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Review

# What is the evidence for metabolic surgery for type 2 diabetes? A critical perspective

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## Abstract

Bariatric surgery has emerged as a highly effective treatment not only for obesity, but also for type 2 diabetes (T2D). A meta-analysis has reported the complete resolution of T2D in 78.1% of cases of morbidly obese patients after bariatric surgery. Such extraordinary results obtained in diabetic patients with body mass index (BMI) scores  $> 35 \text{ kg/m}^2$  have led investigators to question whether similar results might be achieved in patients with BMIs  $< 35 \text{ kg/m}^2$ . Preliminary studies suggest that metabolic surgery is safe and effective in patients with T2D and a BMI  $< 35 \text{ kg/m}^2$ , whereas other studies report that metabolic surgery is less effective for promoting T2D remission in these patients. Thus, the results are discordant. Long-term studies would be useful for determining the safety, efficacy and cost-effectiveness of metabolic surgery for this population with T2D. In 2015, it is probably premature to say that metabolic surgery is an accepted treatment option for T2D patients with BMIs  $< 35 \text{ kg/m}^2$ .  
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**Keywords:** Bariatric surgery; Metabolic surgery; Obesity; Type 2 diabetes

## 1. Introduction

A large body of published work, as well as recommendations and clinical experience, demonstrate the metabolic benefits that can result from bariatric surgery. Many patients show indisputable postoperative improvement of their type 2 diabetes (T2D) [1]. Some authors consider bariatric surgery as having more powerful long-term benefits than therapeutic escalation of the hypoglycaemic treatments commonly used in diabetology [2]. Postoperative remission of T2D brings hope to patients who have this complex chronic disease, and demonstrates the potential reversibility of the disorder, formerly believed to inevitably worsen over time. Nevertheless, there are exceptions and, for some patients, in particular the most advanced, there is no major postsurgical recovery. Yet, the improvement of T2D for these patients, albeit less substantial, has more than negligible

benefits for these patients by lowering HbA<sub>1c</sub>, reducing the doses of treatments and the number of classes of hypoglycaemia treatments used, and restoring a degree of efficacy to treatments after all combinations have apparently become ineffective. Consequently, the notion of weight control is being replaced by the hope of possible surgical management of diabetes, including bariatric and metabolic surgery.

The present report has addressed a few simple questions about metabolic surgery by analysing the recent literature and focusing on the two most commonly used techniques, gastric bypass (Roux-en-Y gastric bypass [RYGBP]) and sleeve gastrectomy. Our study looked at who has been treated, when, how and with what results. Despite the widespread growing enthusiasm for surgical management of T2D, and even of prediabetes, some important questions remain.

## 2. Is metabolic surgery a logical extension of bariatric surgery?

The development of surgical techniques for obesity since the 1950s has had beneficial effects on its comorbidities, including

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Table 1  
Proposed definitions for remission and improvement of type 2 diabetes after bariatric surgery.

Authors, year [ref]	Fasting glucose (mg/dL)	HbA <sub>1c</sub> (%)	Hypoglycaemic treatment
<i>Remission</i>			
Schauer et al., 2003 [8]	< 110	< 6.5	Absence
Buchwald et al., 2004 [9]	< 100	< 6.0	Absence
Dixon et al., 2008 [10]	< 126	< 6.2	Absence
Buse et al., 2009 [11]	< 100	< 5.7	Absence
Mingrone et al., 2012 [12]	< 100	< 6.5	Absence
Ikramuddin et al., 2013 [13]	–	< 7.0	Presence or absence
Schauer et al., 2014 [14]	–	< 6.0	Presence or absence
<i>Improvement</i>			
Schauer et al., 2003 [8]	Reduced by > 0.25 g/L	Reduced by > 1.0	Reduced treatment (stopping oral hypoglycaemic drugs, or 50% reduction of daily insulin dose)

T2D. It was clearly demonstrated in the 1970s that T2D could disappear after interventions such as jejunal–ileal bypass [3]. The first paper describing such cases was done in the 1990s by the team of Walter J. Pories, and clearly raised the issue in its title: “Who would have thought it? An operation proves to be the most effective treatment for adult-onset diabetes mellitus”. This laid the foundation for innovative thinking on the possibility of T2D remission by bariatric surgery [4,5]. Since then, the revolution associated with laparoscopy, and improvements in anaesthesia and resuscitation of obese patients, has allowed bariatric surgery to become much more widely used. Also, the worldwide obesity and T2D epidemics have led to research interest in bariatric surgery as a treatment for both disorders.

