Journal of
Obesity and Chronic Diseases

https://doi.org/10.17756/jocd.2025-054

Research Article

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Outpatient Sleeve Gastrectomy Leak Rates and Their Management

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Received: August 03, 2025
Accepted: September 10, 2025
Published: September 16, 2025

Citation: Correia VP, Gomes OC, Lalanda R, Marques P, Nogueira F, et al. 2025. Outpatient Sleeve Gastrectomy Leak Rates and Their Management. *J Obes Chronic Dis* 9(1): 22-30.

Published by United Scientific Group

Abstract

Introduction: Sleeve gastrectomy (SG) is now a widely performed bariatric procedure; however, staple-line leaks remain a challenging adverse event. This study evaluates leak rates, management strategies, and weight loss outcomes after ambulatory laparoscopic SG.

Methods: 567 consecutive patients were analyzed with severe obesity who underwent outpatient laparoscopic SG between 2019 and 2022 at a tertiary hospital. Among these, 20 patients with endoscopically confirmed staple-line leaks were compared to the remaining 547 patients without leaks (controls). Demographic data, surgical details, leak time to clinical presentation, management strategies, and longitudinal weight loss metrics (assessed at 3, 6, 12, 24, and 36 months) were evaluated and analyzed using appropriate statistical tests.

Results: The overall leak rate was 3.52% (n = 20). Patients in the leak group had significantly lower baseline median body mass index (BMI) and excess body weight (EBW) compared to controls. The median time from initial surgery to endoscopic diagnosis was 10 (1 - 49) days with all leaks located proximally. Median fistula orifice size was 4 (2 - 20) mm with 85% (n = 17) being small defects (< 10 mm diameter). Endoscopic management achieved closure of fistula orifice in 100% (n = 20) of patients with a median leak closure time of 10 (2 - 22) weeks with repeat sessions when needed. Weight loss outcomes in patients with leaks were significantly inferior at 12, 24, and 36 months compared to controls.

Conclusion: Outpatient SG carries a low but significant risk of leaks. Early detection and endoscopic treatment yield effective leak management while maintaining acceptable long-term weight loss outcomes. Further prospective studies are warranted.

Keywords

Obesity, Bariatric surgery, Sleeve gastrectomy, Leak management, Endoscopy

Introduction

In the early 2000s there was a surge in the utilization of bariatric surgery for management of obesity which coincided with advances in and large-scale adoption of laparoscopy [1]. SG was initially described in 2003 as a simplification of the duodenal switch, in which a partial pylorus-sparing vertical gastrectomy is performed with resection of the fundus, body and antrum along the greater curvature of the stomach [2]. Despite initial slow adoption, it gained much traction after the American Society for Metabolic and Bariatric Surgery (ASMBS) issued a position statement in 2012 endorsing the vertical SG as an effective and safe stand-alone bariatric procedure [3]. SG has now replaced the Roux-en-Y gastric bypass (RYGB) as the most performed bariatric operation in the United States [4]. Its effectiveness RYGB s is deemed to stem not only from the restriction it provides but also from the hormonal changes and metabolic improvement it produces as consequence of reduced ghrelin serum concentration, which leads to decrease in hunger signaling as well as anorexigenic gut hormone production, as part of the hind-gut effect, in the distal bowel, leading to increase in glucagon-like peptide-1 and peptide YY concentrations [5].

In the latest position paper of the ASMBS, a review of studies that included a total of 2248 patients with ≥ 5 years follow-up, showed that SG had a long-term success with percentage excess weight loss (%EWL) of 37 - 86% and good safety profile [6]. It seems that the SG's perceived simplicity and reproducibility may have distracted awareness from staple line leaks, bleeding and gastric tube stricture [7]. Reported leak rates are variable, ranging from as low as 0% to 4.6% for primary operations to as high as 10% in revisional procedures [8]. Their management is also not standardized, with several authors proposing different approaches [9].

Gastric leak is defined as the "leak of luminal contents from a surgical anastomosis between two hollow viscera or an effluent of gastrointestinal content through a suture line" [10]. Leaks can also be defined by the timing of diagnosis according to the International SG Expert Panel Consensus into "acute" if observed within 7 days of primary procedure, "early" if occurring between 1 – 6 weeks after SG, "late" if observed after the 6th week and "chronic" if lasting more than 12 weeks. Based on localization, they can also be classified as proximal or distal, with the consensus statement proposing stenting as a viable option for management of acute proximal leaks and conversion to RYGB in proximal chronic leaks [10, 11].

This retrospective observational study reports on 567 patients who underwent laparoscopic SG at a single tertiary university hospital. We aimed to determine the incidence of fistulas after SG performed on an outpatient basis, efficacy and time to fistula closure with a primarily endoscopic management strategy as well as to demonstrate the weight loss achieved at defined time intervals in these patients compared to those who did not develop fistulas.

