



# Helicobacter Pylori Infection Prevalence and Histopathologic Findings in Laparoscopic Sleeve Gastrectomy

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## Abstract

**Introduction** *Helicobacter pylori* (*H. pylori*) is a type of bacteria that affects more than half of the world's population and has been associated with gastritis. The relationship between *H. pylori* and obesity is controversial. Laparoscopic sleeve gastrectomy (LSG) is the most commonly used surgery for morbidly obese patients. The aim of this study was to investigate the rate of *H. pylori* in patients undergoing LSG.

**Methods** Biopsy specimens of 32,743 patients who underwent esophagogastroduodenoscopy (EGD) and resection materials from 1257 patients who underwent LSG were examined histopathologically. The relationships between body mass index (BMI), age, gender, *H. pylori* infection, and intestinal metaplasia (IM) were investigated in patients with gastritis.

**Results** In patients undergoing EGD, the association of *H. pylori* infection was found to be increased in males and the elderly ( $p < 0.001$ ). The presence of gastritis and IM was significantly higher with *H. pylori* infection ( $p < 0.001$  and  $p = 0.001$ , respectively). *H. pylori* infection was significantly higher in patients over the age of 41 years ( $p < 0.001$ ). There was no significant difference between the results of *H. pylori* before and after LSG surgery ( $p = 0.923$ ). The presence of *H. pylori* together with gastritis and IM was found to be significant ( $p < 0.001$ ).

**Conclusions** *H. pylori* infection increases with age. No significant difference was found in the examination for *H. pylori* before and after LSG surgery. In addition, no relationship was found between *H. pylori* and excess weight. However, due to the low average age of patients who underwent LSG, further studies are needed in this area.

**Keywords** Obesity · Sleeve gastrectomy · Pathologic findings · *Helicobacter pylori*

## Introduction

*Helicobacter pylori* (*H. pylori*) infection is one of the most common infections in humans. It has been estimated that more than half of the world's population is infected with *H. pylori* [1]. Many risk factors have been defined for *H. pylori*

infection, such as living in crowded environments, poor hygiene conditions, low socioeconomic status, poor nutrition, smoking, alcohol consumption, blood groups, social status, and age [2, 3]. *H. pylori* has been linked to chronic active gastritis, peptic ulcer disease, gastric adenocarcinoma, and mucosa-associated lymphoid tissue (MALT) lymphoma [4–7]. According to 2015 data from 100,000 people in Turkey, the incidence of stomach cancer was reported to be 14.2% in men and 6.3% in women [8]. The incidence of gastric cancer is higher in Turkey than in European Union countries. The higher incidence of *H. pylori* in Turkey could be a reason for the increased incidence of gastric cancer.

The association between *H. pylori* and obesity remains controversial. The prevalence of *H. pylori* infection in obese patients was reported to be lower than in the general population [9, 10]. Other studies reported a higher *H. pylori* prevalence in obese patients [11–13]. The significant increase in body mass index (BMI) observed after *H. pylori* eradication suggests a possible inverse correlation between *H. pylori*

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infection and obesity [14]. In some studies, *H. pylori* was reported to have no effect on reducing body weight [15]. A cross-sectional study showed that the *H. pylori* infection positive group had significantly higher BMI levels than the *H. pylori* infection negative group [14, 16]. For this reason, it is necessary to explore the true association between *H. pylori* infection and obesity.

Laparoscopic sleeve gastrectomy (LSG) is the most preferred bariatric procedure performed worldwide. It involves the resection of the majority of the greater curvature of the stomach. Thus, a large part of the stomach that is infected with *H. pylori* is resected. In addition, the majority of acid-producing cells are resected, and the risk of marginal ulceration is negated. It was shown that despite a high prevalence of *H. pylori* found in immunohistochemical staining of resected stomach specimens, the postoperative prevalence of *H. pylori* was low by urea breath test [17]. Therefore, this retrospective study was performed to investigate the detection incidence of *H. pylori* infection in patients undergoing endoscopy and in patients undergoing LSG surgery (obese patients).

## Materials and Methods

This study was conducted at the Balıkesir Atatürk City Hospital, Department of General Surgery. The records of patients who underwent esophagogastroduodenoscopy (EGD) and patients who underwent LSG surgical treatment for morbid obesity between January 2013 and December 2017 were retrospectively identified from the hospital database system, and their medical records were evaluated.

