Annals of Medicine and Surgery 62 (2021) 446–449

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Does Laparoscopic Sleeve Gastrectomy lead to Barrett's esophagus, 5-year esophagogastroduodenoscopy findings: A retrospective cohort study

Salman Al Sabah [a,*], Amina AlWazzan [a], Khalifa AlGhanim [a], Hussain A. AlAbdulrazzaq [a], Eliana Al Haddad [b]

[a] Kuwait University, Kuwait City, Kuwait
[b] Al Amiri Hospital, Kuwait City, Kuwait

ARTICLE INFO

Keywords:
Barrett's esophagus
Gastroesophageal reflux disease
Weight loss
Gastric sleeve
Middle east
Arabian gulf

ABSTRACT

Introduction: Laparoscopic Sleeve Gastrectomy (LSG) is one of the most prevalent approaches to tackle obesity and its co-morbidities. The main complication following the LSG is Gastro-esophageal reflux disease (GERD), with most patients developing worsening symptoms of GERD, and a small number progressing to Barrett's esophagus. This retrospective analysis aims to assess the rate of GERD pre- and post- LSG as well as the rate of progression to Barrett's.

Methods: Data was collected from 1639 patients. 92 patients fit our inclusion criteria. Data was then analyzed and summarized against similar literature.

Results: Of 64 (69.6%) patients who had normal EGD findings pre-LSG, only 28 patients (30.4%) had the same results 5 years post-LSG (p= < 0.05). The number of patients who had Grade A GERD almost quadrupled post-LSG, increasing from 3 patients (3.3%) to 14 (15.2%). Patients with esophagitis/gastritis/duodenitis increased from 20 (21.7%) to 32 patients (34.8%). Patients with hiatal hernias increased from 4 (4.4%) to 10 patients (10.9%). The most significant result is that 2 out of 92 patients developed Barrett's Esophagus (2.2%), while 7 other patients developed further serious complications.

Conclusion: LSG is a very effective and safe bariatric procedure. However, the major downslide is that it can lead to the aggravation of GERD symptoms. This paper and the included literature demonstrate that LSG does lead to a substantial increase in the rate of GERD, however, the percentages of Barrett's Esophagus are markedly low. Performing an EGD pre- and post- LSG is an important protocol that aids in the diagnosis and management of LSG related GERD.

1. Introduction

The Middle East has had an alarmingly increasing and dominating number of obesity and its co-morbidities in its population, and therefore, surgical weight loss interventions are consequently increasing in number in that region [1–4].

As of recent years, one of the most prevalent and widely preformed weight loss procedures is the Laparoscopic Sleeve Gastrectomy (LSG) [2,5]. In France during 2011 there was a 43.9% increase in LSG [6], while in the USA, from the years 2010–2014, LSG was the predominant type of bariatric surgery performed according to the American College of Surgeons National Surgical Quality Improvement Program database [7].

Furthermore, surgically induced weight loss has been shown to reduce systemic inflammation that ultimately may contribute to metaplastic changes in the esophagus [8]. LSG, however, has the potential to lead to Gastroesophageal reflux, abnormal gastric and small intestinal emptying and esophageal dysmotility. Gastroesophageal Reflux Disease (GERD) and cholestasis have been shown to be common long-term complications of sleeve gastrostomies [2,6]. De novo acid reflux disease has been found to develop in 1 out of 5 patients [2], impacting the quality of life by requiring lifelong PPI therapy, as well as carrying an increased risk of esophagitis and Barrett's Esophagus [2,5,9].

Abbreviations: Laparoscopic Sleeve Gastrectomy (LSG), Gastroesophageal Reflux Disease (GERD)- Esophagogastroduodenoscopy (EGD)- Enhanced Recovery After Surgery (ERAS); Bariatric Analysis and Reporting Outcome System (BAROS)- Roux-en-Y gastric bypass (RYGB), Body Mass Index (BMI).

