



Long-Term Relationship Between Tobacco Use and Weight Loss after Sleeve Gastrectomy

Franco José Signorini¹ · Virginia Polero¹ · Germán Viscido¹ · Luciano Navarro¹ · Lucio Obeide¹ · Federico Moser¹

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Abstract

Background Smoking cessation had been typically associated with weight gain. We have reported that there is no relationship between tobacco use and weight loss after bariatric surgery in the short term. The objective of this study was to establish the relationship between weight loss and the smoking habit in patients undergoing bariatric surgery and to analyze weight loss on severe smokers and on those patients who stopped smoking during the long-term postoperative period.

Methods One hundred eighty-four patients included in our previous study were contacted by phone at 7 years after sleeve gastrectomy. They were again divided into three groups: (A) smokers, (B) ex-smokers, and (C) non-smokers. Demographics and weight loss at 6, 12, 24, and 7 years were analyzed. Smokers were subdivided for further analysis into the following: group A1: heavy smokers, group A2: non-heavy smokers, group A3: active smokers after surgery, and group A4: quitters after surgery. Student test was used for statistics.

Results One hundred two patients were included. The follow-up was 80.74 ± 7.25 month. Group A: 29 patients, group B: 34 patients, and group C: 39 patients. Mean BMI was 34.35 ± 8.44 kg/m² and the %EWL was 56.95 ± 27 . The subgroup analysis showed the following composition: group A1: 6 patients, group A2: 23 patients, group A3: 23 patients, and group A4: 6 patients. Weight loss difference among groups and subgroups was statistically non-significant.

Conclusions This study reaffirms the hypothesis that weight loss among bariatric patients is independent from smoking habit even at long-term follow-up and regardless from cessation.

Keywords Smoking · Tobacco · Sleeve gastrectomy · Sleeve · Bariatric · Weight loss · Smoking habits · Substance abuse

Introduction

Obesity has recently been recognized as a chronic disease. It has not only been associated with diabetes, hypertension, and dyslipidemia, but it has also been identified as an independent cause of preventable death [1, 2].

Bariatric surgery has become the most effective method for long-term weight loss and comorbidities resolution among obese patients. It has been demonstrated that bariatric surgery reduces the risk of cardiovascular events [3, 4].

Smoking is also an important cardiovascular risk factor, and its association with weight loss has been clearly established [5].

On the other hand, the relationship between bariatric surgery weight loss and tobacco use has not been clearly studied yet.

In Argentina, tobacco consumption is decreasing. In 2013, the WHO published that the consumption was 25.1%, continuing the decline in relation to previous data (29.7% in 2005, 27.1% in 2009). On the other hand, population over 18 years old showed an increase in overweight, going from a prevalence of 35.4% in 2009 to 37.1% in 2013; and obesity, from 8.0 to 20.8% in the mentioned periods [6].

In a previous report, we demonstrated that there is no relationship between weight loss and smoking in bariatric patients within a short-term follow-up [7]. The aim of this study is to analyze this relationship in the long term.

✉ Franco José Signorini
fransign@hotmail.com

¹ General Surgery Department, Bariatric Surgery Program, Hospital Privado Universitario de Córdoba, Naciones Unidas 346, (5016) Córdoba, Argentina

Methods

We extended the post-sleeve gastrectomy evaluation of our previous study, which included 184 patients who were

Fig. 1 Heavy smoking index

HEAVY SMOKING INDEX

- How many cigarettes does the patient smoke each day?
 - + 31 (+1.5 pack) = 3 points
 - 21-30 (1-1.5 pack) = 2 points
 - 11-20 (0.5-1 pack) = 1 point
 - 1-10 (-0.5) = 0 point
- How soon after waking does the patient smoke the first cigarette?
 - Within 5 minutes = 3 points
 - From 6-30 minutes = 2 points
 - From 30-1 hour = 1 point
 - More than 1 hour = 0 point

HEAVY SMOKING INDEX SCORE (add points 1 & 2 above):

0-1= Light Smoker 2-3= Moderate Smoker 4-6= Heavy Smoker

evaluated for smoking habit before and 6, 12, and 24 months after sleeve gastrectomy. Every patient was contacted by phone, and a follow-up survey was conducted to determine weight and smoking habit. The patients were divided into three groups: (A) smokers, (B) ex-smokers, and (C) non-smokers. Additionally, smokers were subdivided using the Heavy Smoking Index (HSI) [8] for further analysis; group A1: heavy smokers and group A2: non-heavy smokers. Patients with a score ≥ 4 were considered heavy smokers (Fig. 1). Smokers were also classified upon smoking status after surgery as follows: group A3: active smokers and group A4: quitters after surgery.

