ORIGINAL RESEARCH PAPER

Surgery

KEY WORDS: rectal cancer, low anterior resection, body mass index.

THE EFFECTS OF OBESITY ON THE SURGICAL COMPLICATIONS AND PATHOLOGICAL RESULTS IN RECTAL CANCER SURGERY

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ABSTRACT

Aim: The aim of this study was to ascertain the effects of body mass index (BMI) on postoperative complications and the total the number of excised and metastatic lymph nodes in patients with low anterior resection (LAR) because of rectal cancer.
Material – Method: A total of consecutive 110 patients, who had undergone low anterior resection in our clinic between 2010 and 2017, were covered by the study. The patients were classified into three groups as per their BMI: Those with a BMI of 24.9 (kg/m2) and below were designated as normal (Group I), those with a BMI of 25-30 (kg/m2) were designated as overweight (Group II), while those patients with a BMI over 30 (kg/m2) were designated as obese (Group III). Comparisons were carried out among the groups with regards to demographic features, surgical duration and the need for blood transfusion, postoperative complications, and histopathological results.
Results: When the groups were scrutinized it was seen that Group III had a higher rate of comorbidity. The clinical characteristics other than comorbidity and the rates of intraoperative and postoperative complications proved to be similar. The results of the pathological analyses conducted among the groups revealed that BMI had no effects on the number of excised lymph nodes, the number of metastatic lymph nodes, and the ratio of metastatic lymph nodes to excised lymph nodes.
Conclusion: We are of the opinion that BMI neither affects the total number of excised and metastatic lymph nodes nor increases the rate of surgical complications in rectal cancer surgery.

Introduction

Colorectal cancers are the most common fourth cancer type and occupy the second place in cancer-related deaths in the US according to 2014 data (1). Obesity proves to be an increasingly significant health issue in developed countries and is a known risk factor for gastrointestinal carcinogenesis. It is seen more frequently in men than women. Moreover, its incidence increases after the 4th decade (2). Today, the treatment of rectum cancer varies from local treatments to abdominoperineal resection (APR) and even to pelvic exenteration. Possible postoperative complications may result in prolonged hospitalization and mortality.

Obesity continues to increase in the western world and maintains its status as an increasingly growing problem for surgeons. BMI's effects on surgical techniques, surgical complications, duration of hospitalization, and mortality in patients with rectum cancer prove to be a controversial issue. In contrast to studies that have shown that obesity increases the rate of postoperative complications, there are studies in literature that have demonstrated that BMI was not related to such complications as well (3-5).

The relationship between intraoperative and postoperative clinical results of patients with rectum cancer who had undergone low anterior resection was investigated within the scope of this study.

Material - Method

Patients

The patients who had undergone elective curative surgery because of rectum cancer between January 2010 and December 2017 in Kartal Koşuyolu Higher Specialty Training and Research Hospital's Gastroenterology Clinic were included in the study.

Exclusion criteria from the study included patients with palliative resection, distant organ metastases, subtotal colectomy, total proctocolectomy, abdominoperineal resection, Hartmann's procedure or pull-through procedure, and those with insufficient file information. A total of 110 patients who met the inclusion criteria among these patients were included in the study.

The mesorectum was resected 5 cm below the distal border of the tumor in cases with tumors of the upper rectum, while total mesorectal excision (TME) was performed for tumors of the lower and middle rectum. All the anastomoses had extraperitoneal localizations and a drain was placed in each patient that would drain the pelvic and anastomotic areas.

BMI Assessment and Classification

According to the classification set forth by the World Health Organization (WHO): people with BMI <18.5 are underweight, with BMI between 18.5 and 24.9 are normal, with BMI between 25 and 29.9 are overweight, with BMI between 30 and 39.9 are obese, and with BMI >40.5 are morbidly obese (6). All the patients' weights (kg) and heights (cm) were measured and their BMI was calculated during the preoperative preparation stage. Our patients, on the other hand, were classified into three groups as per their BMI: Those with a BMI of 24.9 (kg/m2) and below were designated as normal (Group I), those with a BMI of 25-30 (kg/m2) were designated as overweight (Group II), while those patients with a BMI over 30 (kg/m2) were designated as obese (Group III).

