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The relationship between gastric wall thickness and age, gender, body mass index in patients undergoing laparoscopic sleeve gastrectomy

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ABSTRACT

Introduction: The most feared complication of sleeve gastrectomy is the development of leakage from the gastrectomy line. The aim of this study is to determine the range of gastric wall thickness in the fundus, corpus and antrum and to provide ideas that may help minimize complications that may occur after laparoscopic sleeve gastrectomy.

Materials and Methods: 101 consecutive patients who underwent sleeve gastrectomy surgery for obesity and severe obesity between 2017 and 2018 in this study were analyzed. Sleeve gastrectomy specimens were fixed in 10% formol solution. Sections were taken from the antrum, corpus and fundus and stained with hematoxylin and eosin. Measurements were made between the serosa and mucosa pili at five different points of each preparation. Results from these five different sites were averaged and recorded.

Results: Our study was conducted on a total of 101 cases, 79 (78.2%) women and 22 (21.8%) men. Mean age is 38.79±10.34 (61-19) years. Body mass index (BMI) ranged between 36.4kg/m2 and 64.9kg/m2 with a mean of 46.07±5.55kg/m^2. While 76 (75.2%) of the patients had a BMI level below 50kg/m^2, 25 (24.8%) had a BMI level of 50kg/m^2 and above. Gastric wall thicknesses of 101 patients who underwent sleeve gastrectomy were measured at antrum, corpus and fundus localizations and classified according to gender, age, and BMI. As a result of the statistical analysis, results obtained between the groups according to gastric wall measurements were not statistically significant ($p>0.05$). In our study, no statistical differences were found between gastric wall thickness and age, gender, and BMI.

Conclusion: Accurate determination of stomach wall thickness will help prevent complications that may result in death.

Keywords: Sleeve gastrectomy, gastric wall thickness, obesity

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Introduction

In the treatment of obesity, surgical treatments are used when the effectiveness of medical treatments is limited.[1,2] Today, laparoscopic sleeve gastrectomy (LSG) is frequently preferred in bariatric surgery.[2] Although at first glance LSG may give the impression of a deceptively simple surgical procedure, it is a surgical method that is open to significant complications that may have serious negative consequences for the patient when they occur during and after surgery. One of the most important of these complications is stapler line leakage.[3] There are many reasons for stapler line leakage after LSG. Further studies are needed to determine these reasons and find solutions.[4,5] Some of the reasons for stapler line leakage are stapler selection that is not compatible with the thickness of the stomach wall, insufficient duration of tissue compression, or inappropriate stapler pressure. The leakage and bleeding rates reported after bariatric procedures performed using stapler devices range from 0.4% to 4%.[1] The objectivity of stapler selection has not yet been fully established. This is because there is no available method for objective measurement of tissue thickness before cartridge selection. The aim of this study is to determine the range of gastric wall thickness in the fundus, corpus and antrum and to provide ideas that may help minimize complications that may occur after LSG.

Materials and Methods

Ethics committee approval was received for the study from the local clinical research ethics committee with decision number HNEAH KAEK 2019/KK/15. Informed consent was obtained from all individual participants included in the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

G Power 3.1 program was used to calculate the number of samples and perform power analysis. Data from Huang R and Gagner M's study titled 'A thickness calibration device is needed to determine staple height and avoid leaks in laparoscopic sleeve gastrectomy' were used as reference. Mean and standard deviation values were given for stomach wall thickness in female and male patients who underwent LSG. The effect size of stomach wall thickness was calculated as (d:0.5). It was determined that at least 46 samples should be studied with 80% power and 20% alpha error in the analysis.

We included 101 patients who underwent consecutive sleeve gastrectomy surgery for obesity and between 2017 and 2018 in our clinic. Resected gastric antrum, corpus and fundus gastric wall thicknesses were measured under microscope and recorded. Pathology preparations were analyzed.

It was decided that the patients required surgery according to the criteria specified in the Medical Procedures Directive of the Ministry of Health. After the preoperative blood tests and radiological imaging were completed, internal medicine, pulmonology, endocrinology, cardiology, psychiatry and anesthesia consultations were routinely performed. Gastroscopic examinations were performed routinely. Patients who did not have mass lesions, ulcers or gastritis at the end of gastroscopic examination were included. Patients with gastritis and ulcer problems were included in the study if they had normal gastric mucosa during the control gastroscopic examination performed after medical treatment. Preoperative breathing exercises and prophylactic thromboembolism treatment were performed.

