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CLINICAL REPORT

Laparoscopic Sleeve Gastrectomy is a Novel and Effective Treatment for Obesity in Patients with Chronic Kidney Disease

Helen L. MacLaughlin · Wendy L. Hall · Ameet G. Patel · Iain C. Macdougall

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Abstract Obesity increases the risk of progression of chronic kidney disease (CKD) towards kidney failure and may preclude access to kidney transplantation. Weight loss surgery remains relatively novel in obese patients with CKD, with several studies reporting results using Roux-en-Y bypass and adjustable gastric banding. However, in obese patients with CKD, kidney failure after bypass surgery and gastric band erosion after kidney transplantation have been reported. We present the first report of laparoscopic sleeve gastrectomy (LSG) performed for the treatment of obesity in patients with CKD. Weight loss, blood pressure and lipids, estimated kidney function, surgical complications and adverse events were studied. Nine obese patients with CKD (five of whom were undergoing haemodialysis treatment) underwent LSG, with median body mass index decrease of 8.4 kg/m^2 and excess weight loss of 43.0% after 6 months. Four of the five patients on haemodialysis were added to the kidney transplantation waiting list as a result of weight loss achieved with LSG. Adverse events occurred in three patients: myocardial infarction (one patient), acute kidney injury secondary to dehydration (one patient) and compromised dialysis access (one patient). There was one complication—a gastric leak, detected 7 months after LSG, requiring further surgical intervention and nasojejunal feeding, and no mortality. Our preliminary evidence suggests that LSG is an effective treatment for obesity in patients with CKD. However, there may be additional risk associated with the procedure in patients with CKD, requiring further study.

Keywords Obesity · Bariatric surgery · Laparoscopic sleeve gastrectomy · Weight loss · Chronic kidney disease

H. L. MacLaughlin · W. L. Hall
Diabetes and Nutritional Sciences, School of Medicine,
King's College London,
London, UK

A. G. Patel · I. C. Macdougall
School of Medicine, King's College London,
London, UK

H. L. MacLaughlin (✉)
Department of Nutrition and Dietetics, King's College Hospital,
Denmark Hill,
SE5 9RS, London, UK
e-mail: helen.maclaughlin@nhs.net

A. G. Patel
Department of Surgery, King's College Hospital,
Denmark Hill,
SE5 9RS, London, UK

I. C. Macdougall
Department of Renal Medicine, King's College Hospital,
Denmark Hill,
SE5 9RS, London, UK

Introduction

Obesity is associated with inflammation, insulin resistance, hypertension and dyslipidemia and contributes to chronic kidney disease (CKD) progression and kidney failure [1–5]. In line with the rising prevalence of obesity, now almost one third of patients commencing dialysis in the United States are obese (body mass index (BMI) >30 kg/m^2) [6]. Access to kidney transplantation decreases as BMI increases above 35 kg/m^2 [7]. In those patients with a BMI >35 kg/m^2 who do receive a kidney transplant, mortality increases and kidney graft survival decreases compared to patients with a BMI of 30–35 kg/m^2 also undergoing kidney transplantation [8]. Conversely, in haemodialysis patients,

increasing BMI is associated with a survival advantage, at least in the short term [9–11].

Management of obesity is now an important consideration in patients with CKD, yet may be even more complex than within the general population, given the additional limitations on dietary and fluid intake and reduced clearance of excess metabolites due to diminished or absent kidney function. Lifestyle modification in obese patients with CKD led to significant reductions in systolic blood pressure, proteinuria and glomerular hyperfiltration with weight loss [12]. However, in patients with BMI >35 kg/m^2, even successful weight loss achieved with lifestyle interventions may be insufficient to qualify for access to deceased donor kidney transplantation. Bariatric surgery leads to sustained weight loss, resolution of diabetes and reduction in traditional cardiovascular risk factors and is more cost effective for weight loss than non-surgical options particularly in the longer term [13, 14].

Observational studies of gastric bypass and gastric banding in obese patients with CKD demonstrate significant weight loss and reduction in glomerular hyperfiltration and proteinuria [15–20] and improve candidacy for kidney transplantation [21, 22]. However, some studies report negative effects on the kidney in a minority of patients. A small sub-population has developed hyperoxaluric nephrolithiasis and chronic oxalate nephropathy after gastric bypass [23–25]. Similarly, gastric band erosion and subsequent removal has been reported post kidney transplantation and may have been related to the initiation of immunosuppression associated with transplantation [26].

