Management of leak after laparoscopic sleeve gastrectomy: a retrospective analysis of a single-center experience

Amr H. Afifi, Mostafa Nagy, Mohammed Matar

Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Amr H. Afifi, MD, Zip Code 11772. Tel: 01007872550; E-mail: dr_amrhamed1984@yahoo.com

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Introduction

Laparoscopic sleeve gastrectomy (LSG) is the most commonly performed bariatric surgery around the world. It is characterized by technical simplicity, better perioperative morbidity, and relative ease of revision. However, it is not without complications. Leakage occurs in around 1–3% of those undergoing primary LSG and around 10% in those with revisional surgery. Management plans vary considerably with a wide spectrum of options. This can range from conservative nonoperative treatment to conversion to another bariatric operation. This study aims to share our center's experience in the management of leaks after LSG with its outcomes and adverse events and to correlate the clinical-laboratory picture with imaging modalities in patients with leaks.

Patients and methods

This is a retrospective analysis of a prospectively maintained data for patients presenting to our center with leaks after LSG. A total of 23 patients (N=23) were included in this analysis. Collected data included vital data [heart rate (HR), respiratory rate (RR), and body temperature], laboratory data (total leukocyte count, C-reactive protein, and erythrocyte sedimentation rate) as well as data from pelviabdominal computed tomography scan with oral and IV contrast. Females constituted 69.6% of patients. Mean age was 43.91 ± 6.54 years and mean preoperative BMI was 44.48 ± 6.53. Patients were grouped according to treatment modality into three groups. Group I was successfully treated with conservative management. Group II underwent laparoscopic drainage and endoscopic self-expandable metallic stents. Group III patients were managed by conversion to one anastomosis gastric bypass.

Results

Median leakage time was 10 days. Early leakage (<3 days) occurred in 8.7%, intermediate leakage (3–14 days) occurred in 60.9%, and late leakage (>14 days) occurred in 30.4%. Only one patient (4.35%) had the HR, temperature, and RR within normal ranges. Elevated values of HR, temperature, and RR were recorded in 91.3%, 95.6%, and 91.3%, respectively. Group I had 0% complications. Group II patients had stent migration in 21.42% of cases and persistent vomiting in 35.71% of patients, respectively. Group III patients had bleeding in 28.57%, respiratory tract infection in 14.29%, and wound infection in 14.29%.

Conclusion

Leakage after LSG is a dreadful complication. However, with appropriate management the outcomes can be substantially improved.

Keywords:
complications, laparoscopic sleeve, leakage, metabolic surgery

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Introduction

Sleeve gastrectomy (SG) was first described by Hess and Hess (1998) as part of biliopancreatic diversion with duodenal switch in 1990 [1]. It is a procedure during which greater curvature of the stomach is removed reducing the gastric volume by around 80%. Laparoscopic sleeve gastrectomy (LSG) provides a favorable profile with its technical simplicity, better perioperative morbidity profile, shorter operative time, and the ability to be revised or used as part of multistaged operation [2]. For these reasons, the registry-based results, which is operated by the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) evaluated 394 431 operations performed in 54 countries and noted that LSG has been the most common bariatric surgery performed accounting for 46.0% of the total operations [3]. Despite its advantages, LSG is not without complications. Bleeding is the most frequent

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complication occurring after LSG with an incidence of 1.16–4.94% of the patients [4]. The most dreadful complication after LSG is leakage. It occurs in around 1–3% in those undergoing SG for the first time and around 10% in those with revisional surgery [5]. Leakage has a wide range of presentations, from asymptomatic and diagnosed incidentally to the fully blown clinical picture of septic shock. Patients usually have elevated total leukocyte count (TLC), procalcitonin, and C-reactive protein (CRP) [6]. Diagnosis of leakage depends mainly on abdominal, contrast-enhanced computed tomography (CT) scanning with virtual gastroscopy. In a multicenter study examining the utility of contrast CT scan, authors reported a detection rate of 86% of the patients with a sensitivity of 83–93% and specificity of 75–100% [7].

Management plans can vary considerably, with a spectrum ranging from conservative management to reoperation. Stable patients with favorable conditions can be safely managed conservatively with focused follow-up. Those patients suffering from more severe leakage manifestations at presentation or having multiple comorbidities may require open or laparoscopic peritoneal lavage with or without stent insertion [6].

