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Analysis of the predictive value of quantitative parameters of abdominal fat on CT in postoperative intestinal obstruction for gastric cancer

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► ***Original article***

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ABSTRACT

Background: To analyze the value of quantitative parameters of Computed Tomograph (CT) abdominal fat in predicting postoperative intestinal obstruction for gastric cancer. ***Materials and Methods:*** A retrospective analysis was conducted on 120 gastric cancer patients treated between January 2017 and December 2021. These patients were divided into two groups: an observation group with postoperative intestinal obstruction (28 patients) and a control group without (92 patients). CT scans were used to measure the Subcutaneous Fat Area (SFA) and Visceral Fat Area(VFA), calculate the SFA-VFA difference, and the VFA/SFA ratio. The receiver operating curve (ROC) was employed to evaluate the predictive efficacy of these CT measurements. ***Results:*** The observation group exhibited significantly lower VFA and SFA compared to the control group ($P < 0.05$), while the differences in VFA/SFA ratio and SFA-VFA were not statistically significant. The area under the ROC curve (AUC) for the combined VFA and SFA in predicting postoperative intestinal obstruction was 0.902, with a 95% confidence interval of 0.859 to 0.956. This combined measure showed higher sensitivity (96.02%) and comparable specificity (85.24%) than single measurements. Logistic regression analysis identified diabetes, malnutrition, C-Reactive Protein (CRP) levels, VFA, and SFA as risk factors for postoperative intestinal obstruction ($P < 0.05$). ***Conclusion:*** The combined quantitative assessment of VFA and SFA using abdominal CT improves the sensitivity of predicting postoperative intestinal obstruction in gastric cancer patients. This complication is multifactorial, emphasizing the importance of a comprehensive approach in the clinical evaluation and management of these patients.

INTRODUCTION

Gastric cancer is a malignant tumor of the digestive system originating from the gastric mucosa epithelium, with the characteristics of high incidence and high mortality, which has a serious adverse impact [1] on the daily life and life safety of patients. Surgery is the main method of clinical treatment for gastric cancer, which can effectively prolong the survival time of patients and reduce mortality [2]. Despite advancements in surgical techniques, postoperative complications such as intestinal obstruction remain a considerable threat to patient recovery and safety. Current literature acknowledges the multifactorial nature of these complications, highlighting factors like inflammatory response and nutritional status [3,4]. However, the role of abdominal fat, quantifiable through CT scans, has not been sufficiently explored. This study aims to fill this gap by examining the predictive value of CT-measured abdominal fat parameters (subcutaneous fat area and visceral fat area) in postoperative intestinal obstruction among gastric cancer patients. Through this, the study seeks to contribute to more accurate risk assessments and improve postoperative management strategies for gastric cancer patients. Previous studies [5-7] have touched on aspects of abdominal fat and its relation to surgical outcomes, but none have specifically focused on its predictive value for postoperative intestinal obstruction in gastric cancer. This investigation is therefore crucial for advancing our understanding and management of postoperative complications in gastric cancer.

Based on this, 120 patients with gastric cancer who underwent surgery in our hospital from January 2017 to December 2021 were selected to explore the predictive value of CT abdominal fat quantitative parameters for postoperative intestinal obstruction of gastric cancer, as reported below.

This research pioneers in rigorously examining the predictive value of CT-measured abdominal fat parameters (SFA and VFA) for postoperative intestinal obstruction in gastric cancer patients. While previous studies have investigated various risk factors associated with postoperative complications in gastric cancer, the specific role of quantitative fat parameters, as assessed by CT, has not been thoroughly explored. The innovation of this paper lies in analyzing how combined quantitative measurement of CT abdominal fat parameters enhances the predictive efficacy for postoperative intestinal obstruction in gastric cancer patients.

