



# The Relationship Between Histopathologic Findings and Body Mass Index in Sleeve Gastrectomy Materials

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## Abstract

**Objective** For treatment of obesity, which is one of the important health problems of the present time, lifestyle modification, pharmacotherapy, behavioral treatment methods, and surgical procedures are commonly used. Sleeve gastrectomy is widely used among surgical procedures. We aimed to investigate the relationship between histopathologic findings and body mass indices (BMIs) of cases with sleeve gastrectomy in our study.

**Methods** Thirty-seven patients were included in our study who underwent sleeve gastrectomy and whose operation materials were examined histopathologically in our hospital. Two pathologists re-evaluated all gastrectomy materials. The relationship between BMI and the presence of gastritis, atrophy, intestinal metaplasia (IM), *Helicobacter pylori* (HPL), and other histopathological findings was investigated.

**Results** The mean age of patients included in the study was  $34.7 \pm 9.3$  years. Of patients, 70.3% were female and 29.7% were male. There was a statistically significant difference between BMI and IM among the evaluated histopathologic parameters. Moreover, IM was significantly more present in patients with type 2 diabetes.

**Conclusions** There is no previous study investigating the relationship between gastric histopathological findings and BMI in sleeve gastrectomy patients. We think that the statistically significant difference between BMI and IM that we found in our study may shed light on studies to be performed in the future.

**Keywords** Sleeve gastrectomy · Obesity · BMI · Histopathology · Intestinal metaplasia

## Introduction

Obesity, which can be defined as being above the expected ideal weight according to age, sex, and height, is a serious health problem that causes an increase in morbidity and mortality rates and is accepted as epidemic nowadays [1–3].

Particularly, dietary nutrition overdose and impaired energy balance due to sedentary lifestyle are the main causes of obesity [4]. Body mass index (BMI), which was approved by the World Health Organization (WHO) in 1997 as an obesity criterion in the evaluation of obesity, is obtained by dividing the body weight (kg) of the person by their height (m) squared ( $\text{kg}/\text{m}^2$ ). For patients who are evaluated according to BMI, BMI = 25.0–29.9  $\text{kg}/\text{m}^2$  is classified as overweight (overweight), BMI = 30–40  $\text{kg}/\text{m}^2$  as obese, and BMI > 40  $\text{kg}/\text{m}^2$  as morbidly obese [5].

There are different ways of coping with obesity which constitutes a risk factor for many diseases such as type II diabetes mellitus (DM), hypertension (HT), hyperlipidemia, coronary artery disease, steatohepatitis, and sleep apnea syndrome. For treatment, physical activity, diet changes, behavioral modification, and pharmacotherapy are commonly used; however, morbidly obese patients achieve better outcomes with surgical treatments compared to other treatments [6]. Various bariatric surgical procedures such as laparoscopic sleeve gastrectomy, laparoscopic biliopancreatic diversion-duodenal switch, and

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Roux-en-Y gastric bypass can be used in the treatment of obesity [6]. For the past few years, laparoscopic sleeve gastrectomy alone has begun to be used as a successful bariatric operation. Sleeve gastrectomy is a restrictive operation in which a large portion of the fundus and corpus along the large curvature and approximately 60% of the stomach is resected. The resected stomach in sleeve gastrectomy is routinely sent to the pathology laboratory for histopathological examination. In general, histopathological findings other than inflammatory processes are not expected, but sometimes histopathologic findings that require treatment and follow-up can be observed.

In this study, we aimed to investigate the relationship between the BMI of patients and histopathologic findings of sleeve gastrectomy materials sent to the pathology laboratory for routine examination.

## Materials and Methods

Thirty-seven patients who underwent sleeve gastrectomy with the diagnosis of morbid obesity in the General Surgery Department of Kafkas University Medical Faculty Health Research and Application Center between 2012 and 2017 were included in the study. Patients with unknown pre-operative BMI were excluded from the study. The demographic data of the cases were obtained from the hospital automation system. This study is a retrospective study and no data regarding the cases were disclosed or available at any time. In addition, informed consent was not obtained because the study was retrospective and no data regarding the cases were disclosed.

Hematoxylin and eosin (H&E)-, alcian blue (AB)-, and Giemsa-stained slides obtained from pathology archives were re-evaluated by two pathologists. On histopathological examination, gastritis, atrophy, intestinal metaplasia (IM), *Helicobacter pylori* (HPL), edema, lymphoid aggregate, and lymphoid follicles were evaluated. Then, the relationship between the BMIs of patients and these histopathologic parameters were statistically evaluated using the *t* test, Mann-Whitney *U* test, and one-way ANOVA test.

