



## The Impact of Body Mass Index on the Surgical Outcomes in Open Rectal Cancer Surgery

Ali Solmaz<sup>1\*</sup>, Osman Bilgin Gülçiçek<sup>1</sup>, Elif Binboğa<sup>1</sup>, Aytaç Biricik<sup>1</sup>, Candaş Erçetin<sup>1</sup>, Hakan Yiğitbaş<sup>1</sup>, Erkan Yavuz<sup>1</sup>, Atilla Çelik<sup>1</sup> and Fatih Çelebi<sup>1</sup>

<sup>1</sup>General Surgery Clinic, Bağcılar Training and Research Hospital, Istanbul, Turkey.

### Authors' contributions

This work was carried out in collaboration between all authors. Authors AS and OBG designed the study, authors AS, AB and HY performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author EB helped to collect the data of all patients. Authors CE, EY, AÇ and FÇ managed the analyses of the study. Author AS managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

Technical difficulties which affect the outcomes of abdominal operations are common in obese patients, especially in rectal and gastric cancer cases. In several studies, it has been shown that increased body mass index (BMI) is associated with increased morbidity, reduced lymph node retrieval and prolonged hospital stay after colorectal surgery. The aim of this study was to assess the influence of obesity on the surgical outcomes (surgical margin, number of lymph nodes excised) of rectal cancer patients who were operated by open surgery. One hundred rectal cancer patients who underwent open surgery in a single center between January 2011 and August 2014 were included in this study. Patients were divided into two groups according to their BMI values. According to their preoperative BMI values, patients with a BMI of  $\geq 30$  kg/m<sup>2</sup> (n=29) were defined as 'obese'. Patients with a BMI of  $< 30$  kg/m<sup>2</sup> (n=71) were placed in the normal (non-obese) group. Demographic data, surgical margins, the number of lymph nodes retrieved and surveillance of both groups were compared. Obese and normal groups were statistically indifferent in terms of age, sex and stage of the disease. Comparison of the obese and normal groups showed no statistically

\*Corresponding author: E-mail: [solmazali@hotmail.com](mailto:solmazali@hotmail.com);

significant difference in terms of surgical margins and the number of lymph nodes retrieved. This study showed that obesity does not affect the surgical outcomes in rectal cancer. However, prospective studies with larger patient series are needed.

*Keywords: Rectal cancer; obesity; surgery; surgical success; body mass index.*

## 1. INTRODUCTION

Obesity is a growing health problem in the world. The condition is related to many diseases like coronary artery disease, hypertension, liver steatosis, and stroke, and is also a known risk factor for endometrium, kidney, esophagus, stomach, pancreas, gallbladder, breast, colon, rectum, and thyroid cancer [1-3].

In several studies, it has been reported that increased body mass index (BMI) is associated with increased morbidity, reduced lymph node retrieval and prolonged hospital stay after colorectal surgery [4,5]. Technical difficulties may affect the outcomes of abdominal operations in obese patients, especially in rectum and gastric cancer cases, and might as well be associated with surgical difficulty of the disease [6,7]. The BMI has been used to define the extent of obesity. According to the definition by the World Health Organization (WHO), a person with a BMI over 30 is defined as 'obese' in western countries. However, this range may differ based on the geography [8].

Several recent studies showed that obesity affect the outcomes of the surgery in terms of the lymph nodes dissected in breast and gastric cancer [9,10]. The aim of this study was to assess the influence of obesity on the surgical outcomes (surgical margin, number of lymph nodes excised) in rectal cancer patients who underwent open surgery.

## 2. METHODS

### 2.1 Patients

All patients who underwent curative open surgery for rectal cancer at Bağcılar Training and Research Hospital between January 2011 and September 2014 were evaluated retrospectively. Patients who had been performed curative surgery for rectal cancer and whose preoperative BMIs had been recorded were included in the study. Exclusion criteria were a history of bariatric surgery and patients with colon cancer proximal to the rectosigmoid region. Follow-up of

all patients after surgery were done according to the European Society for Medical Oncology (ESMO) guidelines [11].