MATERIALS AND METHODS

General Information

A total of 120 patients with gastric cancer surgery in our hospital from January 2017 to December 2021 were selected, and they were divided into two groups according to whether intestinal obstruction occurred after surgery. 28 patients with intestinal obstruction were set as the observation group, and 92 patients without intestinal obstruction were set as the control group. The ethics committee of the hospital has approved it. (1) Inclusion criteria: 1) All patients met the diagnostic criteria of "gastric cancer" in "Chinese Consensus on screening, endoscopic diagnosis and Treatment of early gastric cancer"; [6] 2) All patients in the observation group were diagnosed by abdominal CT, X-ray and physical examination. 3) Age >18 years old; 4) normal audio-visual and communication skills with good cooperation; 5) American Society of Anesthesiologists (ASA) grade I-II; 6) no abnormal function of major organs such as kidney and liver; 7) Complete and complete clinical data. [2] Exclusion criteria: 1) combined immunodeficiency diseases or use of immunosuppressants in the past one month; 2) Combined with other malignant tumors; 3) with a history of drug dependence, drug use or alcohol abuse; 4) combined with abdominal infectious diseases; 5) combined with stroke, myocardial infarction and other cardiovascular and cerebrovascular diseases; 6) those who participated in other studies during the same period or withdrew from the study due to changes in their condition; 7) patients with coagulation dysfunction.

The ethical approval for this study was granted by the Ethics Committee of Changxing County People's Hospital, ensuring adherence to ethical guidelines and the protection of participants' rights and wellbeing. The study received its approval under the registration number EC-CXCPH-2017-0577, with the registration dated January 15, 2017. This approval is pivotal for the legitimacy and ethical integrity of the research, confirming that the study's methods and objectives are in line with established ethical standards.

Methods

Abdominal CT

256-slice GERevolution CT (GE, New Jersey, USA) examination was used to carry out abdominopelvic non-contrast or enhanced scanning, parameter settings: 150 kVp tube voltage, 200 mAs tube current, pitch is 0.9, 0.5r/s tube speed, 512×512 matrix, 128 mm × 0.6 mm collimation width, 5 mm layer thickness, 5 mm layer spacing, 0.625 mm reconstruction layer thickness, 0.300 mm reconstruction layer spacing, from the septum roof scanning to the pubic symphysis. Enhanced scanning: 70 mL Iopromide Injection (Bayer, Germany) was injected through the elbow vein with a high-pressure syringe at an injection rate of 3.5 mL/s, arterial phase scanning was performed at 25-30 s of injection, and venous phase scanning was performed at 65-70 s of injection, and the obtained images were transmitted to the GE AW3.2 post-processing workstation, and the quantitative parameters of CT abdominal fat were calculated in the mode of volume reproduction, and the specific measurement methods were as follows: the abdominal visceral fat area was outlined along the anterior edge of the patient's spine and the inner edge of the abdominal wall muscles, and the fat attenuation range was -190~- 30 HU, the total pixel volume of the corresponding fat area is calculated by the computer, divided by 5mm layer thickness, that is, the VFA, the area of interest (ROI) is delineated along the outer edge of the abdominal wall muscle and the outer edge of the abdominal wall skin, and the pixel volume of the fat area is calculated by the computer, divided by 5mm layer thickness, that is, the SFA and the SFA-VFA difference and VFA/SFA are calculated.

Clinical data collection

Retrospective investigation and analysis method was used to collect patients' personal information by reviewing medical records, examination reports, interviews, *etc*., including gender (male, female), ASA grade (grade I, II), age (≥ 60 years old, < 60 years old), Tumor, Node （TNM） stage (stage I-II, III-IV), degree of differentiation (well-differentiated, moderately differentiated, poorly differentiated), body mass index (BMI) (≥ 24 kg/m^2, < 24 kg/m^2), intraoperative blood loss (≥ 100 mL, < 100 mL), operation time (≥ 3 h, < 3 hours), smoking history (yes, no), alcohol history (yes, no), diabetes mellitus (yes, no), hypertension (yes, no), malnutrition (yes, no), CRP. CT Scanner: OptimaScan Pro 3000, manufactured in Germany. Contrast Agent: Iohexol Supreme, produced in the United States. Software for Analysis: MediQuant Analyzer 4.2, developed in Japan.