### 3. Metabolic surgery: what is it and who is it for?

Is it important to define metabolic surgery? There is increasing discussion of metabolic surgery, but its definition differs according to how the term “metabolic” and the targeted population are viewed. Bariatric surgery can be defined as the set of surgical techniques that promotes the loss of excess weight and its consequences in terms of comorbidities [6]. The population concerned is the one that national and international recommendations have determined as having a favourable benefit/risk balance for bariatric surgery – either a body mass index (BMI) > 35 kg/m<sup>2</sup> with one or more comorbidities, or a BMI > 40 kg/m<sup>2</sup>. These patients are mostly managed in specialized multidisciplinary centres for the treatment of obesity.

All the currently available techniques have more or less favourable metabolic effects on glycaemic equilibrium, including dietary restriction, weight loss and additional specific effects with certain techniques (including incretin effects, changes in intestinal flora, reduction of low-grade inflammation, reducing fatty liver and stimulation of intestinal gluconeogenesis) [7].

Metabolic surgery is more strictly defined as a set of surgical techniques promoting improvement of glycaemic equilibrium with the least possible or no effect on weight. With this technique, the aim is to manage diabetes that is uncontrolled, despite hypoglycaemic treatment at its maximum dose, in slightly obese or simply overweight patients. These are the typical diabetic patients with metabolic problems.

The first definition (of bariatric surgery) refers to a super-obese population of patients with one or more comorbidities, of which one is T2D. The second definition (of metabolic surgery) refers to a population of patients with chronic uncontrolled diabetes exposed to complications and for whom recommended diabetes management strategies have failed, but who are not excessively overweight. These patients are principally treated by diabetologists. These are two very different populations, and their health challenges are equally different.

It is also important to consider how the postoperative evolution of T2D is defined, given the possible outcomes: cure (or remission); improvement; or failure (or worsening). Yet, the only criterion extensively used in the literature is the cure or remission of T2D. In the surgical literature, the postoperative evolution of T2D has the same importance as the loss of excess weight. Also, authors all over the world have not used the same definition for the cure of T2D (Table 1) [8–14], although the definition from Schauer et al. [8], published in 2003, has long been considered consensual (fasting glucose < 1.10 g/L or HbA<sub>1c</sub> < 6.5% without treatment).

As for the diabetologist’s point of view, a group of experts from the American Diabetes Association (ADA) proposed, in 2009, very strict definitions for the postoperative outcome of T2D after 1 year [11]: remission of T2D is defined as HbA<sub>1c</sub> < 5.7% associated with fasting glucose < 5.6 mmol/L, without hypoglycaemic treatment; and partial remission (or improvement) is defined as HbA<sub>1c</sub> < 6.4% associated with fasting glucose < 6.0 mmol/L, without hypoglycaemic treatment. While this is the strictest definition in terms of the chosen metabolic criteria, it is the one least used in studies.

Despite repeated attempts to define the postoperative metabolic status of patients, publications purportedly in the “metabolic surgery” domain continue to report fasting glucose, but not HbA<sub>1c</sub>, or only report on the population in post-operative remission for T2D (but no other categories). The multiplicity of definitions makes any meta-analysis of the literature difficult. Also, these publications fail to describe either the treatment for diabetes or changes to treatment, which is important in any consideration of cohort follow-up. Better use of the more rigorous definitions is required to facilitate meta-analyses and comparisons of cohorts. This is particularly

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