The patients were divided into two groups as follows; those with a normal BMI (<30 kg/m<sup>2</sup>) and those with a high BMI (≥30 kg/m<sup>2</sup>) according to the WHO's obesity definition.

### 2.2 Statistical Analysis

All statistical analyses were done using the NCSS (Number Cruncher Statistical System 2007) statistical software (Utah, USA). A two-tailed chi-square test or Fisher's exact test was used to compare the categorical variables (e.g. gender, surgical margin, etc.). Independent paired-samples t-test or Mann-Whitney U test was used to compare the continuous variables (e.g. age). All statistical tests were two-sided, and values of  $p < 0.05$  were considered significant.

## 3. RESULTS

Between January 2011 and September 2014, 158 patients were operated for colorectal cancer at the General Surgery Clinic of Bağcılar Training and Research Hospital. Of these, 118 had a rectal cancer. Due to lack of some data, 100 patients were included in the study. Sixty-five (65%) were male and thirty-five (35%) were female. Median age was 60 (range: 29-90) and median BMI 27 (range: 19-41) kg/m<sup>2</sup>. Seventy-one patients (71%) had a BMI <30 kg/m<sup>2</sup> and twenty-nine (29%) had a BMI ≥30 kg/m<sup>2</sup>. Abdominoperineal resection (Miles operation) was performed on 7 patients (7%) while low anterior resection was performed on the remaining 93 (93%). Proximal and distal surgical margins of all patients were negative. There was no statistically significant difference between the normal (non-obese) and obese groups in terms of age and gender ( $p=0.30$  and  $p=0.78$ , respectively) (Table 1).

Ten patients (14.08%) in the normal group and nine patients (31.03%) in the obese group had positive radial surgical margins; however, the different was not statistically significant

( $p=0.089$ ). No statistically significant difference was found between the mean number of lymph nodes excised in the normal ( $18.75\pm 9$ ) and the obese group ( $19.93\pm 9$ ) ( $p=0.56$ ). Additionally, there was no significant difference between the two groups in terms of mean number of metastatic lymph nodes (normal group:  $1.86\pm 3.74$  and obese group:  $3.31\pm 5.287$ ) ( $p=0.190$ ) (Table 1). Mean number of lymph nodes excised was  $19.81\pm 9.44$  in male patients and  $18.31\pm 7.91$  in female patients. The difference between the two groups was also statistically insignificant ( $p=0.367$ ). Mean number of metastatic lymph nodes were also similar;  $2.39\pm 5.14$  in males vs.  $2.27\pm 3.63$  in females ( $p=0.891$ ) (Table 2).

Local recurrence rate after a median follow-up period of 18 (range: 6-49) months was 7.04% in the normal group and 3.45% in the obese group, again with a statistically insignificant difference ( $p=0.492$ ).

Subgroup analyzing of the patients who received neoadjuvant radiotherapy showed no statistically significant difference between the normal and obese groups in terms of age, gender, the number of retrieved lymph nodes and number of metastatic lymph nodes ( $p=0.642$ ,  $0.926$ ,  $0.524$ , and  $0.212$ , respectively).

#### 4. DISCUSSION

Obesity is increasing gradually all over the world. About one-third of adults in the United States are obese [12]. Obesity affects the surgical outcomes

of abdominal cancer surgery, especially in gastric and rectal cancer cases [13]. Obesity presents with technical challenges especially in pelvic operations; may increase complications and as well affect the surgical and oncologic outcomes of colorectal surgery [14]. The impact of BMI on the surgical outcomes of rectal cancer surgery is less discussed in the literature. Research on the influence of BMI on the mean number of lymph nodes retrieved during rectal cancer surgery remains limited.

According to the article published by Ballian et al. [1] increased BMI is associated with higher blood loss and increased duration of operation; however, does not affect the oncologic and survival outcomes. Some previous studies showed obesity may affect technical difficulties in laparoscopic surgery and increase conversion rate however others not [15,16].

