



Malignant Leakage After Sleeve Gastrectomy: Endoscopic and Surgical Approach

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Published online: 4 July 2020

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Abstract

Purpose Gastric leak occurs after sleeve gastrectomy (SG) in 2% of cases. Most staple-line disruptions (SLD) can be successfully treated with first-line endoscopic procedures. Less favorable situations may lead to more complex therapeutic strategies, like conversion to Roux-en-Y gastric bypass (RYGBP). The aim of our study is to predict the factors of endoscopic treatment failure and to assess the safety of conversion to RYGBP.

Methods We included all patients treated in two centers of academic excellence ($n = 100$) between 2013 and 2017 who had a malignant SLD after SG. A “malignant” leakage met one of the following poor prognosis criteria suggested in the literature: unsuccessfully treated by the first-line endoscopic treatment; generalized peritonitis; anatomical anomalies; gastro-cutaneous or gastro-pleural fistula (GCF/GPF); or chronic leaks (> 4 weeks).

Results No deaths occurred during the follow-up (20 ± 12 months). The endoscopy reported an anatomically abnormal gastric tube in 35 (35%) patients (stenosis [$n = 21$ (21%)], twist [$n = 9$ (9%)], or both [$n = 5$ (5%)]). We could maintain the SG in place in 92% of cases without stenosis, twist, or GCF/GPF. Conversion to RYGBP due to leakage was necessary in 37 (37%) patients. Stenosis, twist, or GCF/GPF significantly prevented healing in multivariate analysis (respectively: $p = 0.020$, OR = 0.17, and $p < 0.001$, OR = 0.07—logistic regression).

Conclusion Endoscopy is the treatment of choice for the management of chronic leaks after SG. The association of anatomical anomalies and GCF/GPF should lead to consideration of conversion to RYGBP.

Keywords Sleeve gastrectomy · Leakage · Chronic · Management

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s11695-020-04818-4>) contains supplementary material, which is available to authorized users.

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Introduction

Bariatric surgery has been gaining acceptance worldwide, and sleeve gastrectomy (SG) has become the most performed technique. SG represented 54% of bariatric procedures in the USA in 2014, a rise from just 3% in 2008 [1, 2]. In France, the number of bariatric interventions has increased by 600% over the last 10 years, reaching 60,000 interventions in 2018 [3], promoted by a high prevalence of severe obesity and a generalized reimbursement by the national health care insurance, if the patient reaches the criteria for bariatric surgery (BMI > 40 kg/m² or > 35 kg/m² with comorbidities). Gastric leak is the deadliest complication after SG, with an occurrence previously described in 3–5.8% of cases. More recently, large series in experienced centers reported a much lower rate of 1–2% [4]. Its management is complex and controversial. According to the American Society of Bariatric and Metabolic Surgery (ASMBS), conservative treatment should

be considered the first-line treatment [5]. Endoscopic procedures have a prominent place in the management of leaks. Pig tail drains (PDs) and covered stents are the most commonly used techniques [6]. PDs offer the advantage of collection drainage and induce efficient granulation. However, in the case of large leaks, this option seems to be less effective [7]. In these cases, endoprotheses or “megastents” are more suitable, enabling the isolation of the fistulous orifice and the dilatation of associated stenosis [8]. Other endoscopic techniques, such as over-the-scope (OVESCO) clip [8], glue [9], e-Vac therapy [10], and septotomy [11], are less commonly used. In some cases, endoscopic treatment does not permit healing and a surgical strategy must be favored. Even though some algorithms have been proposed [7, 12] to guide management of staple-line disruption (SLD), data in the literature are inconsistent due to the high heterogeneity of studied populations (SLD location, size, time of leakage onset, anatomic anomalies of the gastric tube (twist or stenosis)), leading to an absence of worldwide consensus [13]. Although most SLDs can be healed with standard endoscopic procedures associated with optimized nutritional support, it appears that some less favorable situations lead to prolonged care with multiple interventions and, sometimes, to conversion to Roux-en-Y gastric bypass with partial gastrectomy. Furthermore, recurrent leaks have been described, although their initial closure was eventually obtained non-operatively [14]. We defined as *malignant leakage* those poor prognosis cases. The aim of this study was to identify predictive risk factors of endoscopic treatment failure and to assess the safety of endoscopic strategies and conversion to RYGBP.