Methods

Study population

This retrospective observational study included 567 consecutive patients with severe obesity who underwent laparoscopic SG as an outpatient, ambulatory procedure as per institutional and departmental protocol between 2019 and 2022. Cases were retrospectively analyzed, and the occurrence of staple-line leak was identified in 20 patients (Figure 1) who presented to the emergency department with abdominal pain, fever, nausea or vomiting. Those patients whose diagnostic workup was found to be suspicious of leaks, including a positive oral contrast computed tomography (CT) scan, and

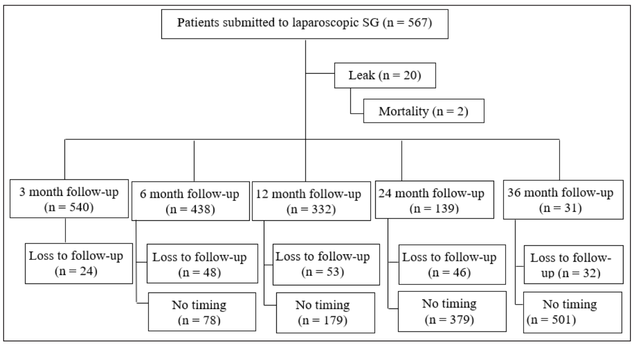

Figure 1: Flowchart of patient inclusion in the study.

ultimately had an esophagogastroduodenoscopy confirming its presence make up the study group (n = 20) while patients submitted to SG without a diagnosed leak were designated as the control group (n = 547). Follow-up periods were defined as 3, 6, 12, 24, and 36 months after surgery.

All procedures were performed in accordance with the ethical standards of the institutional committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Individual patient informed consent has been obtained prior to each procedure for all patients.

Outcome measures

Primary outcomes included incidence of fistulas after SG, time to diagnosis, size of fistula orifice, choice of management strategy and time to fistula closure. Secondary outcomes included the assessment of weight loss related metrics at defined follow-up intervals among cases and controls.

Procedure

Patients with severe obesity referred to our center were evaluated by a multidisciplinary team composed of surgeons, endocrinologists, gastroenterologists, nutritionists and psychologists. Each patient had to obtain approval from all aforementioned groups as well as undergo an upper gastrointestinal endoscopy with negative biopsy results for *Helicobacter pylori* or, in case of positivity, eradication had to be performed and a subsequent breath test with negative result had to be present in order to be considered apt for surgery. Patients with large hiatal hernias (>3 cm) and gastroesophageal reflux symptoms were excluded. Patients approved for surgery underwent SG in a dedicated ambulatory center in our institution and were admitted on the morning of the procedure.

The procedure was standardized with patients under general anesthesia, placed in "beach-chair" position and a 3-port approach (10 mm camera port in the epigastric region, 5 mm working port on the right hypochondrium and 15 mm port in the left hypochondrium). Gastrocolic ligament ligation was initiated close to the greater curvature at the region of the antrum-body transition and continued cranially up until the left diaphragmatic crus with full mobilization of the gastric funds. A 48 Fr bougie was then inserted for calibration and antrum-sparing gastric division was performed with Signia™ Linear Stapler with Tri-Staple™ Technology (Medtronic Inc., Minneapolis, MN), non-buttressed, black 60 mm cartridges.

The resected portion of the stomach was removed through the 15 mm port and hemostatic revision was conducted with occasional necessity of laparoscopic hemostatic clip placement. Finally, staple-line reinforcement with fibrin glue sealant (Tisseel™) was performed in all patients [12]. After surgery, patients were observed in a post-surgical anesthesia care unit and discharged to the ward after 4 - 6 h, at which point clear liquid diet was initiated at a maximum of 50 cc every 2 h. At approximately 12 h post-op, a member of the surgical team rounded on the patients, which were then discharged home if no clinically worrisome signs or symptoms were present.

Managements of leaks after SG

Patients presenting with abdominal pain, nausea and vomiting, fever or respiratory distress after SG were evaluated in the emergency department. All patients underwent laboratory and imaging evaluation with abdominal CT scan with oral contrast and when required oral methylene blue ingestion. CT scans with abdominal collections, positive air bubble sign and extravasation of contrast were considered highly suggestive or diagnostic of fistula after SG.

Time to endoscopy (Figure 2) in days was defined as the time between the date of SG and the first endoscopy with therapeutic intent to close the fistula orifice. Urgent endoscopy was performed, usually within 24 - 48 h after clinical/imaging suspicion of leak and was considered diagnostic of a fistula on identification of leak orifice with extravasation of contrast.

A primarily endoscopic approach (Figure 3) with additional laparoscopic peritoneal lavage and drainage with 32 Fr tubular drains, not necessarily performed concomitantly, in patients with abdominal collections and evidence of sepsis has been standard of care in our institution. When required, IR assisted in draining intra-abdominal or pelvic collections.