The objectives of the study are to share our center's experience in the management of leakage after LSG. The clinical picture and laboratory results are correlated with CT findings in patients presenting with leaks. It also examines various management options and their anticipated outcomes and complications.

Patients and methods

This is a retrospective analysis of a prospectively maintained data for patients presenting with leaks after LSG to our bariatric department in El-demerdash Surgical Hospital, Egypt. The study setting is a Tertiary University Hospital in a middle-income country. Between May 2019 and January 2022, a total of 23 patients presenting to our center were included in the analysis. This study was conducted in full accordance with all applicable Research Ethics Committee (REC) principles and the Local Ethics Committee approved the study.

Data collected

Data collected included demographics such as sex and age; anthropometrics such as weight, height, and BMI; and baseline clinical data such as heart rate (HR), temperature (T), and respiratory rate (RR). Knowing that these parameters tend to change over time and may reflect diurnal variation, we chose the highest values recorded in patients' sheets to be included in the analysis. Follow-up of these signs was done regularly and documented in the original sheets. Local guidelines in our institute dictate that all patients who were suspected to have a leakage after LSG should have CBC with TLC, CRP, and erythrocyte sedimentation rate measured. We derived data regarding the site (upper, middle, or lower leakage) and size of leakage, abdominal collection, and presence or absence of pleural effusion using pelviabdominal CT with oral and IV contrast (c-PACT). Various treatment options were examined regarding feasibility and outcomes.

Data collected included baseline data of the patients presenting with leaks after LSG. We explored the relation between baseline characteristics and temporal presentation of leaks. Sensitivity of clinical data and vital signs in predicting leakages as well as correlation between changes in vital signs and severity of leakage were examined.

Treatment modalities

Management plans varied considerably based on the clinical presentation, general condition of the patients, type of leakage, and the technical expertise present. Two patients presented with more subtle presentation and less morbidities were treated conservatively with nil per os, adequate IV hydration, proton-pump inhibitors, nutritional support, percutaneous draining of any collection, broad-spectrum antibiotics, and follow-up weekly by c-PACT to ensure complete healing of leakage (group I). Nine patients were treated with laparoscopy and placement of self-expandable metallic stents (group II). Laparoscopic drainage was performed first, and stents various sizes (7 and 10 Fr) were placed according to the collection extent, size and shape. After 4–6 weeks, upper gastrointestinal (GI) endoscopy was performed for follow-up. If the leakage was closed, the stent was removed. On the other hand, if the leakage was still present, the stent was replaced by a new one.

Group III patients required conversion to one anastomosis gastric bypass (OAGB)+feeding jejunostomy. These patients presented with leakage associated with sleeve stricture.

Statistical analysis

Data entry was done through a Microsoft Excel spreadsheet (IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp). All continuous variables were expressed as mean±SD of the mean as a measure of variability of data. Normality assumptions were checked first through Kolmogorov–Smirnov test. Frequency data were summarized as percentages. For continuous variables analysis of variance or Mann–

Whitney *U*-test were used as appropriate. Comparison of categorical data was done through χ^2-test or Fischer's exact test as appropriate. Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp. All *P* values less than 0.05 were considered as statistically significant results.

Results

Baseline data

This study included 23 patients (*N*=23), who developed leakage after LSG operation. Sixteen patients (69.6%) were females. Patients' mean age was 43.91 ± 6.54 years (minimum 33 and maximum 55). Mean preoperative BMI was 44.48 ± 6.53 (minimum 35, maximum 55). Table 1 summarizes baseline data of the patients.

Leakage was classified as early (<3 days), intermediate (3–14 days), and late (>14 days). Median leakage time was 10 days. Leakage less than 3 days occurred in two patients (8.7%), between 3 and 14 days occurred in 14 (60.9%) patients, and late leakage occurred in seven patients (30.4%).

Multinomial regression analysis did not reveal any significant factor predicting the timing of leakage ($P>0.05$); neither age, sex, preoperative height, BMI, nor weight was significant. In females, leakage tended to occur at a mean of 10.81 ± 6.59 days, for males it occurred around 12.29 ± 6.24 days. Mean leakage time for patients younger than 40 years, leakage was 8 ± 5.8 days, for those older than 40 the mean leakage time was 12.41 ± 6.33 days. Patients with a BMI of less than 40 had a mean leakage time of 12.75 ± 8.12; those between 40 and 50 had a mean time of 9.9 ± 5.65 days; and those more than 50 had a mean time of 11.6 ± 5.23 days. Figures 1 and 2 provide further elaboration regarding sex and preoperative BMI and the timing of leakage.

