, and IgM expression indicates decreased mucosal defense and weakened complement-mediated phagocytosis. Thus, the reduced phagocytic removal of cancer cells potentially

Table 2 Assignment of the main independent variables

Independent variable	Variable type	Assignment condition
Degree of differentiation	Dichotomous	1 = low differentiation, 0 = medium and high differentiation
Lesion location	Dichotomous	1 = rectum, 0 = left and right hemicolon
Lymphatic vascular invasion	Dichotomous	1 = presence, 0 = absence
CD4 ⁺ /CD8 ⁺	Continuous	-
IgG	Continuous	-
IgA	Continuous	-
IgM	Continuous	-
AGR	Continuous	-
NLR	Continuous	-
CYFRA21-1	Continuous	-
VEGF	Continuous	-
PNI	Continuous	-
YKL-40	Continuous	-

TNM: Tumor node metastasis; Ig: Immunoglobulins; NLR: Neutrophils to lymphocytes ratio; AGR: Albumin-globulin ratio; CYFRA21-1: Cytokeratin 19 fragment antigen 21-1; VEGF: Vascular endothelial growth factor; PNI: Prognostic nutritional index; YKL-40: Inflammatory biomarker Chitinase-3-like protein 1.

Table 3 Logistic regression analysis of variables affecting colorectal cancer relapse after laparoscopic radical resection

Correlative factor	β	Standard error	Wald	P value	Odds ratio	95%CI
Degree of differentiation	2.940	0.543	29.300	< 0.001	18.913	6.523-54.835
Lesion location	2.610	0.510	26.192	< 0.001	13.600	5.005-36.953
Lymphatic vascular invasion	2.516	0.481	27.330	< 0.001	12.375	4.819-31.780
CD4 ⁺ /CD8 ⁺	3.794	0.810	21.936	< 0.001	44.438	9.083-217.423
IgG	2.770	0.537	26.597	< 0.001	15.955	5.568-45.712
IgA	3.438	0.721	14.386	< 0.001	32.975	8.889-642.800
IgM	3.292	0.846	15.145	< 0.001	26.883	5.123-141.065
AGR	2.728	0.675	16.332	< 0.001	15.305	4.076-57.474
NLR	1.567	0.355	19.491	< 0.001	4.792	2.390-9.608
CYFRA21-1	8.672	2.245	14.921	< 0.001	5838.165	71.654-475674.916
VEGF	0.024	0.005	19.752	< 0.001	1.025	1.014-1.036
PNI	0.531	0.117	20.459	< 0.001	1.700	1.351-2.140
YKL-40	0.081	0.016	26.151	< 0.001	1.084	1.051-1.119

TNM: Tumor node metastasis; Ig: Immunoglobulins; NLR: Neutrophils to lymphocytes ratio; AGR: Albumin-globulin ratio; CYFRA21-1: Cytokeratin 19 fragment antigen 21-1; VEGF: Vascular endothelial growth factor; PNI: Prognostic nutritional index; YKL-40: Inflammatory biomarker Chitinase-3-like protein 1.

increases the risk of postoperative relapse in patients[28-30].

The AGR and NLR are markers of inflammation that indicate systemic inflammatory response and immunosuppressive function of the body. Inflammatory responses are triggered when the body is infected or exposed to other stimuli. However, unregulated inflammation can cause significant damage to the body, and a chronic inflammatory state impedes immune infiltration and increases angiogenesis, providing an ideal environment for the growth and reproduction of cancer cells and promoting the generation and spread of cancerous lesions. Relapsing tumors aggravate the inflammatory response in the body and form a negative feedback loop that increases the risk of postoperative relapse in patients[31-33].

In addition to the AGR, a combination of albumin and lymphocyte count readouts in the form of PNI may be a useful marker in cancer biology. Lymphocytes are important components of the immune system and are involved in protein recovery and nutrient transport; therefore, PNI can highlight the nutritional status of an individual. Reduced PNI values indicate decreased lymphocyte counts and albumin levels, along with possible inflammation and malnutrition in the body. This can lead to treatment intolerance and a decline in antitumor immune function, increasing cancer cell proliferation and the risk of postoperative relapse[34-36].

The protein antigen CYFRA21-1 is mainly present in the lymph nodes, bone marrow, and epithelium of healthy individuals. When cells become cancerous, proteases are activated, and normal colorectal epithelial tissues are damaged. When cells die, the activated protease accelerates the dissolution rate, a large amount of CYFRA21-1 is released into the blood, and the expression of CYFRA21-1 in serum is increased. Thus, high expression of CYFRA21-1 indicates extensive cell death or damage. We should be aware of the reinvasion of cancer lesions, which indicates that patients have a high risk of relapse[37-39].