Patients and Methods

Patients

This retrospective study of prospectively collected data included 100 consecutive patients presenting with malignant leakage postsleeve gastrectomy, referred to 2 French tertiary referral centers that specialize in bariatric surgery (Supplemental Figure 1). Both academic centers have been endorsed by the French Ministry of Health (FMH) as obesity centers of excellence. The inclusion period ran from 2013 to 2017, with a minimum of 1 year of follow-up. The diagnosis of leakage was confirmed by CT scan (abscess next to the staple line, leak of contrast agent). SLD is defined as a defect visualized in endoscopy or laparoscopy. Fistula is defined as the symptomatic evolution of SLD with apparition of an abscess. Sixty patients (60%) had acute leaks (< 7 days), 33 (33%) had early leaks (< 1–6 weeks), and 7 (7%) had late or chronic leaks (> 6 or > 12 weeks) [15]. All cases were considered as consolidated when complete healing was observed

clinically and in two consecutive imaging results when preservation of the SG was possible, or when patients benefited from a conversion to RYGBP with complete recovery (normal nutrition). SLDs were classified as “*malignant*,” if at least one of the following poor prognosis criteria was met: (1) not successfully treated by first-line endoscopic treatment (PD or covered stent) OR (2) generalized peritonitis [5] OR (3) anatomical anomalies (twist and/or stenosis) [16] OR (4)-gastro-cutaneous or gastro-pleural fistula (GCF/GPF) [17] OR (5) no favorable evolution at 4 weeks [5].

Management of the Staple-Line Disruption

Initial management combined surgery with endoscopy. Additional endoscopy was systematically performed by a senior endoscopist in order to confirm diagnosis and to specify the characteristics of the leakage: size (considered large when ≥ 10 mm), location (top of staple line, mediogastric, or lower), and association with anatomical abnormalities (stenosis, twist, or both). Laparoscopy was performed for surgical drainage, except for generalized peritonitis that prompted laparotomy. External drainage of the leakage was systematic. All patients received antibiotic treatment and nutritional support with early enteral feeding, either through a jejunostomy or a naso-jejunal tube. Management was similar in both centers. *Endoscopy* consisted mostly in an internal drainage with double PD under general anesthesia, as previously described [17]. A NOTES procedure could be required to fully drain the abscess, with placement of a temporary nasocystic drain. In the case of a large defect (1 cm), a covered stent was initially placed for 15 days and secondarily replaced by PD [7] or by an OVESCO clip. In case of major mediogastric stenosis, we performed multiple hydrostatic sleeve dilatation using an achalasia balloon (diameter 30 to 40 mm). Procedures have been performed or supervised by two endoscopists skilled in interventional endoscopic therapy.

The *radical treatment*, consisting of conversion to RYGBP after optimization of nutritional state, was routinely an open procedure, before gradually becoming a minimally invasive intervention. The technique was standardized with first dissection of the right crus of the diaphragm and then identification of the esophagus, pulled by a Penrose drain. A transverse stapling was then performed either on the upper part of the sleeve or on the esophagus (in cases of a very high fistula). A partial gastrectomy to remove the fistulous orifice was performed. A mechanical anastomosis was confectioned (latero-lateral gastro-jejunal or termino-lateral esojejunal (Orvil 25 mm with EEA XL 25 mm, 3.5 mm, Medtronic)). Alimentary limb length was between 1.0 to 1.5 m. In cases of persistent sepsis before surgery, antibiotics were systematically prescribed for 7 days. Complications were graded according to the Dindo-Clavien classification [18].