Clinical data and imaging modalities

Suspicion of leakage started by clinical examination focusing on vital data that were followed to detect trends, and the highest measurement was recorded. Mean HR recorded was 119.35 ± 14.45 beats/min; mean RR was 25.22 ± 3.22 breaths/min with a mean T of 38.44 ± 3.8°C. In 91.3% of the patients, we found at least one HR measurement above normal (defined as HR >100/min). Temperature was above normal in 95.6% of the patients (defined as T>37.5°C) and 91.3% had RR above normal (defined as RR >20 breaths/min). Only one patient (4.35%) had all his vital signs within normal range. This patient proved to have a minor collection on the subsequent c-PACT scan.

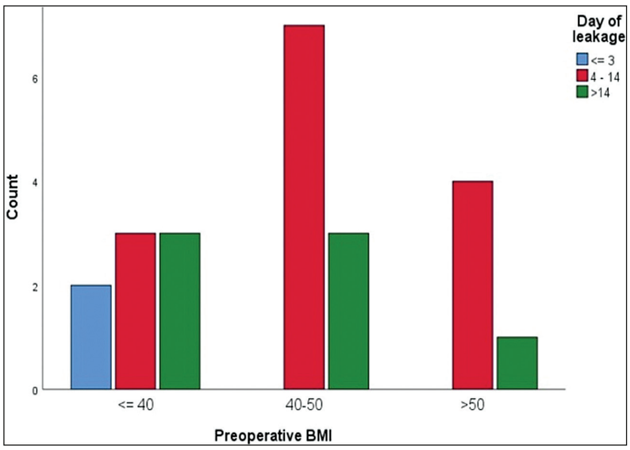
Table 1 Baseline characteristics of patients

Baseline data	Values [*n* (%)]
Number	23
Sex	
Female	16 (69.6)
Male	7 (31.4)
Mean age±SD	43.91 ± 6.54
Mean BMI±SD	44.48 ± 6.53
Leakage	
Early (<3)	2 (8.7)
Intermediate (3–14)	14 (60.9)
Late (>14)	7 (30.4)

TLC, CRP, and erythrocyte sedimentation rate were requested for all suspected patients. Only two patients (8.7%) were normal and all the remaining 21 patients had one of these laboratory tests elevated above normal. Pelviabdominal CT with oral and IV contrast was performed in all patients, A minor collection was reported in two patients (8.7%), moderate collection in eight (34.8%), and a large collection in 13 patients (56.5%). Pelviabdominal CT scan with contrast was done for all patients. It revealed upper leakage in 16 patients (69.6%), middle leakage in three (9.7%), and lower leakage in four patients (12.9%). Table 2 summarizes all the clinical, laboratory, and imaging data.

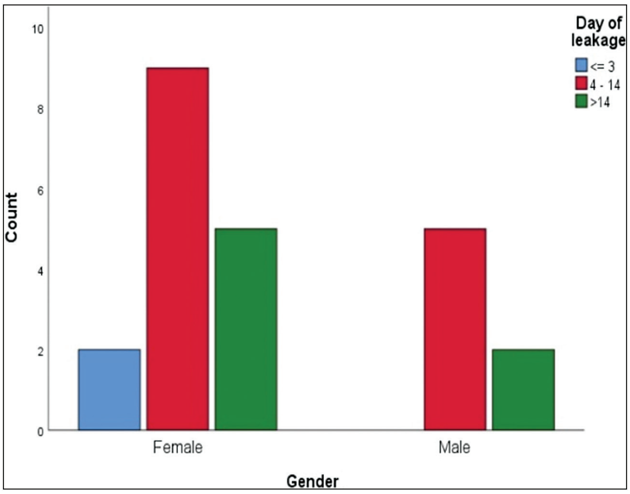
We performed a linear regression for the factors that may be contributing to changes in clinical data. Neither age, sex, preoperative weight, height, or days of leakage was significant ($P>0.05$) in predicting changes in HR, temperature, or RR. This also applied to the multinomial regression that was performed for the amount of fluid collection and CT-detected leakage site. The same predictive values used in linear regression were not significant ($P<0.05$), despite the model showing good fit.