On endoscopy, the location and diameter of fistula orifice in mm was noted. In patients with fistula orifice <10 mm, over-the-scope clips (OTSC) were often considered as first line therapy. A specifically designed endoprosthesis for management of fistulas after bariatric and oncologic surgery on the upper digestive tract, Luso-Cor® esophageal stent has been used as first line therapy irrespective of the size of the fistula orifice. The specific design features of the stent have been associated with low migration rates and high efficacy in fistula closure in a pilot study involving 15 patients [13, 14].

Technical success was defined as immediate successful deployment of the chosen endoscopic device (stent or clip) leading to cessation of active contrast extravasation on the same and/or subsequent reevaluation endoscopy session. Clinical success was defined as successful closure of fistula orifice after removal of the stent confirmed by contrast injection or abdominal CT with oral contrast. Time to fistula closure was defined as the time in weeks between first endoscopy with therapeutic intent to the last therapeutic endoscopy or imaging test confirming fistula closure.

Statistical analysis

Normality of data distribution was assessed by Kolmogorov-Smirnov test. Categorical variables were summarized

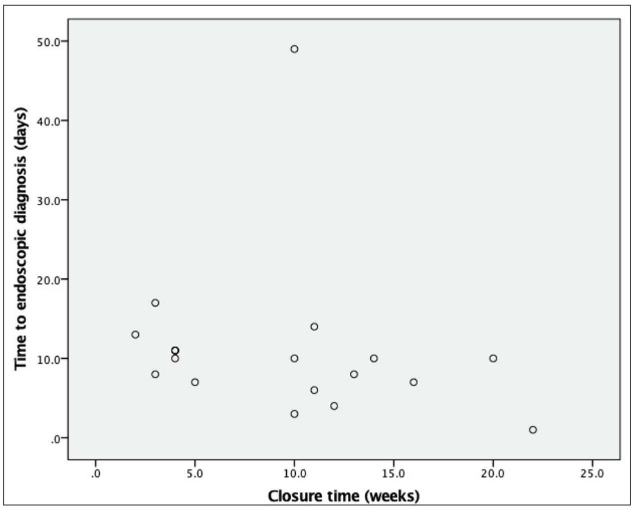

Figure 2: Time to endoscopy post-SG.

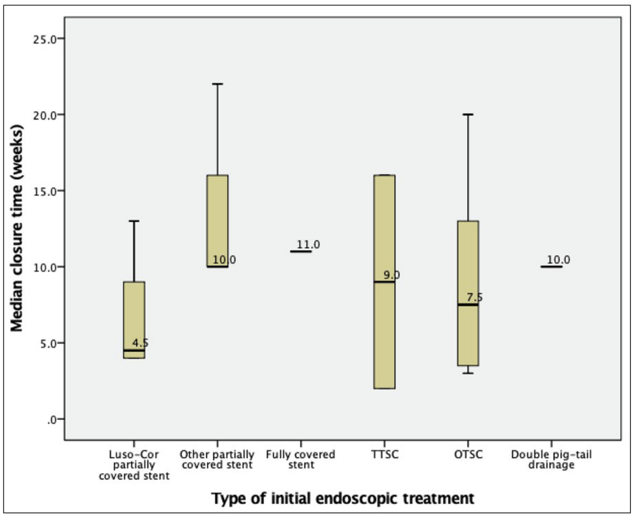

Figure 3: First endoscopic treatment strategies.

as frequencies and percentages and were compared with chi square test of independence. Normally distributed quantitative data was summarized as average ± standard deviation and p values were produced on basis of independent samples t test. Non-parametric quantitative variables were summarized as median (minimum; maximum) and p values were calculated by Mann-Whitney U test. Logistic regression was used to evaluate the association of procedure related metrics such as procedure length, pre-surgical baseline weight, pre-surgical BMI and presence of stenosis with occurrence of leak. All tests were two-tailed and considered significant if p value was lower than 0.05. All statistical tests were conducted using IBM's SPSS version 23.

Results

Patient characteristics and weight loss outcomes

Baseline demographic characteristics were analyzed to identify potential risk factors for leak occurrence (Table 1). Patients in the leak group had a significantly lower median BMI (39.5 kg/m^2 vs 43 kg/m^2, $p < 0.01$) and EBW (49 kg vs 60 kg, p = 0.005) compared to the control group. No statistically significant differences were observed in age (p = 0.976), gender distribution (p = 0.862), or comorbidities such as obstructive sleep apnea (35% (n = 7) vs 22.8% (n = 124); p = 0.353), diabetes (31.6% (n = 6) vs 26.2% (n = 142); p = 0.597), hypertension (47.4% (n = 9) vs 47.4% (n = 259); p = 0.989), or gastroesophageal reflux (21.1% (n = 4) vs 15.8% (n = 86); p = 0.532).

