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Relationship Between Body Mass Index and Recurrence/Anal Fistula Formation Following Initial Operation for Anorectal Abscess

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Background: The association between body mass index (BMI) and recurrence of anorectal abscess remains controversial. This study investigated the exact relationship between BMI and anorectal abscess recurrence or anal fistula formation following initial surgery.





Material/Methods: This was a retrospective registry-based study conducted at the First Affiliated Hospital of Guizhou University of Chinese Medicine. Patients treated for anorectal abscess from 01/2015 to 03/2016 were included. Clinical data and time to recurrence were recorded. The Cox regression model was used to estimate the association between BMI and recurrence.

Results: A total of 790 patients were operated on during the study period. The average age of the participants was 38.3 ± 11.6 years, and 83.2% were male. Median follow-up was 27 (range, 1–38) months. Compared with the low BMI (range, 15.7–22.8 kg/m²) patients, the high BMI (range, 26.0–40.6 kg/m²) patients showed higher risk of recurrence (HR=1.75, 95% CI: 1.15–2.67). In the non-adjusted model, high BMI was found to be positively correlated with recurrence (HR=1.62, 95% CI: 1.10–2.40, P=0.02), and a stronger association was found in the fully adjusted model (HR=1.75, 95% CI: 1.15–2.67, P=0.01). BMI was also used as a continuous variable for sensitivity analysis, and a similar trend was observed (P=0.01 for trend).

Conclusions: Elevated BMI is an independent risk factor of anorectal abscess recurrence and for increased risk of abscess recurrence or anal fistula formation.

MeSH Keywords: **Body Mass Index • Recurrence • Risk Factors**

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Background

Anorectal abscesses are collections of pus within the dermis and deeper skin tissues, most often due to cryptoglandular infection or associated inflammatory bowel disease. Perianal abscesses are the most common type of anorectal abscess [1,2]. Patients with anorectal abscess may have discomfort and even severe pain. The incidence of anorectal abscess varies among countries and areas. It affects an estimated 18 000 patients in the UK every year [3] and the annual incidence is 16.1 per 100 000 in Sweden [4].

A meta-analysis found that fistula surgery with abscess drainage can largely reduce the recurrence of abscess/fistula or reoperation [5], but the patients need to be carefully selected for this procedure [2]. Approximately 29% to 70% of patients with anorectal abscess will develop concomitant fistula, and 33% of these patients are diagnosed with anal fistula months or years after drainage [1,6–12].

Previous studies investigating the association between body mass index (BMI) and anorectal abscess recurrence yielded elusive or even ambiguous results. The findings from recent studies suggest that >25 kg/m² BMI is a risk factor of anorectal abscess recurrence [4,13–15]. Schwandner et al. [15] showed that the recurrence rate was lower in non-obese patients compared with obese ones (14% vs. 28%). Adamo et al. [4] showed that the recurrence rates were similar between obese and non-obese patients during the first 3 years after surgery, but that the risk increased in obese patients after 3 years, but a cohort study reported no correlation [16]. Furthermore, the impact of other risk factors of recurrence such as sex, hypertension, and diabetes on the observed associations is still unclear [4,14,16].

Therefore, the aim of the present study was to investigate the exact relationship between BMI and anorectal abscess recurrence or anal fistula formation following initial surgery. These results could help improve management of patients with anorectal abscess.

Material and Methods

Patients

This was a retrospective registry-based study conducted at the First Affiliated Hospital of Guizhou University of Chinese Medicine from January 2015 to March 2016. The study was approved by the Ethics Committee of the First Affiliated Hospital of Guizhou University of Chinese Medicine. The need for individual consent was waived by the committee because of the retrospective nature of the study.

The inclusion criteria were: 1) diagnosed with perianal abscess; 2) operated on at the First Affiliated Hospital of Guizhou University of Chinese Medicine; and 3) 15–70 years of age. The exclusion criteria were: 1) history of perianal abscess and anal fistula; 2) perianal abscess with anal fistula; 3) combined with diseases like inflammatory bowel disease, tuberculosis, HIV, recto-vaginal fistula, necrotizing myofasciitis, sacral osteomyelitis, tumor, blood system diseases, and cases of perianal abscess due to trauma, and internal hemorrhoid operation, as they are probably more susceptible to recurrence [16,17]; or 4) pregnant.