In our study, we found that obesity did not affect the oncological outcomes (surgical margin positivity and lymph node retrieval) in rectal cancer surgery.

It has been reported that obesity increases postoperative complications in the colorectal surgery but the oncologic outcomes were not discussed in these studies [17,18].

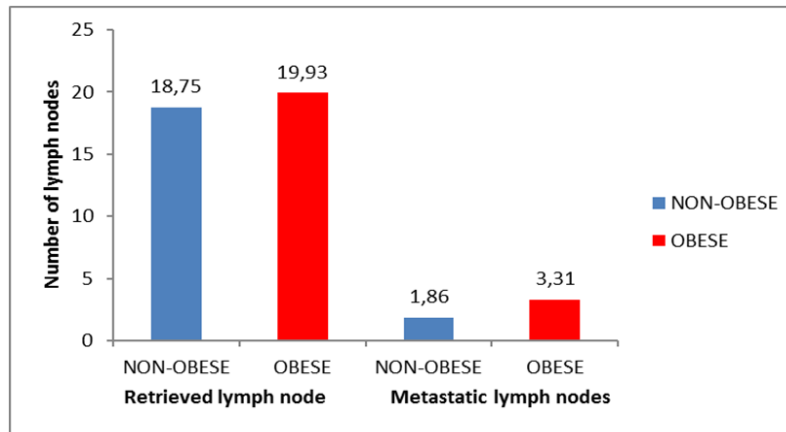
Makino et al. [19] compared the influence of obesity on both short and long-term outcomes after laparoscopic colon surgery, and similar to our findings, the authors found that BMI does not have an effect on the surgical and oncologic outcomes of both obese and non-obese groups.

**Table 1. Demographics and surgical characteristics of the patients (n=100)**

		<30 BMI (n=71)		>30 BMI (n=29)		p
Age		59.52±12.99		58.14±14.49		0.641
Gender	Male	46	64.79%	19	65.52%	0,945
	Female	25	35.21%	10	34,48%	
Radial surgical margin	Negative	61	85.92%	20	68,97%	0,089
	Positive	10	14.08%	9	31,03%	
Number of retrieved lymph nodes		18.75±9.27		19.93±8.71		0.557
Number of metastatic lymph nodes		1.86±3.74		3.31±5.287		0.190
Follow-up period (months)		22.31±15.99		19.86±13.09		0.467

**Table 2. Distribution of the removed lymph nodes by gender (n=100)**

	Male (n=65)	Female (n=35)	p
Number of retrieved lymph nodes	19.81±9.44	18.31±7.91	0.367
Number of metastatic lymph nodes	2.39±5.14	2.27±3.63	0.891



**Fig. 1. Distribution of the retrieved and metastatic lymph nodes in both groups**

In 2010, Chern et al. [20] reported that after neoadjuvant treatment of the T3 and T4 tumors in rectal cancer cases, BMI did not compromise the sphincter preservation or complete resection of the tumor. Our surgical outcomes were similar to their findings in terms of surgical margins. Males have a narrower pelvic anatomy than female patients that may give rise to technical difficulties during rectal cancer surgery and therefore may affect the outcomes of the surgery. However, in this study, there was no difference between male and female patients in terms of the number of lymph nodes retrieved.

In this retrospective study, we evaluated the effect of obesity on oncological outcomes of rectal cancer. There are some limitations in this study which have to be acknowledged. This study was limited by its retrospective and non-randomized nature and relatively short follow-up time. Due to the lack of preoperative data of the patients, we could not feature operation time, blood loss and postoperative complications.

## 5. CONCLUSION

This study has shown that obesity does not influence the surgical oncological outcomes in patients who underwent curative surgery for rectal cancer.

## CONSENT

For this type of retrospective articles consent form is not needed. That's why we did not get any consent form from the participants of the study.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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