The data was analyzed taking into account the following variables: gender, age at time of surgery, and time elapsed since surgery.

The patients were anthropometrically evaluated using body mass index (BMI) and percentage excess weight loss (%EWL).

BMI and %EWL were analyzed at 6, 12, and 24 months and 7 years postoperatively among groups

A, B, and C; groups A1 and A2, A3, and A4 were also compared to each other.

Student’s *t* test was used for %EWL comparison among the different groups. Chi square test was used for the comparison of smoking habits previous and after surgery in each group.

Results

The study sample included 102 of the 184 initially recruited patients. Eighty-two patients could not be contacted. Sixty-two percent (61) were women. Mean age was 48.93 (26–72). Data were obtained at 80.76 \pm 7.25 months. The mean BMI was 34.35 \pm 8.44 kg/m² and the %EWL was 56.95 \pm 27.81 (Table 1). No revisional surgical procedures or death occurred in this series during the study.

Patients were again divided according to their smoking status, and distribution is exposed in Table 1.

Weight loss difference among groups was statistically non-significant at any time (Figs. 2 and 3).

According to the HIS and their smoking status after surgery, patients were subdivided (Tables 2 and 3). The subgroup analysis showed the following composition: group A1 (heavy smokers): 6 patients and group A2 (non-heavy smokers): 23. Smokers were again divided for analysis according to their smoking status after surgery (Table 4): group A3 (active smokers) 23 patients and group A4 (quitters after surgery): 6. Again, weight loss difference was non-statistically significant across the groups (Figs. 4 and 5).

It is worth of mention that 6/29 quit after surgery and only five ex-smokers relapsed. The non-smokers remained their status.

Table 1 Evolution of athropometrics: total group

Follow-up	Number	BMI kg/m ²	%EWL
Initial	102	45.44 \pm 8	
6 months	102	32.87 \pm 6	64.63% \pm 19
12 months	102	30.11 \pm 6	78.38% \pm 23
24 months	102	30.47 \pm 6	74.26% \pm 24
81 months	102	34.35 \pm 8	56.96% \pm 27

BMI body mass index, %EWL percentage excess weight loss. Results are expressed as mean \pm SD

Fig. 2 Evolution of anthropometrics: BMI

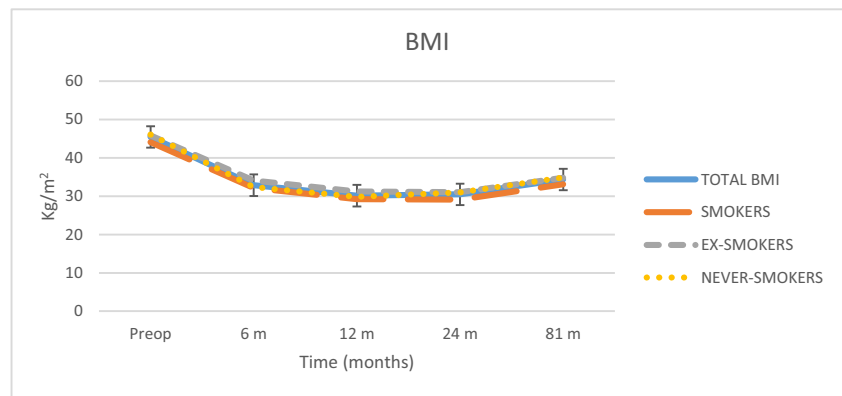
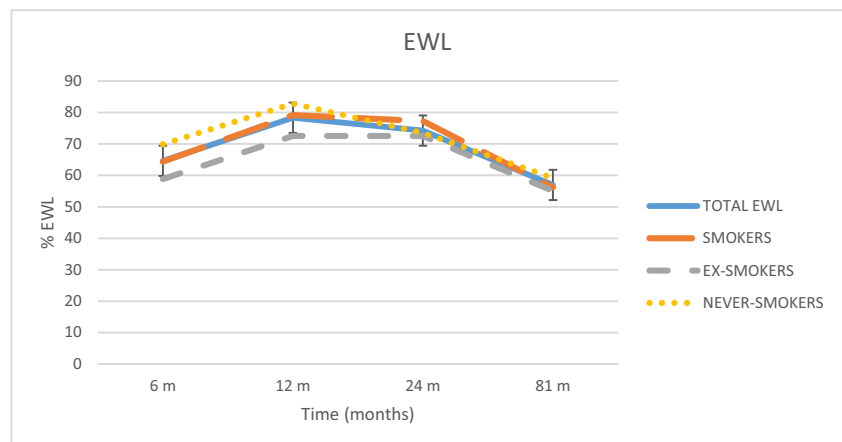


Fig. 3 Evolution of anthropometrics: %EWL



The smoking habit in each group was compared before and after surgery without statistical significance.