All operations were performed by surgeons with experience in bariatric surgery working in our clinic. The procedure was performed in the French position with the patients in reverse Trendelenburg position and using the five trocar method. Starting from the prepyloric area of approximately 3-4 cm, the stomach was mobilized by cutting the gastrocolic and gastrosplenic ligaments with 5 mm ligasure. A 38 Fr orogastric tube was placed. After the resection was completed, the specimen was removed and sent to the pathology laboratory.

Sleeve gastrectomy specimens were fixed in 10% formol solution overnight and subjected to routine tissue follow-up in the pathology laboratory. A 0.5 cm wide, 2 cm long piece sampling of the gastric wall layers was taken from the antrum, corpus, and fundus at 1 cm from the gastric staple line. After tissue tracing, the sections were embedded in paraffin blocks and 7 micron sections were taken. The sections were stained with hematoxylin and eosin, and serosa and mucosa borders were determined under a microscope by a single pathologist. The same pathologist made measurements full thickness specimen between serosa and mucosa pili at five different points in each preparation (Fig. 1). Due to the variable pili folds of the mucosa, the results obtained from five different regions were averaged and recorded.

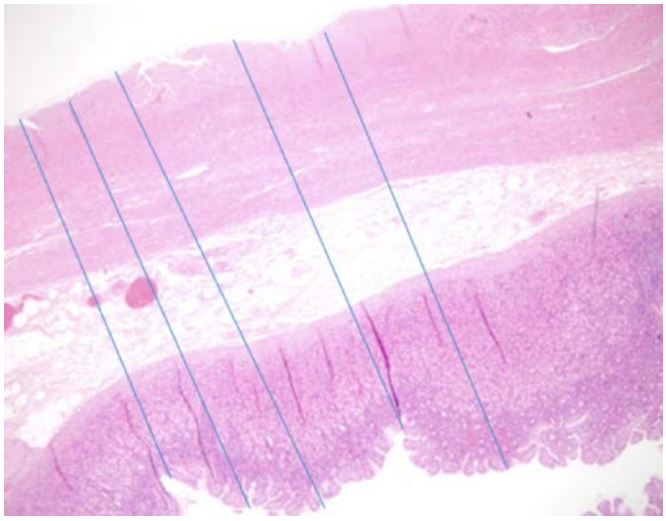

Figure 1. Measuring the full thickness of the gastric antrum wall of a male patient with a body mass index of 42kg/m^2.

Statistical Analysis

IBM SPSS Statistics 22 (IBM SPSS, Türkiye) program was used for statistical analyses while evaluating the findings obtained in the study. The suitability of the parameters to normal distribution was evaluated by Shapiro Wilks test and it was determined that the parameters were suitable for normal distribution. In addition to descriptive statistical methods (mean, standard deviation, frequency), Student's t test was used for comparisons of parameters showing normal distribution according to gender in the comparison of quantitative data. Continuity (Yates) Correction was used for comparison of qualitative data. Significance was evaluated at p<0.05 level.

Results

The study was conducted on a total of 101 patients, 79 (78.2%) women and 22 (21.8%) men. Mean age is 38.79±10.34 (18-61) years. BMI levels ranged between 36.4kg/m^2 and 64.9kg/m^2 with a mean of 46.07±5.55kg/m^2. While 75.2% of the patients had a BMI level below 50kg/m^2, 24.8% had a BMI level of 50kg/m^2 and above (p<0.05).

The distribution of BMI and age groups by gender is given in Table 1. Accordingly, 40.9% of men had a BMI level of 50kg/m^2 and above, which was higher than that of women (20.3%) but not statistically significant (p>0.05). The proportion of men over 40 years of age (63.6%) was statistically significantly higher than women (35.4%) (p:0.033).

Fundus, corpus, and antrum thicknesses according to gender and BMI are given in Table 2. There was no statistically significant difference between the fundus, corpus, and antrum thicknesses in both male and female patient groups, in those with a BMI below 50kg/m^2 and in those with a BMI of 50kg/m^2 and above (p>0.05).

Table 1. Assessment of body mass index and age by gender

	Woman, n (%)	Man, n (%)	p
BMI (kg/m^2)			
<50	63 (79.7)	13 (59.1)	0.088
≥50	16 (20.3)	9 (40.9)	
Age (years)			
≤40	51 (64.6)	8 (36.4)	0.033*
>40	28 (35.4)	14 (63.6)	

Continuity (yates) correction; *p<0.05; BMI: Body mass index.