Many vascular stimulatory factors can stimulate cancer cells to release many angiogenic factors that promote angiogenesis within tumors. VEGF has a strong induction effect that can accelerate tumor abnormalities and rapid growth. High levels of serum VEGF can promote the abnormal proliferation of tumor cells, accelerate the transformation of cancer cells into solid tumors, stimulate their migration and invasion into surrounding tissues and organs, destroy normal colorectal epithelial tissues and cells, accelerate neoangiogenesis, change the microenvironment, and increase the chance of relapse[40-42].

YKL-40 is a secretory glycoprotein mainly produced by chondrocytes, neutrophils, and other cells under the influence of inflammation. YKL-40 has many biological functions and signals through multiple pathways involved in angiogenesis, cell proliferation and differentiation, and immune and inflammatory responses. High YKL-40 expression may accelerate colorectal epithelial-mesenchymal transition (EMT) by upregulating vimentin and N-cadherin and downregulating E-cadherin. Because EMT is an important process for tumor migration and invasion, increased YKL-40 expression may increase the risk of relapse in patients with CRC after radical surgery[43,44].

CONCLUSION

In this study, we highlighted several risk factors associated with relapse in patients with CRC after surgery, which will enable the adoption of targeted interventions in clinical practice based on the combination of risk factors present. These factors can serve as monitoring strategies for identifying high-risk patients and detecting early disease recurrence. Direct interventions to reduce abnormal expression of these serum indicators may also reduce the risk of relapse after radical surgery. However, owing to the retrospective nature of this study and the limited sampling within a single center, the reproducibility and generalizability of our conclusions requires validation through further exploration. In addition, the results of this study revealed that the TNM stage is not a risk factor for postoperative recurrence in patients with CRC, which is inconsistent with the findings of Ma *et al*[45]. However, this study did not elaborate on the reasons for these inconsistent results. Further research is needed to determine the impact of the TNM stage on postoperative recurrence in patients with CRC.

In conclusion, we identified many risk factors for CRC relapse following laparoscopic radical resection, including tumors located in the rectum with low differentiation and lymphatic vessel invasion; low serum expression of CD4⁺/CD8⁺, IgG, IgA, IgM, AGR, and PNI; and high serum expression of NLR, CYFRA21-1, VEGF, and YKL-40. Monitoring these risk factors will help enhance vigilance regarding the risk of CRC relapse after laparoscopic radical surgery.

ARTICLE HIGHLIGHTS

Research background

Colorectal cancer (CRC) is a prevalent and life-threatening disease that often necessitates surgical intervention, such as laparoscopic radical resection. However, despite successful surgical procedures, a subset of patients experiences relapse. The identification of risk factors associated with CRC relapse is crucial for guiding clinical interventions and enhancing patient outcomes. This study aimed to conduct a comparative analysis of baseline data and laboratory indicators in CRC patients to determine the risk factors contributing to relapse following laparoscopic radical resection. A retrospective analysis was performed on 140 CRC patients, of which 30 experienced relapse within three years after surgery. The study revealed that tumors located in the rectum with low differentiation and lymphatic vessel invasion were associated with higher relapse rates. Additionally, specific serum markers, including CD4⁺/CD8⁺ ratio, immunoglobulins (Ig) IgA, IgG, IgM, albumin-globulin ratio (AGR), neutrophils to lymphocytes ratio (NLR), cytokeratin 19 fragment antigen 21-1 (CYFRA 21-1), vascular endothelial growth factor (VEGF), and the inflammatory biomarker Chitinase-3-like protein 1 (YKL-40), were identified as independent risk factors for CRC relapse. These findings underscore the importance of monitoring these factors to reduce the risk of disease recurrence and improve patient outcomes.

Research motivation

CRC is a significant health burden with the potential for relapse even after successful surgical intervention. The identification of risk factors associated with CRC relapse is crucial to guide clinical interventions and enhance patient outcomes. This study aimed to analyze the baseline data and laboratory indicators of CRC patients who underwent

laparoscopic radical resection, with the objective of determining the risk factors contributing to relapse. The findings highlighted several key factors, including tumor location, differentiation, lymphatic vessel invasion, as well as serum markers such as CD4⁺/CD8⁺ ratio, IgG, IgA, IgM, AGR, NLR, CYFRA21-1, VEGF, and YKL-40. Understanding these risk factors can aid in identifying high-risk patients and implementing proactive measures for monitoring and intervention, ultimately reducing the risk of relapse and improving the long-term survival prospects for CRC patients.

