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# Effect of spleen size on complications of laparoscopic sleeve gastrectomy

Sinan Arıcı, Oğuzhan Fatih Ay

Department of General Surgery, T.C. Bursa Yüksek İhtisas Training and Research Hospital, Bursa, Türkiye

## ABSTRACT

**Introduction:** In bariatric surgery, examining the spleen dimensions via USG in a routine manner prior to surgery, could help the physician to predict probable complications on bariatric surgery as enlarged spleen size restricts the surgeon's working area and leaks often occur in the upper part of the stomach adjacent to the spleen. The aim of this research was to elucidate the benefits of spleen USG in pre-operative period to determine the risk of complications in advance.

**Materials and Methods:** A total of 316 patients who had undergone sleeve gastrectomy have been retrospectively analyzed. The spleen dimensions of the patients were obtained from the routine USG reports and CT scans. In this research we took the spleen size as 12 cm from the previous radiological studies in the literature and stated the ones above this reference point.

**Results:** The number of staples and duration of surgery were higher in individuals with abnormal spleen size compared to individuals with normal spleen dimensions. Presence of CAD – arrhythmia and asthma – COPD were effective in the development of complications ($p<0.05$) according to logistic regression analysis. Considering the factors affecting the development of complications, CAD-Arrhythmia caused a 5-fold increase, and asthma-COPD 4.9-fold increased the development of complications.

**Conclusion:** In patients scheduled for bariatric surgery, examining spleen dimensions via USG imaging in a routine manner prior to surgery, could help the physician to predict probable complications on bariatric surgery due to spleen size.

**Keywords:** Bariatric surgery, complication, leakage, sleeve gasrectomy, spleen size

## Introduction

Studies have shown that weight loss improves health conditions and well – being. Treatment options for obesity include surgical and non-surgical treatments. Non-surgical management usually consists of dietary changes, physical exercise, and behavioral therapy aimed at reducing energy intake and increasing energy expenditure (1). However, non–surgical methods may be ineffective in achieving or maintaining weight loss in many obese patients. For this reason, the application of bariatric surgery methods is increasing all over the world. Long-term permanent weight loss is achieved, many comorbidities are prevented by reducing the metabolic effects of obesity, and survival is increased via bariatric surgery (2).

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**Correspondence:** Sinan Arıcı, M.D., T.C. Bursa Yüksek İhtisas Eğitim ve Araştırma Hastanesi, Genel Cerrahi Kliniği, Bursa, Türkiye
**e-mail:** sinan.arici@gmail.com

Laparoscopic Sleeve gastrectomy (LSG) is believed to be the most commonly performed procedure worldwide. It is an irreversible procedure and has a lower risk of complications due to the shorter operation time and the preservation of the anatomical structure. Literature analysis shows that LSG is effective in the short term and has some advantages compared to the current options of Laparoscopic Adjustable Gastric Band and Roux-En-Y Gastric Bypass (3). These advantages can be elaborated as technical convenience, no requirement for intestinal anastomosis, normal intestinal absorption, no foreign body implantation, protection of the pylorus. LSG is considered the most appropriate option in high-risk obese patients and super-obese patients (4).

All complication risks in abdominal surgeries are similar for sleeve gastrectomy in previous studies. The overall mortality rate was 0.3%. The most common mortality was due to pulmonary embolism, cardiopulmonary failure and gastric fistula (5).

Advantages of LSG can be elaborated as significant weight loss, ease of operation for the surgeon, and no effect on nutrient absorption. Dumping syndrome does not occur because the pyloric sphincter is not damaged. In addition, ghrelin is a hormone that secreted to a certain amount from the gastric fundus, so ghrelin levels decrease after surgery, thus appetite and food intake. Bužga et al. (6) investigated the post-operative serum leptin and ghrelin levels of patients who underwent LSG and (n=37) reported that leptin and ghrelin levels decreased significantly in the postoperative period, whereas adiponectin levels increased. In a systemic review of 24 studies by Brethauer et al. (7) in patients who underwent LSG (n=1662) had a weight loss rate of 55.4% and the remission rate of type 2 diabetes (n=754) was 70%. In the TEMD 2019 Bariatric Surgery Guideline, it has been reported that the rate of excess weight loss is between 55 – 70%, and the remission rate of type 2 diabetes is between 66-81% (8).