Longitudinal weight loss outcomes were evaluated at 3, 6, 12, 24, and 36 months after surgery using absolute weight, BMI change, percentage EWL, and percentage total body weight loss (%TBWL) and compared between cases and controls (Figure 4a and 4b). Patients in both groups exhibited significant weight reduction over time (Figure 5a and 5b).

At 12 months, the BMI change in the control group was -12.2 kg/m^2 compared to -10.6 kg/m^2 in the leak group (p = 0.032). %EWL in 12 months was 68.2% in the control group versus 61.4% in the leak group (p = 0.045), while % total weight loss (TWL) was 31.0% in the former compared to 28.2% in patients who developed fistulas after SG (p = 0.049).

At 24 months, the BMI change was -13.8 kg/m^2 in the control group and -11.9 kg/m^2 in the leak group, while %EWL was 74.5% and 67.8%, respectively (p = 0.041). %TWL at this time point was 33.8% in the non-leak group and 30.5% in the leak group (p = 0.044).

At 36 months, patients in the control group had a BMI change of -14.5 kg/m^2, whereas the leak group demonstrated a slightly lower BMI change of -13.1 kg/m^2 (p = 0.048). %EWL at this time was 76.9% in the control group compared to 71.5% in the leak group (p = 0.042), while %TWL was 35.2% in the control group and 31.7% in the leak group (p = 0.047) (Figure 6a and 6b).

Leak characteristics and timing

Among the 20 patients with staple-line leaks, 7 (35%)

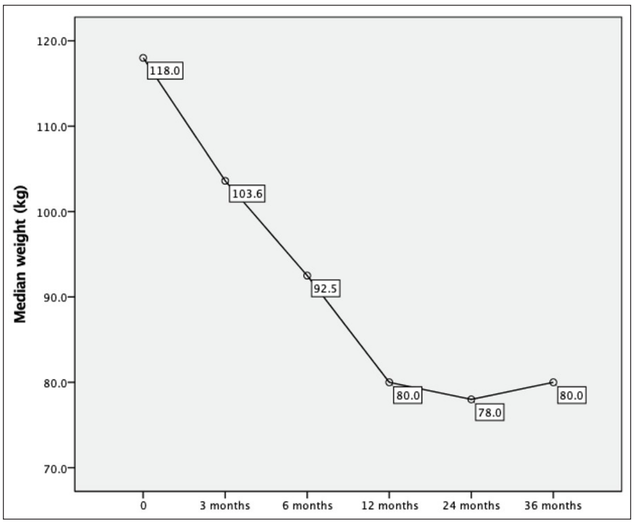

Figure 4a: Absolute weight during follow-up.

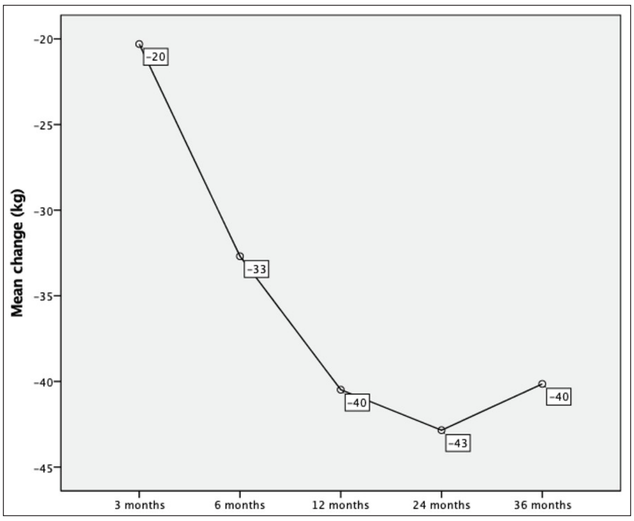

Figure 4b: Absolute weight change during follow-up.

Table 1: Patient and procedure characteristics.

Patients	Overall	SG no leak	SG leak	p
	567	547	20	
Female	462 (81.5%)	445 (81.5%)	16 (80%)	0.862
Male	105 (18.5%)	101 (18.5%)	4 (20%)	
Age (years)	45 (18 – 71)	45 (18 – 71)	42 (29 – 66)	0.976
Weight (kg)	117 (84 – 220)	117 (84 – 220)	109 (91 – 167)	0.052
BMI (kg/m^2)	43 (36.3 – 73)	43 (36.3 – 73)	39.5 (36 – 49)	<0.01
EBW (kg)	60 (46 – 151)	60 (46 – 151)	49 (40 – 87)	0.005
Obstructive sleep apnea	131 (23.2%)	124 (22.8%)	7 (36.8%)	0.353
Diabetes mellitus	149 (26.3%)	142 (26.2%)	6 (31.6%)	0.597
Hypertension	269 (47.5%)	259 (47.4%)	9 (47.4%)	0.989
Dyslipidemia	149 (26.3%)	144 (26.4%)	5 (26.3%)	0.999
Psychiatric disorder	166 (29.4%)	160 (29.4%)	5 (26.3%)	0.765
Muskoloskeletal disorder	142 (25.1%)	136 (25%)	6 (31.6%)	0.510
Gastroesophageal reflux	90 (15.9%)	86 (15.8%)	4 (21.1%)	0.532
Procedure time (min)	51 (18 – 154)	51 (18 – 154)	56 (28 – 118)	0.233
Hospital stays (days)	1 (1 – 112)	1 (1 – 87)	23 (1 – 112)	<0.01