Data collection

The clinical data (age, BMI, sex, occupation, race, marital status, smoking habits, drinking habits, fatigue, diarrhea, diabetes, hypertension, and other variables) were retrieved from the medical records. All blood tests were performed routinely. The participants' height and weight were measured routinely before surgery. BMI was calculated as weight (kilogram) divided by height (meter) squared (kg/m²). The patients were grouped into BMI tertiles: 20.8 (15.7–22.8) kg/m² was regarded as low BMI (n=183), 24.2 (22.9–25.8) kg/m² was regarded as intermediate BMI (n=197), and 28.0 (26.0–40.6) kg/m² was regarded as high BMI (n=202). The covariates were selected a priori based on previous studies on the association between risk factors and anorectal abscess recurrence. According to these studies, risk factors for anorectal abscess recurrence were age, sex, diabetes, smoking habits, BMI, time from disease onset to surgery, and abscess type [4,11,13,15–19].

Operative technique

During the study period, all patients were operated on using the same technique. Patients on continuous epidural anesthesia were placed in the lithotomy position after a preoperative cleansing enema. The anal canal was carefully examined by trained and experienced surgeons to identify the type, extent, and components of the abscess, and to examine for the presence of internal openings. Incision and drainage with fistulotomy (I&D with F) were performed for anorectal abscesses with easily detected internal openings. If the opening was not easy to detect, incision and drainage (I&D) was performed alone. Loculations were freed by blunt digital dissection. Care was taken to preserve the internal anal sphincter. Stool softener was prescribed to all patients for 1 week, with no diet restriction. After the operation, patients were instructed to take a sitz bath twice daily until the wound was healed.

Follow-up

The follow-up data collection was based on the patient's medical records, which include outpatient, inpatient, and telephone

follow-ups. The investigators responsible for data extraction were trained together to ensure uniformity. Follow-up ended on March 1, 2018.

Recurrence

The retrospective study of recurrence was based on the patients' medical records and follow-up interviews. Abscess recurrence and an anal fistula formation were deemed as recurrence. The presence of any 1 of symptoms such as dull perianal pain, swelling, secretion, itchiness, fever, or tenderness was regarded as a sign of recurrence [11,16].

Statistical analysis

Continuous data are presented as mean \pm standard deviation (normal distribution) or medians (range) (non-normal distribution), and categorical data are presented as n (%). The *t* test (normal distribution), Mann-Whitney U test (non-normal distribution), and chi-square test (categorical variables) were performed to detect significant differences between groups. We presented the unadjusted results, the results of minimally adjusted analyses, and the results of the fully adjusted analyses. The covariance adjustment was determined by the following principle: when added to this model, the corresponding odds ratio had to change by a minimum of 10% [20]. To assess the reliability of the results, we performed a sensitivity analysis. When BMI and recurrence showed an evident ratio in the smoothed curve, the likelihood ratio test and bootstrap resampling method were used [21]. Outcome comparisons among different BMI groups were conducted using the Kaplan-Meier method and log-rank test. The Empower Dataweb System (<http://www.empowerstats.com/dataweb/>, X&Y Solutions, Inc., Boston, MA) was used for data input, with all the analyses completed with R software (<http://www.R-project.org>, The R Foundation) and EmpowerStats (<http://www.empowerstats.com>, X&Y Solutions, Inc., Boston, MA). A <0.05 P value (two-sided) was considered to indicate statistical significance.

Results

Baseline characteristics of participants

From January 2015 to March 2016, 790 patients with anorectal abscess were operated on, and of these, 582 patients were included based on the inclusion/exclusion criteria. The average age of the participants was 38.3 ± 11.6 years, and 83.2% were male. The median follow-up was 27 (range, 1–38) months. The cumulative recurrence rate was 27.5%. The recurrence rates in the low, intermediate, and high BMI tertiles were 21.9%, 26.9%, and 33.2%, respectively ($P=0.045$). Recurrences within 3, 6, and 12 months after surgery accounted for 33.1%,

55.0%, and 70.6% of the total recurrence rate, respectively. The characteristics of the patients are listed in Table 1. Only 9 patients had a BMI <18 kg/m² and the sample size was too small for reliable analyses in this group.