Table 2. Evaluation of fundus, corpus, and antrum thicknesses according to gender and body mass index

Thickness (mm)	BMI<50 kg/m^2 Mean±SD	BMI≥50 kg/m^2 Mean±SD	p
Woman			
Fundus	5.54±1.57	6.16±1.24	0.144
Corpus	6.4±1.34	6.84±1.27	0.238
Antrum	6.09±1.54	6.78±1.51	0.115
Man			
Fundus	5.82±0.71	5.91±1.55	0.847
Corpus	6.46±1.62	6.42±1.46	0.954
Antrum	6.4±1.53	6.22±0.79	0.753

Student t test; BMI: Body mass index; SD: Standard Deviation.

Both male and female patients were divided into age groups as below 40 years and above 40 years. The results of gastric fundus, corpus, and antrum measurements of female and male patients according to age groups are given in Table 3. There was no statistically significant difference in fundus, corpus, and antrum thicknesses between age groups in both men and women (p>0.05).

Both male and female patients were separately divided into two groups as BMI>50kg/m^2 and BMI≥50kg/m^2 and gastric fundus, corpus and antrum thicknesses were measured (Table 4). No statistically significant difference was found between the fundus, corpus and antrum thicknesses of women and men in both groups of patients with BMI levels below and above 50kg/m^2 (p>0.05).

Table 3. Evaluation of fundus, corpus, and antrum thicknesses in sexes according to age groups separately

Thickness (mm)	Age ≤40 years Mean±SD	Age >40 years Mean±SD	p
Woman			
Fundus	5.63±1.44	5.73±1.69	0.784
Corpus	6.57±1.26	6.33±1.46	0.443
Antrum	6.29±1.61	6.11±1.46	0.612
Man			
Fundus	5.77±0.80	5.90±1.27	0.805
Corpus	6.0±1.31	6.7±1.61	0.310
Antrum	6.4±1.1	6.28±1.37	0.843

Student t test; SD: Standard Deviation.

There were no significant statistical differences between the fundus-corpus, corpus-antrum, and fundus-antrum wall thicknesses of 101 patients that underwent sleeve gastrectomy whose mean gastric wall thicknesses were calculated (p=0.7 p=0.3 p=0.5, respectively) (Fig. 2).

Discussion

Today, despite the increasing experience in LSG applications in bariatric surgery, the number of complications including staple line leaks remains constant and solutions are still being sought to prevent such complications.[4] There is still limited data on the optimal size of linear staples to be selected according to gastric wall thickness in LSG.[6] In terms of staple and bariatric procedures, Hazem

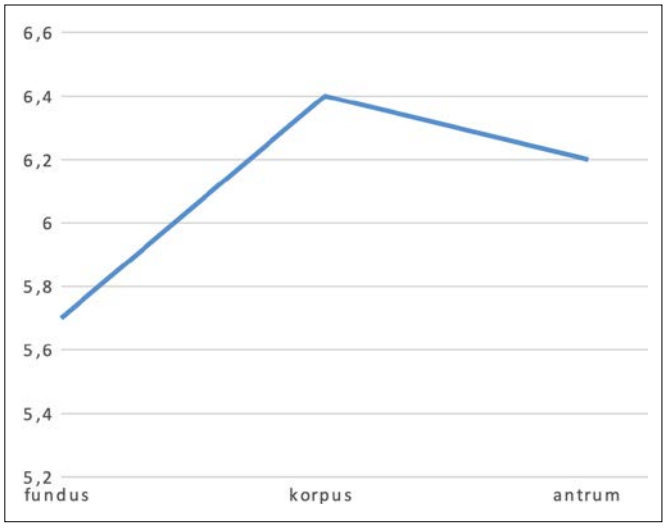

Figure 2. Graphic of mean gastric fundus, corpus and antrum wall thickness.

Table 4. Evaluation of fundus, corpus, and antrum thicknesses in body mass index groups separately according to gender

BMI (kg/m²) Thickness (mm)	Woman Mean±SD	Man Mean±SD	p
<50			
Fundus	5.54±1.57	5.82±0.71	0.328
Corpus	6.4±1.34	6.46±1.62	0.876
Aantrum	6.09±1.54	6.4±1.53	0.510
≥50			
Fundus	6.16±1.24	5.91±1.55	0.661
Corpus	6.84±1.27	6.42±1.46	0.464
Antrum	6.78±1.51	6.22±0.79	0.243

Student t test; BMI: Body mass index; SD: Standard Deviation.