Table 1 Baseline patient characteristics

	Total		Conversion		Healed		<i>p</i> value
	<i>n</i> = 100		<i>n</i> = 37		<i>n</i> = 63		
Preoperative data (<i>n</i> = 100)							
Female	78	(78)	29	(78.4)	49	(77.8)	0.94 ^x
Age (year)	41	± 11	44.2	(11.5)	39.4	(10.8)	0.037 ^t
Initial BMI (kg/m ²)	43.7	± 6.4	42.2	(5.2)	44.4	(7)	0.15 ^t
BMI at referral (kg/m ²)	39.4	[19.4–74.3]	36.5	[24.5–52.6]	41.3	[19.4–74.3]	0.002 ^U
Type 2 diabetes	25	(25)	10	(27)	15	(23.8)	0.75 ^x
Hypertension	28	(28)	10	(27)	18	(28.6)	0.83 ^x
OSA	36	(36)	13	(35)	23	(36.5)	0.84 ^x
Dyslipidemia	4	(4)	4	(10.8)	0	(0)	0.018 ^F
Tobacco use	4	(4)	10	(27.0)	15	(23.8)	0.59 ^x
Previous gastric procedure	20	(20)	11	(29.7)	7	(11.1)	0.02 ^x
AGB	13	(13)	4	(10.8)	8	(12.7)	1 ^F
SG	4	(4)	4	(10.8)	0	(0)	0.017 ^F
VBG	3	(3)	4	(10.8)	0	(0)	0.017 ^F
IGB	1	(1)	0	(0)	1	(1.6)	1 ^F
Nissen	1	(1)	1	(2.7)	0	(0)	0.37 ^F
Gastric leak data (<i>n</i> = 100)							
Time to diagnosis (days)	6	[1–1461]	7	[1–1461]	6	[1–69]	0.72 ^U
Leak classification							
Acute (1–7 days)	60	(60)	23	(62.2)	37	(58.7)	0.61 ^x
Early (1–6 weeks)	33	(33)	3	(8.1)	6	(9.5)	1 ^F
Late (> 6 weeks)	4	(3)	6	(16.2)	18	(28.6)	0.16 ^x
Chronic (> 12 weeks)	3	(3)	2	(5.4)	2	(3.2)	0.62 ^F
Time to referral center (days)	5	[0–1119]	23	[0–1119]	3	[0–66]	0.002 ^U
Endoscopic assessment (<i>n</i> = 100)							
SLD visualization	87	(87)	34	(91.9)	53	(84.1)	0.53 ^x
Location							
Upper part	79	(91)	31	(83.8)	48	(76.2)	1 ^F
Size							
> 10 mm	38	(46)	20	(54.1)	18	(28.6)	0.015 ^x
Treatment in the initial center (<i>n</i> = 100)							
Endoscopic	14	(14)	7	(18.9)	7	(11.1)	0.28 ^x
Surgical	54	(54)	21	(56.8)	33	(52.4)	0.81 ^x
Both	12	(12)	6	(16.2)	6	(9.5)	0.35 ^F
None	44	(44)	15	(40.5)	29	(46)	0.59 ^x
Poor prognosis criteria (<i>n</i> = 100)							
Anatomical anomalies	35	(35)	22	(59.5)	13	(20.6)	< 0.0001 ^x
Stenosis	21	(21)	13	(35.1)	8	(12.7)	0.008 ^x
Twist	9	(14)	6	(16.2)	3	(4.8)	0.053 ^x
Both	5	(3)	3	(8.1)	2	(3.2)	0.274 ^F
Gastro-cutaneous fistula	26	(26)	19	(51.4)	7	(11.1)	< 0.0001 ^x
Gastro-pleural fistula	1	(1)	1	(2.7)	0	(0)	1 ^F
Non-effective first-line endoscopic treatment	87	(87)	30	(81.1)	49	(77.8)	0.93 ^x
Peritonitis							
Localized	45	(45)	11	(29.7)	34	(54)	0.02 ^x
Generalized	31	(31)	12	(32.4)	19	(30.2)	0.78 ^x

Table 1 (continued)

	Total		Conversion		Healed		<i>p</i> value
	<i>n</i> = 100		<i>n</i> = 37		<i>n</i> = 63		
Chronic leak (> 4 weeks)	100	(100)	37	(100)	63	(100)	1 ^x

OSA obstructive sleep apnea, AGB adjustable gastric banding, SG sleeve gastrectomy, VBG vertical banded gastroplasty, IGB intragastric balloon, SLD staple-line disruption

^x chi-square test, ^F Fisher exact test, ^t Student *t* test, ^U Mann-Whitney test

Statistical Analysis

Continuous variables have been expressed as mean ± SD or median (min-max) and analyzed by the unpaired *t* test or Mann-Whitney test, as appropriate. Qualitative variables were expressed as percentages and analyzed using a chi-square test or Fisher exact test, as appropriate. Multivariate analysis and risk ratio calculation have been conducted with logistic regression. All statistical data were obtained using IBM SPSS Statistics v20.0 (SPSS, Inc., Chicago, IL, USA) and figures were generated using GraphPad PRISM, 6.0 (GraphPad Software, La Jolla, CA, USA). The decision tree algorithm was performed in R studio. Differences were considered significant when *p* < 0.05.

