Journal of Scientific Research in Medical and Biological Sciences
ISSN 2709-0159(print) and ISSN 2709-1511 (online)
Volume 4, Issue 2 Article 8
DOI: https://doi.org/10.47631/jsrmbs.v4i2.613

EFFECT OF VISCERAL FAT INDEX ON PERIOPERATIVE EFFICACY OF LAPAROSCOPIC RADICAL RESECTION FOR COLORECTAL CANCER

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ARTICLE INFO

Received: 21 January 2023
Revised: 14 May 2023
Accepted: 16 May 2023

Keywords:
Visceral Fat Index (VAI),
Colorectal Cancer,
Complications, Prediction

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ABSTRACT

Purpose: *To investigate the effect of visceral fat index (VAI) on perioperative period after radical resection of colorectal cancer, and analyze the relationship between VAI and postoperative complications. At the same time, we also discussed whether the correlation between VAI and complications is superior to body mass index (BMI), waist circumference (WC), triglyceride (TG), high-density lipoprotein (HDL) and other common body fat indicators.*

Methods: *From October 2021 to June 2022, 178 colorectal cancer patients in the Gastrointestinal Surgery Department of the First Affiliated Hospital of Chongqing Medical University were collected. Various indexes of patients were obtained through preoperative physical examination and blood examination. VAI value was calculated by formula, because of the high triglyceride-waist-circumference phenotype (increased waist circumference and hypertriglyceridemia) and visceral fat index (Vai, assessed according to waist circumference, body mass index, triglyceride and high-density lipoprotein cholesterol) , it is considered a cheap and effective marker for visceral (intra-abdominal) obesity and metabolic disorders. and then divided into groups according to dichotomy. Because the visceral index grade was divided into a total of 30 grades, according to grade, into the high VAI value group (VAI grade more than 15 grades) and the low VAI group (no more than 4 grades), with 89 patients in the high VAI group; There were 89 patients in the low VAI group. The relationship between VAI value and postoperative complications of patients was discussed by using statistical methods, and whether it was better than other body fat indexes was further analyzed.*

Results: *178 patients met the inclusion criteria and were divided into 89 patients in the high VAI group and 89 patients in the low VAI group according to the dichotomy. In patients with high VAI value, the operation time was significantly prolonged (213.01 ± 63.67 vs 190.34 ± 68.69 p=0.02), and the tumor N stage was higher (p=0.04). The results of ROC curve revealed that the area under the curve of VAI value was larger than that of BMI, waist circumference, triglyceride and high-density lipoprotein, suggesting that the value of VAI value was higher in diagnosis.*

Conclusions: *The increase of VAI can prolong the operation time of colorectal cancer patients undergoing radical surgery, affect the recovery of the body after surgery, and increase the risk of complications. At the same time, compared with BMI, waist circumference, triglyceride and high-density lipoprotein, VAI has a better prediction effect on complications, which can be popularized in clinical work.*

INTRODUCTION

Colorectal cancer is a common digestive tract tumor with high incidence and mortality. According to the latest statistics in 2021, colorectal cancer ranks the third in both male and female incidence and mortality [1]. At present, surgical operation is still the preferred method for the treatment of colorectal cancer. Radical resection of colorectal cancer can completely remove the solid tumor and improve the survival rate of patients[2-3]. With the improvement of living standards and changes in eating habits, there are more and more obese patients. Obesity will not only increase the risk of cardiovascular and cerebrovascular diseases, but even affect the prognosis of tumor patients [4-5]. Studies have shown that abdominal obesity can aggravate postoperative insulin resistance and induce inflammatory response, which is not conducive to postoperative recovery [6]. In addition, due to the accumulation of visceral fat in obese patients, the complexity of the anatomical level and the difficulty of surgical field exposure are increased, and the operation space under laparoscopy is reduced, thus increasing the difficulty of surgery [7-8].

Body mass index (BMI) is a common index used in clinical screening for obesity, which can simply assess whether a patient is obese. However, for patients with invisible obesity (implicit obesity refers to individuals who have lost fat weight, reduced muscle content and increased fat content, but their standard weight is still within the normal range), can not be accurate screening, thus affecting the implementation of individualized treatment. Compared with body mass index, visceral fat index can cover more invisible obese patients, and it has been more widely used in the screening and auxiliary diagnosis of diabetes and hypertension [9-10] Visceral fat index is to scan the fat around the viscera through CT, nuclear magnetic or other imaging examinations, and obtain the fat area by scanning. The lower the visceral fat grade is, the lower the subcutaneous fat content is, which belongs to the condition of low body fat content. If the visceral fat index is higher, the higher the risk of suffering from hypertension, heart disease, fatty liver and other diseases will be.