* Corresponding author.
E-mail addresses: salman.k.alsabah@gmail.com (S. Al Sabah), amina.t.alwazzan@gmail.com (A. AlWazzan), khalifasalghanim@gmail.com (K. AlGhanim), alabdulrazzaqh@gmail.com (H.A. AlAbdulrazzaq), eliana.h91@gmail.com (E. Al Haddad).

https://doi.org/10.1016/j.amsu.2021.01.096
Received 26 December 2020; Received in revised form 24 January 2021; Accepted 26 January 2021
Available online 31 January 2021

This retrospective analytical paper sets to explore the development of Gastroesophageal reflux disease and its pathological progression into Barrett's Esophagus in patients who underwent a Laparoscopic Sleeve Gastrectomy.

2. Methods

The primary aims of this retrospective analysis is to assess for new or worsening symptoms of GERD, as well as to assess the risk of developing Barrett's esophagus 5 years following an LSG.

The inpatient hospitalization data was collected from October 2008 until October 2013 at a government hospital. A total of 1639 patients who underwent LSG were drafted into this study. Only 92 patients fit our inclusion criteria and had an EGD performed pre-LSG and 5 years post-op. All Esophagogastroduodenoscopy's (EGD) were done at our government hospital by a specialist endoscopist. Patients were excluded from the cohort study population if they had missing or implausible data, had multiple surgeries, and suffered from the common post-sleeve complications, such as leaks, strictures, and hiatal hernias larger than or equal to 2 cm in size. The data was then pooled, and pre- and post-sleeve complications were recorded and pooled against the available data.

2.1. Diagnosis and management

Esophagogastroduodenoscopy (EGD) is the gold criteria for diagnosing Barrett's Esophagus [4]. The esophageal mucosa is best viewed with an upper gastrointestinal endoscopy and was used when patients had not responded to an empirical trial therapy of proton pump inhibitor twice a day.

Surgical management of gastroesophageal disease is indicated for patients with severe, refractory symptoms or complications such as Barrett Esophagus and nonhealing Erosive Esophagitis. Enhanced recovery after surgery (ERAS) protocol was used for post-operative LSG because it reduces care time by over 30% and reduces complications post operatively by over 50%. It has also been shown to reduces the hospital stay from 4.7 to 2.1 days and lowers morbidity rate [10]. Both EGD and ERAS were included in the preoperative step.

2.2. Sleeve gastrectomy technique

The LSG procedure was performed using five laparoscopic ports in a standard split-leg French position. Devascularization of the greater curvature of the stomach was done starting from 4 to 6 cm from the pylorus and up to the angle of His before a 36-Fr calibrating bougie was passed through the stomach to the duodenum. The sleeve was then performed with a linear laparoscopic stapler. Finally, the bougie was pulled proximally and an assessment of leak was done by injection of 100 ml of methylene blue. No intra-abdominal drains were placed.

2.3. Statistical analysis

Statistical analysis of the data was carried out using SPSS software version 22. The significance of the difference between the two values was analyzed using a two-tailed unpaired Student's *t*-test. For all data comparisons, the t-value is 0.072, the p-value is 0.047 and the statistical significance was defined as $p < 0.05$. % excess weight loss (EWL) was calculated using an ideal body weight equivalent to a body mass index (BMI) of 25 kg/m2.

The work has been reported in line with the STROCSS criteria [11].

3. Results

3.1. Preoperative demographics

The average age of the patients included was 34.9 years. The average weight preoperatively was 124 kgs, corresponding to a BMI of 46.8 kg/m^2 (Table 1).

The Los Angeles classification for esophagitis has been used to classify the severity of esophagitis [12]. Preoperatively, the majority of patients (69.6%) had normal EGD findings. 3 (3.3%) patients presented with GERD Grade A [12]. 20 (21.7%) patients presented with esophagitis/gastritis/duodenitis, 4 (4.4%) patients with hiatal hernias, and only 1 (1.1%) patient with a gastric ulcer (Table 2) (See Table 3).

