



# Impact of Sleeve Gastrectomy on Type 2 Diabetes Mellitus, Gastric Emptying Time, Glucagon-Like Peptide 1 (GLP-1), Ghrelin and Leptin in Non-morbidly Obese Subjects with BMI 30–35.0 kg/m<sup>2</sup>: a Prospective Study

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## Abstract

**Background** The study was conducted to evaluate the impact of laparoscopic sleeve gastrectomy (LSG) on type 2 diabetes mellitus (T2DM) in patients with a body mass index (BMI) of 30.0–35.0 kg/m<sup>2</sup>. Possible mechanisms, including alterations in gastric emptying time (GET), glucagon-like peptide 1 (GLP-1), ghrelin and leptin, were evaluated.

**Methods** Twenty obese patients with T2DM and with a BMI of 30.0–35.0 kg/m<sup>2</sup> underwent LSG during March 2012 to February 2015. Glycosylated haemoglobin (HbA1c), fasting plasma glucose (FPG) and GET were measured at baseline, 3 months, 6 months, 12 months and 24 months after surgery. Fasting and post-prandial levels of serum GLP-1, ghrelin and leptin were measured pre-operatively and after 3 and 6 months.

**Results** The average duration of follow-up was 17.6 months, and 10 patients had completed 2 years of follow-up. After 2 years, the average BMI decreased from 33.4±1.2 to 26.7±1.8 kg/m<sup>2</sup>. The mean HbA1c decreased from 8.7±1.6 to 6.7±1.5 %, respectively. Ten patients achieved complete remission. Insulin could be stopped in all six patients who were on it pre-operatively. Meal-stimulated GLP-1 response and serum insulin at 30 min showed a significant increase following surgery. There was a significant decrease in GET.

**Conclusions** This prospective study confirms the positive impact of LSG on diabetic status of non-morbidly obese patients. The possible mechanisms include the rise in post-prandial GLP-1 level induced by accelerated gastric emptying, leading to an increase in insulin secretion. LSG also leads to decreased ghrelin and leptin levels which may have a role in improving glucose homeostasis after surgery.

**Keywords** Sleeve gastrectomy · Diabetes mellitus · Class 1 obesity · Mechanisms · Gastric emptying time · Glucagon-like peptide 1

## Introduction

Diabetes is currently the most common non-communicable disease worldwide. According to the International Diabetes Federation, 6.4 % of 20–79-year age groups are diabetic which is translated to roughly 285 million people and is expected to reach 7.7 % by 2030 [1]. Type 2 diabetes mellitus (T2DM) is a progressive disease with a gradual increase in insulin resistance and beta cell failure which often requires intensification of medical therapy.

Pories et al., in his landmark article, highlighted that surgery can be a more effective treatment for T2DM than medical treatment alone [2]. Bariatric procedures with malabsorptive component lead to a remission rate of 70–80 % in obese patients with type 2 diabetes [3]. Laparoscopic sleeve gastrectomy (LSG), a less complex procedure, has also shown a beneficial effect with resolution rates of 50–80 % [4, 5]. These impressive results have led to consideration of LSG as a treatment option for T2DM in patients with a body mass index (BMI) <35 kg/m<sup>2</sup>. The few prospective studies assessing the response of LSG in patients with BMI <35 kg/m<sup>2</sup> have shown

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