Elariny was the first to measure gastric wall thickness at three different points in patients who were operated on. He demonstrated that the gastric tissue was thickest in the pyloric region and thinnest in the fundus.[7]

Rawlins et al. measured the wall thickness of resected sleeve gastrectomy specimens and showed that gastric wall thickness was significantly different in the antrum, corpus, and fundus. They found that the gastric wall in the antrum was statistically thicker in men than in women. They observed that BMI affected the antrum wall thickness only in those with a BMI above 50kg/m². In the light of these data, they concluded that a thicker staple cartridge should be used in the antrum.[8] In our study, no significant statistical difference was found in the gastric antrum corpus and fundus region according to gender and BMI.

Van Rutte et al. measured the wall thickness of resected sleeve gastrectomy specimens at 5 different points along the main line in 33 patients with a mean age of 42 years. Their measurements were based on the pressure after flattening the gastric folds with finger pressure and subtracting the weight pressure of the gastric specimen. The mean compression pressure was 2.80g/m², 2.5 times lower than previous studies. The gastric antrum was thicker than the fundus and there was a significant difference in gastric wall thickness. As a result, it was reported that the use of a purple cartridge in the gastric antrum and corpus and a gold cartridge in the fundus may be appropriate.[9]

Huang et al.[10] found that the gastric antrum was the thickest and the gastric fundus was the thinnest in both sexes. When evaluated in terms of gastric wall thickness and

appropriate staple use, 16.55% of female patients were found to be suitable for black cartridge use in the gastric antrum region. They emphasized that there is no standard method for measuring gastric wall thickness today.[7] For this reason, in our study, we planned to measure gastric wall thickness under a microscope, which we think is a more sensitive measurement method.

According to some studies, gender is a factor affecting gastric wall thickness.[7,8,10] In Rawlins' study, gastric antrum wall thickness was found to be statistically thicker in male patients than in female patients. In addition, it was shown that gastric wall thickness was increased in patients with BMI≥ 50kg/m^2.[8] In some other studies, a significant relationship between BMI and gastric wall thickness could not be demonstrated.[7,9,10]

Complete knowledge of stomach wall thickness enables better stapler use. Thus, it is one of the factors that can reduce the staple line leakage rate. There are also studies on preoperative measurement of gastric wall thickness by ultrasonography (USG) and computed tomography (CT).[11,12] In a study by Yazar et al. using preoperative USG and pathologic measurements of postoperative gastric specimens, it was concluded that gastric antrum wall thickness was not related with gender or BMI, but gastric wall thickness increased in patients with gastritis.[11] Unlike our study, only antrum wall thickness was measured in this study.[11] The part of the study in which pathologic measurements were performed used the same method technically as our study. However, the study did not mention how gastric mucosa folds were standardized. Since we realized that the most variable gastric wall layer in our study was the mucosa, we measured the mucosa layer from 5 different points and averaged it in the histopathological examination. Similarly, no relationship was found between gender, BMI, and stomach wall thickness. Pickhardt and Asher found no significant relationship between antral thickness and gender in their study in which gastric wall thickness was measured in the portal venous phase, axial sections and using an electronic ruler to obtain the actual wall thickness size with oral and intravenous contrast-enhanced CT.[12] Similar to this study, there was no statistical relationship between antrum wall thickness and gender in our study.

According to the results of the study conducted by Booker et al., gastric fundus wall thickness was found to be significantly thicker in men than in women, but no significant difference was found between the groups in terms of age and BMI.[13] In our study, when men and women were evaluated in terms of gastric fundus wall thickness, no statistically significant difference was found, although technical measurements were similar to Booker et al.[13] In the study by Larsen, gastric wall thickness measured by endoscopic ultrasound was not correlated with BMI. In addition, no difference was observed between antrum, corpus, and fundus. In addition, the thickest measured gastric localization in patients with obesity was recorded as fundus and the thinnest measured as corpus.[14] In our study, no significant results were found in terms of BMI and age and gastric wall thickness.

The limitation of our study is the stomach wall thickness was measured as full thickness. Gastric mucosa thickness fluctuates due to gastric folds. For this reason, we made measurements from five different regions. It may also be an option to take measurements between the muscularis propria and serosa, where more stable measurements can be made from the stomach wall layers. We think that similar studies need to be conducted in larger patient groups.

Conclusion

Acurate determination of the gastric wall thickness will help to avoid complications that may result in mortality. In our study, no statistically significant difference was found in antrum, corpus and fundus wall thickness measurements according to gender, age and BMI. Further studies on gastric wall thickness are needed. We think that this study may contribute to the relationship between staplers, which are frequently used in bariatric surgery, and stomach wall thickness.

Disclosures

Ethics Committee Approval: Ethics committee approval was received for the study from the Haydarpasa Numune Training and Research Hospital Ethics Committee with decision number HNEAH KAEK 2019/KK/15 (Date: 19/02/2019).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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