Data

Patients' data on age, sex, BMI, left ventricular ejection fraction (EF), diabetes mellitus (DM), hypertension (HT), chronic obstructive pulmonary disease (COPD), chronic kidney failure, preoperative laboratory results, and history of smoking were collected retrospectively in the preoperative stage.

The duration of surgery (minutes), blood transfusions used in the surgery, and the duration of hospitalization (days) were also recorded.

Mortality cases seen during the first 30 days of follow-up in the postoperative stage were defined as surgical mortality, while the surgical complications observed within the same time period were set as morbidity. The postoperative complications were graded according to the Clavien-Dindo Classification (7).

The depth of invasion, the number of excised lymph nodes, and the number of detected metastatic lymph nodes were recorded from the data offered in the pathology reports. The pathological staging of the tumors were carried out according to the 7th Edition of the American Joint Committee on Cancer's (AJCC) TNM staging system.

I. The primary endpoint of the study;
   Was to investigate whether body mass index gave way to intraoperational technical challenges and postoperative complications.
II. The secondary endpoint of the study;
   Was to establish to what degree did body mass index affected the pathological results.

Statistical Analysis

The SPSS (Statistical Package for Social Sciences, Inc., Chicago, IL, USA) for Windows 21.0 was used to conduct statistical analyses of the collected data. The mean, minimum, maximum, and standard deviation figures were calculated for the data collected from the patients covered by the study. Categorical groups were compared by the chi-square test, while the Kolmogorov-Smirnov test was used to test the distribution of the data. Normally distributed data were analyzed by the ANOVA test. The relationship among the groups with statistical significance was set forth by the post-hoc Tukey test. Nonparametric data, on the other hand, were assessed by the Kruskal-Wallis analysis. The results were set between 95% confidence interval, while statistical significance was determined to be at the $p<0.05$ level.

Results

Demographic Characteristics

The cases of a total of 110 patients with LAR because of rectum cancer between January 2010 and December 2017 were analyzed. There were 19 patients in Group I with normal BMI (<24.9 kg/m2), 60 overweight patients in Group II (BMI= 25-30 kg/m2), and 31 obese patients in Group III (BMI >30 kg/m2). The results of the study revealed that the rates of HT, COPD, and DM in Group III were significantly higher than those of Group I and Group II. **Table 1** summarizes the clinical features of the patients.

Intraoperative Characteristics and Postoperative Complications

When the duration of surgery and blood transfusion during the surgery were assessed, it was seen that there was no difference among the groups. **Table 2** summarizes intraoperative characteristics. Mortality was seen only in 3 patients in Group II within the postoperative 30 days. No statistically significant difference, however, was found among the groups (p: 0.277). Surgical and non-surgical postoperative complications are presented in **Table 3**, while the comparisons of the complications according to the Clavian-Dindo Classification are summarized in **Table 4**.

Pathological Evaluation

When **Table 5**, which presents the correlation analyses between BMI and the pathological features of the tumors, was scrutinized it would clearly be seen that there was no correlation between BMI and tumor size, and the total number of excised and metastatic lymph nodes.

Discussion

Some studies in literature have shown that obesity gave way to technical challenges in pelvic procedures and was a predisposing factor for colorectal postoperative complications. Some other studies, however, have also shown that obesity did not affect postoperative complications, oncological sufficiency of the resection, and long-term follow-up results of the patients. Surgical challenge was evaluated to be duration of operation, the need for blood transfusion, and the number of excised lymph nodes within the scope of our study. There was, however, no difference among the groups. Intraabdominal and systemic complications were determined to be postoperative complications but no difference among the groups was found.

It is known that comorbidity generally increases the rates of intraoperative and postoperative complications. Coronary artery disease, diabetes mellitus, obstructive sleep apnea, hyperlipidemia, hypertension, degenerative osteoarthritis, diseases of the gall bladder, and steatohepatitis are listed among the diseases that are often associated with obesity. These comorbidities bring about a dramatic decrease in the quality of life and life expectancy in patients with a high BMI (9). When the demographic data were investigated within the framework of our study, it was observed that DM and HT were significantly higher in the obese group.

