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ORIGINAL CONTRIBUTIONS

Endoscopic Management of Sleeve Stenosis

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Abstract

Purpose Sleeve gastrectomy is one of the most popular bariatric procedures performed. A complication of this surgery is sleeve stenosis, causing significant morbidity and the need for corrective intervention. Endoscopic treatment using pneumatic dilation has evolved as an effective, and minimally invasive, technique to successfully treat this complication. Here we report our experience with endoscopic management of sleeve stenosis at a tertiary bariatric center.

Material and Methods We identified all patients that underwent endoscopic management of sleeve stenosis at a tertiary bariatric center from 2010. We reviewed patient demographics, operative data, interval to endoscopic treatment, and outcomes of pneumatic dilations.

Results Sixty seven patients underwent 130 endoscopic dilations. The majority of these patients were female (71%), and at the time of sleeve gastrectomy average age was 43.3 years (range 18–68 years) and average BMI was 41.5 kg/m^2 (range 31–63 kg/m^2). The time interval to first endoscopic procedure was 7.2 months (range 0.75–53 months), with an average of 2 procedures per patient. During the follow-up period, the success rate of endoscopic dilatation was 76.1%, while the remaining 16 patients underwent conversion to gastric bypass. Two patients underwent emergency conversion to gastric bypass for sleeve perforation during the procedure (1.5%). There was a modest weight gain of 3 kg (4.2% total body weight) after sleeve dilatation.

Conclusions Endoscopic management of sleeve stenosis is safe and effective, with a success rate of over 75%. During endoscopic management, there was a 1.5% risk of sleeve perforation requiring emergency surgery. Mild weight regain occurred following endoscopic sleeve dilation.

Keywords sleeve gastrectomy · Stenosis · Stricture · Endoscopy · Pneumatic dilation

Key Points 1. Sleeve stenosis is complication of sleeve gastrectomy.
2. Pneumatic dilation is safe and effective with a 76% success rate and 1.5% risk of perforation.
3. Slight weight regain is expected.

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Introduction

Sleeve gastrectomy is the most popular bariatric procedure worldwide, with over 340,000 cases performed in 2016 [1]. Although considered to have a high safety profile, significant post-operative complications remain even at the most experienced of bariatric centers [2]. There is a paucity of data regarding the complication of sleeve stenosis, which results in dysphagia, epigastric pain, vomiting, reflux, and eventually malnutrition and vitamin deficiencies.

Sleeve stenosis is described as either "true" stricture, which is most common at the angular incisura, or as a "twisted" sleeve ("helix" sleeve) that occurs during the surgery due to misalignment of the staple line causing a tight angle along the long axis of the sleeve. A "true" stricture may be due to stapling too close to the bougie, postoperative hematoma, inflammation, or later scar formation [2]. A "twisted" sleeve usually presents later (late stenosis), and is more functional in regard to the patients' symptoms and presentation. The prevalence is reported to be as high as 4% in some series [2–4]. The most prevalent symptom is dysphagia, usually with solid foods. This may occur relatively soon after surgery, or develop later after an uneventful post-operative course. Other symptoms more common with a later presentation include vomiting and reflux.

Diagnosis of sleeve stenosis can be challenging, especially in the immediate post-operative period when some degree of dysphagia and epigastric discomfort is expected. Diagnosis can be confirmed using upper gastrointestinal swallow study showing either no passage through the sleeve, or narrowing, with or without some degree of reflux [5, 6]. Upper endoscopy is another effective modality for diagnosis.

There are several endoscopic management options for a stenotic sleeve. Pneumatic dilations, endoscopic stricturoplasty with argon beam, and endoscopic stents have all been reported either as sole or combined treatment methods [7–10]. The small cohorts of these studies make it difficult to adequately compare the different treatment options. Therefore, there are no clear evidence-based guideline recommendations for the optimal endoscopic treatment of sleeve stenosis. Questions remain regarding which technique is superior, how many endoscopic attempts should be made until a formal surgical conversion is necessary, what is the complication rate, and how much weight gain is to be expected after successful dilatation? Here we report the largest series thus far on endoscopic management of sleeve stricture, using pneumatic dilation with or without argon beam stricturoplasty, in an attempt to answer some of these questions.

Aim

Our aim was to evaluate the efficacy and safety of endoscopic balloon dilation with or without stricturotomy in patients with symptomatic sleeve stenosis. We analyzed the number of procedures needed to relieve symptoms, time from the operation, and weight regain following the endoscopic treatment.

Materials and Methods

All the patients in our bariatric surgery data base who underwent sleeve gastrectomy from 2010 till 2016 were reviewed in this study. Also included in the cohort were patients referred to our center with stenosis after surgery at an outside center. Patients with symptoms of dysphagia were either sent for upper GI swallow series or directly for endoscopy. We reviewed patient demographics, operative data, interval to endoscopic treatment, and outcomes of pneumatic dilations including number of dilations per patient, complications, and need for conversion to gastric bypass. Symptomatic resolution or improvement of symptoms and the ability to tolerate solid foods were considered successful outcomes. We then collected current data on patients and calculated weight regain following sleeve dilation. The primary endpoint was clinical resolution, defined as resuming oral diet and avoidance of further surgical or endoscopic intervention. Secondary endpoints were incidence of sleeve stenosis, degree of weight regain, and adverse outcomes.