Univariable analyses

The univariable analyses (Table 2) showed that BMI and I&D with F were associated with recurrence. The Kaplan-Meier curves showed that patients in the upper BMI tertile (26.0–40.6) kg/m² had a higher cumulative incidence of recurrence (Figure 1).

Multivariable analysis

The relationship between BMI and recurrence was evaluated using the Cox proportional hazards regression model. As presented in Table 3, 3 models were constructed: (1) non-adjusted; (2) minimally adjusted for demographic factors (sex, age, ethnicity, occupation, and marital status); and (3) fully adjusted for all factors (sex, age, ethnicity, occupation, marital status, diabetes, hypertension, smoking habits, drinking habits, fatigue, diarrhea, time from disease onset to surgery, surgical approach, abscess type, red blood cell count, platelet count, fibrinogen, and leukocyte count). In the non-adjusted model, the high BMI group was found to be positively correlated with recurrence (HR=1.62, 95% CI: 1.10–2.40, $P=0.02$). In the minimally adjusted model, the results showed slight distinct changes (HR=1.69, 95% CI: 1.13–2.52, $P=0.01$). A more obvious association was found in the fully adjusted model (HR=1.75, 95% CI: 1.15–2.67, $P=0.01$). BMI was also used as a continuous variable for sensitivity analysis, and a similar increased trend was observed ($P=0.01$ for trend).

Stratified analysis for the type of surgery

I&D with F was associated with a lower recurrence of anorectal abscess (Table 2), but there was no difference in the stratified analysis between the 2 procedures (P for interaction was 0.49), indicating that the relationship between BMI and recurrence was stable (Table 4).

Discussion

The association between BMI and the recurrence of anorectal abscess remains controversial [4,14–16]. This study aimed to evaluate the relationship between BMI and the recurrence of anorectal abscess or anal fistula formation. There was a strong and significant association between elevated BMI and the recurrence rate. The high BMI group (range, 26.0–40.6 kg/m²) was found to be positively correlated with recurrence (HR=1.75, 95% CI: 1.15–2.67). To test the reliability of the results, BMI

Table 1. Characteristics of the subjects by BMI tertiles.

Characteristics	BMI tertiles (kg/m ²)			P
	Low (15.7–22.8)	Intermediate (22.9–25.8)	High (26.0–40.6)	
N	183	197	202	
Age (years)	36.7±12.7	39.5±11.3	38.7±10.6	0.047
Time from disease onset to surgery (days)	11.9±33.5	7.8±10.5	7.8±14.5	0.099
Leukocyte count (×10 ⁹ /L)	10.54±3.99	10.76±3.99	11.09±3.40	0.361
Red blood cell count (×10 ⁹ /L)	4.91±0.58	5.14±0.56	5.24±0.52	<0.001
Platelet count (×10 ⁹ /L)	218.60±63.49	216.03±60.14	232.20±67.81	0.026
Fibrinogen (g/L)	4.30±1.40	4.52±1.39	4.55±1.38	0.158
Sex, n (%)				<0.001
Male	130 (71.0%)	172 (87.31%)	182 (90.1%)	
Female	53 (29.0%)	25 (12.7%)	20 (9.9%)	
Age (years), n (%)				0.196
<40	107 (58.5%)	97 (49.2%)	109 (54.0%)	
≥40	76 (41.5%)	100 (50.8%)	93 (46.0%)	
Ethnicity, n (%)				0.867
Ethnic Han	167 (91.3%)	179 (91.3%)	187 (92.6%)	
Minority	16 (8.7%)	17 (8.7%)	15 (7.4%)	
Married, n (%)	129 (70.5%)	156 (79.2%)	166 (82.2%)	0.018
Occupation, n (%)				0.817
Technical occupation	141 (77.5%)	149 (75.6%)	163 (80.7%)	
Manual occupation	15 (8.2%)	21 (10.7%)	13 (6.4%)	
Unemployment	20 (11.0%)	20 (10.2%)	21 (10.4%)	
Retired	6 (3.3%)	7 (3.6%)	5 (2.5%)	
Smoking habits, n (%)	72 (39.3%)	111 (56.4%)	100 (49.5%)	0.004
Drinking habits, n (%)	81 (44.3%)	116 (58.9%)	111 (55.0%)	0.013
Seafood-based diet, n (%)	5 (2.7%)	11 (5.6%)	13 (6.4%)	0.222
Spice food diet, n (%)	98 (53.6%)	97 (49.2%)	98 (48.5%)	0.571
Diabetes, n (%)	13 (7.1%)	18 (9.1%)	14 (6.9%)	0.661
Excessive fatigue, n (%)	80 (43.7%)	79 (40.1%)	88 (43.6%)	0.716
Hypertension, n (%)	10 (5.5%)	17 (8.6%)	23 (11.4%)	0.117
Diarrhea, n (%)	4 (2.2%)	6 (3.1%)	14 (6.9%)	0.042
Time from disease onset to surgery, n (%)				0.767
<7 days	101 (55.2%)	116 (58.9%)	115 (56.9%)	
≥7 days	82 (44.8%)	81 (41.1%)	87 (43.1%)	