## Results

The mean age of the patients included in the study was  $34.7 \pm 9.3$  years (median 35). The youngest patient was 20 and the oldest patient was 50 years old. Of cases, 70.3% were female and 29.7% were male. In terms of diabetes, 18.9% of the cases had DM, 42.9% of DM cases were using insulin and 57.1% were on oral antidiabetic (OAD) treatment. Of DM cases, 2.7% (1 case) continued to use treatment after the operation. This case, who used insulin before the operation, started to use OAD after the operation. One of the non-DM cases died due to myocardial infarction not associated with

operation 6 months after surgery. The follow-up of other cases continues without any complications.

Active or active chronic gastritis was observed in all evaluated cases histopathologically. Atrophy was observed in 70.3% of the cases. Focal mild atrophy was detected in 23 (88.5%) and focal moderate atrophy in 3 (11.5%) of 26 patients with atrophy. Of the 34 cases with HPL, 16 (47.1%) showed mild, 13 (38.2%) moderate, and 5 (14.7%) severe positivity. IM was detected in 8 cases and all the cases revealed incomplete IM with moderate intensity. In addition, 8 (21.6%) cases had edema and 5 (13.5%) had significant vascular congestion. Histopathological findings of cases are given in Table 1.

No statistically significant relationship was found between BMI and age, gender, type or severity of gastritis, presence or severity of HPL, presence or severity of lymphoid follicle, presence or severity of lymphoid aggregate, or presence of edema, while a statistically significant relationship was found between BMI and IM ( $p < 0.0001$ ). The statistical relationship between the histopathological parameters and the mean BMI values of the cases is given in Table 2.

IM was less common in cases with a high BMI mean, while IM was more common in cases with low BMI mean. Age distribution of IM cases was as follows: 50% were 21–30 years, 25% were 31–40 years, 12.5% were 41–50 years, and 12.5% were 51–60 years. In cases where IM was not detected, 41.4% of cases were in 21–30 age group, 31% in 31–40 age group, 17.2% in 41–50 age group, and 10.3% in 51–60 age group. The mean age of the cases with IM was  $34.1 \pm 11.6$  years (median 32) and the mean age of the cases without IM was  $34.9 \pm 8.8$  years (median 35). When IM cases were evaluated in terms of DM, IM was found in 13.3% in

**Table 1** Histopathological findings of cases

Histopathological findings		Number	Percent
Diagnosis	Chronic gastritis	27	73.0
	Active chronic gastritis	10	27.0
Severity of gastritis	Mild	17	45.9
	Moderate	17	45.9
	Severe	3	8.1
Atrophy	+	26	70.3
	–	11	29.7
HPL	+	34	91.9
	–	3	8.1
IM	+	8	21.6
	–	29	78.4
Lymphoid follicle	+	22	59.5
	–	15	40.5
Lymphoid aggregate	+	34	91.9
	–	3	8.1

**Table 2** Relationship between evaluated histopathological findings and BMI

Histopathological findings		Mean	Standard deviation	<i>F</i>	<i>p</i>
Diagnosis	Chronic gastritis	43.348	3.7631	1.572	0.103
	Active chronic gastritis	45.820	4.5845		
Atrophy	+	43.350	3.6748	2.743	0.129
	–	45.591	4.7488		
HPL	+	43.885	4.1420	0.190	0.520
	–	45.500	3.7802		
IM	+	40.788	1.0895	12.451	0.000
	–	44.907	4.1714		
Lymphoid follicle	+	44.418	4.3352	1.014	0.477
	–	43.427	3.7653		
Lymphoid aggregate	+	44.241	4.1839	4.087	0.266
	–	41.467	1.2342		

non-DM cases, whereas IM was present in 57.1% of DM cases and this difference was statistically significant ( $p = 0.012$ ). The same statistical significance was not found between the BMI of DM cases and the BMI of non-DM cases ( $p > 0.050$ ). Considering the presence of IM and treatment, there was no relationship between type of treatment and IM for pre-operative DM.

## Discussion

Obesity is one of the major epidemic health problems of our era. Although obesity is seen as simple weight gain, medical, surgical, and behavioral treatment methods are applied for the treatment of this situation which may be related to mortality due to diseases such as diabetes and heart diseases. Among surgical treatments, sleeve gastrectomy and gastric bypass surgery are frequently used nowadays [6]. Histopathologic examination is routinely performed on operation material that is resected during the sleeve gastrectomy procedure.