Statistical Analysis

Data are presented as mean ± standard deviations, or median scores where appropriate given the distribution of the data. Data were analyzed using the software package SPSS 17.0 for Windows. Distribution of the data was checked for normality using the Kolmogorov–Smirnov test; parametric data are presented as mean ± standard deviation, and analyzed using Student's two-sample t test for two sample comparisons. All tests were two tailed and results with a $p<0.05$ were considered statistically significant.

Endoscopic Technique

All endoscopic procedures were performed under conscious sedation. Dilatation procedures were done using a pneumatic 30mm balloon (Rigiflex esophageal balloon; Boston Scientific, Natick, MA, USA). The balloon was introduced over a guide wire (Amplatz Super Stiff 0.038 inch; Boston Scientific, Natick, MA, USA) and advanced to the stenotic sleeve under direct endoscopic visualization. Once in position, the balloon was inflated to 30mm 20PSI for duration of 2 min. The procedure was repeated if insufficient improvement was noticed in 1–2 weeks. If no improvement at all was noticed after 2 sessions, an endoscopic stricturoplasty was added

before the balloon dilatation in the next session. Argon beam strictiroplasty was done by applying argon plasma coagulation (Erbe Vio200 D; forced coagulation, 70W, 2 L/min) along the staple line in the stenotic area. The combined endoscopic treatment was done for a maximum of additional two sessions. If insufficient clinical improvement was achieved after 4 sessions, the patient was defined as refractory sleeve stenosis and referred for surgery. Routine proton pump inhibitor was prescribed for 1 month post endoscopic treatment (Esomeprazole 40mg BID).

Results

Sixty seven consecutive patients underwent 130 endoscopic dilations from Feb. 2013 to Jan. 2017, the majority were female (51, 76.1%). Patients' demographics are shown in Table 1. During this time period, 1386 sleeve gastrectomies were performed in our bariatric center. Twenty three of the 67 patients were referred from other medical centers, giving a sleeve stenosis rate of 3.2% in our facility (44/1386).

At the time of sleeve gastrectomy, the average age was 43.3 years (range 18–68 years) and the average BMI was 41.5 kg/m^2 (range 31–63 kg/m^2). Interval to the first endoscopic procedure at our institute was 7.4 months (range 0.75–53 months) (Table 2), with an average of 2 procedures per patient (range 1–5 procedures per patient) (Table 3). Fifteen patients had additional dilation attempts at an outside hospital prior to referral to our medical center.

Success rate was 76.1% (51 of 67), while the remaining 16 patients eventually underwent surgical intervention to relieve their stenosis. Thirteen patients underwent argon beam stricturoplasty along with their pneumatic dilation. Success rate in these patients was 61.5% (8 of 13). The average time from surgery was 9 weeks and the average follow-up post endoscopic treatment was 1.9 years (2 months–4years).

Adverse outcomes occurred in 3 patients. Two patients experienced sleeve perforation, and were emergently converted to RYGB. One patient experienced a cerebrovascular accident during the endoscopic treatment. Aspirin was stopped a week prior to dilatation in accordance to the practice in our hospital. The patient was hospitalized in the Neurology department and underwent thrombolysis without hemorrhagic complications. Following this, we amended our practice and endoscopic dilatations were performed without withholding Aspirin. While minor bleeding and discomfort was universal after dilatation, no hospitalization, major bleeding requiring endoscopic hemostasis, or blood transfusion was encountered.

Revisional surgery was indicated in 16 patients who failed endoscopic management of their stricture. Two conversions were urgent for acute sleeve perforation during the endoscopic procedure—both revised to a roux-en-y gastric bypass. Six other patients were electively converted to roux-en-y gastric bypass, another 7 patients underwent a single anastomosis gastric bypass and 1 patient was found to have a kinked sleeve secondary to adhesions that were lysed with satisfactory outcome.

At an average follow-up of 22 months (range 2–53 months) from the last endoscopic procedure and 31.5 months (range 9–82 months) following the index operation, minor weight regain was noticed with an average regain of 3 kg, or a delta BMI of 1.5kg/m^2. Average weight regain following endoscopic sleeve dilation was 3 kg (4.2% total body weight). Nadir BMI for the entire cohort was 25.6 kg/m^2, which increased to 27.1 kg/m^2 at the latest follow-up after their stricture was resolved. Eighteen patients (26.8%) regained over 5% of their lost weight, and elevated their BMI from24 kg/m^2 to 27.2 kg/m^2. Ten of these patients had a more significant weight regain of over 10%, reflecting an increase of 4.3 BMI points (23.2 kg/m^2 to 27.5 kg/m^2).