3.2. Postoperative results

Post operatively, the number of patients with normal EGD findings significantly dropped to 28 (30.4%) patients ($p = 0.004$). 14 patients were found to have GERD (15.2%), of which 13 (92.8%) were classified as Grade A and 1 as Grade C [12]. Only one of the 13 patients that were found to have Grade A GERD post-op presented with it preoperatively.

The number of patients that were found to have gastritis/esophagitis/duodenitis increased to 32 (34.8%) postoperatively, while the number of patients with hiatal hernias increased to 10(10.9%), and the patients that were found to have Barrett's esophagus went up from no patients to 2 (2.2%).

There were a few findings that only appeared on the EGD post-operatively, and those included an incompetent cardia in 2 (2.2%) patients, significant constriction was seen in 2 (2.2%) patients, gastric leak in 1 (1.1%) patient, a gastric ulcer in 1 (1.1%) patient and 1 (1.1%) patient developed esophageal candida.

The average length of stay for patients after their LSG procedure was 3.4 days.

4. Discussion

4.1. GERD

Gastroesophageal disease is caused by the reflux of gastric acid into the esophagus, with the main symptom of GERD being heartburn [4]. Physical findings are usually normal, and patients present with the two primary complaints of regurgitation and heartburn. It is considered as an irreversible condition due to the inappropriate relaxation of the lower esophageal sphincter [8,13]. Severe GERD is classified as nocturnal, postprandial and is exacerbated when lying down or bending over. It is a difficult condition to diagnose because most patients misinterpret their pain as chest pain, however, relief with antacid is appropriate enough for diagnosis once ischemic heart disease is excluded [8,13]. When it comes to obese patients, it has been shown that there is a 30–60% risk of GERD in those undergoing sleeve gastrostomies [14], while post-operatively, patients who had an LSG tend to develop even worse symptoms of GERD from when they are first diagnosed [13–15].

4.2. Barrett's esophagus

5–15% of patients that have undergone an endoscopy for symptoms of GERD are shown to have Barrett's esophagus [4]. There is also a 10.1% incidence of Barrett esophagus in patients with uncomplicated gastroesophageal reflux disease [4] It has also been proven that there is a high incidence of hiatal hernias and Barrett's esophagus over a 10 year period following LSG (45% and 15%) respectively [9]. Barrett's is speculated to be caused by GERD which consequently causes the

Table 1
Pre-op demographics of the patients.

Variable	N (SD)
Average age (years)	34.85 (±10.59)
Average BMI (kg/m^2)	46.80 (±9.14)
Length of stay (in days)	3.4
Average height (in cm)	162.94 (±8.13)
Average starting weight (in kg)	124.03 (±24.33)

Table 2
The breakdown of the results (92 patients in total).

Findings	Pre-Op findings (n %)	Post-Op (n %)	P-Value
Normal EGD findings	64 (69.6%)	28 (30.4%)	
GERD	3 (3.3%)	14 (15.2%)	**0.004**
Grade A	3 (3.3%)	13 (92.8%)	**0.007**
Grade C		1 (7.1%)	0.320
Infection (esophagitis/gastritis/duodenitis)	20(21.7%)	32 (34.8%)	0.057
Hiatal Hernias	4 (4.4%)	10 (10.9%)	0.109
Gastric Ulcer	1 (1.1%)	1 (1.1%)	1.000
Barrett's Esophagitis	0	2 (2.2%)	0.158
Other findings only appeared post-LSG:	• 2 patients with incompetent cardias (2.2%) • 2 patients had significant narrowing/constriction (2.2%) • 1 patient had a leak discovered (1.1%) • 1 patient had an ulcer (1.1%) • 1 patient had esophageal candida (1.1%)		

Table 3
The Los Angeles classification of Esophagitis [11].