Leakage is the most common cause of mortality in LSG. These leaks most often occur in the upper part of the stomach hence, the upper part of the stomach is adjacent to the spleen (4). Based on this situation, it is thought that the increase in the size of the spleen restricts the surgeon's working area during surgery. This may cause an increase in complications, an increase in the number of staples used in the surgery, and a prolongation of the operation time. In our desktop search, up to date we could not find a similar study in the literature.

In patients scheduled for bariatric surgery, examining the spleen dimensions via Ultrasonography (USG) imaging in a routine manner prior to surgery, could help the physician to predict probable complications on bariatric surgery due to spleen size. Briefly, the aim of this research was to elucidate the benefits of spleen USG in pre-operative period to determine the risk of complications in advance.

## Materials and Methods

A total of 316 patients who had undergone LSG in our institution between 01.06.2016 – 01.06.2021 have been retrospectively analyzed. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all participants. The study has been approved at 15/12/2021 by Bursa Yuksek Ihtisas Training and Research Hospital Ethical Committee with protocol number 2021/21-22.

The patients were evaluated pre-operatively in a multidisciplinary approach for LSG. This evaluation included surgeons, anesthesiologists, endocrinologists, pulmonologists, cardiologists, and psychiatrists. Laboratory tests were performed to evaluate the preoperative hormonal and metabolic status of patients. In addition, patients were routinely evaluated with gastroscopy, ultrasonography, Electrocardiograph and pulmonary function test. After this evaluation, patients who were found to have conditions that prevented them from undergoing surgery were excluded from the study. The spleen dimensions of the patients were obtained from the routine USG reports or Computerized Tomography (CT) scans. In this research we took the spleen size as 12 cm from the previous radiological studies in the literature and stated the ones above this reference point (9).

### Surgical Technique

All patients were operated with the same laparoscopic technique in our institution. A total of 5 trocars; 10 mm from the subxiphoid, umbilicus and right subcostal midclavicular line, 12 mm from the left subcostal midclavicular line, and 5 mm from the left subcostal mid-axillary line were inserted. The gastrocolic ligament was opened using energy devices. The stomach was freed by proximally to the pylorus, distally at the angle of hiss. Left crus dissection was routinely performed to evaluate the

presence of hiatal hernia and to fully mobilize the fundus. Gastric resection was performed with an endoscopic stapler, starting 3 – 4 cm proximal to the pylorus, guided by a 36F bougie, which was advanced to the duodenum via the orogastric route by the anesthesia team. After leak control with methylene blue, the gastrectomy specimen was removed from the abdomen, a Jackson-Pratt drain was placed along the staple line.

Patients who had previous upper abdominal surgery (hiatal hernia, gastric band, splenectomy, etc.), people who were operated for revision surgery and those with known hematological disorders were excluded from the study.

### Statistical Analysis

The data collected within the scope of the study were analyzed with SPSS (Statistics For Social Sciences) IBM program version 23.0 (IBM Corp., Armonk, NY). Frequency and percentage were given for categorical data, and median, minimum and maximum descriptive values for continuous data. For comparisons between groups, "Mann Whitney U-Test" was utilized for the two groups, "Pearson Chi-Square or Fisher's Exact Test" was used to compare categorical variables, and "Logistic Regression Analysis" was used to determine risk factors affecting the development of complications. The results were considered statistically significant when the p value was less than 0.05.

## Results

The distribution of demographic and clinical findings according to the spleen size of the participants was given in Table 1. When the table was examined, it was determined that there was a statistically significant difference between the two groups in terms of the number of staples and the duration of the operation ($p<0.05$). It was determined that the number of staples and the duration of surgery were higher in individuals with abnormal spleen size compared to individuals with normal spleen dimensions.