Discussion

Smoking and obesity have become the most important preventable cardiovascular risk factors [1, 2]. In addition to this, a morbid obese patient had a twofold increased risk of becoming a smoker [9]. Our long-term results support our previous findings that there was no relationship between smoking and weight loss among bariatric patients found [7]. Hence, bariatric surgery could be beneficial not only by decreasing the cardiovascular risk, but also by not increasing tobacco consumption.

“Symptom substitution” is the phenomenon where an abusive behavior is replaced by another one if the main source is not appropriately treated. This situation is well recognized between smoking cessation and weight gain [10]. However, this behavior was not observed in our patients. One reason might be related to the patient concern for the surgery outcome. Bak et al., noted that some patients avoid smoking relapse because they are worried about the higher risk of anastomotic complications like leak or marginal ulcer [11].

The literature referring this topic remains scarce, in fact a large recent review assessing weight loss predictors after surgery that included 36,175 reports from 1954 to 2016 has only found our previous investigation [12]. Most of the reports assessing smoking habits analyze the influence between tobacco consumption and surgery complications, being

Table 2 Distribution according to pre-operative smoking status

Group	Number	%EWL 6 m	%EWL 12 m	%EWL 24 m	%EWL 81 m
A: smokers	29	66 ± 17	75 ± 19	68 ± 20	56,18 ± 20
B: ex-smokers	34	58 ± 16	73 ± 19	74 ± 21	55,07 ± 35
C: non-smokers	39	66 ± 20	77 ± 24	71 ± 24	59,17 ± 25

A vs. B vs. C: non-significant $p < 0.05$

Table 3 Smoker’s distribution according to HIS

Group	Number	%EWL 6 m	%EWL 12 m	%EWL 24 m	%EWL 81 m
A1: Heavy	6	69.36 ± 8	88.08 ± 11	93.83 ± 12	64.87 ± 8.4
A2: Non-heavy	23	63.09 ± 18	76.90 ± 21	72.97 ± 25	53.92 ± 21

A1 vs. A2: non-significant $p < 0.05$ at any time

Table 4 Smoker’s distribution according to smoking habit after surgery

Group	Number	%EWL 6 m	%EWL 12 m	%EWL 24 m	%EWL 81 m
A3: Active	23	63.78 ± 15	78.05 ± 21	75.04 ± 26	56.21 ± 20
A4: Quitters	6	66.73 ± 21	83.64 ± 18	85.89 ± 11	56.11 ± 16

A3 vs. A4: non-significant $p < 0.05$ at any time

pulmonary, the ones with the strongest association [13], but do not investigate the relation between the weight loss and the level of tobacco use after bariatric surgery [14].

As mentioned in our previous publication, neither Lent [15], nor Conason [16] could find significant differences in smoking

habit and weight loss after bariatric procedures. The second noticed that there was a statistically significant increase in substance abuse in patients undergoing gastric bypass and adjustable gastric band. It is worth of notice that these conclusions were based on the analysis of the entire group of substances.