Results

Baseline Patients’ Characteristics

Characteristics of the 100 included patients are reported in Table 1. Median leakage diagnosis was made 6 (1-1461) days after the sleeve gastrectomy.

Staple-line disruptions have been clearly identified on the top of the sleeve in 79 (91%) patients. The orifice was large (> 1 cm) in 38 (46%) patients. Anatomical abnormal gastric tube at the endoscopy was reported in 35

(35%) patients, involving a stenosis (*n* = 21, 21%), a twist (*n* = 9, 9%), or both (*n* = 5, 5%).

Association of Endoscopy and Laparoscopy with Preservation of the SG

All patients had an endoscopy for diagnosis of the SLD. Ninety (90%) patients had an endoscopic management of the leakage (PD *n* = 87, covered stent *n* = 10), most of the time associated with a laparoscopy for abscess drainage or for

Table 2 Characteristics of patients and complications in the conversion to RYGBP group. Multivariate analysis was performed by logistic regression

	<i>n</i> = 38
Time to conversion to RYGBP, (d) med (min-max)*	186 [3–1163]
Weight at conversion to RYGBP, (kg) mean ± SD	91 ± 18
Cause of conversion	
Reflux	1 (3)
Chronic leakage	32 (84)
Early conversion	4(11)
Laparoscopic procedure, <i>n</i> (%)	14 (37)
Esojejunal anastomosis, <i>n</i> (%)	15 (39)
Hospital duration stay, (d) mean ± SD	13 ± 11
Per-operative complications, <i>n</i> (%)	4 (11)
Splenectomy, <i>n</i> (%)	2 (5)
Colon or small bowel injury, <i>n</i> (%)	2 (5)
Early postoperative complications, <i>n</i> (%)	15 (39)
Dindo-Clavien ≥ 3	8 (21)
Digestive	
Gastro-jejunal anastomosis leak, <i>n</i> (%)	3 (8)
Excluded stomach leak, <i>n</i> (%)	1 (3)
Evisceration/ bowel obstruction, <i>n</i> (%)	2 (5)
Intra-abdominal collection without leak, <i>n</i> (%)	4 (11)
Gastro-jejunal anastomosis stenosis, <i>n</i> (%)	1 (3)
Non-digestive	
Brachial vein thrombosis, <i>n</i> (%)	1 (3)
Subclavicular vein thrombosis, <i>n</i> (%)	1 (3)
Hyperthermia (unknown origin), <i>n</i> (%)	2 (5)

*Patients converted for gastro-esophageal reflux were excluded

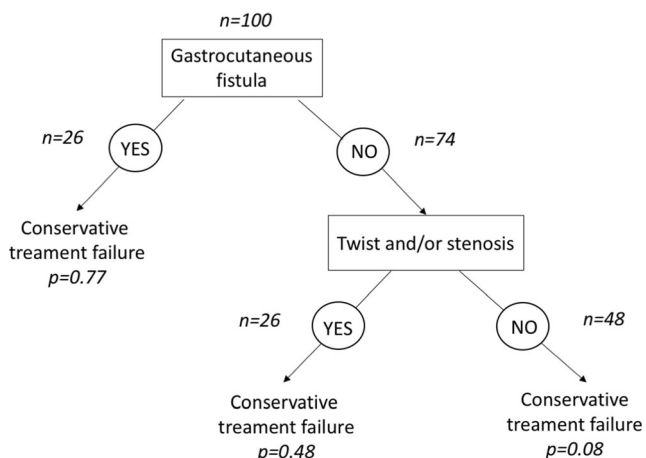


Fig. 1 Decision tree algorithm of malignant leakage management

peritonitis cleansing. For 12 patients, a NOTES procedure was required to fully drain the abscess, with placement of a temporary nasocystic drain. Ten patients (10%) benefited from the placement of a covered stent. For 3 of them, an OVESCO clip was placed during the ablation of the endoprosthesis, but the orifice re-opened and all had PD. We did multiple hydrostatic sleeve dilatation using an achalasia balloon (diameter 30 to 40 mm) in 7 patients, which led to the complete healing of the leakage. An average of 3 ± 2 endoscopy under general anesthesia had to be performed to obtain recovery of satisfactory sleeve anatomy and closure of the staple-line disruption.