Table 1 continued. Characteristics of the subjects by BMI tertiles.

Characteristics	BMI tertiles (kg/m ²)			P
	Low (15.7–22.8)	Intermediate (22.9–25.8)	High (26.0–40.6)	
Abscess type				0.827
Perianal	142 (77.6%)	159 (80.7%)	151 (74.8%)	
Ischiorectal	19 (10.4%)	19 (9.6%)	24 (11.9%)	
Intersphincteric	12 (6.6%)	8 (4.1%)	11 (5.5%)	
Supralevator	6 (3.3%)	9 (4.6%)	11 (5.5%)	
Submucosal	4 (2.2%)	2 (1.0%)	5 (2.5%)	
Surgical approach				0.859
I&D	118 (64.5%)	123 (62.4%)	125 (61.9%)	
I&D with F	65 (35.5%)	74 (37.6%)	77 (38.1%)	

BMI – body mass index; I&D – incision and drainage; I&D with F – incision and drainage with fistula treatment. Data are presented as mean ±SD for continuous variables and percentage for categorical variables.

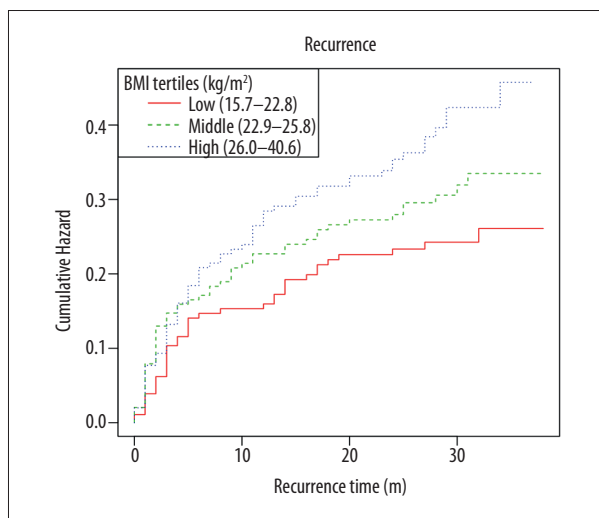


Figure 1. Kaplan-Meier curves of the cumulative event rate of recurrence stratified by the following baseline body mass index (BMI) tertiles: low BMI (15.70–22.80) kg/m² (n=183), intermediate BMI (22.90–25.80) kg/m² (n=197), and high BMI (26.00–40.60) kg/m² (n=202).

was also used as a continuous variable for sensitivity analysis, and a trend of increase was observed.