**Table 1. Distribution of Demographic and Clinical Findings of Participants**

| Characteristics | Total (n=316) n (%) or Median (Min–Max) | Normal Spleen Size (n=289) n (%) or Median (Min–Max) | Abnormal Spleen Size (n=27) n (%) or Median (Min–Max) | p |
|---|---|---|---|---|
| Age, year | 39 (18-63) | 39 (18-63) | 35 (18-58) | 0.433 |
| Gender | | | | 0.074 |
| Male | 59 (18.7) | 50 (17.3) | 9 (33.3) | |
| Female | 257 (81.3) | 239 (82.7) | 18 (66.7) | |
| BMI | 43.9 (35-63) | 43.7 (35-63) | 45 (40.1-58.2) | 0.092 |
| Duration of Hospital Stay, days | 6 (3-105) | 6 (3-44) | 7 (4-105) | 0.176 |
| Complications | 27 (8.5) | 24 (8.3) | 3 (11.1) | 0.715 |
| Leakage | 11 (3.5) | 9 (3.1) | 2 (7.4) | 0.240 |
| Bleeding | 16 (5.1) | 15 (5.2) | 1 (3.7) | 1.000 |
| Death | 2 (0.6) | 2 (0.7) | 0 (0) | 1.000 |
| Comorbidity | 116 (36.7) | 102 (35.3) | 14 (51.9) | 0.134 |
| Hypertension | 53 (16.8) | 46 (15.9) | 7 (25.9) | 0.183 |
| Diabetes Mellitus | 40 (12.7) | 35 (12.1) | 5 (18.5) | 0.361 |
| CAD – Arrhythmia | 10 (3.2) | 10 (3.5) | 0 (0) | 1.000 |
| HL | 3 (0.9) | 3 (1) | 0 (0) | 1.000 |
| Asthma – COPD | 22 (7) | 20 (6.9) | 2 (7.4) | 1.000 |
| OSAS | 8 (2.5) | 7 (2.4) | 1 (3.7) | 0.515 |
| Thyroid | 8 (2.5) | 8 (2.8) | 0 (0) | 1.000 |
| **Number of Staples** | **5 (4-9)** | **5 (4-8)** | **7 (5-9)** | **<0.001** |
| **Operation Time, minutes** | **135 (70-290)** | **135 (70-290)** | **185 (155-260)** | **<0.001** |

The results of the logistic regression analysis examining the risk factors affecting the occurrence of complications in patients were given in Table 2. When the table was examined; it was determined that the presence of Coronary Artery Disease (CAD) – arrhythmia and asthma – Chronic Obstructive Pulmonary Disease (COPD) were effective in the development of complications ($p<0.05$). Considering the factors affecting the development of complications, CAD-Arrhythmia increased 5 fold and Asthma-COPD increased 4.9 fold in the development of complications.

There was no statistically significant difference in other demographic and clinical findings.

## Discussion

LSG is among the most effective long-term surgical approaches in the prevention of morbid obesity. It was first described by Gagner in 2003 (10). Staple line leaks and bleeding are among the complications that most affect morbidity and mortality after LSG surgery. Staple line leaks seen after LSG have been reported as 0.5-24% in different studies (11). Despite the developing stapler technology, anastomotic leaks continue to be a serious problem for surgeons. The gastroesophageal junction and proximal stomach region are the most common areas of leakage. Reasons such as technical inadequacy, insufficient blood circulation, local sepsis, and ischemia resulting from insufficient oxygenation are among the generally accepted causes of staple line leaks. Leaks seen in the early period are manifested by symptoms of sudden onset of abdominal pain, tachycardia and fever. However, late period leakage is an important problem as it cannot be detected by abdominal examination findings in most of the patients (12).

**Table 2. Analysis of Risk Factors Affecting the Development of Complications**

| Characteristics * | OR (95% CI) | p |
|---|---|---|
| Age, year | 0.99 (0.95-1.02) | 0.452 |
| BMI | 0.98 (0.90-1.07) | 0.648 |
| Comorbidity | 1.68 (0.76-3.70) | 0.201 |
| Hypertension | 1.14 (0.41-3.16) | 0.800 |
| Diabetes Mellitus | 0.85 (0.24-2.97) | 0.801 |
| CAD – Arrhythmia | **5.04 (1.22-20.74)** | **0.025** |
| HL | NA | NA |
| Asthma – COPD | **4.88 (1.73-13.76)** | **0.003** |
| OSAS | 1.55 (0.18-13.08) | 0.687 |
| Thyroid | NA | NA |
| Number of Staples | 1.49 (0.99-2.23) | 0.055 |
| Operation Time, minutes | 1.00 (0.98-1.01) | 0.418 |

* OR: Odds Ratio; CI: Confidence Interval; NA: Not Applicable.