Observation indicators

CT abdominal fat quantitative parameters: SFA, VFA, SFA-VFA difference, VFA/SFA were compared between the two groups.

Statistical analysis

Statistic Package for Social Science (SPSS) 26.0 software (IBM, Armonk, NY, USA) was used for data processing. Measurement data were normal distribution t test and F test, expressed as "$\chi \pm s$ ", count data $^2\chi$ test and rank sum test, expressed as

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"[n/ (%)]". ROC curve was drawn to analyze the predictive efficacy of CT abdominal fat quantitative parameters for postoperative intestinal obstruction of gastric cancer. logistic regression analysis was used to analyze the risk factors of postoperative intestinal obstruction of gastric cancer, P < 0.05, there was a difference in comparison.

RESULTS

CT Abdominal Fat Analysis

The VFA and SFA in the observation group were lower than those in the control group (P < 0.05), and the difference values of VFA/SFA and SFA-VFA in the observation group were compared with those in the control group (P > 0.05), see table 1 and figures 1 and 2.

Table 1. Comparison of CT abdominal fat quantitative parameters between two groups (`χ ± s).

Group	n	VFA (cm^2)	VFA/ SFA	SFA (cm^2)	SFA-VFA Difference (cm^2)
Observation group	28	87.62± 8.26	1.24± 0.26	109.52± 10.62	21.63±6.88
Control group	92	101.55± 10.74	1.18± 0.37	120.06± 8.37	18.51±7.52
t	--	6.312	0.799	5.466	1.959
P	--	0.000	0.426	0.000	0.053

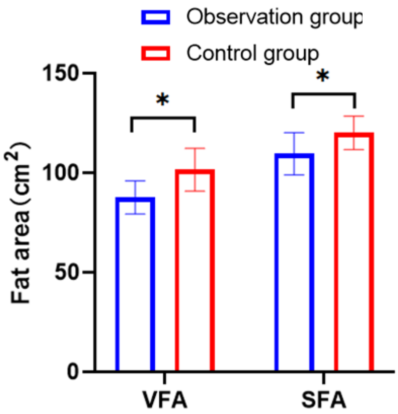

Figure 1. Comparison of SFA and VFA between the observation group and control group. *Note: SFA: Subcutaneous Fat Area; VFA: Visceral Fat Area.*

Figure2. Computed tomography (CT) scans of the abdomen in patients with gastric cancer. **(A)** The patient's abdominal enhanced CT showed significant thickening of the gastric wall in the antrum, which was later confirmed as a malignant tumor in the antral part of the stomach. **(B)** Abdominal CT suggested significant dilation and gas accumulation in a portion of the small intestine, leading to a diagnosis of "intestinal obstruction." *Note: CT: Computed tomography*.

In table 1, we present a comparison of abdominal fat quantitative parameters between two distinct groups, the Observation group and the Control group, characterized by different sample sizes (28 and 92, respectively). The parameters assessed in this study include Visceral Fat Area (VFA), VFA-to-Subcutaneous Fat Area (SFA) ratio (VFA/SFA), Subcutaneous Fat Area (SFA), and the difference between SFA and VFA (SFA-VFA). The results reveal notable differences between the two groups. The Observation group exhibited a significantly lower mean VFA of 87.62 cm^2 (± 8.26) compared to the Control group, which had a mean VFA of 101.55 cm^2 (± 10.74). Additionally, the VFA/SFA ratio was higher in the Observation group (1.24 ± 0.26) compared to the Control group (1.18 ± 0.37), although this difference was not statistically significant (p=0.426). In terms of SFA, the Observation group displayed a mean SFA of 109.52 cm^2 (± 10.62), while the Control group had a slightly higher mean SFA of 120.06 cm^2 (± 8.37). Interestingly, the SFA-VFA difference, which represents the disparity between SFA and VFA, was notably higher in the Observation group (21.63 cm^2 ± 6.88) compared to the Control group (18.51 cm^2 ± 7.52). Statistical analysis using *t-tests* demonstrated significant differences between the two groups for VFA (P = 0.000) and SFA (P = 0.000), indicating that the Observation group had significantly lower VFA and SFA levels than the Control group. However, no significant difference was observed for the VFA/SFA ratio (P = 0.426).