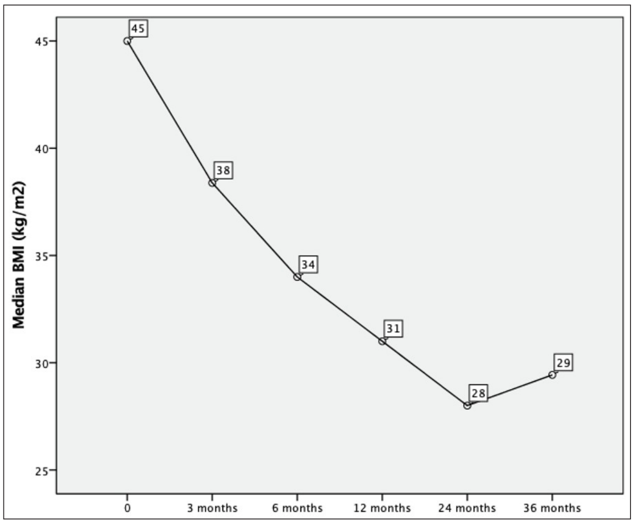

Figure 5a: BMI during follow-up.

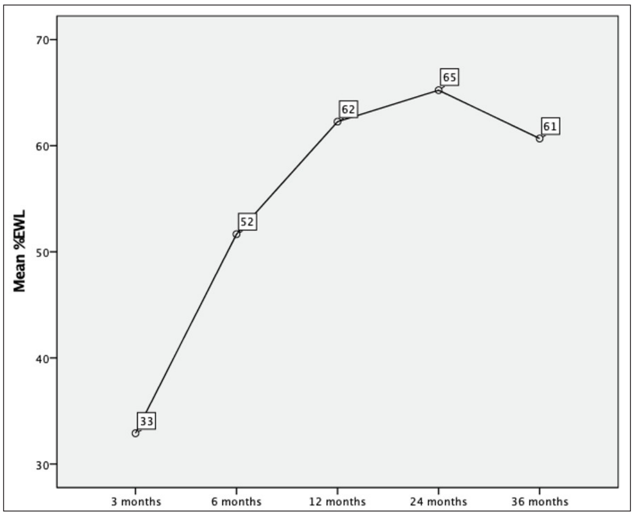

Figure 6a: EWL.

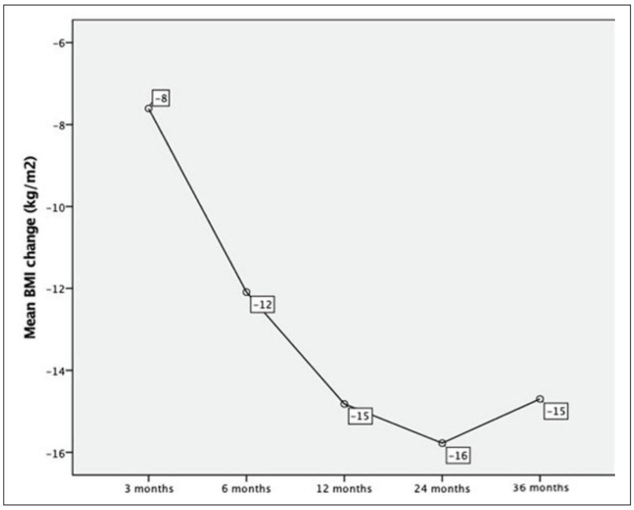

Figure 5b: BMI change during follow-up.

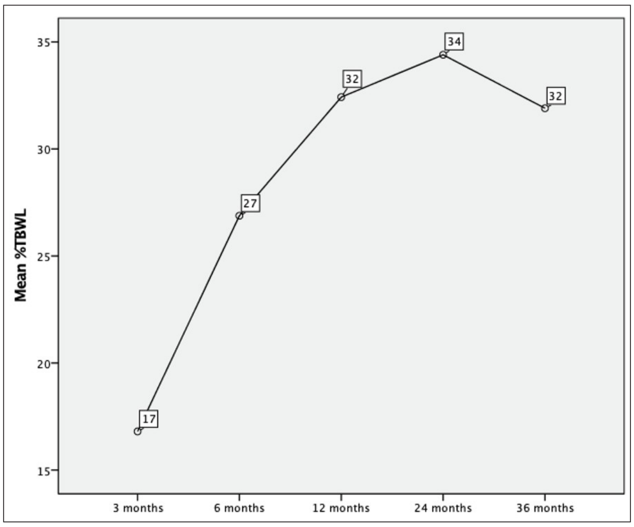

Figure 6b: TBWL.

were acute (<7 days), 12 (60%) were early (1 – 6 weeks), and 1 (5%) was late (6 – 12 weeks). No chronic leaks (>12 weeks) were observed (Table 2).