Radical Treatment

Out of 100 patients presenting with malignant leakage, conversion to RYGBP for leakage was necessary for 37 patients (Fig. 1) (median time 191.5 [11; 1163] days). From these, 4 were converted in the first month (early conversion), and 2 were converted because of a gastro-esophageal reflux related to a mediogastric stenosis without persistence of the SLD. These 2 cases were considered failures of the treatment. One more conversion had to be performed after healing of the SLD (at 4 months) because of a crippling gastro-esophageal reflux, despite well-conducted PPI treatment at 19 months. As no stenosis had been identified, we considered that initial treatment was successful. Characteristics and complications of conversion to RYGBP are reported in Table 2. Procedures were laparoscopic in 37% of them. Laparotomy rate decreased overtime (first tertile: 70% vs third tertile: 20%, $p = 0.070$). Esojejunal anastomosis was necessary in 39% of the cases because SLD extended over the esogastric junction. Anastomotic leakage happened in 3 patients. Evolution was satisfactory with endoscopic treatment in all cases.

Long-Term Follow-Up

No deaths occurred during the mean follow-up period of 20 ± 12 months. All patients fully recovered from their leakage but one, who showed the persistence of a dead-end fistula associated to a gastric stenosis leading to food intolerance. However, she refused additional surgery to convert her SG to RYGBP. When we managed the SLD without conversion to RYGBP, 49% of patients reported having GERD symptoms requiring proton pump inhibitor treatment, while 8.8% after conversion to RYGBP ($p < 0.001$). Excess weight loss was, at last follow-up, $73 \pm 34\%$ when the SG could be preserved and $84 \pm 31\%$ after RYGBP ($p = 0.150$).

Predictive Factors of Conversion to RYGBP

When a gastro-cutaneous fistula or gastro-pleural fistula with anatomical anomalies was recorded ($n = 10$), healing of the leakage happened in only one patient, after 73 days (3 endoscopic procedures with dilatations). All other patients had to be converted into a RYGBP after a mean time of 162 days, except one who refused surgery.

In the absence of anatomical anomalies and without gastro-cutaneous fistula, endoscopic treatment, associated when needed to surgical drainage allowed complete healing in 75% of the patients at 4 months (Fig. 2b). Success rate reached 92% at 9 months (Fig. 2a). Complete healing happened as late as 11 months after surgery for one patient, who had multiple dilatations because of a twist of the gastric tube.

By decision tree analysis, we showed that the first risk factors for chronic leakage were the presence of gastro-cutaneous fistula, with the probability of endoscopic treatment failure of 0.77 (Fig. 1). The second risk factor was anatomic anomaly of the sleeve, such as twist or stenosis. In the absence of those two

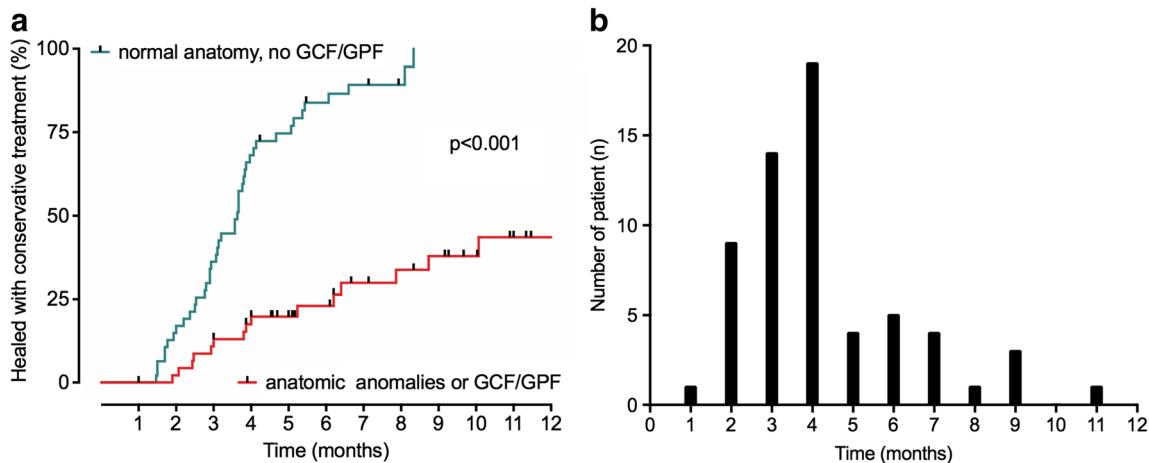


Fig. 2 Evolution of endoscopic treatment success over time. **a** Endoscopic treatment success in the good prognosis group (blue line): no anatomic anomaly and no gastro-cutaneous fistula and in the bad prognosis group (red line): anatomic anomaly and/or gastro-cutaneous