In summary, the findings from this study suggest that the Observation group has lower levels of visceral and subcutaneous fat compared to the Control group, with a significant difference in VFA and SFA. The VFA/SFA ratio did not differ significantly between the groups. These results provide valuable insights into the distribution of abdominal fat in the two groups and may have implications for further research on factors influencing abdominal fat composition.

Predictive Efficacy of CT Parameters

When the optimal cut-off value of VFA was 90.62cm^2 and the optimal cut-off value of SFA was 111.08 cm^2, the AUC of VFA and SFA combined in predicting postoperative intestinal obstruction of gastric cancer was 0.902, and the 95% confidence interval was 0.859 - 0.956. The sensitivity of combined VFA and SFA in predicting postoperative intestinal obstruction (96.02%) was higher than that of single detection (75.12%, 70.34%) (P < 0.05). The specificity of combined VFA and SFA in predicting postoperative intestinal obstruction of gastric cancer (85.24%) was compared with that of single detection (80.36%, 78.52%) (P >0.05), see table 2 and figure 3.

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Table 2. Predictive performance of CT abdominal fat quantitative parameters for postoperative intestinal obstruction in gastric cancer.

Indicators	AUC	95%CI	cut-off value	Sensitivity	Specificity
VFA	0.70+	0.634-0.742	90.62 cm^2	75.12	80.36
SFA	0.619	0.554-0.657	111.08 cm^2	70.34	78.52
Joint	0.902	0.859-0.956	--	96.02	85.24

Note: CT: Computed Tomography; SFA: Subcutaneous Fat Area; VFA: Visceral Fat Area; AUC: Area Under the Curve.

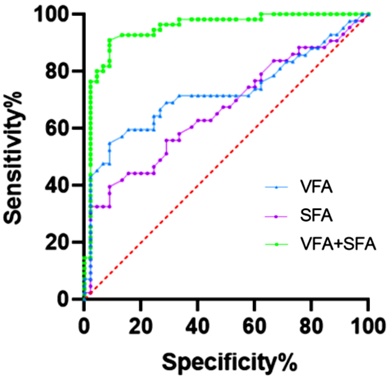

Figure 3. ROC of SFA, VFA, and the combination of both on postoperative intestinal obstruction in gastric cancer. *Note: SFA: Subcutaneous Fat Area; VFA: Visceral Fat Area.*

Risk Factor Evaluation

Table 3 presents the results of a univariate analysis aimed at identifying risk factors associated with postoperative intestinal obstruction in patients diagnosed with gastric cancer. This study involved two distinct groups, namely the Observation group (n=28) and the Control group (n=92). Various potential risk factors were meticulously examined, yielding several noteworthy findings. Firstly, there was no statistically significant difference in gender distribution between the Observation and Control groups (p=0.446), with 57.14% males in the Observation group and 48.92% in the Control group. Similarly, factors such as ASA classification, age, TNM staging, and the degree of differentiation did not exhibit significant differences between the groups (P>0.05). Furthermore, parameters like BMI, intra-operative blood loss, smoking history, history of alcohol consumption, and hypertension showed no significant variations between the two groups (P>0.05). Nevertheless, there was a notable trend observed in the duration of surgery, where a higher proportion of Control group patients had surgeries lasting less than 3 hours (P=0.092), although this difference did not reach statistical significance. Importantly, two factors stood out as statistically significant predictors of postoperative intestinal obstruction. Patients in the Observation group had a significantly higher prevalence of diabetes (P=0.001) and malnutrition (P=0.002) compared to the Control group. Moreover, C-reactive protein (CRP) levels were significantly elevated in the Observation group (30.62±9.25 mg/L) compared to the Control group (18.26±6.17 mg/L) (P=0.000).