Grade A	One (or more) mucosal break no longer than 5 mm, that does not extend between the tops of two mucosal folds
Grade B	One (or more) mucosal break more than 5 mm long that does not extend between the tops of two mucosal folds
Grade C	One (or more) mucosal break that is continuous between the tops of two or more mucosal folds but which involves less than 75% of the circumference
Grade D	One (or more) mucosal break which involves at least 75% of the esophageal circumference

development of esophagitis and subsequent metaplastic changes of the esophageal lining [8], with the development of dysplasia and adenocarcinoma being the main concern due to Barrett's [4,8]. Even though intestinal metaplasia in the esophagus is a protective mechanism against further acidic injury, it is associated with a high risk of esophageal adenocarcinoma, given that dysplasia is the most important indicator of potential risk of malignancy. Therefore, pre-existing large hiatal hernias, GERD and Barrett's esophagus are considered contraindications for LSG [9,14].

4.3. Literature review

The exploration of several other literatures included in this section lead to the discovery that this study coincided with some of the previous results that have evaluated the complications and efficacy of LSG, further reinforcing the significance of the results of this study when it comes to GERD and Barrett's post-LSG. Although the Laparoscopic Sleeve Gastrectomy is the most popular weight loss procedure worldwide, and in the Middle East specifically, to this date, there is no significant amounts of data on it.

The most persuasive argument that can be included in the discussion segment of our study is made by the aid of two papers conducted by Genco et al. [9] and Felsenreich et al. [5] Out of 110 patients included in the study by Genco et al., only 19 (17.2%) developed nondysplastic Barrett's Esophagus after preforming an EGD study, whereas erosive gastritis had a substantial increase in both incidence and severity [9]. Although the Felsenreich et al. study showed de novo metaplastic changes of Barrett's Esophagus in 15% of the patients who had an LSG, the troublesome small sample size of 53 patients makes acquiring a concluding thought difficult [5].

When looking at studies performed in the middle east and gulf region, a retrospective review of 121 adolescent patients done at Makassed General Hospital and the American University of Beirut Medical Center, showed a Mean Body Mass Index decrease from 41.83 kg/m^2 to a mean BMI of 28.68 kg/m^2 at 8 years post-LSG follow up. Diabetes, hypertension, and dyslipidemia completely resolved during a 5 year follow up. Gastroesophageal reflux disease was reported in 17.4% of patients initially, and then it decreased to 10.3% in patients who were followed up at a minimum of 5 years. These results are contradictory to our study, where our data showed an increase in documented GERD from 3.3% preop to 15.2% post-op, while the percentage of patients with normal EGD findings decreased from 69.6% to 30.4%.

However, it is important to note that the percentages of symptomatic lithiasis and weight regain that necessitated surgical intervention were 13.7% and 4.5% respectively.

A 5-year follow-up study done in Lebanon had similar findings which showed that the gastric sleeve reduces risks of long-term complications and provides stable and satisfactory weight loss results [3].

Another study conducted in the UAE made a comparison between the indications or complications necessitating reversing a gastric sleeve to a Roux-en-Y gastric bypass procedure after 36 months. Complications of gastric sleeve such as a Hiatal hernia, reflux, leaks, stricture, and helical twists were the main reasons that required the conversion of LSG to a RYGB [16].

An additional study was conducted with data collected from hospitals in Kuwait, KSA and Egypt, in order to evaluate the role of EGD in a morbidly obese population [17]. 3219 underwent bariatric surgery, of which 75% underwent LSG. 28% of those patients had presented with upper digestive symptoms and an EGD was performed. Findings were normal in 2414 (75%) of patients, and the abnormal findings were high only in patients that presented with upper digestive problems [16].

Another Lebanese study preformed a retrospective review that aimed to look into the long-term outcomes of LSG in the middle eastern obese population, specifically 5 or more years post-op. LSG improved or resolved diabetes by a percentage of 87.5%, hypertension by 68%, and asthma by 81.7%. Results were especially excellent for patients with a BMI>45 kg/m^2 [2]. However, new onset gastroesophageal acid reflux disease developed in 21.2% of patients. Long-term complications included hiatal hernias requiring repair in 1.4%, incisional hernias in 2.7%, and symptomatic lithiasis in 9.6% [2].