fistula. Vertical black ticks are for each conversion over time. Log-rank test. **b** Bar graph of repartition over time of healed patients in the endoscopic treatment group. GCF gastro-cutaneous fistula, GPF gastro-pleural fistula

Table 3 Predictive factors of conservative treatment failure

	<i>p</i> value	Exp (<i>B</i>) (IC 95%)
Age (years)	0.380	0.97 [0.91–1.04]
BMI at referral (kg/m ²)	0.442	0.97 [0.88–1.06]
Median time to referral center (days)	0.069	1.05 [1.00–1.10]
Previous gastric procedures	0.991	1.01 [0.16–6.54]
Anatomical anomalies	0.020	0.17 [0.04–0.76]
Gastro-cutaneous/pleural fistula	0.001	0.07 [0.02–0.34]
Localized peritonitis	0.196	2.10 [0.55–8.08]
SLD size > 10 mm	0.737	0.79 [0.20–3.08]

risk factors, the probability of endoscopic treatment failure was 0.08. Other significant risk factors in univariate analysis were (Table 1) age ($p = 0.037$), BMI at referral (0.002), median time to referral center ($p = 0.002$), previous gastric procedures (0.02), localized peritonitis (0.02), and SLD size over 10 mm ($p = 0.015$). In multivariate analysis (Table 3), gastro-cutaneous fistula ($p = 0.001$) and twist or stenosis ($p = 0.018$) were significantly associated to failure of the endoscopic treatment. The adverse impact of a long period of time before referral was close to significance ($p = 0.069$).

Discussion

This study illustrated the natural history of SLD after sleeve gastrectomy through a large cohort with the longest follow-up reported in the literature to date and based on a strategy of promotion of treatments preserving the sleeve as much as

possible. We confirmed the poor prognosis of “malignant leakage” and illustrated the decisive impact of (1) twist and stenosis of the gastric sleeve and (2) the persistence of a gastro-cutaneous or gastro-pleural fistula. In expert centers specialized in obesity surgery, we obtained delayed healing of chronic fistula, illustrating the effectiveness of a relentless endoscopic approach AND documented that conversion to RYGBP could be a safe option, allowing for better control of GERD and a shorter treatment.

We aimed to focus on poor prognosis SLD because we were disappointed by the disparity of the data extracted from case reports, original articles, and reviews that did not match with our personal experience (see Table 4). We observed that a cluster of patients that, although slightly evocated in the literature, represented a substantial part of the patients of a tertiary referral center and did not present a favorable evolution after first-line endoscopic treatment. We recruited them retrospectively from 2 centers of excellence (COE) and described them as “malignant leakage” (see the “Patients and Methods” section). The impact of stenosis or twist of the gastric tube, creating an upstream hyper pressure [19], and the impact of gastro-cutaneous or gastro-pleural fistulas that create an hypopressure (compared with intragastric pressure [20]), have been already suggested in the onset [4] and the persistence of SLD [12, 19, 21, 22]. In this study, we documented and measured their preeminence over patients’ related factors (i.e., age, sex, BMI, comorbidity history, and previous gastric procedure). We think that preventing the SLD from local hyper pressure should be a priority, by removing underlying stenosis and promoting solid fasting with enteral nutritional support.