In summary, this univariate analysis underscores the significance of diabetes, malnutrition, and elevated CRP levels as potential risk factors for postoperative intestinal obstruction in gastric cancer patients. Conversely, various other demographic and clinical factors did not show significant associations with this adverse postoperative outcome in the study population.

Table 3. Univariate Analysis of Risk Factors for Postoperative Intestinal Obstruction in Gastric Cancer.

Group		Observation group (n=28)	Control group (n=92)	χ^2/t	P
Gender	Male	16 (57.14)	45 (48.92)	0.582	0.446
	Female	12 (42.86)	47 (51.08)		
ASA classification	Class I	8 (28.57)	22 (23.91)	0.248	0.618
	Class II	20 (71.43)	70 (76.09)		
Age	≥60 years old	7 (25.00)	19 (20.66)	0.239	0.625
	<60 years old	21 (75.00)	73 (79.34)		
TNM staging	Stage I-II	18 (64.29)	60 (65.22)	0.008	0.928
	Stage III-IV	10 (35.71)	32 (34.78)		
Degree of differentiation	High differentiation	12 (42.86)	37 (40.22)	1.634	0.442
	Medium differentiation	10 (35.71)	43 (46.74)		
	Low differentiation	6 (21.43)	2 (2.17)		
BMI	≥24 kg/m2	7 (25.00)	19 (20.66)	0.239	0.625
	<24 kg/m2	21 (75.00)	73 (79.34)		
Intra-operative blood loss		14 (50.00)	44 (47.83)	0.041	0.840
		14 (50.00)	48 (52.17)		
Duration of surgery		9 (32.14)	16 (17.39)	2.832	0.092
		19 (67.86)	76 (82.61)		
Smoking history		15 (53.57)	53 (57.61)	0.143	0.706
		13 (46.43)	39 (42.39)		
History of alcohol consumption		17 (60.71)	58 (63.04)	0.050	0.824
		11 (39.29)	34 (36.96)		
Diabetes		15 (53.57)	20 (21.74)	10.529	0.001
		13 (46.43)	72 (78.26)		
Hypertension		11 (39.29)	41 (44.57)	0.244	0.622
		17 (60.71)	51 (55.43)		
Malnutrition		16 (57.14)	24 (26.09)	9.317	0.002
		12 (42.86)	68 (73.91)		
CRP (mg/L)		30.62±9.25	18.26±6.17	8.186	0.000

Note: CT: Computed Tomography; SFA: Subcutaneous Fat Area; VFA: Visceral Fat Area; AUC: Area Under the Curve; ASA: American Society of Anesthesiologists; BMI: Body Mass Index; CRP: C-Reactive Protein; TNM: Tumor, Node, Metastasis (staging system)

Intestinal Obstruction Risk Factors in Gastric Cancer Surgery

Table 4 presents the results of a multivariate analysis aimed at identifying significant risk factors associated with postoperative intestinal obstruction in patients with gastric cancer. The analysis employed a comprehensive examination of several factors, and the following key findings emerged:Diabetes emerged as the most influential risk factor, with a Wald value of 18.264, a β coefficient of 0.286 and an odds ratio (OR) of 1.326 (95% CI: 1.133 - 1.551), indicating a robust association between diabetes and the occurrence of postoperative intestinal obstruction (P<0.001). Malnutrition also demonstrated a strong association, with a Wald value of 15.652, a β coefficient of 0.263 and an OR of 1.306 (95% CI: 1.120-1.486), emphasizing its significance as a risk factor