When compared to our study, only 3.3% of patients presented with GERD Grade A, 4.4% with hiatal hernia and 1.1% with gastric ulcer.

When studying clinically significant EGD findings in an obese Chinese population containing 268 patients, the overall prevalence of abnormal EGD findings was 51.1% [18], which included; gastritis (32.5%), hiatal hernias (17.9%), duodenitis (8.6%) and erosive esophagitis (7.5%); 27.2% had Group B lesions. Older age, the use of NASID and the presence of reflux symptoms were significant risk factors of Group B lesions. However, the negative predictive value in low-risk patients was weak, which calls for routine preoperative endoscopy for all patient undergoing this procedure [18].

4.4. Limitations

This study did present with some challenging limitations. In the context of several strengths and limitations of the general study design, it is a retrospective study not a randomized controlled one. No centralized data were used. It did not include patients who presented with symptoms of GERD prior to LSG. No prior biopsies were taken for Barrett's esophagus. Pre-operative endoscopy is mandatory for all patients, but post-operative EGDs were not preformed or included in this criteria, and therefore we had a smaller sample size than we could have.

5. Conclusion

LSG is a very popular procedure used to eliminate a great percentage of excess weight and obesity-related co-morbidities. Just as any other procedure, it is accompanied by some complications. The main complication explored in this paper is GERD and its accompanying risk

of progression to Barrett's esophagitis. This study and the literature included exhibited a very low percentage of patients developing Barrett's esophagus post-operatively.

LSG is therefore a very safe and effective bariatric procedure that can assist the obese population in reducing the morbidity and mortality associated with obesity and its comorbidities. However explorative EGDs are highly recommended as a precaution and for optimal safety measures.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Sources of funding

N/A.

Author contribution

SAS: study design, writing, proofreading.
AAW: data collection, writing.
KAG: data collection, data analysis.
HAA: data collection, writing.
EAH: writing, proofreading, submission.

Research registration number

1. Name of the registry: ClinicalTrials.gov.
2. Unique Identifying number or registration ID: NCT04587310.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://clinicaltrials.gov/show/NCT04587310/

Guarantor

Dr. Salman Al Sabah.

Informed consent

Informed consent was obtained from all individual participants included in the study.

"Provenance and peer review not commissioned, externally peer-reviewed".

Declaration of competing interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.01.096.