Table 4 Review of literature of sleeve leakage series

Article	Country	<i>N</i>	Chronic leakage	Leakage rate (%)	Conversion rate (%)	Healing time (months)	Identified risk factors
Csendes 2010	Chile	16	No	4.66	0	1.5 ± 0.8	–
Moszkowicz 2013	France	22	Yes*	–	41	–	Previous bariatric procedure
Chouillard 2015	France	75	Yes*	–	40	–	–
Donatelli 2015	France	67	Yes	–	5	1.9 (0.3–7.6)	Chronic leakage
Moon 2015	USA	15	Yes	2.8	20	–	–
Nedelcu 2015	France	19	No	–	0	3.4 (2–14)	–
Garofalo 2016	Canada	11	Yes*	1.1	18	2.2 (0.9–5.3)	–
Nimeri 2016	UAE	14	Yes*	–	21	1.6 ± 0.3	Chronic leakage, stenosis
Rebibo 2016	France	86	Yes*	2.9	12	3.7 (0.5–14.1)	Large retained gastric fundus
Sasson 2016	USA	31	Yes*	–	61	–	–
El Sayes 2017	Germany	36	Yes*	2	31	–	Stenosis, chronic leakage
Al Hajj 2018	Lebanon	20	Yes*	2.5	60	7.3 (5–12)	Complex leakage
Bashah 2020	Qatar	72	No*	–	2.9	2.0 ± 0.2	–
Caiazza 2020	France	100	Yes*	–	37	5.3 ± 4.7	Stenosis or twist, gastro-cutaneous fistula

*Including patients referred to this center of excellence from other hospitals

Endoscopic treatment—associated, if needed, with laparoscopic drainage and adequate nutritional support and antibiotics in order to minimize risk factors of SLD persistence—has been considered the gold standard for the management of the large majority of leaks after SG [5], even for chronic SLD [19]. External drainage was removed as soon as possible to prevent gastro-cutaneous fistulas which impaired SLD closure. In this study, repeated endoscopic procedures allowed the closure of chronic leakage in 92% of the cases in the absence of stenosis or gastro-cutaneous fistula. Disappointingly, those successful results were not reproduced in cases associated with poor prognosis criteria, which represented half of our cohort. Radical treatment has been suggested [19, 23] either by conversion to RYGBP (with gastro-jejunal anastomosis or esojejunal anastomosis) or by fistulojejunostomy associated with a transit bipartition [24]. This last technique seems to offer a low postoperative morbidity, but it still needs to be assessed in the long term. At the time of our study, we had no experience in this technique and privileged the classical conversion to RYGBP. Primary healing was obtained for most patients (92%), and no patient had to be operated upon for leakage (endoscopic treatment only) or hemorrhage after RYGBP. At the end of our study, delay for conversion remained controversial. The decision to redo surgery (e.g., duration of attempt to heal the SLD conservatively) should combine both optimized surgical strategy, based on the probability of endoscopic treatment success [22], adhesions maturation process [25], and patients' choices. We brought reliable data to feed the decision-making process of surgeons and to inform the patient that complete healing could be obtained up to 11 months after surgery, but that the great majority (75%) occurred after less than 4 months of multimodal, optimized, and intensive treatment. As a result, we promptly informed patients with chronic SLD that we could be constrained to convert their SG to RYGBP and plan this intervention at 6 months. We were used to cancel it in most cases.

We reported herein that the time between surgery and diagnosis/treatment of the SLD did not significantly impact its prognosis in this series of chronic leakage, unlike the period of time between diagnosis of the SLD and transfer to the referral center (univariate $p = 0.002$; multivariate $p = 0.069$). This result is in line with the experience of the recently published OSEAN network, which showed the benefits of the concentration of complications in highly specialized centers in terms of morbidity and mortality [24].

However, our study had some limitations related to the retrospective collection of data, which are heterogenous due to the large panel of situations in terms of patient's characteristics, SLD and gastric sleeve features, or type of treatment performed before transfer. Endoscopic and surgical management could be difficult to transpose to other teams because of skills, but also because of variability of practice from one country to another, for example, the consideration of pig tail

drains versus covered stents [6]. We hope that the large number of patients and the recruitment through 2 different centers of excellence could attenuate this heterogeneity and make our results convincing and operable.

Conclusion

Malignant leakage after sleeve gastrectomy can be managed conservatively in most cases. Patients presenting with risk factors for chronic leakage—such as gastro-cutaneous leaks, complex leaks, and twist or stenosis of the gastric tube—should be managed with a radical approach. Based on our data, we propose conversion to RYGBP after 6 months to optimize endoscopic treatment and to prevent surgical difficulties due to intra-abdominal adhesions.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest. Informed consent was obtained from all individual participants included in the study. For this type of study, formal consent is not required.

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