Research objectives

This study aimed to compare baseline data and laboratory indicators of CRC patients who underwent laparoscopic radical resection to identify risk factors associated with CRC relapse. The objectives were to determine the differences in tumor characteristics, analyze serum markers, assess statistical significance, identify independent risk factors using logistic regression, and provide insights for clinical monitoring and interventions to reduce relapse risk and improve patient outcomes.

Research methods

This study utilized a retrospective analysis of baseline data from 140 CRC patients admitted to the hospital between January 2018 and January 2020. The included subjects were followed up until death or a maximum of three years. Comparative analysis was conducted to compare the baseline data and laboratory indicators between patients who experienced relapse and those who did not. Tumor characteristics, including location, differentiation, and lymphatic vessel invasion, were assessed. Serum markers, such as CD4⁺/CD8⁺ ratio, IgG, IgA, IgM, AGR, NLR, CYFRA21-1, VEGF, and YKL-40, were measured and compared between the relapse and non-relapse groups. Statistical analyses were performed to determine the significance of the observed differences. Logistic regression was employed to identify independent risk factors associated with CRC relapse after laparoscopic radical surgery. The research methods aimed to provide valuable insights into the identification and monitoring of risk factors for disease recurrence and improving patient survival outcomes.

Research results

Out of the 140 CRC patients included in the study, 30 cases (21.43%) experienced relapse within three years after laparoscopic radical resection, while 110 patients (78.57%) did not relapse. The relapse group exhibited a higher frequency of tumors located in the rectum with low differentiation and lymphatic vessel invasion compared to the non-relapse group. Significant differences were observed in the levels of several serum markers. The relapse group showed lower expressions of CD4⁺/CD8⁺ ratio, IgG, IgA, IgM, AGR, and PNI. Conversely, the relapse group had higher levels of NLR, CYFRA21-1, VEGF, and YKL-40. Logistic regression analysis confirmed that all these altered factors were independent risk factors for CRC relapse following laparoscopic radical surgery, with odds ratios greater than 1 and statistically significant values ($P < 0.05$). These findings emphasize the importance of monitoring these factors for reducing disease recurrence and improving patient survival outcomes.

Research conclusions

Based on our comparative analysis of baseline data and laboratory indicators in CRC patients who underwent laparoscopic radical resection, we have identified several important conclusions. Firstly, tumors located in the rectum with low differentiation and lymphatic vessel invasion are associated with a higher risk of relapse after surgery. Additionally, lower levels of CD4⁺/CD8⁺ ratio, IgG, IgA, IgM, AGR, and PNI, along with higher levels of NLR, CYFRA21-1, VEGF, and YKL-40, serve as independent risk factors for CRC relapse following surgery. These findings highlight the significance of monitoring these factors to guide clinical interventions and reduce the risk of disease recurrence. By focusing on these risk factors, healthcare professionals can enhance patient surveillance and develop strategies to improve survival outcomes in CRC patients undergoing laparoscopic radical resection.

Research perspectives

The identification of multiple risk factors for CRC relapse following laparoscopic radical surgery provides valuable insights into improving patient outcomes. Moving forward, prospective studies should focus on validating these findings in larger patient populations and diverse healthcare settings. Further investigations can explore the molecular mechanisms underlying the identified risk factors to gain a deeper understanding of their roles in disease recurrence. Additionally, the development of predictive models incorporating these risk factors could aid in personalized treatment strategies and postoperative surveillance. Long-term follow-up studies are warranted to assess the impact of monitoring these factors on long-term survival and quality of life in CRC patients. Furthermore, intervention studies targeting modifiable risk factors may offer potential avenues for reducing disease relapse rates. Overall, continued research efforts in this field will contribute to optimizing clinical management and ultimately enhancing the prognosis of CRC patients undergoing laparoscopic radical resection.

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FOOTNOTES

Author contributions: Luo J proposed the concept of this study; He MW contributed to data collection; Luo J and Luo T contributed to formal analysis; Lv GQ participated in the survey; Luo T contributed to these methods; Lv GQ, He MW, and Luo J guided the research; Lv GQ validated this study; Luo J contributed to the visualization of this study; Luo J wrote the first draft; All authors reviewed and edited the manuscript.

Institutional review board statement: This study was reviewed and approved by the Ethics Committee of the Shenzhen University Hospital.

Informed consent statement: All study participants or their legal guardian provided informed written consent about personal and medical data collection prior to study enrolment.

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