There were 32,743 patients who underwent EGD and 1257 patients who underwent LSG following preoperative endoscopy who were included in the study. All surgical procedures were performed at the Balıkesir Atatürk City Hospital by three surgeons. All procedures were completed laparoscopically. The technique for LSG has been well-described. The greater curvature blood supply was taken with a power energy source and transection of the stomach was performed with a stapling device. All cases were performed over 36 French bougies, with transection beginning 3–5 cm from the pyloric valve. Care was taken to preserve the incisura angularis. The staple line was terminated on the gastric side just distal to the gastroesophageal junction. Each resected stomach specimen was extracted from the abdominal cavity through a dilated 12-mm trocar incision using a specimen bag. At the end of the operation, a drain was placed alongside the staple line. The resected specimen was sent to pathology for analysis.

Endoscopy biopsy specimens and resected stomach specimens were fixed in 10% formalin and embedded in paraffin. Biopsies were taken from the gastric antrum and corpus in patients undergoing EGD. Five specimens were taken from the gastrectomy material in the patients who underwent LSG.

The following specimens were obtained: two from the antrum, two from the corpus, and one from the incisura angularis. The sections were subsequently stained with hematoxylin and eosin. Giemsa staining was used to determine the presence of *H. pylori*, and alcian blue staining was used to evaluate the presence of intestinal metaplasia. Histological grading was based on the Sydney classification [18]. All the LSG specimens were analyzed by three pathologists who were unaware of any clinical information. Accordingly, the following histopathologic variables were examined for each case: *H. pylori* density, polymorphonuclear neutrophil activity, degree of chronic inflammation, and degree of glandular atrophy. The presence of intestinal metaplasia was graded as mild, moderate, or severe. *H. pylori* density was graded as none, mild when only a few microorganisms were present, moderate when bacteria were present in separate foci, and severe when near complete or complete surface layering with *H. pylori* was observed. Location of gastritis (antrum, fundus/body, cardia, diffuse), type of gastritis (active, chronic or other [lymphocytic, granulomatous, eosinophilic, or other]), grade of the presence of *H. pylori*, chronic inflammation, active inflammation, glandular atrophy, and intestinal metaplasia were reported.

## Ethical Consideration

Before initiating the present study, the researchers obtained approval from the Balıkesir University Medical Faculty Clinical Research Ethics Committee (decision no: 154, date: 26 September 2018) and written permission from the Balıkesir Atatürk City Hospital, where the research was conducted. The research was conducted in accordance with the Helsinki Committee requirement.

This was a retrospective study. Since the evaluated records did not contain any identifying information, informed consent did not apply.

## Statistical Analysis

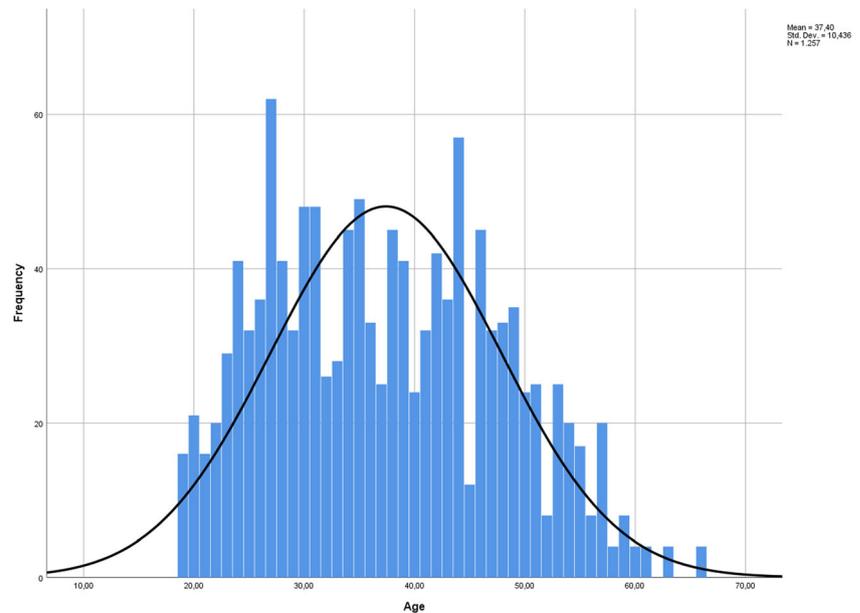
The data obtained from this study were transferred to the SPSS program (version 25.0, SPSS Inc., Chicago, IL, USA) and then analyzed. Comparisons between groups were made

**Table 1** Demographic characteristics of the study population

	Gender	<i>n</i>	%	Mean age	SD
EGD	Male	15,919	48.62%	52.22	17.02
	Female	16,824	51.38%	51.31	17.89
LSG	Male	317	25.22%	37.37	10.67
	Female	940	74.78%	37.35	10.86

EGD, esophagogastroduodenoscopy; LSG, laparoscopic sleeve gastrectomy; *n*, number of patients; SD, standard deviation

Fig. 1 Age histogram



using Student's *t* test for continuous variables. The statistical significance between groups was tested using the chi-square test or Fisher's exact test for categorical variables. The histologic scores for gastritis were treated as ordinal variables.