In this study, only 9 patients had BMI <18 kg/m². Therefore, to ensure a sufficient number of patients in each group, BMI data were grouped by tertiles instead of using the traditional cut-off BMI values, and the association with anorectal abscess recurrence was observed. Our findings are consistent with a large-scale case-control study of 1342 patients [13], in which multivariable logistic regression models were used to evaluate the

OR of BMI on recurrence, and showed that a BMI >25 kg/m² was independently associated with the risk of anal fistula. A study of 220 patients also showed similar results: Schwandner et al. [15] showed that the recurrence rate was lower non-obese patients compared with obese (BMI ≥30 kg/m²) ones (14% vs. 28%). Nevertheless, there was insufficient adjustment for potential confounders since some factors that were closely related to recurrence (such as sex, time from disease onset to surgery, abscess type, and leukocyte count) were not adjusted for [11,16,17,19]. Hence, the conclusions of these previous studies are limited [13,15]. Another study reported that obesity was positively associated with risk of perianal abscess [4]. Due to different study populations and study designs, the risk magnitude varied extensively among these studies [4,13,15]. Indeed, Adamo et al. [4] showed that the recurrence rates were similar between obese and non-obese patients during the first 3 years after surgery, but that the risk increased in obese patients after 3 years. Nevertheless, a cohort study reported no association at all between BMI and recurrence [16].

At our center, 2 different surgical procedures are routinely used for the management of anorectal abscesses. If the internal opening of the anorectal abscess is easy to detect, I&D with F is routinely performed, but if it is not easy to detect, I&D is performed alone. The recurrence of an abscess and the formation of an anal fistula were both deemed as recurrence. A meta-analysis found that I&D with F could largely reduce the recurrence of abscess/fistula or reoperation [5]. In the present study, according to the univariable and multivariable analyses, I&D with F reduced the recurrence of anorectal abscess, but there was no difference in the stratified analysis between these 2 procedures.

Table 2. Univariable analyses for the risk of recurrence.

	HR (95% CI)	P-value
Sex		
Male	1.0	
Female	0.75 (0.48, 1.17)	0.21
Age (years)		
Age (years)	1.00 (0.99, 1.02)	0.64
Age (years)		
<40	1.0	
≥40	1.18 (0.86, 1.61)	0.30
BMI (kg/m²)		
BMI (kg/m ²)	1.04 (1.00, 1.08)	0.03
BMI tertiles (kg/m²)		
Low (15.7–22.8)	1.0	
Intermediate (22.9–25.8)	1.29 (0.85, 1.94)	0.23
High (26.0–40.6)	1.62 (1.10, 2.40)	0.02
Ethnicity		
Ethnic Han	1.0	
Minority	1.18 (0.70, 2.02)	0.53
Marital status		
No	1.0	
Yes	1.01 (0.70, 1.46)	0.97
Occupation		
Technical	1.0	
Manual	1.26 (0.75, 2.11)	0.39
Unemployment	0.96 (0.57, 1.62)	0.88
Retired	0.74 (0.27, 2.01)	0.56
Smoking habits		
No	1.0	
Yes	1.08 (0.79, 1.47)	0.63
Drinking habits		
No	1.0	
Yes	1.20 (0.87, 1.64)	0.26
Diet with seafood		
No	1.0	
Yes	1.35 (0.71, 2.56)	0.36
Excessive fatigue		
No	1.0	
Yes	1.11 (0.82, 1.52)	0.50

Table 2 continued. Univariable analyses for the risk of recurrence.

	HR (95% CI)	P-value
Diet with spicy food		
No	1.0	
Yes	0.98 (0.72, 1.33)	0.89
Diarrhea		
No	1.0	
Yes	0.88 (0.39, 2.00)	0.77
Diabetes		
No	1.0	
Yes	1.10 (0.64, 1.91)	0.72
Hypertension		
No	1.0	
Yes	1.29 (0.78, 2.14)	0.32
Time from disease onset to surgery(days)		
	1.00 (0.99, 1.01)	0.67
Time from disease onset to surgery(days)		
<7	1.0	
≥7	1.03 (0.75, 1.40)	0.86
Abscess type		
Perianal	1.0	
Ischiorectal	1.18 (0.74, 1.90)	0.49
Intersphincteric	0.42 (0.15, 1.14)	0.09
Suprlevator	1.00 (0.47, 2.14)	0.99
Submucosal	1.28 (0.47, 3.46)	0.63
Surgical approach		
I&D	1.0	
I&D with F	0.21 (0.13, 0.33)	<0.0001
Leukocyte count (×10 ⁹ /L)		
	1.02 (0.98, 1.06)	0.32
Red blood cell count (×10 ⁹ /L)		
	0.94 (0.71, 1.23)	0.64
Platelet count (×10 ⁹ /L)		
	1.00 (1.00, 1.00)	0.19
Fibrinogen (g/L)		
	1.06 (0.95, 1.18)	0.30

