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# **Accessibility to kidney transplant and long-term outcomes in patients with severe obesity after bariatric surgery**

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## **Introduction**

Obesity and BMI are increasing rapidly in patients with end-stage renal disease (ESRD) [1]. Kidney transplantation (KT) decreases long-term mortality in patients with obesity and ESRD compared to those on dialysis [2]. However, due to surgical technical challenges and increased risks of delayed graft function (DGF), graft loss, and acute rejection [3], KT access remains limited for patients with obesity, especially in severe cases ( $\text{BMI} > 35 \text{ kg/m}^2$ ) and in those with abdominal adiposity. Both sarcopenia and high TDM-measured vessel to skin distance is associated with more frequent KT complications [4]. Consequently, many centers impose BMI thresholds, recommending weight-loss before patients are actively placed on KT waiting list to subsequently access KT.

Bariatric surgery (BS) offers significant and sustained weight-loss, improves obesity-related comorbidities, and reduces mortality [5]. While BS carries a higher risk of short-term complications in ESRD patients [6], it improves KT accessibility and reduces 5-year mortality in patients with severe obesity and ESRD [7]. Thus, KDIGO guidelines now recommend offering BS for ESRD patients with  $\text{BMI} > 40 \text{ kg/m}^2$  or  $> 35 \text{ kg/m}^2$  with comorbidities.

Although few studies report early KT outcomes post-BS, long-term events such as graft survival, complications, and weight maintenance post-KT remain unclear [6]. Furthermore, the effects of BS on sarcopenia in ESRD patients are not known, nor whether BS prevents new-onset diabetes (NODAT) or post-KT weight gain. This study aims to evaluate KT accessibility graft survival, weight maintenance, lean mass changes, and obesity-related complications in patients with ESRD and severe obesity at least five years post-BS.

## **Methods**

Detailed methods are available in the supplemental material.

## **Study Population**

This study included patients with ESRD on dialysis, temporarily ineligible for KT due to obesity, who underwent BS between 2009 and 2017 at Pitié-Salpêtrière Hospital, Paris, as part of the BARICAN cohort [8]. Ethical approval was obtained from the French Research Ethics Committee (CPP Ile-de-France-1, N°13533), and all participants provided informed consent.

### **Bariatric Surgery and Data Collection**

Baseline and follow-up data, including weight, body composition (fat mass, lean mass), and diabetes status, were collected at baseline, one, and five years post-BS. Sarcopenia was defined using appendicular lean mass/weight ratio thresholds by gender [9]. Severe surgical complications were recorded within 30 days post-BS.

### **Kidney Transplant and Data Collection**

Kidney-related data included ESRD etiology, dialysis duration, and HLA incompatibility. Post-KT data included NODAT, delayed graft function (DGF), and graft survival rates.

### **Statistical Analysis**

Continuous variables were expressed as mean  $\pm$  SD, and categorical variables as absolute values and percentages. All analyses were performed using R Studio software (version 1.2.1335).

## **Results**

### **Baseline Characteristics and Evolution After Bariatric Surgery**

Table 1 summarizes patients' baseline and follow-up characteristics. Most patients underwent sleeve gastrectomy (SG, n=19), while 3 had Roux-en-Y gastric bypass (RYGB). Preoperative BMI averaged  $40.5 \pm 4.6$  kg/m<sup>2</sup>. Common obesity-related comorbidities included type 2 diabetes (50%), hypertension (82%), and obstructive sleep apnea (67%). Preoperative lean mass was  $53.9 \pm 7.4\%$ , with 36.3% of patients having sarcopenic obesity (75% male). At one-year, total weight-loss was  $21.4 \pm 8.5\%$ . Lean mass loss was  $8.1 \pm 6.2$  kg corresponding to

36.7% of total weight-loss. At one-year post-BS, body composition changed towards an increase in % lean mass and % appendicular lean mass. The prevalence of sarcopenic obesity decreased from 36% to 18% post-BS. At five years, lean appendicular mass remained stable (data from 13 subjects).

### **Bariatric Surgery Morbidity in ESRD Patients**

No deaths occurred within 30 days post-BS, but 18.2% experienced severe complications, including fistulas, abscesses, anastomotic ulcers, and stenosis.