Early detection of the leak is the most important criterion in reducing the mortality that may occur as a result of abscess, peritonitis, sepsis, and multiorgan failure after staple line leak. The rate of mortality is between 1 – 10% (13). Late determination of this table causes morbidities such as prolonged hospitalizations, repeated hospitalizations and increased treatment costs. Physical examination, inflammatory parameters, and computed tomography are used to detect anastomotic leaks (14).

Leaks occur when intraluminal pressure exceeds tissue or suture line resistance. Mechanical leaks occur within the first 48 hours, and ischemic leaks occur 5 – 6 days after the operation. Leaks are thought to be due to increased tension of the anastomotic line, suture or staple, tissue ischemia, distal obstruction or hematoma (15).

Despite the innovations in staples technology, the most post-operative complications occur due to this stapler line. The most common complications after resection of the staples line are bleeding and leaks (16). Although there is no clear consensus on supporting the stapler line, there are publications recommending it. (17, 18).

Major et al. (2018) reported that the number of stapler firings during LSG could be a possible predictor for perioperative complications after LSG. The median number of stapler cartridges used during LSG procedure was 4 (ranging between 3 – 8), and in multivariate logistic regression analysis, the absolute number of stapler firings was significantly related to a higher rate of postoperative complication (19). Penna et al. (2021) published that high absolute number of stapler firings was linked to increased intraoperative blood loss, postoperative bleeding, and prolonged hospital stay. Their data provided further evidence that the higher number of stapler firings during LSG is an indicator of surgical technique reflecting intraoperative difficulties, increased operation time and finally resulting in a higher rate of post-operative complications, although there was no association with the incidence of staple line leaks (20). Up to date the association of multiple stapler firings and higher risk of anastomotic leakage has already been described in colorectal surgery but not in LSG (21).

At this point we would like to emphasize the anatomical

location of spleen. These leaks most often occur in the upper part of the stomach hence, the upper part of the stomach is adjacent to the spleen (9). The normal size of the spleen should be apprximately 12 cm but in case of enlarged spleen dimensions, it may predispose to post-operative leakege. The increase in spleen size restricts the surgeon's working area during surgery, an increase in the number of staples and prolongation of the operation time. This may cause an increase in complications. In our study, the number of staples and the duration of surgery were higher in individuals with abnormal spleen size compared to individuals with normal spleen dimensions. Additionally, the presence of CAD – arrhythmia and asthma – COPD were effective in the development of complications thus, increasing the duration of hospitalization. Each increase in complications increased the length of stay in the hospital 1.5 fold, while CAD – arrhythmia caused 5 fold and asthma – COPD 4.9 fold. On the contrary no study has yet been published on the influence of asthma and CAD in the development of complications in LSG patients.

The main limitation of this study could be attributed to its retrospective nature. On the other hand up to date this was the first study elaborating the effect of spleen size on the development of complications following LSG.

## Conclusion

Regarding the results of this research, one can state that: in patients scheduled for bariatric surgery, examining the spleen dimensions via USG imaging in a routine manner prior to surgery could help the physician to predict probable complications and difficulty of bariatric surgery due to spleen size.

### Disclosures

**Ethichs Committee Approval:** The study has been approved at 15/12/2021 by Bursa Yuksek Ihtisas Training and Research Hospital Ethical Committee with protocol number 2021/21-22.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

**Authorship Contributions:** Concept – S.A.; Design – S.A.; Supervision – S.A.; Materials – O.F.A.; Data collection and/or processing – O.F.A.; Analysis and/ or interpretation – S.A., O.F.A.; Literature search – S.A., O.F.A.; Writing – S.A.; Critical review – S.A.