To date, the safety and efficacy of laparoscopic sleeve gastrectomy (LSG) for the treatment of obesity in patients with CKD has not been reported in the literature. Restrictive bariatric surgery procedures, such as LSG and gastric banding, do not increase the risk of kidney stone disease in patients without CKD [27]. LSG is effective in obese patients without CKD [28, 29] and has few complications [30]. We now present the first results of LSG used to treat obesity in patients with CKD and report on weight loss, complications of LSG and post-operative adverse events.

Subjects and Method

A retrospective review of written and electronic medical records for consecutive patients with CKD, who underwent LSG for weight loss between March 2007 and August 2010 at King's College Hospital, London, and under the care of a nephrologist was conducted. The study was approved by the local research ethics committee. The pre-specified measures selected to be examined were weight and BMI loss, length of hospital stay, blood pressure, serum cholesterol and triglycerides, antihypertensive and lipid-lowering medication changes, approximate kidney function by estimated glomerular filtration rate using the four-variable Modification of Diet in Renal Disease Study equation [31, 32], inflammatory response (C-reactive protein) and kidney transplantation wait-listing, as well as all post-surgical complications and all adverse events occurring during the follow-up period. Complications include gastrectomy leak, bleeding requiring transfusion or invasive intervention and 30-day mortality. Possible adverse events include compromised dialysis access, cardiovascular events including myocardial infarction, cardiac arrhythmia and stroke, acute kidney injury and re-hospitalisation during the study period. Weight loss was measured as BMI loss (in kilograms per metre squared), percent excess weight loss (weight loss/difference between baseline weight and the midpoint of the 1983 Metropolitan Life Insurance Tables) and percent excess BMI loss (absolute BMI loss/baseline BMI−25) [33].

All patients underwent a routine pre-operative evaluation prior to surgery. The LSG was performed by a single experienced surgeon (AP) for all patients. Six trocars were utilised and LSG was performed with standard techniques using a 38-Fr bougie. After devascularisation of the greater curvature, the LSG commenced 4–6 cm proximal to the pylorus on the greater curvature and continued towards the angle of His. The completed staple line was reinforced with sutures. Post-operatively, all patients received anticoagulation therapy and wore compression stockings for embolism prophylaxis.

Gastrografffin meal and follow-through analyses were performed for all patients and methylene blue dye tests were completed on patients with post-operative drains in situ to detect gastric leak. Post-operative dietary education was provided by dietitians experienced in the dietary management of either weight loss surgery or CKD, but not both, due to the novelty of this procedure in patients with CKD. Post-operative diet consisted of fluids only for 4 weeks, pureed consistency foods for a further 2–4 weeks, followed by soft foods for an additional 4 weeks, then the gradual return to normal foods in reduced portions. Additionally, fluid and electrolyte management was incorporated into the dietary education for all patients, with a fluid intake of 2 L/day recommended for patients not on dialysis and without evidence of oedema and up to 1.5 L/day for patients on dialysis.

Results

Nine patients (three males and six females) with CKD, median age of 44.0 years and median BMI of 44.2 kg/m^2 underwent LSG for the treatment of obesity. Individual background and demographic data, plus length of

Table 1 Background and demographic data and length of stay for nine obese patients with CKD who underwent LSG for weight loss

Patient	Age (years)	Sex	Estimated kidney function	Cause of CKD	Diabetes	LOS (days)
A	44	Female	40%	Porphyria	No	9
B	38	Female	100%, with proteinuria	Focal segmental glomerulosclerosis	No	4
C	39	Male	6%, on haemodialysis	Focal segmental glomerulosclerosis	No	16
D	41	Female	7%, on haemodialysis	Adult polycystic kidney disease	Yes	6
E	53	Female	7%, on haemodialysis	Diabetes	Yes	10
F	41	Male	5%, on haemodialysis	Hypertension	No	9
G	48	Male	10%, on haemodialysis	Hypertension	No	9
H	51	Female	18%	Immunoglobulin A nephropathy	No	8
J	60	Female	65%	Hypertension/obesity	No	6

LOS length of perioperative hospital admission

perioperative hospitalisation, are listed for each patient in Table 1. Five patients had end-stage kidney failure requiring chronic haemodialysis and, at the time of surgery, had required dialysis for a median period of 18 months, ranging from 11 to 106 months. In this series, patient J underwent a re-sleeve gastrectomy, after an initial procedure was performed 3.5 years earlier in another centre, and significant weight re-gain had occurred. Patients were followed up for between 6 and 39 months, with a median follow-up period of 9 months.