Benoist et al. (3) found in their study that the duration of surgery was longer in the obese patient group, while Ballian et al. (10) stated that the amount of intraoperative hemorrhaging in addition to the duration of surgery was higher in the obese patient group.
Bokey et al. (11) investigated the cases of 255 patients who had undergone surgery because of rectum cancer in their study. The authors found that the rates of only 3 (wound site infection, small bowel obstruction, and elongated ileus) of the 21 complications that they listed were higher in the obese patient group. There are other studies which have found that the rates of some complications were higher in the obese patient group in concordance with this study (12, 13). In contrast to such studies, there are others that did not find any differences between the groups as well (10). The results of our study revealed no difference among the groups as per postoperative complications.
There is no consensus in literature on the minimum number of lymph nodes that is necessary to accurately identify early stage

rectum cancer. Moreover, the number of excised lymph nodes in patients who had undergone surgery following neoadjuvant therapy is significantly lower. AJCC and the American College of Pathologists (CAP) have recommended that at least 12 lymph nodes needed to be evaluated in order to accurately identify early stage colorectal cancers (8, 14).

There are a number of studies in literature which have investigated the effects of obesity on the total number of excised lymph nodes and metastatic lymph nodes (10, 11, 15). But the results of these studies vary. When the patients covered by our study were evaluated, it was seen that 12 and more lymph nodes were excised in 76 (69%) out of 110 patients. 24 patients out of the remaining 34 patients were reported to have undergone neoadjuvant therapy. Moreover, when the mean number of excised lymph nodes was scrutinized it was found that this value was over 12 in all the three groups. The results of our study revealed that BMI had no effects on the total number of excised lymph nodes, the number of metastatic lymph nodes, and on the ratio of metastatic lymph nodes to excised lymph nodes.

There are a couple of significant limitations in our study. The first one pertains to the fact that our study was a retrospective observational study which brought about limitations in the study design. The second one refers to the fact that the study population was heterogeneous since not all the patients received neoadjuvant CRT because of the location of their tumors and because of the existence of laparoscopic LAR cases.

The correlation between obesity and the challenges it brings about in rectal cancer surgery is only at an inferential level and the significance of these proves to be a controversial issue. Studies conducted on the subject have yielded different results. The effects of BMI on the intraoperative and postoperative clinical results of patients with LAR because of rectum cancer at a single center were investigated within the scope of this study. The results of our study revealed that BMI did not complicate the surgical technique, did not increase the rate of postoperative complications, and did not affect the pathological results. Nevertheless, randomized controlled studies focusing on this question should be conducted.

Table 1. Demographic characteristics of patients according to BMI group

		Group 1 (n:19)	Group 2 (n:60)	Group 3 (n:60)	P- value
Age (mean ± standart deviation)		59 ±12	64±9	62±12	0,204
Sex	Male	12 (63,2%)	29(48,3%)	21(67,7%)	0,169
	Famale	7 (36,8%)	31(51,7%)	10 (32,3%)	
Laboratory	Hematocrit	37±3	39±5	38±4	0,156
	Albumin	4±0,4	4,1±0,5	3,9±0,5	0,479
	CEA	10±17,1	8±17,9	5±7,5	0,497
	CA 19-9	7,7±6,4	11,7±14,2	48,4±146,5	0,104
Ek hastalık	DM	0	13(21,7%)	9(29%)	**0,04***
	COPD	0	9 (15%)	18 (58,1%)	**0,01***
	CRF	2 (10,5%)	2 (3,3%)	1 (3,2%)	0,388
	CAD	0	13 (21,7%)	6 (19,4%)	0,088
	HT	5 (26,3%)	29 (48,3%)	23 (74,2%)	**0,003***
Smoking history		7 (36,8%)	11 (18,3%)	7 (22,6%)	0,245
Neoadjuvant chemoradiotherapy		6 (31,6%)	26 (43,3%)	14 (45,2%)	0,601
ASA	1	1(5,3%)	2(3,3%)	1(3,2%)	0,186
	2	11(57,9%)	21(35%)	7(22,6%)	
	3	7(36,8%)	35(58,3%)	23(74,2%)	
	4	0	2 (3,3%)	0	
Left Ventricul Ejection Fraction		63±5	61±8	64±2	0,062

* Differences between the groups with Chi square test is statistically significant p<0,05
CEA: Carcinoembryonic antigen, CA 19-9: Carbohydrate antigen 19-9, DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, CRF: Chronic renal failure, CAD: Coronary artery disease, HT: Hypertension, ASA: American Society of Anesthesiologists