HR – hazard ratio; CI – confidence interval; BMI – body mass index; I&D – incision and drainage; I&D with F – incision and drainage with fistula treatment.

The present study has some strengths. First, a generalized linear model was applied to assess the linear relationship between BMI and recurrence. Second, since this was an observation-based study and unavoidable confounding might have been involved, the analyses were adjusted for confounding

factors to minimize the residual confounding, which was not performed in the previous studies. This helped identify high-risk patients and improve postoperative follow-up management.

Table 3. Relationship between BMI and risk of recurrence of an abscess or the formation of an anal fistula in different models.

Exposure	Non-adjusted HR (95% CI) P	Minimally adjusted HR (95% CI) P	Fully adjusted HR (95% CI) P
BMI (kg/m ²)	1.04 (1.00, 1.08) 0.03	1.04 (1.01, 1.09) 0.03	1.05 (1.01, 1.10) 0.02
BMI tertiles (kg/m ²)			
Low (15.7–22.8)	1.0	1.0	1.0
Intermediate (22.9–25.8)	1.29 (0.85, 1.94) 0.23	1.25 (0.82, 1.89) 0.30	1.30 (0.85, 1.99) 0.23
High (26.0–40.6)	1.62 (1.10, 2.40) 0.02	1.60 (1.07, 2.39) 0.02	1.75 (1.15, 2.67) 0.01
P for trend	0.01	0.02	0.01

Non-adjusted model: model without adjustment. Minimally adjusted model: model with adjustment for demographics. Fully adjusted model: model with adjustment for sex, age, ethnicity, occupation, marital status, diabetes, hypertension, smoking habits, drinking habits, diarrhea, time from disease onset to surgery, surgical approach, abscess type, red blood cell count, platelet count, fibrinogen, and leukocyte count. HR – hazard ratio; CI – confidence interval; BMI – body mass index.

Table 4. Subgroup analysis of the associations between BMI and risk of recurrence of an abscess or the formation of an anal fistula.

Characteristics	HR (95% CI)	P for interaction
Surgical approach		0.49
I&D	1.05 (1.01, 1.10)	
I&D with F	1.00 (0.89, 1.14)	

Stratification adjusted for all the variables (sex, age, ethnicity, occupation, marital status, diabetes, hypertension, smoking habits, drinking habits, excessive fatigue, diarrhea, time from disease onset to surgery, surgical approach, abscess type, red blood cell count, platelet count, fibrinogen, and leukocyte count) except the stratification variables themselves. HRs (95% CI) were derived from Cox proportional hazards regression models. HR – hazard ratio; CI – confidence interval; I&D – incision and drainage; I&D with F – incision and drainage with fistula treatment.

Nevertheless, this study has several limitations. The assessment of recurrence was underpowered because of the relatively small number of events observed and the relatively short follow-up (37 months at the most); therefore, cautious evaluation is needed before applying our findings to other populations of different demographic and clinical backgrounds. Despite the control of important epidemiological and clinical covariates in

the analyses, possible residual bias could not be ruled out. In addition, our study excluded some of the previously reported risk factors (e.g., anorectal abscess/fistula history and IBD) for recurrence, which may have biased our results. Those factors were excluded because of the large proportion of patients with missing data. Further well-designed and standardized observational studies are needed to determine the real association between BMI and recurrence of anorectal abscess.

Conclusions

An association was found between high BMI and a significantly higher risk of recurrence of anorectal abscess. Our findings may help identify high-risk patients and improve postoperative follow-up management.

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Conflict of interest

None.

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