### **Accessibility to Kidney Transplant After Bariatric Surgery**

The mean follow-up post-BS was  $9.3 \pm 2.4$  years. Among 22 patients, 16 (73%) received KT at an average BMI of  $29.7 \pm 3.4$  kg/m<sup>2</sup>, with a median delay of  $2.7 \pm 1.7$  years post-BS (Table 1). Abdominoplasty was required in 25% (n=4) of patients to facilitate KT. Of the 6 who did not receive KT, 3 reached the target weight, but 2 died from BS-unrelated causes, and 1 failed to achieve weight-loss goals.

### **Long-Term Transplantation Outcomes in Bariatric Surgery Patients**

Among the 16 transplanted patients, 75% (n=12) maintained functional grafts after a  $6.9 \pm 2.3$ -year follow-up. The remaining 4 patients included 2 with graft function loss (1 acute and 1 chronic rejection) and 2 died from BS-unrelated causes (Covid-related complications). DGF occurred in 18.8% of cases, and NODAT was seen in 7.7% of patients (table 1).

### **Long-Term Weight and Metabolic Outcomes in Transplanted Patients**

Weight stabilized in the first two years post-KT, with a slight regain by year five, thus BMI increased from  $28.9 \pm 3.2$  to  $31.0 \pm 4.6$  kg/m<sup>2</sup> between one and five years. Average weight regain from BS nadir reached  $12.6 \pm 16.9\%$  by year five. Diabetes remission was seen in 42.9% at five years post-KT, with one case of relapse.

## **Discussion**

This study provides a detailed account of long-term KT outcomes in patients with severe obesity and ESRD who underwent BS prior to KT. We observed a high KT accessibility rate (73%) post-BS, likely due to our long follow-up period ( $9.3 \pm 2.4$  years), compared to lower reported rates (20%) in studies with shorter follow-up [6]. The average time between BS and KT was  $2.7 \pm 1.7$  years. This delay depends on weight-loss, but also blood type and graft incompatibility. Preparation time for BS and the need for abdominoplasty (required in 25% of patients) may extend the wait for KT, particularly in older patients. Our observed DGF rate of 18.8% was much lower than that observed (32.2%) in patients with severe obesity without BS [10]. Graft survival was favorable at 75% after  $6.9 \pm 2.3$  years.

While we acknowledge an increased BS morbidity in ESRD patients (18%) compared to non-ESRD patients (<5%) [11]), aligning with previous reports [7], long-term mortality reduction in this population supports BS as a viable option.

Our study is also the first to assess sarcopenia prevalence before and after BS in patients with obesity and ESRD. Pre-BS sarcopenic obesity reached 36.3%, thus higher than in older hospitalized adults with severe obesity. BS led to lean mass loss (36.7% of total weight-loss), thus higher than the 26.7% reported in non-ESRD patients [12]. Nevertheless, in this frail population body composition improved after BS with an increase in % lean mass and a decrease in sarcopenic obesity from 36.8% to 21% one year post-BS.

In contrast to typical weight gain after KT, our patients experienced weight stabilization in the first two years post-KT, with a gradual regain by year five, within the expected range for BS patients [13]. Long-term weight maintenance ( $20.4 \pm 9.5\%$  loss) was achieved on average five years post-KT with inter-individual variability. Additionally, diabetes remission persisted in 42.9% of patients five years post-KT, thus a little lower than in non-ESRD patients (54%) [8].

Despite the small sample size and retrospective design, our study highlights the benefits of BS in improving KT access for patients with severe obesity and ESRD, with favorable long-term graft survival and maintenance of BS-induced weight loss and metabolic improvements. Prospective studies and larger datasets are needed to further validate these findings.

## Figure Legends

### Figure 1 Long-term weight change after bariatric surgery in patients with kidney transplant

Evolution of (A) percent weight loss (compared to pre-bariatric surgery weight) in transplanted patients. Scale of x axis is discrete (not continuous) and arbitrary. BS: Bariatric surgery; KT: Kidney transplant; Nadir: lowest weight reached in the two years post BS

**Conflicts of interest:** The authors declare that they have no conflict of interest

Data described in the manuscript and analytic code book will be made available upon request.

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