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Original article

The impact of bariatric surgery on estimated glomerular filtration rate in patients with type 2 diabetes: a retrospective cohort study

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Abstract

Background: Diabetes mellitus is the most common cause of end-stage renal disease, which is associated with increased morbidity and mortality. The impact of bariatric surgery on chronic kidney disease is unclear.
Objectives: Our primary aim was to assess the impact of bariatric surgery on estimated glomerular filtration rate (eGFR) in type 2 diabetes (T2D) patients. Our secondary aim was to compare the impact of bariatric surgery versus routine care on eGFR in patients with T2D.
Setting: University Hospital, United Kingdom.
Methods: A retrospective cohort analysis of adults with T2D who underwent bariatric surgery at a single center between January 2005 and December 2012. Data regarding eGFR were obtained from electronic patients records. eGFR was calculated using the Modification of Diet in Renal Disease formula. Data regarding patients with T2D who did not undergo bariatric surgery ("routine care") were obtained from patients attending the diabetes clinic at the same center from 2009 to 2011.
Results: One hundred sixty-three patients were included (mean age 48.5 ± 8.8 yr; baseline body mass index 50.8 ± 9.1 kg/m^2) and were followed for 3.0 ± 2.3 years. Bariatric surgery resulted in an improvement in eGFR (median [interquartile range] 86.0 [73.0−100.0] versus 92.0 [77.0−101.0] mL/min/1.73 m^2 for baseline versus follow-up, respectively; $P = .003$), particularly in patients with baseline eGFR ≤60 mL/min/1.73 m^2 (48.0 [42.0−57.0] versus 61.0 [55.0−63.0] mL/min/1.73 m^2; $P = .004$). After adjusting for baseline eGFR, glycated hemoglobin (HbA1C), body mass index, age, and gender, bariatric surgery was associated with higher study-end eGFR compared with routine care (B = 7.787; $P < .001$).
Conclusion: Bariatric surgery results in significant improvements in eGFR in T2D patients, particularly those with an eGFR ≤60 mL/min/1.73 m^2, while routine care was associated with a decline in eGFR. (Surg Obes Relat Dis 2016;▮:00–00.)

Keywords: Bariatric surgery; Type 2 diabetes; Chronic kidney disease; Nephropathy; Albuminuria; Renal function; Estimated glomerular filtration rate

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Chronic kidney disease (CKD) secondary to diabetes is the most common cause of end-stage renal disease (ESRD) and is associated with increased morbidity and mortality [1,2]. About 20% to 40% of patients with microalbuminuria can progress to overt proteinuria, 20% of whom will have progressed to ESRD within 20 years [1]. CKD progression to ESRD requiring renal replacement therapy is variable and depends on multiple modifiable and nonmodifiable factors such as obesity, blood pressure (BP), metabolic control, gender, and ethnicity [3,4].

Glycaemic and BP control and the use of renin–angiotensin–aldosterone system (RAAS) inhibitors are the mainstay of treatment to slow down the decline in renal function and the progression to ESRD; however, despite better metabolic control in patients with type 2 diabetes (T2D), ESRD remains very common [5].

Obesity, which is very common in patients with T2D, is also a modifiable risk factor in the development of CKD [6–8]. The mechanisms linking obesity to CKD are complex and multifactorial, including hypertension, activation of the sympathetic nervous system, activation of the RAAS, increased inflammation, low adiponectin, insulin resistance, obstructive sleep apnea, and endothelial dysfunction, among others [8–11].

Meta-regression analysis from 522 patients across 13 trials found that independent of decline in mean arterial pressure, each 1 kg weight loss was associated with 110 mg (95% confidence intervals 60−160 mg; $P < .001$) decrease in proteinuria and 1.1 mg (95% confidence interval. 5−2.4 mg; $P = .011$) decrease in microalbuminuria. This potentially suggests an important role for weight loss in the management of CKD and emphasizes the importance of obesity in the pathogenesis of CKD [12].

Bariatric surgery is the most effective treatment for obesity that results in sustained long term weight loss [13]. Several randomized and nonrandomized clinical trials found that bariatric surgery was superior to intensive medical management in patients with T2D, particularly in regard to metabolic parameters including hyperglycemia, weight, BP, hypertriglyceridemia, and low high-density lipoprotein [14–18]. Diabetes remission rates after bariatric surgery were 30% to 90%, depending on the definition of the remission used, length of follow-up, the type of bariatric surgery, and diabetes duration, among other factors [14,16,17,19,20].

Hence, due to its impact on multiple CKD and cardiovascular disease risk factors, it would be expected that bariatric surgery could have a favorable impact on renal function in patients with T2D. On the other hand, bariatric surgery may have no impact on renal function in the short-medium term due to the effect of metabolic memory resulting in sustained vascular dysfunction despite improvements in metabolic control and weight loss [21]. Bariatric surgery, particularly Roux-en-Y gastric bypass (RYGB), may even have a harmful effect on the kidneys due to the possibility of chronic hyperoxaluria resulting in further insult to kidneys that are already damaged by diabetes [22].

The primary aim of this study was to assess the impact of bariatric surgery on estimated glomerular filtration rate (eGFR) in patients with T2D. A secondary aim was to compare the impact of bariatric surgery versus routine care in patients with T2D.

Methods

We conducted a retrospective cohort analysis of adult patients ($\geq$18 yr old) with T2D who underwent bariatric surgery at our center in the United Kingdom between January 2005 and December 2012. Data regarding patients who had bariatric surgery and their diabetes status were obtained from a prospectively maintained bariatric surgery database, which is kept up to date by the weight management team. Data regarding eGFR was obtained from the electronic patients records. Baseline eGFR was defined as the latest eGFR available within 1 month preceding surgery. Follow-up eGFR was the latest available on our hospital electronic system postsurgery. Patients with no baseline or follow-up eGFR were excluded from analysis. eGFR was calculated using the Modification of Diet in Renal Disease formula. eGFR $\geq$120 mL/min/1.73 m^2 was considered to be consistent with hyperfiltration as in previous studies [23–25].

Data regarding patients with T2D who did not undergo bariatric surgery (“routine care”) were obtained from another prospective study assessing the pathogenesis of microvascular complications in patients with T2D. The comparator prospective study included adults with T2D and excluded patients with ESRD. Patients in this group were recruited from the diabetes clinic at the same center in which the bariatric surgery was performed from 2009 to 2011.

The comparator “routine care” group data was collected as part of a project that was approved by the Warwickshire Research Ethics Committee (REC number 08/H1211/145). The data regarding patients who underwent bariatric surgery and their eGFR were collected during routine clinical care and as part of health service evaluation assessing the outcomes of bariatric surgery at our center, and hence ethical approval was not required.

Data analysis was performed using SPSS 22.0 software (SPSS Inc., Chicago, IL). Data was presented as frequencies or mean (standard deviation [SD]). Independent continuous variables were compared using the Student’s t test. Paired t test was used to compare presurgical and postsurgical parameters. Nonparametric tests were used if the data was not normally distributed. Categorical variables were compared using the χ^2 test. Multiple linear regression models were used to assess predictors of study-end eGFR in patients who underwent bariatric surgery and to assess the relationship between bariatric surgery versus routine care