Figure 1



Preoperative BMI and day of leakage differences.

Figure 2



Sex differences and its effect on leakage timing.

Table 2 Summary of the clinical, laboratory, and imaging data

Clinical parameter	Mean±SD	Percentage above normal (%)
Heart rate	119.35±14.45	91.3
Temperature	38.44±3.8	95.6
Respiratory rate	25.22±3.22	91.3
Total	–	95.6
Laboratory and radiology data		
TLC, CRP, ESR	Positive	21 (91.3)
	Negative	2 (8.7)
Abdominal CT scan leakage site	Upper leakage	16 (69.6)
	Middle leakage	3 (9.7)
	Lower leakage	4 (12.9)

CRP, C-reactive protein; CT, computed tomography; ESR, erythrocyte sedimentation rate; TLC, total leukocyte count.

One-way analysis of variance was calculated to correlate the laboratory findings with imaging. For severity of pelvic collections as diagnosed by c-PACT (minor, moderate, severe), it was correlated with increasing changes in HR, RR, and temperature (P<0.0001, 0.001, and 0.0001, respectively). The effect did not persist for pleural effusion (P>0.05), except for the marginally significant correlation between the severity of effusion and changes in body temperature (P=0.05). Based on the site of leakage as guided by c-PACT, no significant difference was found between upper, middle, and lower leaks in HR, RR, and temperature (P>0.05).

Treatment options and complications

Choice of the management modality was guided by patients' general condition and type of leakage (Fig. 1). Two patients (8.7%) underwent successful conservative management (group I), the leak was closed on follow-up upper GI endoscopy and c-PACT . Of the patients,14 (60.9%) required laparoscopic drainage together with endoscopic stent placement (group II); 11 patients had the leak orifice closed on follow-up upper GI and c-PACT; and three patients had stent migration and leak was not closed so they needed endoscopic removal of the migrated stent and reinsertion of stent, which was later on removed after the leak was closed and seven (30.4%) patients were treated by conversion to OAGB (group III). No complications were recorded in the conservative management group, in eight patients (57.14%) in group II and four patients (57.14%) in group III. Complications occurred in patients managed by laparoscopy and stent drainage such as persistent vomiting in five patients (35.71%), who were managed by proton-pump inhibitors and their condition improved after stent removal. In those managed with OAGB, complications were bleeding in two patients (28.57%) and were managed conservatively; there was respiratory tract infection in one patient (14.29%) and wound infection in another one (14.29%). Table 3 summarizes these findings.

Table 3 Management lines and their complications

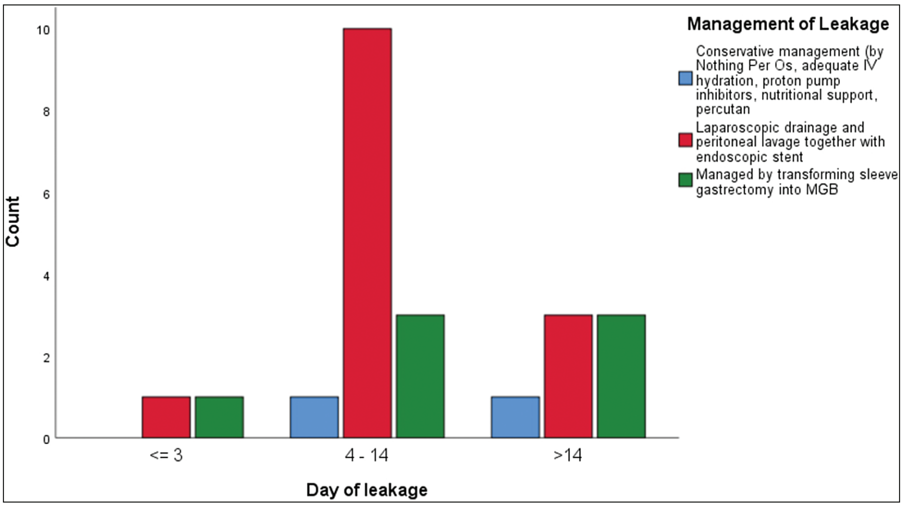
Procedure done	Complications anticipated	*N* (%)
Conservative management	–	0
Laparoscopy and stenting	Stent migration	3 (21.42)
	Vomiting	5 (35.71)
Minigastric bypass conversion	Bleeding	2 (28.57)
	Respiratory tract infection	1 (14.29)
	Wound infection	1 (14.29)