This study aims to explore the influence of visceral fat index on perioperative efficacy after radical resection of colorectal cancer, and compare and analyze its value in predicting short-term complications compared with traditional body fat index.

METHODOLOGY

1.1 General Information

We included a total of patients who received radical resection of colorectal cancer in our hospital from October 2021 to June 2022. There were 105 males (60.0%) and 73 females (40.0%). The average age was (62.85±12.06) years, ranging from 22 to 88 years. 96 cases of rectal cancer (53.9%) and 82 cases of colon cancer (46.1%). Clinical stage 1 (36 cases, 20.2%), stage 2 (71 cases, 39.9%), stage 3 (71 cases, 39.9%). Hypertension 45 cases (25.3%); 19 cases were diabetic, accounting for 10.7%. Table 1.

1.2 Inclusion and exclusion criteria

Inclusion criteria: 1) Pathological confirmation of colorectal cancer; 2) Newly treated patients who underwent laparoscopic radical resection of colorectal cancer; 3) Patients with complete case data; 4) No history of other abdominal operations; 5) lucid and able to cooperate with doctors for treatment; 6) Tolerance to surgery. Exclusion criteria: 1) Open surgery; 2) Complicated with perforation, obstruction and other related tumor complications; 3) Patients undergoing palliative surgery due to stage IV tumor; 4) Patients with a history of neoadjuvant radiotherapy and chemotherapy before surgery.

1.3 Surgical Methods

All confirmed patients underwent laparoscopic radical resection of colorectal cancer, preoperative routine colonoscopy and enhanced CT or MRI examination of chest, abdomen and abdomen were performed to evaluate surgical indications. After successful anesthesia, the head low and foot high supine position was selected, and the operative area was disinfected

and covered with towel. The peritoneum was established with a small incision up the umbilical cord, and the peritoneum pressure was between 10 and 12mmHg. trocar was placed into the abdominal cavity, and laparoscopy was performed to explore the abdominal cavity to determine whether the tumor invaded the surrounding organs and whether there was ascites. The activity, size and specific location of the tumor were observed, and the possibility of radical resection of the tumor was determined. The operative area was exposed, and the tumor was removed in strict accordance with the standardized surgical procedures [12]. The resection was performed according to the location of the lesion. Intraoperative attention was paid to the protection of the ureter and nerve tissue, and intraoperative routine irrigation of the abdominal cavity, hemostasis, and incision suture were performed. All confirmed patients underwent laparoscopic radical resection of colorectal cancer, preoperative routine colonoscopy and enhanced CT or MRI examination of chest, abdomen and abdomen were performed to evaluate surgical indications. After successful anesthesia, the head low and foot high supine position was selected, and the operative area was disinfected and covered with towel. The peritoneum was established with a small incision up the umbilical cord, and the peritoneum pressure was between 10 and 12mmHg. trocar was placed into the abdominal cavity, and laparoscopy was performed to explore the abdominal cavity to determine whether the tumor invaded the surrounding organs and whether there was ascites. The activity, size and specific location of the tumor were observed, and the possibility of radical resection of the tumor was determined. The operative area was exposed, and the tumor was removed in strict accordance with the standardized surgical procedures [12]. The resection was performed according to the location of the lesion. Intraoperative attention was paid to the protection of the ureter and nerve tissue, and intraoperative routine irrigation of the abdominal cavity, hemostasis, and incision suture were performed.

1.4 Data Collection

According to the inclusion and exclusion criteria, we collected relevant data of patients meeting the criteria, including the following relevant indicators: 1) Basic information of patients: gender, age, height, weight, waist circumference; 3) Perioperative indicators: operation time, amount of blood loss, postoperative complications (anastomotic fistula, anastomotic bleeding, intestinal obstruction, abdominal infection, pulmonary infection, incision infection, chylous leakage, lower limb venous thrombosis), length of hospital stay; 4) Related data of disease stages: tumor T stage, N stage, M stage.