Table 2. Intraoperative Findings

	Group 1 (n:19)	Group 2 (n:60)	Group 3 (n:60)	P- value
Operations time (minute)	269±41	284±77	265±45	0,328
İntraoperative blood transfusion	2 (10,5%)	3 (5%)	3 (9,7%)	0,599
Laparoscopic Surgery	10 (52,6%)	16 (26,7%)	10 (32,3%)	0,110
Diversion stoma	8 (42,1%)	37 (61,7%)	18 (58,1%)	0,322
Intraoperative Bleeding Amount (ml)	179±96	218±133	183±107	0,291

Table 3. Postoperative Complications

		Group 1 (n:19)	Group 2 (n:60)	Group 3 (n:60)	P- value
Abdominal Comlications	Wound İnfection	2 (10,5%)	18 (30%)	9 (29%)	0,226
	Abdominal abcess	1 (5,3%)	6 (10%)	5(16,1%)	0,462
	Anastomotic fistula	2 (10,5%)	11 (18,3%)	6 (19,4%)	0,689
	Rectal hemorrhage	0	5 (8,3%)	0	0,113
	Postoperative ileus	1 (5,3%)	9 (15%)	5(16,1%)	0,499
	Evisceration or eventratıon	0	5 (8,3%)	2 (6,5%)	0,431
Systemic Complications	Atelectasis	2 (10,5%)	10 (16,7%)	9 (29%)	0,211
	Pneumonia	0	3 (5%)	1 (3,2%)	0,591
	Pleural effusion	1 (5,3%)	1 (1,7%)	0	0,398

	Renal Failure	1 (5,3%)	5 (8,3%)	3(9,7%)	0,857
	ARDS	0	1(1,7%)	0	0,657
	Catheter infection	1 (5,3%)	0	0	0,089
Length of stay in hospital		10±6	8±2	9±3	0,265
İn- Hospital death		0	3 (5%)	0	0,277

ARDS: Acute Respiratory Distress Syndrome

Table 4. Comparison of complications by Clavian Dindo Classification

		Group 1 (n:19)	Group 2 (n:60)	Group 3 (n:60)	P- value
Non complicated		17 (89,5%)	29 (48,3%)	13 (41%)	0,111
Clavian Dindo Classification	I	0	6 (10%)	5 (16,1%)	
	II	1 (5,3%)	13 (21,7%)	7 (2,6%)	
	III	0	5 (8,3%)	3 (9,7%)	
	IV	1 (5,3%)	4 (6,7%)	3 (9,7%)	
	V	0	3 (5%)	0	

Table 5. Pathological characteristics

			Group 1 (n:19)	Group 2 (n:60)	Group 3 (n:60)	P- value
Number of lymph nodes retrieved			18±7	15±7	18±9	0,144
Number of pathologic lymph node			2±3	2±3	3±4	0,276
LNR	(a) LNR: 0		11 (57,9%)	29 (48,3%)	9 (29%)	0,484
	(b) 0< LNR ≤ 0,07		0	3 (5%)	2 (6,5%)	
	(c) 0,07< LNR ≤ 0,2		3 (15,8%)	12 (20%)	8 (25,8%)	
	(d) LNR> 0,2		5 (26,3%)	16 (26,7%)	12 (30%)	
Depth of infiltration	T1		3 (15,8%)	8 (13,3%)	4 (12,9%)	0,405
	T2		1 (5,3%)	14 (23,3%)	5 (16,1%)	
	T3		12 (63,2%)	33 (55%)	14 (45,2%)	
	T4		3 (15,8%)	5 (8,3%)	8 (25,8%)	
Lmph node İnvolvement	N0		10 (52,6%)	27 (45%)	9 (29%)	0,782
	N1	A	2 (10,5%)	11 (18,3%)	8 (25,8%)	
		B	1 (5,3%)	5 (8,3%)	2 (6,5%)	
		C	1 (5,3%)	2 (3,3%)	2 (6,5%)	
	N2	A	3 (15,8%)	10 (16,7%)	4 (12,9%)	
		B	2 (10,5%)	5 (8,3%)	6 (19,4%)	

LNR: The ratio of metastatic lymph nodes to excised lymph nodes

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