Depending on the timing of leakage, those presenting with early leakage were managed with either laparoscopic drainage and stent placement (one patient) or conversion to MGB in another. No patient was managed with conservative treatment in this stratum. For most of the patients presenting with intermediate leakage, the treatment plan was mainly with laparoscopic drainage and stenting in 10 patients (71.4%), conversion to OAGB in three patients (21.4%), and conservative management in one patient (7.1%). Those presenting with late leakage were treated with either drainage and stenting or OAGB conversion (three patients, 42.9%) for each option, and conservative treatment in one patient (14.3%). Figure 3 gives a visual representation of these findings.

Discussion

In this retrospective analysis of 23 patients presenting to our center with leakage after LSG, 60.9% of leaks detected occurred between 3 and 14 days after the operation. In patients with suspected leakage, proper history taking and clinical examination focusing on patients general condition should be made. Vital data seemed to be sensitive in our patients; however, continuous monitoring of vital data rather

Figure 3



Management of the leakage based on presentation timing.

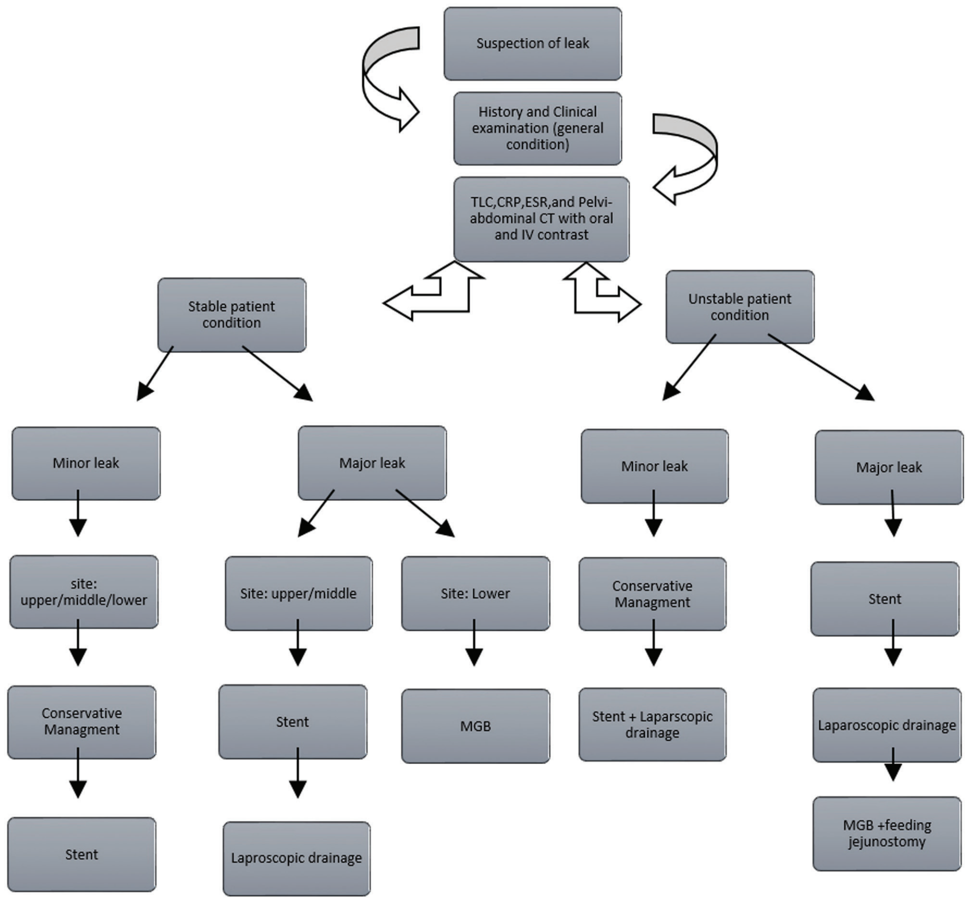
than accounting on single measurement should be considered. Laboratory markers came negative in two patients (8.7%), and those patients showed a more favorable course on the subsequent radiology and follow-up. Pelviabdominal CT scanning with oral and IV contrast can effectively determine the site of leakage, with most of the leaks occurring in the upper part (around 70% of cases). These leaks were associated with concomitant pleural effusions.