## Results

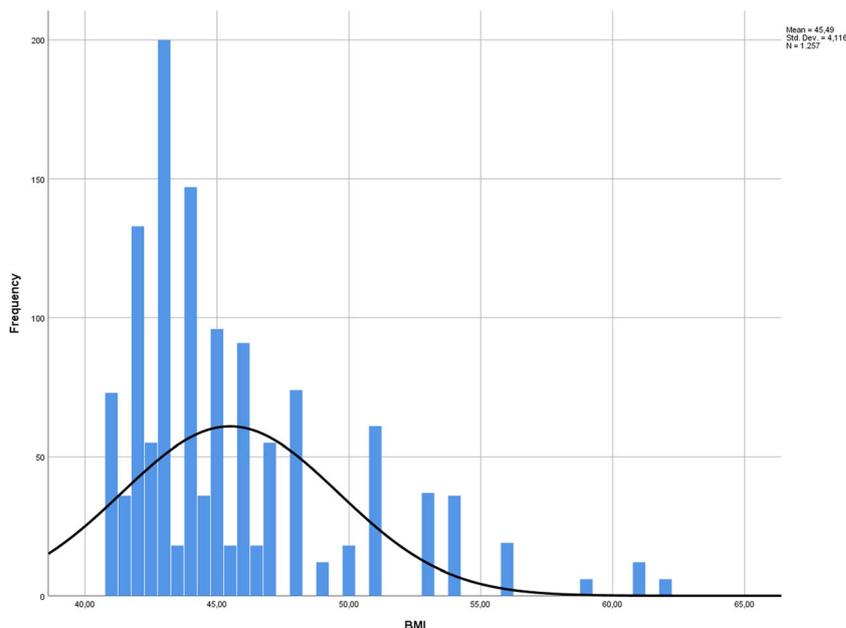
The data of 32,743 patients who underwent EGD and 1257 patients who underwent LSG between 1 January 2013 and 31 December 2017 at the Balıkesir Atatürk City Hospital were evaluated retrospectively. Of the patients who underwent EGD, 15,919 (48.62%) were male and 16,824 (51.38%) were female ( $p = 0.152$ ). The mean age of the male patients was  $52.22 \pm 17.02$ , and the mean age of the female patients was  $51.31 \pm 17.89$  (Table 1). Of the patients who underwent EGD, 50.10% were positive for *H. pylori*. When the biopsy results of the patients who underwent EGD were examined, the rate of *H. pylori* was found to be higher in males than in females ( $p < 0.001$ ). In terms of age groups, significantly higher *H. pylori* positivity was found in patients over 41 years of age ( $p < 0.001$ ). The coexistence of *H. pylori* with intestinal metaplasia was significantly higher ( $p = 0.001$ ). Similarly, the coexistence of *H. pylori* with gastritis was significantly higher ( $p < 0.001$ ). Of the 1257 patients who underwent LSG, 317 (25.22%) were male and 940 (74.78%) were female. The mean age of the male patients was  $37.37 \pm 10.67$ , and the mean age of the female patients was  $37.35 \pm 10.86$  (Fig. 1). The mean preoperative BMI of the patients who underwent LSG was  $43.82 \pm 3.58 \text{ kg/m}^2$  (Table 2) (Fig. 2). The samples prepared from the sub-total gastric resection materials of the patients who underwent LSG were stained with hematoxylin and eosin, Giemsa, and alcian blue stains, and were examined histopathologically. When the patient age and *H. pylori* detection