Table 1 Demographics

No. of patients	67
No. of procedures	130
Mean age at LSG (range)	43.3 (18–68)
Male/female (%)	16/51 (76.1%)
Mean BMI at LSG (SD)	41.5 (31–63)

LSG, laparoscopic sleeve gastrectomy, *BMI* body mass index (kg/m^2)

Table 2 Interval between sleeve gastrectomy to first dilation attempt

Interval	N	Successful	%	Perforation
0–6 months	45	33	73.3	2
6–12 months	10	8	80	0
>12 months	12	10	83.3	0

Table 3 Number of dilation attempts

# of attempts	N	Successful	%	Perforation
1	30	24	80	1
2	19	16	84.2	1
3	11	7	63.6	0
4	6	4	66.7	0
5	1	0	0	0

Discussion

Laparoscopic sleeve gastrectomy is the leading surgical procedure for the treatment of obesity and the related metabolic co-morbidities. Despite being a safe procedure, adverse events are well documented. Among them is sleeve stenosis, which results in dysphagia, vomiting, excessive weight loss, severe reflux, and epigastric pain. Following sleeve gastrectomy, some degree of dysphagia is expected, which usually improves over time and enables patients to advance to solid foods in small volumes. It is actually somewhat of a subjective diagnosis by the surgeon and dietician. Patients with ongoing dysphagia to solid foods and frequent episodes of vomiting were referred for endoscopy, with or without an upper GI swallow series. All patients with clinically significant dysphagia were first referred to endoscopic dilation and only in cases of endoscopic failure were they later referred for surgery.

A delay in diagnosis, or neglect of this complication, may result not only in severe morbidity but also significant malnutrition and possible irreversible neurological complications secondary to vitamin deficiencies [11]. The incidence of clinically significant adverse event is scarcely reported and believed to be under diagnosed. In this series, the incidence of sleeve stenosis was 3.2%, within the range reported in previous publications [2–4].

Several endoscopic treatments have been described in small series including dilatations with pneumatic balloons and fully covered self-expandable metal stents, with and without suturing [7–9, 12]. In this series, we report the outcome of our treatment algorithm starting with balloon dilatation, and if no improvement, adding stricturoplasty in the following treatments.

The average interval between surgery and the first dilation was over 7 months. This delayed presentation may be attributed to the fact that all sleeve patients during the immediate post-operative period are expected to have some degree of dysphagia. Also because clinically significant stenosis takes time to form fibrosis, and to become symptomatic. Therefore, to realize that there is a mechanical problem with the sleeve, would take time for both the surgeon and the patient.

Similar to previous reports by Dhorepatil et al. [2], an average of 2 dilations were necessary before symptom resolution. Our practice is to attempts a total of 4 dilations with/without argon beam stricturoplasty. If there is no improvement, patients are then referred for surgery.

Argon beam stricturoplasty became available at our institution later in the study period. This explains why it was utilized in only 13 patients who failed balloon dilation. The lower success rate of argon beam stricturoplasty, when compared to balloon dilation (61% vs. 76%), may be attributed to the "stubborn" characteristics of these strictures that were inherently stronger.

We found the dilation procedure to be safe, with only 2 acute perforations in 130 procedures (1.5%). Both perforations occurred early in our series, possibly still during the learning curve of the technique. Both underwent emergent conversion to RYGB and recovered well.

Surgical conversion to either a RYGB or a Mini Gastric bypass was done to those who failed endoscopic management. The decision of which bariatric anatomy to convert the sleeve depends on the height of the stricture location. If the stricture was high, therefore a small, short pouch remained then an RYGB was performed. When the stricture was relatively distal and enabled a longer pouch, a mini gastric bypass was the procedure of choice due to its single anastomosis anatomy.

Endoscopic stenting is another option as a salvage procedure in patients failing to respond to dilation treatment. However, this is not incorporated into our practice guidelines due to a high percentage of intolerance with long fully covered self-expanding stents (FCSEMS). Shorter FCSEMS have been found to be better tolerated, yet need to be fixated using endoscopic suturing that was not available at our institution during the study time period [8, 9].

Weight regain is a possible consequence following dilatation of the stenosis, and has not been evaluated in earlier publications. Minor weight regain was noticed with an average regain of 3 kg, or a delta BMI of 1.5kg/m^2. Patients with excessive weight loss after the gastrectomy regained more weight after the dilation, yet reached a similar BMI at the end of follow when compared to the rest of the cohort.

Conclusions

Endoscopic management of sleeve stenosis is safe and effective, with a success rate of over 75%. The remaining patients can be successfully converted to roux-en-y gastric bypass or one anastomosis gastric bypass. Sleeve perforation requiring emergency surgery is a rare complication. Mild weight regain is expected.

Declarations 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.

For this type of study formal, consent is not required

Conflict of Interest The authors declare no competing interests.

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