The median time to endoscopy was 10 (1 – 49) days (Figure 2). Notably, patients with acute leaks were diagnosed sooner (median of 4 days), whereas those with early and late leaks had a wider range of diagnostic intervals (Table 2).

All leaks were located proximally (n = 20, 100%), consistent with prior studies indicating that the highest-pressure zone within the gastric sleeve occurs near the gastroesophageal junction. Median fistula orifice size was 4 (2 - 20) mm. Leak orifices were predominantly small (<10 mm), occurring in 17 patients (85%), whereas 3 (15%) had larger defects (≥10 mm). Concomitant gastric strictures were identified in 8 patients (40%), suggesting that increased intraluminal pressure may contribute to leak formation.

Among the 20 patients with staple-line leaks in our series, all underwent a primarily endoscopic approach (Table 2). Regarding the first endoscopic treatment choice (Figure 3), self-expanding metal stents were utilized in 45% (n = 9) of cases; of which Luso-Cor® partially covered stent was employed in 5 patients (25%), other partially covered stents (e.g., Olympus' HANAROSTENT®) in 15% (n = 3) and in 1 patient (5%) a fully covered stent was chosen. In half of the patients with leaks (50%) a primary endoscopic closure with clipping strategy was proposed. OTSC were used in 40% (n = 8), while through-the-scope clips (TTSC) were applied in 10% (n = 2). One patient (5%) was initially treated with endoscopic drainage by a double-pig tail drain.

Depending on clinical evolution, some patients receive additional or alternative devices (e.g., OTSC after partial stent migration). In patients whose leak orifice was <10 mm, an OTSC or TTSC was typically firstline. Patients with larger or more complex defects were often treated by exclusion with an endoprosthesis.

The median number of endoscopic sessions to fistula closure required per patient was 2 (1 - 5), although those with larger leaks or concomitant strictures generally needed more than two sessions.

Table 2: Clinical characteristics of patients with leak.

Variable		No	Percentage (min – max)
Leak occurrence		20	3.52%
Type of leak	Acute (<7 days after surgery)	7	35%
	Early (1 – 6 weeks after surgery)	12	60%
	Late (6 - 12 weeks after surgery)	1	5%
	Chronic (>12 weeks after surgery)	0	–
Time to endoscopic diagnosis (days)		10	1 – 49
Size of leak orifice	Size in mm	4	2 – 20
	Small (<10 mm)	17	85%
	Large (≥ 10 mm)	3	15%
Location	Proximal	20	100%
	Distal	0	–
Concomitant presence of stricture		8	40%
First endoscopic treatment modality	Luso-Cor® partially covered stent	5	25%
	Other partially covered stent	3	15%
	Fully covered stent	1	5%
	TTSC	2	10%
	OTSC	8	40%
	Double pig-tail drainage	1	5%
Time to closure (weeks)		10	2 – 22 (p = 0.917)
Luso-Cor® partially covered stent		4.5	4 – 13
Other partially covered stent		10	10 – 22
Fully covered stent		11	11 – 11
TTSC		9	2 – 16
OTSC		7.5	3 – 20
Double pig-tail drainage		10	10 – 10
Mortality	30-day mortality	1	0.17%
	Mortality in patients with leak (non-attributable)	2	0.35%

Overall, the initial technical success rate was 50% (n = 10) owing to primary endoscopic closure (OTSC and TTSC) failing 50% of the time it was employed (n = 5) while primary stenting only failed once (11.1%). In secondary endoscopic management we always resorted to stenting with the Luso-Cor® device being the preferred choice in 70% of those cases (n = 7). Tertiary fistula recurrence was observed in 43% (n = 3) and all were managed with re-stenting leading to definite fistula closure (Figure 7).

Concomitant gastric strictures were identified in 8 (40%) of the 20 leak patients. Endoscope passage was possible in all of them and treatment in these cases was always directed towards stent placement. None of these patients required formal surgical revision for the stricture alone, as the stenting effectively relieved the obstruction and reduced intraluminal pressure on the leak site.

In our cohort, a total of 16 out of 20 leak patients (80%) underwent urgent laparoscopic peritoneal lavage (i.e., within 48 h of presentation). This was typically indicated by clinical and radiologic signs of diffuse peritonitis or large abscesses in addition to the staple-line leak.

Patients who underwent peritoneal lavage (n = 16) had a median hospital stay of 51 (14 - 112) while those who did not had a median stay of 37 (14 - 72) days. This difference was not significant (p = 0.596). The difference in the number of endoscopies required also did not reach statistical significance in our series (p = 0.072), but there was a trend toward fewer endoscopic sessions, despite longer hospital stay, among patients with peritoneal lavage possibly due to facilitated and prompt source control that allowed for more effective endoscopic management of the leak. Similarly, the rate of interventional radiology (IR) drainage was lower (but insignificant, p = 0.432) in the lavage group (again, likely due to earlier control of sepsis and fluid collections).