Stable patients with minor leak and contained collection were managed conservatively. In case of failure with persistent leak, self-expanding metallic stent insertion was carried out. Patients who were stable and had major leakage were managed by self-expanding metallic stent in upper and middle leakage unlike patients with lower leakage who had conversion to one OAGB surgery. Unstable patients with minor leakage were managed conservatively, and then laparoscopic drainage and stent insertion were performed. Patients who were unstable and had major leakage were managed by laparoscopic drainage and stent insertion. If failed, OAGB with feeding jejunostomy was done. Management algorithm for patients with leakage is shown in Figure 4. Stent migration occurred in 21.42% and postoperative persistent vomiting occurring in 35.71%. Bleeding and infectious complications following conversion to MGB occurred in 14.29% for each complication.

The pioneering study by Alizadeh and colleagues based on the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) database sheds light on the predictors and risk factors for leaks after bariatric surgery. This retrospective cohort noted that around the world the incidence of leakage decreased to only 0.5% after LSG. This study highlighted that performing intraoperative provocation testing (endoscopic vs. air insufflations or methylene blue dye injection) was associated with a higher risk of postoperative leak (0.8 vs. 0.4%, respectively, P<0.01). In our study, however, we were not able to document exactly the number of provocation tests performed; however, this is performed frequently in our center. Placement of abdominal surgical drains greater than 30 days was also associated with higher risk for leakage (1.6 vs. 0.4%, respectively, P<0.01). Important factors that were associated with increased risk of leakage were hypertension [adjusted odds ratio (AOR), 1.36), diabetes mellitus (AOR, 1.18), and sleep apnea (AOR, 1.52)] [8].

Similar to our study a study by Bashah and colleagues reported the outcomes of a single center in the treatment of leaks after LSG. Authors shared the management algorithm in their center. Stable patients were managed conservatively followed by CT-guided drainage and endoscopy±intervention and lastly total parenteral nutrition. Unstable patients were managed with laparoscopic drainage followed by endoscopy±intervention and lastly feeding jejunostomy versus peripherally inserted central line insertion according to surgeon's preference. In their study, 34 (46.6%) patients were treated conservatively; 54 (73.9%) of their patients were treated with endoscopic stent placement; however, they did not report the exact number of complications and only mentioned that 'life-threatening stent complications occurred' [9]. In our study, nine patients required laparoscopic drainage. Stent migration occurred in 21% of the cases, this contrasts the results of van Wezenbeek *et al.* [10], which described stent migration in 66.7% of patients.An older study by Csendes and colleagues reported fever as the most frequently encountered clinical finding. This mirrors

Figure 4



Management algorithm for patients with leakage.

our results where 95.6% of the patients had fevers above the normal range, outperforming HR and RR. While they diagnosed leak with liquid sulfate barium, we depend on pelviabdominal CT scan with oral and IV contrast. However, we could not find out the exact rate of negative findings in c-PACT. In their study, early leaks (those between the first and fourth day postoperatively) occurred in 44% of the patients. In our study, early leaks occurred in 8.7% of the patients. However, some discrepancy exists in the definition between the two studies. Most of the leaks in their study occurred in the upper part of the sleeve (14 patients; 87.5%). This is similar to our findings where 16 patients (69.6%) had upper part leakage [11].

The main limitation of this study is its retrospective nature; however, it reports a fair number of patients from a single tertiary referral center in a resource-limited country. Being a single-center study may limit generalization of the results. One major drawback of this study is the absence of the total number of LSGs performed to detect the overall leakage rate and compare it with other studies. Other limitations include the absence of baseline comorbidities such as hypertension, diabetes mellitus and obstructive sleep apnea, and baseline vital and biochemical data of the patients. Nevertheless, this study provides a preliminary basis for the management of leakage after sleeve gastrectomy.

Conclusions

Leakage after LSG is a dreadful complication. Clinical and laboratory data should be examined very carefully as they are useful markers for the detection of leakage process. Multiple management plans are available with varying success and adverse outcome profiles.

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Nil.

Conflicts of interest

No conflict of interest.

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