Research Methods The patient's body mass index (BMI) was calculated according to the patient's preoperative physical examination: BMI= weight/height (kg/m2). According to the reference [11], the visceral fat index (VAI) was calculated:

VAI (male) = WC (cm) / [39.68 + 1.88 ×BMI(kg/m2)] ×TG(mmol/L) / 1.03 × 1.31 / HDLC(mmol/L)

VAI (female) = WC(cm) / [36.58 + 1.89 ×BMI(kg/m2)] ×TG(mmol/L) / 0.81 × 1.52 / HDLC(mmol/L) (WC is waist circumference, TG is triglyceride, HDLC is high-density lipoprotein cholesterol). Patients were divided into high VAI group and low VAI group according to the visceral fat standard. The differences of BMI,WC ,TG and HDL between the two groups were compared, and the operation time, blood loss and postoperative short-term complications of patients with different VAI were analyzed. Receiver operating characteristic (ROC) curve was further drawn to analyze the area under the curve (AUC) of VAI prediction of postoperative short-term complications.

1.6 Statistical Processing

The statistical data were analyzed by SPSS26.0 software and expressed by percentage (%) with $\chi 2$ test. Measurement data were expressed as mean ± standard deviation (± s), and independent sample t test was performed for comparison between the two groups. Receiver Operating Characteristic Curve (ROC) was plotted to analyze the area under the curve (AUC) of VAI, BMI, WC, TG and high-density lipoprotein in predicting complications. $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

2.1 Comparison of general clinical data

A total of 178 patients who met the inclusion criteria were included and relevant data were analyzed. They were grouped according to the VAI numerical dichotomy, including 89 patients in the group with high VAI value and 89 patients in the group with low VAI value. Through comparative analysis of the basic data of the two groups, it was found that there were statistical differences in WC, BMI, TG and high density lipoprotein between the two groups ($P < 0.05$). There were no statistically significant differences in age, sex, ASA grade, hypertension, diabetes, previous history of abdominal surgery and tumor location between the two groups ($P > 0.05$) (Table 1).

Table 1 Comparison of general data between patients with high VAI and low VAI

Characteristic	high VAI (n=89)	low VAI (n=89)	P
Age	63.47±11.84	62.23±12.31	0.50
Gender			
male	54	51	0.65
female	35	38	
BMI	24.32±2.91	22.73±3.17	0.52
ASA			
1	13	15	0.71
2	66	67	
3	10	7	
Waistline (cm)	87.34±8.03	81.67±7.84	
TG(mmol/L)	1.67±0.66	0.90±0.23	0.51
HDL(mg/dL)	1.05±0.20	1.45±0.35	0.58
Hypertension			
Yes	27	18	0.12
No	62	71	
Diabetes			
Yes	12	7	0.23
No	77	82	
History of abdominal surgery			
Yes	17	15	0.70
No	72	74	
Tumor location			
Colon	43	39	0.55
Rectum	46	50	

2.2 Comparison of perioperative indexes in patients with different VAI

By comparing the perioperative period and tumor stage of the two groups, we found that patients with high VAI value had longer operation time than patients with low VAI value, the difference was statistically significant (P=0.02), while the amount of blood loss (P=0.66) and length of hospital stay (P=0.77) were not statistically significant between the two groups. By comparing the tumor stages of the two patients, we found that there was no statistical difference between the two patients in TNM stage (P=0.98), T stage (P= 0.49) and M stage (P= 0.80), but there was a statistical difference in N stage (P=0.04). This suggests that elevated VAI may lead to an increase in the number of lymph nodes dissected in colorectal cancer patients (Table 2).

Table 2 Comparison of perioperative period and tumor stage in high VAI and low VAI groups

Characteristic	high VAI (n=89)	low VAI (n=89)	*P*
Operation	213.01±63.67	190.34± 68.69	0.02

time (min)			
Amount of bleeding (ml)	67.87±71.15	63.37±65.10	0.66
Length of stay (day)	8.65±5.81	8.89±4.85	0.77
Clinical stage			
I	18	19	0.98
II	35	35	
III	28	26	
IV	8	9	
TNM-T			
T1	6	6	0.49
T2	13	16	
T3	25	32	
T4	45	35	
TNM-N			
N0	53	59	0.04
N1	16	22	
N2	20	8	
TNM-M			
M0	81	80	0.80
M1	8	9	