Ultimately, all 20 patients (100%) achieved clinical success with repeated endoscopic interventions, percutaneous or lapa-

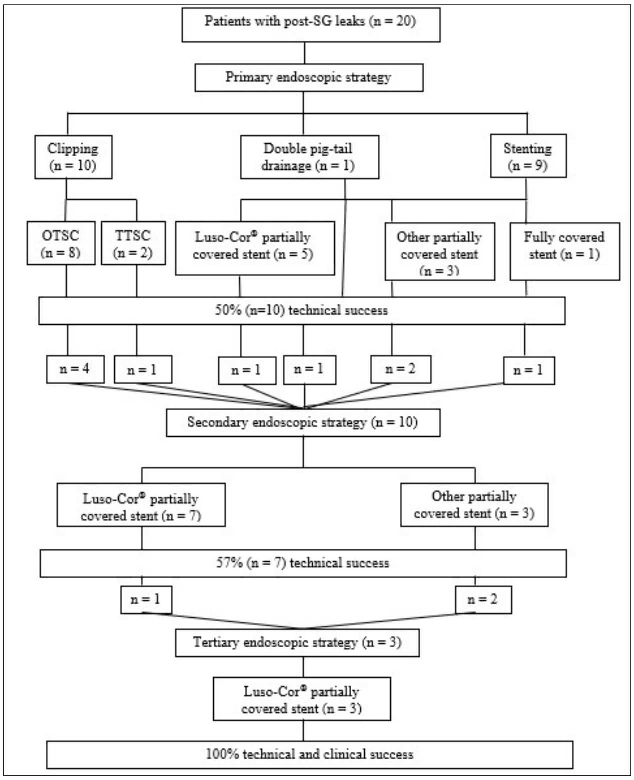

Figure 7: Endoscopic management.

roscopic drainage when necessary, and supportive care. The median time to fistula closure was 10 (2 - 22) weeks from the first therapeutic endoscopy to the final imaging confirming closure.

Adverse events and mortality

Median hospital stay was significantly longer in the leak group with 23 (1 – 112) days compared to the control group's 1 day (1 – 87) ($p < 0.01$). One of the patients on the control group suffered a pulmonary thromboembolism and required specific treatment and rehabilitation which ultimately led to prolonged hospitalization.

Surgical revision was warranted in 2 cases (10%) due to fistula persistence with abdominal collection in which repeat peritoneal lavage and drainage were performed concomitantly with secondary endoscopic management.

The overall mortality rate in the study cohort was 0.52% (n = 3), while the 30-day operative mortality rate was 0.17% (n = 1). Among patients with leaks, 2 (10%) deaths were observed.

Discussion

In this series of 567 consecutive patients who underwent outpatient laparoscopic SG, we observed a 3.52% leak rate, which falls within the 0 – 4.6% range reported in other large cohorts [7-9]. Notably, Aurora et al. [8] analyzed 4,888 patients and found an overall leak rate of 2.2%, while Sakran et al. [9], in a multicenter experience of 2,834 patients, described a 3.1% leak rate. Our findings thus parallel these large-scale studies and reinforce that SG, even when performed in an outpatient setting, carries a low but significant risk of leaks.

Leak incidence and risk factors

Our data suggests that even in a protocol-driven outpatient environment, leaks can occur at a small but not negligible rate. This aligns with prior large-scale analyses indicating that leak rates may vary widely depending on patient risk factors, surgeon experience, and technical nuances [1, 15, 16]. Interestingly, no major inter-operator technical differences in SG performance were identified in our series.

While patients in our cohort who developed leaks had a lower baseline BMI and lower EBW than controls, some studies have emphasized higher BMI as a potential risk factor [4], others have reported leak occurrence across a wide spectrum of BMIs, pointing to the multifactorial nature of leak pathogenesis [17, 18]. Differences in tissue quality, vascular perfusion, and local pressure gradients may each play a role in patients at the lower end of the BMI range [14].

Timing, location, and clinical presentation

Consistent with previous series, most SG fistulas in our study were acute or early [10, 11]. We found the proximal sleeve near the gastroesophageal junction, often considered a high-pressure susceptible zone, to be the predominant site of disruption, in accordance with most literature accounts [7, 8]. Early recognition remains paramount, as prompt endoscopic or radiologic evaluation can lead to more effective source control [2, 12]. We found a strong negative correlation between time to diagnosis and closure duration. This highlights the importance of early leak detection, as timely intervention significantly reduces morbidity. However, we also noted that acute leaks (<7 days) typically presented with more exuberant clinical findings, as in prior reports [9].