Median length of hospital stay was 9 days, ranging from 4 to 16 days. Patient A was admitted to the critical care unit for <48 h with reduced kidney function on day 1 post-operatively, which recovered on day 2, and patient C required high dependency care post-operatively due to a chest infection. Gastrograffin meal and follow-through reports were negative for gastric leak in all patients, and delayed stomach emptying was observed in patient G. C-reactive protein level rose in the immediate post-operative period in all patients, peaked at days 4–7, but settled back to baseline level by 3 months.

There was no 30-day mortality and no mortality during the observation period. One complication was evident in a single patient post-operatively. Patient E, on haemodialysis, had a normal gastrograffin follow-through and methylene blue dye test prior to discharge. Ongoing investigations of a persistently low haemoglobin level that was unresponsive to erythropoietin treatment led to the detection of a small gastric leak associated with a subphrenic collection 7 months post-operatively. Patient E underwent evacuation of the collection, stenting and re-stenting of the leak via laparoscopy and required enteral nutrition support with complete nasojejunal feeding for 7 weeks and then a further 12 weeks after an unsuccessful trial of oral intake, whilst the leak healed.

Minor adverse events occurred in two of nine patients. In patient F, dialysis access was compromised with fistula thrombosis day 1 post-operatively, requiring angioplasty and stenting on day 4. Patient H experienced acute kidney injury secondary to dehydration 2 weeks post-operatively, requiring hospitalisation and intravenous rehydration. Kidney function in this patient remained below baseline for 2 months but returned to baseline by 3 months. One major adverse event occurred. Patient E displayed non-symptomatic significant electrocardiogram changes 3 weeks post-operatively, suggestive of myocardial infarction with non-Q wave coronary occlusion. Subsequent angiography showed obstruction of the left anterior descending artery, requiring angioplasty and stenting.

Median BMI loss was 8.4 kg/m^2 at 6 months, resulting in a median BMI of 34.7 kg/m^2 (range 29.2–38.8 kg/m^2). Median excess BMI loss was 49.2% (range 35.0–59.2%) for the series, 6 months after sleeve gastrectomy. Median excess weight loss was 43.0% (range 31.2–53.6%) after 6 months and the rate of excess weight loss (in percent) up to 1 year is presented in Fig. 1 for each patient. The rate of

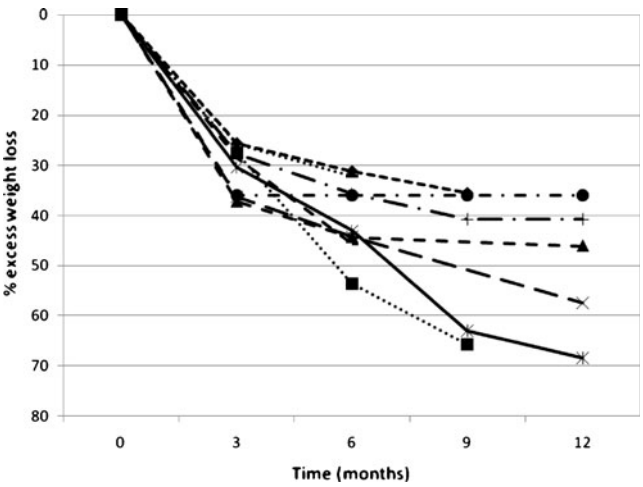

Fig. 1 Percent excess weight loss (% excess weight loss=[absolute weight loss/(baseline weight−ideal weight using midpoint of 1983 Metropolitan Life Insurance Tables for medium frame)]×100) after LSG in nine obese patients with CKD

weight loss decreased after 3 months in all but one patient, with only patient B continuing to lose weight at the same rate for up to 6 months. Median systolic blood pressure decreased from 136 to 126 mmHg between baseline and 6 months, and there was no change in median diastolic blood pressure.