2.3 Comparison of short-term postoperative complications in patients with different VAI

By comparing the short-term postoperative complications between the two groups, we found that there was no statistical difference in terms of specific complications between the two groups ($P > 0.05$). However, in terms of the incidence of overall complications, the incidence of total postoperative complications in the high VAI group was higher than that in the low VAI group ($P=0.04$). It indicates that higher VAI value may lead to the increase of short-term postoperative complications. (Table 3)

Table 3 Short-term complications in patients with high VAI and low VAI

Characteristic	high VAI (n=89)	low VAI (n=89)	Total	P
anastomotic stoma	7	4	11	0.35
anastomotic bleeding	2	1	3	1.00
ileus	5	3	8	0.72
abdominal infection	8	5	13	0.39
pulmonary infection	5	3	8	0.72
Incision infection	2	3	5	1.00
chylous fistula	4	2	6	0.68
Phlebothrombosis	3	2	5	1.00
Total	36	23	59	0.04

2.4 Comparison of VAI and body fat indexes in predicting short-term postoperative complications

By drawing the area under ROC curve (AUC), we found that the area under ROC curve (AUC) of VAI (0.754) was larger than that of BMI (0.579), WC (0.579), TG (0.579) and high-density lipoprotein (0.579) (FIG. 1). This indicates that VAI is better than single BMI, WC, TG and high-density lipoprotein in predicting the incidence of short-term complications after radical resection of colorectal cancer.

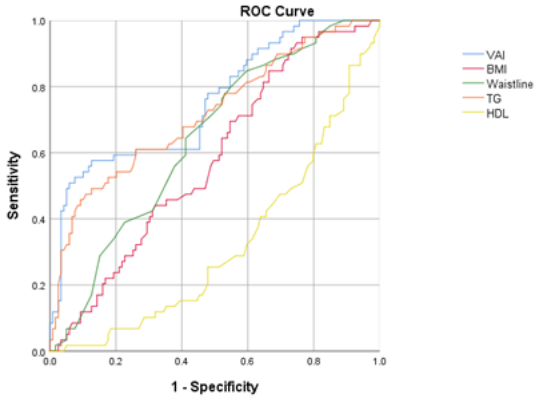

Figure 1. ROC curve of VAI and different body fat indexes predicting short-term postoperative complications

3 Discussion

Colorectal cancer is a common malignant tumor, resulting in the death of about 600,000 patients every year. Laparoscopic assisted radical resection of colorectal cancer is the main treatment method for this disease when the surgical indications are met [13]. However, some objective factors will still affect the surgical effect, among which overweight or obesity is a common influencing factor. The body of obese patients is in a state of micro-inflammation, and adipocytokines can combine with pro-inflammatory factors to induce inflammatory response, which is not conducive to postoperative recovery [14-15]. At the same time, the accumulation of visceral fat in obese patients will increase the complexity of the anatomical level, increase the difficulty of surgical field exposure, reduce the operating space under laparoscopy, and generally lead to an increase in the poor prognosis of patients. As the most commonly used index to judge obesity clinically, BMI can be used to judge the surgical efficacy and postoperative complications of colorectal cancer patients to a certain extent [16], but because it cannot accurately reflect the abdominal fat content in the body, it leads to the neglect of some invisible obese patients, although BMI is a simple method to measure whether people have a healthy weight. But now a new study shows that a person with a normal BMI is not necessarily healthy. That's because slim people are likely to have a lot of visceral fat, or visceral fat, that accumulates around the mesentery, liver, and pancreas. Too much visceral fat increases the risk of diabetes, heart disease and high blood pressure. At the same time, WC, TG and high-density lipoprotein can also reflect the perioperative conditions of patients to some extent (generally speaking, the larger WC, the higher body fat, TG content, body fat, HDL content, body fat, BMI, body fat), but these indicators are too simple and have limited clinical guiding significance. Visceral fat is fatty tissue attached to the mesentery surrounding the abdomen and gastrointestinal tract, which supports and holds the internal organs in place. The increase of visceral fat is closely related to the incidence of hypertension, diabetes, hyperlipidemia, and cardiovascular diseases. The right amount of fat is necessary to protect our internal organs. In a pooled analysis of all studies, the amount of visceral adipose tissue (compared in the highest and lowest categories) was associated with an increased risk of colorectal adenomas, as well as an increased difficulty of abdominal surgery. VAI integrates the four indicators of appeal and takes into account the advantages of appeal indicators. Our study further confirms that VAI can better predict the perioperative conditions of patients with colorectal cancer, and is better than the other four indicators. Patients with high VAI had higher body fat than those with low VAI, and VAI did reflect body fat. This study firstly compared and analyzed the differences in WC, BMI, TGs and high-density lipoprotein among patients with different VAI, and found that patients with high VAI had larger WC, higher BMI, higher TGs and lower high-density lipoprotein values, indicating that VAI is indeed a good indicator of body fat obesity.