(P<0.001). Elevated C-reactive protein (CRP) levels were found to be another substantial risk factor, as indicated by a Wald value of 14.068, a β coefficient of 0.234, and an OR of 1.264 (95% CI: 1.106-1.422) (P < 0.001).Furthermore, visceral fat area (VFA) and subcutaneous fat area (SFA) were also identified as significant risk factors. VFA exhibited a Wald value of 11.068, a β coefficient of 0.198 and an OR of 1.113 (95% CI: 1.082-1.395), while SFA showed a Wald value of 10.064, a β coefficient of 0.181 and an OR of 1.102 (95% CI: 1.026-1.381). These results underscore the relevance of both VFA and SFA in predicting postoperative intestinal obstruction in gastric cancer patients (P < 0.001).

Table 4. Multivariate analysis of risk factors for postoperative intestinal obstruction in gastric cancer.

Factors	Wald values	β value	OR value	SE value	95%CI	P value
Diabetes	18.264	0.286	1.326	0.542	1.133-1.551	<0.001
Malnutrition	15.652	0.263	1.306	0.498	1.120-1.486	<0.001
CRP	14.068	0.234	1.264	0.381	1.106-1.422	<0.001
VFA	11.068	0.198	1.113	0.352	1.082-1.395	<0.001
SFA	10.064	0.181	1.102	0.334	1.026-1.381	<0.001

Note: SFA: Subcutaneous Fat Area; VFA: Visceral Fat Area; CRP: C-Reactive Protein; CI: Confidence Interval.

In summary, the multivariate analysis highlights diabetes, malnutrition, elevated CRP levels, VFA, and SFA as significant and independent risk factors for postoperative intestinal obstruction in the study population. These findings contribute valuable insights into the multifactorial nature of this postoperative complication in gastric cancer patients.

DISCUSSION

At present, surgery is still the first step in the clinical treatment of gastric cancer, including radical distal subtotal gastrectomy, combined organ resection, laparoscopic wedge resection, total gastrectomy, *etc* [7]. Gastric cancer surgery is highly traumatic and complex, involving digestive tract reconstruction and lymph node dissection. Patients are prone to complications [8,9] such as intestinal obstruction after surgery. If intestinal obstruction is not treated in time and effectively, it will cause complications such as intestinal ischemic necrosis and intestinal perforation, which will prolong the postoperative recovery time and increase the cost [10,11] of treatment to a certain extent. Therefore, accurate and reasonable assessment of the risk of intestinal obstruction after gastric cancer surgery is of positive significance for alleviating the pain of patients and reducing medical costs. This study showed that the VFA and SFA in the observation group were lower than those in the control group. It is suggested that VFA and SFA are relatively low in patients with intestinal obstruction after gastric cancer surgery. VFA and SFA are negatively correlated with the occurrence of intestinal obstruction. High levels of VFA and SFA are protective factors for intestinal obstruction after gastric cancer surgery. The analysis is as follows: Visceral fat has a protective effect on serosa, peritoneum and intestine during gastric cancer surgery, which can inhibit the release of inflammatory mediators and reduce the symptoms such as intestinal edema, thereby reducing the risk of intestinal obstruction. On the contrary, in patients with low visceral fat, the peritoneum and intestinal tract are easily affected by inflammatory mediators during the operation, and the probability of intestinal obstruction is relatively high [12]. Researchers [12] found that patients with intestinal obstruction had lower Visceral Fat Area (VFA) compared to those without intestinal obstruction, which aligns with the findings of our study, confirming that intestinal obstruction patients tend to have relatively lower VFA.