## References


1. McCafferty BJ, Hill JO, Gunn AJ. Obesity: scope, lifestyle ınterventions, and medical management. Tech Vasc Interv Radiol 2020;23:100653. [CrossRef]
2. Emile SH, Elfeki H, Elalfy K, Abdallah E. Laparoscopic sleeve gastrectomy then and now: an updated systematic review of the progress and short-term outcomes over the last 5 years. Surg Laparosc Endosc Percutan Tech 2017;27:307–17.
3. Wise ES, Amateau SK, Ikramuddin S, Leslie DB. Prediction of thirty-day morbidity and mortality after laparoscopic sleeve gastrectomy: data from an artificial neural network. Surg Endosc 2020;34:3590–6. [CrossRef]
4. Dietrich A, Aberle J, Wirth A. Obesity surgery and the treatment of metabolic diseases. Dtsch Arztebl Int 2018;115:705–11. [CrossRef]
5. Lbalshy MA, Fayed AM, Abdelshahid MA, Alkhateep YM. Role of staple line fixation during laparoscopic sleeve gastrectomy. Int Surg J 2017;5:156–61. [CrossRef]
6. Bužga M, Zavadilová V, Holéczy P, Švagera Z, Švorc P, Foltys A, et al. Dietary intake and ghrelin and leptin changes after sleeve gastrectomy. Wideochir Inne Tech Maloinwazyjne 2014;9:554–61. [CrossRef]
7. Brethauer SA, Hammel JP, Schauer PR. Systematic review of sleeve gastrectomy as staging and primary bariatric procedure. Surg Obes Relat Dis 2009;5:469–75.
8. Türkiye Endokrinoloji ve Metabolizma Derneği. Bariyatrik Cerrahi Kılavuzu. Ankara: Miki Matbaacılık; 2019. p. 95.
9. Ehimwenma O, Tagbo MT. Determination of normal dimension of the spleen by ultrasound in an endemic tropical environment. Niger Med J 2011;52:198–203. [CrossRef]
10. Gagner M, Rogula T. Laparoscopic reoperative sleeve gastrectomy for poor weight loss after biliopancreatic diversion with duodenal switch. Obes Surg 2003;13:649–54.
11. Jurowich C, Thalheimer A, Seyfried F, Fein M, Bender G, Germer CT, et al. Gastric leakage after sleeve gastrectomy-clinical presentation and therapeutic options. Langenbecks Arch Surg 2011;396:981–7. [CrossRef]
12. de Aretxabala X, Leon J, Wiedmaier G, Turu I, Ovalle C, Maluenda F, et al. Gastric leak after sleeve gastrectomy: analysis of its management. Obes Surg 2011;21:1232–7. [CrossRef]
13. Csendes A, Braghetto I, León P, Burgos AM. Management of leaks after laparoscopic sleeve gastrectomy in patients with obesity. J Gastrointest Surg 2010;14:1343–8. [CrossRef]
14. Endo Y, Ohta M, Tada K, Saga K, Takayama H, Hirashita T, et al. Clinical significance of upper gastrointestinal endoscopy before laparoscopic bariatric procedures in Japanese patients. Surg Today 2019;49:27–31. [CrossRef]
15. García-Gómez-Heras S, Garcia A, Zubiaga L, Artuñedo P, Ferrigni C, Duran M, et al. Prevalence of endoscopic findings before bariatric surgery and their ınfluence on the selection of the surgical technique. Obes Surg 2020;30:4375–80. [CrossRef]
16. Moulla Y, Lyros O, Mehdorn M, Lange U, Hamade H, Thieme R, et al. Preoperative upper-gı endoscopy prior to bariatric

surgery: essential or optional? Obes Surg 2020;30:2076–84.

17. Salama A, Saafan T, El Ansari W, Karam M, Bashah M. Is routine preoperative esophagogastroduodenoscopy screening necessary prior to laparoscopic sleeve gastrectomy? Review of 1555 cases and comparison with current literature. Obes Surg 2018;28:52–60. [CrossRef]
18. Sakran N, Goitein D, Raziel A, Keidar A, Beglaibter N, Grinbaum R, et al. Gastric leaks after sleeve gastrectomy: a multicenter experience with 2,834 patients. Surg Endosc 2013;27:240–5.
19. Major P, Wysocki M, Pędziwiatr M, Pisarska M, Małczak P, Wierdak M, et al. More stapler firings increase the risk of perioperative morbidity after laparoscopic sleeve gastrectomy. Wideochir Inne Tech Maloinwazyjne 2018;13:88–94.
20. Della Penna A, Lange J, Archid R, Hönes F, Königsrainer A, Quante M. Impact of resection volume/stapler firings-ratio on perioperative complications and weight loss after laparoscopic sleeve gastrectomy. Obes Surg 2021;31:207–14.
21. Balciscueta Z, Uribe N, Caubet L, López M, Torrijo I, Tabet J, et al. Impact of the number of stapler firings on anastomotic leakage in laparoscopic rectal surgery: a systematic review and meta-analysis. Tech Coloproctol 2020;24:919–25.