Endoscopic imaging and histopathologic examination are performed in hospital applications for stomach diseases which often present with non-specific symptoms such as burning, pain, and nausea in daily life. In histopathologic examinations, the severity of inflammation, atrophy, intestinal metaplasia, and HPL is evaluated.

Studies evaluating histopathological findings of sleeve gastrectomy materials are available on national and international sites [7–12]. In a study conducted between 2009 and 2014, 241 cases were evaluated; 50.6% had no significant histopathologic findings, 37.8% had gastritis, 5.4% had lymphoid aggregates, and 1.2% had IM [11]. Similarly, in another study that reported no significant findings in 52% of cases, it was reported that the most common lesion detected in abnormal cases was chronic gastritis at 33% and the second most observed lesion was active chronic gastritis in 6.8%. In the same study, 2.2% of the cases had lymphoid aggregates [8]. In a large series with 976 cases evaluated, 38.9% of the cases had chronic

gastritis and HPL was detected in 8.6% of the cases [12]. In a different study conducted on 656 cases, chronic gastritis was observed in 74.4% of cases and HPL positivity was reported in 7.3% [13]. In a study in which lymphoid hyperplasia was detected in 33.3% of cases, active chronic gastritis was reported in 23.0%, whereas gastritis was reported in 55.7% in a study involving 106 cases [10, 14]. In Jordan, 93.3% chronic gastritis and 51.3% HPL positivity were reported in a study including cases with a mean BMI of 45.1 [15]. Research from our country detected chronic gastritis in 71% of cases, active chronic gastritis in 8.2%, HPL positivity in 17.3%, and IM in 7.3% [7]. In our study, we observed gastritis in all cases included in the study which revealed very high rates compared to reports in the literature. Of gastritis cases, 73.0% were chronic and 27.0% were active chronic gastritis. We also found HPL presence (91.9%) and lymphoid aggregate presence (91.9%) at a very high rate in our study compared with the literature. We observed IM presence in 21.6% of cases and all cases showed incomplete IM morphology.

In statistical analysis, we found a significant relationship between BMI and IM. IM was observed more frequently in cases with lower BMI mean whereas IM was observed less in cases with higher BMI mean. No studies have been conducted to show the relationship between BMI and histopathological findings until now and this is the first study in the literature to note this correlation. There are previous studies which only report the mean BMI value in cases where histopathological findings were evaluated [15, 16].

Leptin is a hormone produced and secreted mainly by adipocytes. In a sense, the more obese the patient, the higher circulating leptin concentration will be observed. In addition, other tissues like placenta, brain, mammary gland, and pituitary gland have the ability to produce leptin and the gastric epithelium has also been reported as a source of leptin in both mammals and non-mammalian vertebrates [17]. Moreover, the existence of other leptin-like hormones that may exert direct or indirect effects on the histopathological characteristics of the stomach or other tissues cannot be eliminated or excluded [18].

When these data are evaluated, it can be considered that one of the potential factors in the etiology of the relationship between IM and BMI or other changes that can be seen in the stomach may be leptin or other leptin-like hormones which needs further studies to confirm this association.

As a result of our study, the statistical difference between DM cases and non-DM cases compared with the presence of IM is also one of the issues that need to be investigated. This difference may be caused by lipopolysaccharide-binding protein which has been shown to be significantly associated with insulin sensitivity and different inflammatory as well as metabolic markers in type 2 diabetes patients [19].

Finally, our study shows the importance of evaluating the histopathological changes of the operation materials as well as the identification of suitable candidates to undergo sleeve gastrectomy [20]. Moreover, post-operational endoscopic follow-ups are also noteworthy not just because of the long-term histopathologic changes observed in follow-up studies in rodents [21], but due to IM which is an important lesion that needs to be followed for gastric adenocarcinoma.

In conclusion, our study is the first study to evaluate the relationship between BMI and histopathological findings, although there is a limitation due to the low number of the cases. We consider that our study will shed light on studies with larger series of cases in the future and that it will be a source of inspiration for new studies in terms of neoplastic processes and the relationship between BMI and IM.

## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** This study was approved by the ethics committee of the Faculty of Medicine of Kafkas University on September 27, 2017 (Document No. 80576354-50-99 / 149).

**Informed Consent** For this type of study (retrospective), formal consent is not required.

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