Endoscopic management and outcomes

All 20 patients with confirmed leaks were managed with a primarily endoscopic approach, complemented by laparoscopic or percutaneous drainage as necessary. In line with Al Zoubi et al. [11], who noted that endoscopic therapy can achieve closure in up to 90% of SG leaks, our series achieved 100% clinical success with repeated sessions when needed.

Concomitant strictures were detected in 8 (40%) of the 20 patients with leaks. In all cases, the endoscope could traverse the narrow segment with careful maneuvering. No patient required surgical revision solely for stricture management as endoscopic stenting was successful in all of those cases, reinforcing the role of minimally invasive therapies for both strictures and leaks.

The Luso-Cor® partially covered stent, originally described by Ferreira et al. [13] played a crucial role in leak resolution in our institution, demonstrating reliable closure rates leading to a total median closure time of 10 (2 – 22) weeks which is in agreement with Al Zoubi et al. [11], whose study reported a median time to leak defect closure of 9.5 weeks also using similar endoscopic techniques. While the literature varies regarding first-line endoscopic devices, multiple studies corroborate that stenting offers a robust option for larger or complex leaks [7, 19, 20]. OTSC has proven highly effective for small orifices (<10 mm) [21], but may fail in larger, irregular defects, as seen in our cohort and corroborated by Nedelcu et al. [22]. Notably, we found that re-stenting or switching from clips to stents in cases of recurrence led to definitive healing in all patients.

Role of laparoscopic peritoneal lavage

For patients presenting with diffuse peritonitis, large collections, or sepsis, urgent laparoscopic peritoneal lavage (<48 h after presentation) was performed to achieve rapid source control. These observations align with Sakran et al. [9] who highlighted the importance of immediate drainage for large or symptomatic fluid collections. Adjunctive surgical drainage was common (80% in our series) and although hospital stay was non-significantly different from those who did not receive peritoneal lavage, there were fewer percutaneous drainage procedures in these patients. This hybrid approach of laparoscopic lavage plus endoscopic stenting aligns with other reports advocating for aggressive, multidisciplinary management to achieve rapid source control [9, 23]. When sizable collections persisted or were anatomically inaccessible to laparoscopic intervention, IR drainage was employed. Patients who received early peritoneal lavage often required fewer subsequent IR drainage sessions, suggesting that aggressive initial management may reduce the need for multiple interventions.

Impact on weight loss

Weight loss outcomes at 12, 24, and 36 months demonstrated significant reductions in BMI and TWL. Our results show a greater reduction in BMI compared to studies by Sakran et al. [9] Furthermore, our reported EWL at 12 months (68.2%) slightly surpasses findings by Rosenthal et al. [10], who reported an average of 63.5% over a similar follow-up interval.

Leak patients in our cohort had statistically inferior weight loss at 12, 24, and 36 months postoperatively. These findings resonate with the broader literature suggesting that early postoperative complications can disrupt the standard dietary progression and follow-up protocols critical to optimal weight loss [5, 24]. Prolonged hospitalization, repeated interventions, and dietary disruption following a leak episode may cumulatively hamper the achievement of target weight-loss milestones [25]. Nonetheless, once healing is achieved, many patients still achieve substantial long-term benefits, reflecting the metabolic and hormonal advantages of SG [2, 26].

Outpatient SG feasibility

Despite the inherent risks, the feasibility of outpatient SG has been documented in several recent studies, showing low rates of severe morbidity when patient selection is stringent and protocols are standardized [1, 24]. Our 0.17% thirty-day operative mortality rate and 3.52% leak occurrence are both comparable to inpatient bariatric programs [6]. However, the present findings emphasize the importance of close postoperative surveillance and patient education, especially in the first few weeks following surgery, to ensure early identification of complications [10].

Conclusion

In conclusion, our experience with outpatient SG confirms a leak rate consistent with existing literature and highlights the efficacy of a primarily endoscopic strategy combined with prompt drainage when necessary. Despite high closure rates, the presence of a leak adversely impacted long-term weight loss. As SG continues to dominate bariatric practice, improvements in operative technique, standardized perioperative pathways, and novel endoscopic technologies will be critical to mitigating leak-related morbidity and preserving optimal metabolic outcomes.

Limitations and Future Directions

This study is limited by its retrospective design and single-center nature. Larger multicenter cohorts or prospective registries would allow for more robust analysis of risk factors, leak detection strategies, and comparative effectiveness of various endoscopic devices. Additionally, prospective randomized trials comparing different stent types and clipping strategies, particularly in large or chronic leaks, could help refine best practices. Finally, while our results indicate that early detection and endoscopic management are effective, it remains essential to optimize surgical technique and develop advanced predictive tools to minimize leak risk in the first place.

Acknowledgments

None.

Conflict of Interest

All procedures were performed in accordance with the ethical standards of the institutional committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Individual patient informed consent has been obtained prior to each procedure for all patients.

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