status were compared, no significant result was obtained ( $p = 0.082$ ). However, when the patients were grouped according to age groups, the rate of *H. pylori* was significantly higher in patients 41 years and older than in other patients ( $p < 0.001$ ) (Table 3). There was no significant difference between gender and *H. pylori* frequency in patients who underwent LSG ( $p = 0.925$ ). *H. pylori* was detected in 395 of the patients (31.42%) who underwent LSG. There was no significant difference between the results of *H. pylori* examination before LSG surgery and the postoperative results ( $p = 0.923$ ) (Table 4). Of the patients who underwent LSG, 622 (49.48%) had signs of gastritis. The following outcomes were found: chronic inactive gastritis in 435 patients (34.61%), chronic active gastritis in 97 patients (7.72%), follicular gastritis in 35 patients (2.78%), lymphoid aggregate in 36 patients (2.86%), intestinal metaplasia in 19 patients (1.51%), and chronic atrophic gastritis in five patients (0.39%) (Table 5). There was a significant correlation between the presence of *H. pylori* and intestinal

**Table 2** HP incidence according to BMI groups

BMI	<i>H. pylori</i>		Total	<i>p</i> value	
	Negative	Positive			
BMI group 41–46	Count	614	289	903	0.886
	%	68.0%	32.0%	100.0%	
47–52	Count	167	71	238	100.0%
	%	70.2%	29.8%	100.0%	
53–58	Count	65	27	92	100.0%
	%	70.7%	29.3%	100.0%	
59+	Count	16	8	24	100.0%
	%	66.7%	33.3%	100.0%	
Total	Count	862	395	1257	100.0%
	%	68.6%	31.4%	100.0%	

Fig. 2 BMI histogram



metaplasia ( $p = 0.001$ ). In addition, the presence of *H. pylori* together with gastritis was significant ( $p < 0.001$ ). Similarly, the coexistence of gastritis with intestinal metaplasia was found to be significant ( $p < 0.001$ ) (Table 6).

### Discussion

The prevalence of *H. pylori* was 50.10% in the patients who underwent EGD. This rate was low compared with previous studies [9, 19]. We used the histological examination of Giemsa stained preparations in the diagnosis of *H. pylori*. In other studies, different tests, such as serology, ELISA, and urea breath tests, were used. The rate of *H. pylori* positivity in other studies with endoscopic biopsy was consistent with our study [20]. *H. pylori*-associated gastritis was found in 31.42% of the

patients who underwent LSG. In the literature, the rates of *H. pylori*-associated gastritis in patients who underwent LSG were reported to be between 10 and 44%, so our results are consistent with the literature [20, 21]. There are studies showing that the prevalence of *H. pylori* is lower in patients undergoing LSG, but no significant relationship between obesity and *H. pylori* prevalence was found in another study [22, 23]. In patients undergoing EGD, *H. pylori* was found to be higher in males and in patients over 45 years of age. In patients undergoing LSG, no significant difference between *H. pylori* and gender was found. In patients over the age of 45 years, *H. pylori* was significantly higher, which is in accordance with previous studies [22]. In three patients who underwent LSG, an anastomotic leak was detected in the postoperative period. *H. pylori* was positive in one of the patients with anastomotic leakage. Rossetti et al. [24] found no correlation between *H. pylori* and postoperative complications. However, studies on a larger series are needed. In our study, we found a significant relationship between *H. pylori* and gastritis and intestinal metaplasia in patients undergoing EGD ( $p < 0.001$ ). Similarly, there was a significant correlation between *H. pylori* and gastritis in patients undergoing LSG ( $p < 0.001$ ). In addition, there was a significant

Table 3 HP incidence according to age groups

Age	<i>H. pylori</i>		Total	<i>p</i> value	
	Negative	Positive			
Age range 19–30	Count	307	87	394	< 0.001
	%	77.9%	22.1%	100.0%	
31–40	Count	247	117	364	100.0%
	%	67.9%	32.1%	100.0%	
41–50	Count	214	134	348	100.0%
	%	61.5%	38.5%	100.0%	
51+	Count	94	57	151	100.0%
	%	62.3%	37.7%	100.0%	
Total	Count	862	395	1257	100.0%
	%	68.6%	31.4%	100.0%	

Table 4 Comparison of *H. pylori* detection before and after LSG surgery

		EGD	LSG	<i>p</i> value
<i>H. pylori</i>	Negative	Count	862	0.923
	%	53.6%	68.6%	
Positive	Count	583	395	100.0%
	%	46.4%	31.4%	
Total	Count	1257	1257	100.0%
	%	100.0%	100.0%	