Fig. 4 Smokers: heavy vs. non-heavy

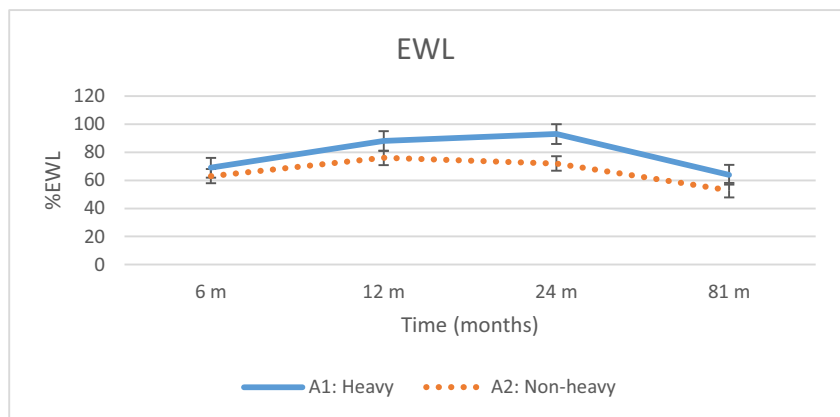
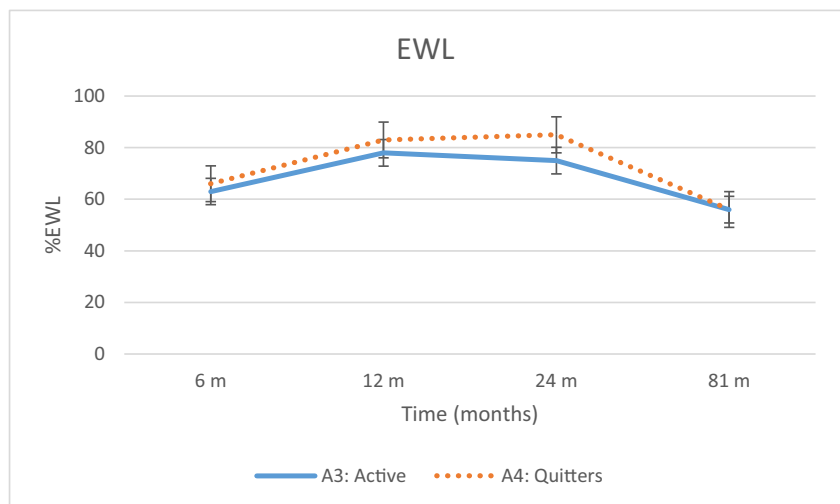


Fig. 5 Smokers: active vs. quitters



However, when data from tobacco use was analyzed separately, the same association could not be established, meaning that weight loss did not increase tobacco use.

Adam et al. [17], published one of the few reports available in the literature referring the relationship between tobacco use and post-surgical weight loss. They conclude that active smokers loose more weight than former or never smokers at 6 and 12 months, even though, they used gastric banding and gastric by-pass as surgical procedures which might lead to have heterogeneity in the sample. Moreover, smoking population was small and the follow-up showed no differences at 24 months.

Meniscalco et al. [18], have found no differences among smoking habits at 3, 6, and 12 months in a small sample were patients underwent intragastric balloon collocation, gastric band placement, and other surgical procedures.

Tobacco consumption was assessed by two methods, first we identified the pre-operative smoking habit based on chart review and after that, we updated the smoking status using a simple questionnaire, reproducible, and easy to interpret based on HIS [8]. We re-evaluated 102 of the initially 184 recruited patients at more than 7 years of follow-up. No statistically significance was found among groups, neither in weight loss, nor in the smoking habits. Furthermore, we studied the impact of heavy smoking vs. non-heavy smoking in weight loss. Again, no difference was found between these two groups: smoking habit did not have any influence in weight loss.

In this report, every patient was contacted by phone. We recognize that not only some studies suggest that women tend to under-report their weight [19], but also patients might have a tendency to underestimate the level of tobacco consumption [20]. This could be considered as a limitation but there is good evidence that support the reliability of self-reported weight following bariatric surgery [21].

A strength of this study is the long-term follow-up. This report not only provides evidence of the independence between weight loss in bariatric patients and smoking, but also shows the endurance of laparoscopic sleeve gastrectomy results among time with a %EWL of 56 at 7 years. This result is consistent with prior studies. Diamantis et al., exposed in a recent meta-analysis a EWL of 62.3, 53.8, 43, at 5, 6, and 7 years, respectively [22]. Hirth et al., had similar results in his report with a very good follow-up [23]. It is worth to mention that these series had only 13 and 14 patients at 7 years, respectively.

As exposed before, evidence tends to show that smoking habit and weight loss after bariatric surgery are independent variables even at long-term follow-up. Therefore, the benefits of bariatric surgery among cardiovascular risk could be enhanced by not increasing tobacco consumption as a symptom substitution syndrome.

Conclusion

This study reaffirms the hypothesis that weight loss among bariatric patients is independent from smoking habit even at long-term follow-up and regardless from cessation.

Compliance with Ethical Standards

For this type of study, formal consent is not required.

Conflict of Interest The authors declare that they have no competing interests.

Informed Consent Does not apply.

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