Antihypertensive agents were reduced in three out of seven patients on antihypertensive therapy, ceased in one out of seven patients and remained unchanged in three out of seven patients. Early weight loss led to a reduction in median serum cholesterol by 3 months from 5.5 to 4.6 mmol/L and medium triglycerides did not change. Three patients were on statin therapy for lipid lowering at baseline, which was ceased in one patient and remained unchanged in two patients. Of the two of nine patients with diabetes, one was on insulin therapy. The insulin dose was decreased from 50 to 38 U/day 1 month post-LSG, and HbA1c improved from 9.0% to 6.1%. Proteinuria decreased in the one patient with proteinuria at baseline, but there was no improvement in estimated kidney function in any patient with weight loss.

Of the five patients on haemodialysis, patients C, D, E and F were listed for kidney transplantation over the study period at 4, 5, 10 and 12 months post-LSG, respectively. Patient E was suspended from the waiting list after being listed due to infection and the subsequent diagnosis of gastric leak and subphrenic collection. Patient G has not yet been listed for kidney transplantation, as weight remains above the target established by the transplant surgeon 12 months after LSG.

Discussion

This is the first study to describe the weight loss achieved, adverse events and complications after LSG in obese patients with CKD. After 6 months, excess BMI decreased by 49% and excess body weight was reduced by 43%. Systolic blood pressure and serum cholesterol decreased, and antihypertensive and lipid-lowering medications were reduced in some patients. There was no mortality, one major surgical complication and three adverse events in this series. This is the first study to support the use of LSG as an effective treatment for obesity in patients with CKD.

A systematic review of weight loss after LSG as a primary procedure in the general population indicates that weight loss achieved is 36–85% of excess body weight after a follow-up period of 3–60 months, including excess weight loss of 35–59% after 6 months [34], which suggests that the weight loss achieved in patients with CKD is within the range evident in those without CKD undergoing the same procedure. Rate of weight loss in this series only began to differ between patients 3 months post-operatively, once dietary restriction of all solid foods is no longer necessary. Differences in the rate of weight loss between patients became apparent once a larger variety of foods, differing textures and quantities began to be tolerated. However, the importance of considering weight loss in the context of the starting BMI is highlighted in this series by patient F, who still achieved a reduction in excess BMI of 49% despite no further weight loss after 3 months, due to a lower starting point than the rest of the series.

A complication rate of 0–15.3% has previously been reported in a systematic review of LSG [34]. In this small retrospective study, it is not possible to determine the relationship between LSG and the adverse events observed. More complications and adverse events may occur in obese patients with CKD than in the general population, as patients with CKD demonstrate a higher risk of cardiovascular disease [35, 36], which may impact upon healing and wound stabilisation and the cardiovascular event rate in the post-operative observation period. Interestingly, although patient E became anaemic prior to the detection of the gastric leak, other causes of anaemia were investigated initially, yet anaemia may be an early sign of leak or bleeding post bariatric surgery. Additionally, the importance of adequate hydration during rapid weight loss [37], even in patients with impaired or depleted kidney function with reduced urine output, remains apparent, with two of three adverse events in this series likely related to inadequate hydration post-operatively, despite the use of intravenous fluids post-operatively and provision of patient education on goal oral fluid intake after discharge.

Four out of five patients on dialysis were listed for kidney transplantation within 12 months following weight loss achieved after sleeve gastrectomy. As the mean waiting time for kidney transplantation is now over 2 years, it remains too early to report on successful kidney transplantation in these patients. Reductions in antihypertensive and lipid-lowering medications indicate that other factors associated with obesity may also be reduced in obese patients with CKD following weight loss surgery with LSG.

In conclusion, this paper describes the early course of the first nine obese patients with CKD electing to undergo LSG in a single centre. LSG appears to be a reasonable option to consider in the treatment of obesity in patients with CKD, particularly with a view to improving access to kidney transplantation wait-listing. However, the procedure may carry a higher rate of complications and adverse events in patients with CKD than in those without CKD, so careful monitoring of fluid intake, kidney function and dialysis access is required. Larger prospective, controlled studies of LSG in obese patients with CKD are needed to provide insight into the safety and effectiveness of this procedure in the treatment of obesity in patients with CKD.

Conflict of Interest Statement The results presented in this paper have not been published or submitted previously in whole or in part. There are no conflicts of interest to declare.

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