**Table 5** Prevalence of histopathologic diagnoses in sleeve gastrectomy specimens

Diagnosis	<i>n</i>	Percentage
No specific pathologic change	635	50.52%
Chronic inactive gastritis	435	34.61%
Chronic active gastritis	97	7.72%
Lymphoid aggregates	36	2.86%
Follicular gastritis	35	2.78%
Intestinal metaplasia	19	1.51%

relationship between *H. pylori* and intestinal metaplasia in patients undergoing LSG ( $p = 0.001$ ). Onzi et al. showed a significant relationship between *H. pylori* and foveolar hyperplasia and chronic gastritis. After LSG, *H. pylori*-related foveolar hyperplasia, chronic gastritis, and comorbidities were reported to be reduced [25]. Although there is a relationship between *H. pylori* infection and gastritis, it is not recommended to routinely perform EGD on patients preoperatively because it was not shown to be associated with symptoms in the postoperative period [26]. However, whether or not *H. pylori* infection disrupts anastomosis healing and contributes to the development of marginal ulcers is a controversial subject [21, 27]. It was reported that long-term untreated *H. pylori* infection before LSG could increase the risk of gastroesophageal reflux disease (GERD) and gastric cancer [28]. The use of non-steroidal anti-inflammatory drugs (NSAIDs) and smoking should be considered in patients with postoperative dyspeptic symptoms; if these are not present, the presence of *H. pylori* should be investigated [29]. Preoperative routine screening for *H. pylori* will result in unnecessary screening and treatment costs. LSG surgery was reported to provide *H. pylori* eradication in a small-scale study [17]. The most common histopathological findings are chronic gastritis, chronic active gastritis, follicular gastritis, and lymphoid aggregate. In our study, these were found in 34.61%, 7.72%, 2.78%, and 2.86% of patients, respectively. The rates of Safaan et al. [30] were consistent with our study at 33.0%, 6.8%, 2.7%, and

2.2%, respectively. Chronic active gastritis was found to be slightly higher in our study, but it was consistent with other studies [20]. The association of *H. pylori* with intestinal metaplasia was significantly higher in patients undergoing EGD. In our study, however, 1.51% of patients who underwent LSG had intestinal metaplasia, which was consistent with previous studies [30, 31]. All of our LSG patients underwent preoperative EGD according to the European Association of Endoscopic Surgery (EAES) guidelines [32]. The findings were consistent with postoperative histopathology. The rate of intestinal metaplasia was higher in patients who underwent EGD than in patients who underwent LSG (5604 [17.12%] vs. 19 [1.51%]). We think this is due to the fact that the patients undergoing LSG were younger ( $52.22 \pm 17.02$  vs.  $37.37 \pm 10.67$ ). Mao et al. [33] reported that intestinal metaplasia increased with age and peaked between the ages of 50 and 59 years [33]. Their research was consistent with ours. In the histopathological examination after LSG surgery, routine follow-up and treatment were recommended in patients with intestinal metaplasia [31]. In our study, preoperative eradication therapy was administered to the symptomatic 184 patients who were found to have *H. pylori* on EGD. In the postoperative period, *H. pylori* eradication therapy administered to 71 patients with intestinal metaplasia and dyspeptic complaints. Patients who did not have any symptomatic complaints were not given any eradication treatment after LSG surgery. LSG is effective in the treatment of obesity, and most patients with preoperative *H. pylori* in EGD have no stomach symptoms. We believe that there is no need for routine *H. pylori* eradication treatment before LSG surgery. However, more studies are needed on this subject.

## Conclusion

*H. pylori* infection increased with age. There was no significant difference in the rate of *H. pylori* before and after LSG surgery. Therefore, we think that it is not necessary to determine the

**Table 6** Comparison of gastric and intestinal metaplasia with the presence of *H. pylori*

Histopathologic findings			<i>H. pylori</i>		Total	<i>p</i> value
			Negative	Positive		
Intestinal metaplasia	Negative	Count	856	382	1238	0.001
		%	99.3%	96.7%	98.5%	
	Positive	Count	6	13	19	
		%	0.7%	3.3%	1.5%	
Gastritis	Negative	Count	631	4	635	< 0.001
		%	73.2%	1.0%	50.5%	
	Positive	Count	231	391	622	
		%	26.8%	99.0%	49.5%	
Total		Count	862	395	1257	
		%	68.6%	31.4%	100.0%	

presence of *H. pylori* before LSG surgery. In addition, no significant correlation was found between *H. pylori* and excess weight. However, due to the low average age of patients who underwent LSG, further studies are needed in this area.

### Compliance with Ethical Standards

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

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