This study showed that the area under the curve of VFA and SFA combined in predicting postoperative intestinal obstruction of gastric cancer was 0.902 and the 95% confidence interval was 0.859 - 0.956. The sensitivity of VFA and SFA combined in predicting postoperative intestinal obstruction of gastric cancer was 96.02%, which was higher than that of single detection (75.12%, 70.34%). The combined detection of VFA and SFA has a high sensitivity in predicting postoperative intestinal obstruction after gastric cancer surgery, which makes up for the deficiency of single detection. The above parameters can be obtained by abdominal CT scan, and the detection is convenient and non-invasive, which has broad application prospects in the prediction of postoperative intestinal obstruction of gastric cancer. The study showed that there was no significant difference in the difference of VFA/SFA and SFA-VFA between the observation group and the control group. The specificity of the combination of VFA and SFA (85.24%) in predicting postoperative intestinal obstruction was not different from that of single detection (80.36%, 78.52%). It is suggested that the specificity of the combined detection of VFA, SFA and single detection is not significantly different, and the potential rationale for this trend could be associated with factors, including the limited size of the patient cohort within our study. Consequently, it is imperative to amplify the clinical sample size and undertake extensive, multi-center prospective investigations. These endeavors will serve to augment the body of evidence, affording a more comprehensive basis for appraising the clinical utility of CT - based quantitative parameters of abdominal fat in the diagnosis of postoperative intestinal obstruction following gastric cancer surgery.

This study shows that diabetes, malnutrition, CRP, VFA and SFA are risk factors for postoperative intestinal obstruction in patients with gastric cancer. It is suggested that the occurrence of postoperative intestinal obstruction of gastric cancer is related to the above factors. Patients with diabetes mellitus are

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generally in a state of high blood glucose and are prone to metabolic disorders, which affect the normal function of the intestine and increase the risk [13] of intestinal obstruction. Studies conducted by scholars [13] have indicated that diabetes is a risk factor for post-laparoscopic gastric cancer surgery small bowel obstruction, which is consistent with the findings of our study. The function of T lymphocytes and natural killer cells in patients with malnutrition is inhibited, and the body will release a large number of inflammatory mediators after surgery, which aggravates intestinal edema and other symptoms, thereby increasing the incidence [14] of intestinal obstruction. The over-expression of CRP means that the inflammatory response of the body will be aggravated, and patients are more likely to develop intestinal obstruction. Scholarly investigations [14] have revealed that a positive CRP test is a risk factor for post-colorectal cancer surgery intestinal obstruction with an OR of 2.354 and a 95% CI ranging from 1.541 to 3.211, aligning closely with the findings of our study.The decrease of VFA and SFA has been confirmed to be related to the occurrence of intestinal obstruction after gastric cancer surgery in this study. It can be speculated that when VFA and SFA are decreased, they will promote the occurrence of intestinal obstruction.

To sum up: Abdominal CT fat quantitative parameters VFA and SFA are relatively low in patients with intestinal obstruction after gastric cancer surgery. Combined detection of VFA and SFA has high sensitivity in predicting the risk of intestinal obstruction, which makes up for the deficiency of single detection. BMI, diabetes, malnutrition and CRP are all risk factors for inducing intestinal obstruction. BMI, diabetes, malnutrition and CRP are all risk factors for inducing intestinal obstruction. In clinical practice, symptomatic treatment should be given as early as possible according to the above risk factors and individual differences to minimize the incidence of intestinal obstruction.

CONCLUSION

Our study contributes significantly to the understanding of postoperative risks in gastric cancer surgery. By highlighting the predictive value of abdominal fat parameters, it paves the way for more refined risk assessment models and underscores the need for a holistic approach to patient evaluation in the context of gastric cancer surgery.

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Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

Ethical Considerations: The study was reviewed and approved by the Ethics Committee of Changxing County People's Hospital. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Author Contributions: J.Y. and Y.Z. contributed equally to the conception and design of the study; acquisition of data; and analysis and interpretation of data. F.W. was involved in drafting the manuscript and revising it critically for important intellectual content. All authors read and approved the final manuscript.

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