In this study, it was found that patients with high VAI value (changed to patients in the discussion, do not use the code "group") had longer operation time and hospital stay than

patients with low VAI value. This may be because patients in the group with elevated VAI value are relatively obese and have more visceral fat, which leads to difficulty in operation and correspondingly prolongation of operation time for patients. Some studies have found that visceral obesity can affect the curative effect of patients after radical resection of colorectal cancer [17], and the results are consistent with our study. At the same time, our study also found that patients with high VAI value had higher tumor N stage, which also suggested that the increase of VAI value may lead to more mesangial lymph node dissection in patients with colorectal cancer, thus affecting the prognosis of patients. However, relevant studies have shown that diabetes can lead to an increase in the number of lymph node metastases in patients with colorectal cancer [18-19]. In our study, although there was no statistical difference in diabetes between the increased VAI group and the decreased VAI group, the incidence of diabetes in the increased VAI group was higher than that in the decreased VAI group. It is possible that with the gradual increase of sample size, the difference between the two groups in diabetes can be better reflected.

The occurrence of postoperative complications of colorectal cancer is an important factor affecting the prognosis of patients. Timely understanding of the risk of complications can provide a basis for improving the prognosis [20]. This study suggests that the total postoperative short-term complication rate of patients with high VAI value is increased compared with that of patients with low VAI, suggesting that the increase of VAI may lead to the increase of postoperative complications. The increase of postoperative complications may be related to the following reasons: 1) The accumulation of adipose tissue in the abdominal cavity of patients with high VAI value increases the difficulty of the operation to a certain extent and leads to the increase of the operation time, thus leading to the increase of postoperative complications. 2) Patients with high VAI value usually differ from ordinary people in fat metabolism and other aspects, and can secrete more inflammatory factors, thus leading to the increase of postoperative complications [21]. Our study further found that, compared with traditional indicators, VAI value has more advantages in predicting postoperative complications of colorectal cancer, which may be due to the fact that VAI value is a mixed calculation value, whose calculation process includes a variety of obesity-related indicators and covers more patients with latent obesity. Therefore, it has more advantages in predicting postoperative complications in patients with colorectal cancer. Patients with high preoperative VAI value should be paid attention to by clinicians.

In summary, VAI is an effective indicator of body fat status, and its high value can lead to prolonged operation time of patients undergoing radical resection of colorectal cancer, affect perioperative efficacy, and increase the risk of short-term postoperative complications. At the same time, compared with BMI, WC, TG and high-density lipoprotein, VAI has a better predictive effect on short-term postoperative complications, which is a practical and effective predictor and can be promoted and applied in future clinical work. However, this study also has certain limitations: 1) The sample size is relatively small and the clinical data collected are few, so the results need to be further discussed in a larger prospective clinical study. 2) Although there are differences in N stage among the patients in this study, whether it can affect the prognosis of patients can be followed up for further exploration.

CONCLUSION

In summary, VAI is an effective indicator of body fat status, and its high value can lead to prolonged operation time of patients undergoing radical resection of colorectal cancer, affect perioperative efficacy, and increase the risk of short-term postoperative complications. At the same time, compared with BMI, WC, TG and high-density lipoprotein, VAI has a better predictive effect on short-term postoperative complications, which is a practical and effective predictor and can be promoted and applied in future clinical work. However, this study also has certain limitations: 1) The sample size is relatively small and the clinical data collected are few, so the results need to be further discussed in a larger prospective clinical study. 2)

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FUNDING

This study was supported by the Science and Technology Planning Project of Yuzhong District of Chongqing City (20210115).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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