References

[1] A. Al Kadi, Z.R. Siddiqui, A.M. Malik, M. Al Naami, Comparison of the efficacy of standard bariatric surgical procedures on Saudi population using the bariatric analysis and reporting outcome system, Saudi Med. J. 38 (3) (2017) 251–256.
[2] H. Dakour Aridi, R. Alami, H. Tamim, G. Shamseddine, T. Fouani, B. Safadi, Long-term outcomes of laparoscopic sleeve gastrectomy: a Lebanese center experience, Surg. Obes. Relat. Dis. 12 (9) (2016) 1689–1696.
[3] H. Dakour Aridi, G. Khazen, Safadi By, Comparison of outcomes between laparoscopic roux-en-Y gastric bypass and sleeve gastrectomy in a Lebanese bariatric surgical practice, Obes. Surg. 28 (2) (2018) 396–404.
[4] P. Nau, H.T. Jackson, A. Aryaie, A. Ibele, D. Shouhed, E. Lo Menzo, et al., Surgical management of gastroesophageal reflux disease in the obese patient, Surg. Endosc. 34 (1) (2020) 450–457.
[5] D.M. Felsenreich, R. Kefurt, M. Schermann, P. Beckerhinn, I. Kristo, M. Krebs, et al., Reflux, sleeve dilation, and Barrett's esophagus after laparoscopic sleeve gastrectomy: long-term follow-up, Obes. Surg. 27 (12) (2017) 3092–3101.
[6] R. Caiazzo, F. Pattou, Adjustable gastric banding, sleeve gastrectomy or gastric bypass. Can evidence-based medicine help us to choose? J. Vis. Surg. 150 (2) (2013) 85–95.
[7] Z. Khorgami, S. Shoar, A. Andalib, A. Aminian, S.A. Brethauer, P.R. Schauer, Trends in utilization of bariatric surgery, 2010-2014: sleeve gastrectomy dominates, Surg. Obes. Relat. Dis. 13 (5) (2017) 774–778.
[8] B. Andrew, J.B. Alley, C.E. Aguilar, R.D. Fanelli, Barrett's esophagus before and after Roux-en-Y gastric bypass for severe obesity, Surg. Endosc. 32 (2) (2018) 930–936.
[9] A. Genco, E. Soricelli, G. Casella, R. Maselli, L. Castagneto-Gissey, N. Di Lorenzo, et al., Gastroesophageal reflux disease and Barrett's esophagus after laparoscopic sleeve gastrectomy: a possible, underestimated long-term complication, Surg. Obes. Relat. Dis. 13 (4) (2017) 568–574.
[10] M. Trotta, C. Ferrari, G. D'Alessandro, G. Sarra, G. Piscitelli, G.M. Marinari, Enhanced recovery after bariatric surgery (ERABS) in a high-volume bariatric center, Surg. Obes. Relat. Dis. 15 (10) (2019) 1785–1792.
[11] R. Agha, A. Abdall-Razak, E. Crossley, N. Dowlut, C. Iosifidis, G. Mathew, et al., STROCSS 2019 Guideline: strengthening the reporting of cohort studies in surgery, Int. J. Surg. 72 (2019) 156–165.
[12] L.R. Lundell, J. Dent, J.R. Bennett, A.L. Blum, D. Armstrong, J.P. Galmiche, et al., Endoscopic assessment of oesophagitis: clinical and functional correlates and further validation of the Los Angeles classification, Gut 45 (2) (1999) 172–180.
[13] S.A. Brethauer, J. Kim, M. el Chaar, P. Papasavas, D. Eisenberg, A. Rogers, et al., Standardized outcomes reporting in metabolic and bariatric surgery, Surg. Obes. Relat. Dis. 11 (3) (2015) 489–506.
[14] C. Asge Standards Of Practice, J.A. Evans, V.R. Muthusamy, R.D. Acosta, D. H. Bruining, V. Chandrasekhara, et al., The role of endoscopy in the bariatric surgery patient, Surg. Obes. Relat. Dis. 11 (3) (2015) 507–517.
[15] R. Kavanagh, J. Smith, U. Bashir, D. Jones, E. Avgenakis, P. Nau, Optimizing bariatric surgery outcomes: a novel preoperative protocol in a bariatric population with gastroesophageal reflux disease, Surg. Endosc. 34 (4) (2020) 1812–1818.
[16] J.S. Barajas-Gamboa, J. Landreneau, C. Abril, J. Raza, R. Corcelles, M. Kroh, Conversion of sleeve gastrectomy to Roux-en-Y gastric bypass for complications: outcomes from a tertiary referral center in the Middle East, Surg. Obes. Relat. Dis. 15 (10) (2019) 1690–1695.
[17] M.E. Abd Ellatif, H. Alfalah, W.A. Asker, A.E. El Nakeeb, A. Magdy, W. Thabet, et al., Place of upper endoscopy before and after bariatric surgery: a multicenter experience with 3219 patients, World J. Gastrointest. Endosc. 8 (10) (2016) 409–417.
[18] J. Lee, S.K. Wong, S.Y. Liu, E.K. Ng, Is preoperative upper gastrointestinal endoscopy in obese patients undergoing bariatric surgery mandatory? An asian perspective, Obes. Surg. 27 (1) (2017) 44–50.