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EFFECT OF WEIGHT LOSS AFTER 5 YEARS FOLLOW-UP GASTRIC SLEEVE SURGERY ON RENAL PARAMETERS IN OBESE PATIENTS

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Aim: Obesity is a worldwide health problem of epidemic proportions. The aim of this study was to evaluate the effect of weight loss after bariatric surgery (particularly gastric sleeve) on renal function after 5 years of follow-up. *Methods:* This is a prospective study of 60 patients who underwent gastric sleeve surgery for weight loss, with a follow-up period of 5 years, being consequently evaluated at 1 month, 3 months, 1 year and 5 years. At baseline moment patients met the surgical criteria IDF 2011 guideline. Data was analyzed statistically, using SPSS (20 ed) software. *Results:* From total of 60 patients, 16.6 % were males and 83.3% females and mean age was 41.6±12.5 years old. BMI: baseline – 44.5±9.8 kg/m^2, 1 month – 40.8±9.5, 3 months –35.5.6±8.4, 1year – 30.8±6.8, and 5 years 30±6kg/m^2 (p=0.008 at 1 month compared to baseline) with a baseline GFR mean of 91.4±29 ml, at 1 month –91.5±33.2, at 3 months –102.6±27.5, at 1 year –113.7±33.8 and at 5 years –118.1±35 ml/min/m^2 (p = 0.001 at 1 month measurement and p=0.002 at 5 years measurement from baseline). GFR was negative correlated with visceral mass percent from baseline to 1 month (p = 0.002), baseline to 1year (p = 0.009). BSA did not correlate with GFR, but correlated with visceral fat percent at all scheduled visits. Throughout the 5 years of follow up were no significant correlations between GFR and other parameters followed in the study. *Conclusion:* The results of this study showed beneficial effects of bariatric surgery for significant weight loss and fat redistribution by reducing the percentage of fat and visceral mass, evident from the first month after surgery, even before recording a marked weight loss. Kidney function improves (evaluated by GFR) 5 years after LSG and related weight loss. The improvement of GFR is most significant at 1 month and 5 years after surgery. GFR was negative significant correlated with visceral mass percent at 1 month and 1 year follow-up. Limitation of the study was given by the lack of information regarding proteinuria and /or microalbuminuria. In future we express our wish to expand current data to a larger patient database which will allow us to complete and differentiate statistical data between genders.

Key words: Obesity, RFG, body surface area, body mass index.

INTRODUCTION

Obesity became a worldwide health problem of epidemic dimensions. Because of obesity's proportion and because of its related complications and comorbidities this disease becomes a burden for the healthcare system and a threat for the population. Literature data suggests that obesity has a negative effect on kidney function, and extensive experimental and clinical studies underline this statement, but yet there is no certain data describing obesity related glomerulopathy[1] and why only some patients with obesity develop end stage renal disease.

Kidney hemodynamic is affected by obesity by following mechanisms (as a response to increased metabolic needs): renal blood flow (RBF) is increasing[2], glomerular filtration rate (GFR) is increasing[3], and elevating filtration fraction (FF). As a result, hyperfiltration and glomerulomegaly can produce glomerular damage. It is not yet understood why. By contrast, carefully performed autopsy studies showed that kidney weight and glomerular volume are more strongly correlated with each other and to body surface area (BSA) rather than other body size parameters (body weight, height or body mass index-BMI)[4]. Therapeutic approaches that are reducing glomerular hyperfiltration may provide a way to prevent or delay the development of renal disease in the obese with certain risk factors (low birth weight, conditions associated with low number of nephrons).

Adipose tissue, especially visceral fat, produces bioactive substances that contribute to the pathophysiologic renal hemodynamic and structural changes that are leading to obesity-related nephropathy[5]. Adipocytes contain all the components of the renin-angiotensin-aldosterone system (RAAS), plasminogen activator inhibitor, as well as adipocyte specific metabolites such as free fatty acids, leptin, and adiponectin, which affect renal function and structure. Adiponectin supports normal function of the podocyte, as a consequence hypoadiponectinemia that appears in obesity is associated with endothelial cell dysfunction, impaired endothelium-dependent vasodilatation, disinhibition of leukocyte-endothelium adhesion, and activation of RAAS[6]. In addition, fat is infiltrated by macrophages that can alter their phenotype and foster a proinflammatory environment which advances pathophysiologic changes associated with obesity in the kidney[7].

A recent study from 2013 showed that an increased waist/hip ratio (WHR) is associated with an unfavorable renal hemodynamic profile, with lower GFR and ERPF (effective renal plasma flow), and with higher FF, independent of BMI, in a population of nonhypertensive, nondiabetic healthy persons[8]. These data come to support epidemiologic studies showing that central body fat distribution is an independent risk factor for renal damage and suggest that renal hemodynamic factors could be involved in the increased renal risk.

RBF and GFR in humans are traditionally expressed /1.73 m^2 body surface area (BSA) to normalize for differences in body size. It's important to note that the increases in absolute GFR observed in obesity are not disproportionate to the increases in BSA.

The aim of this study was to evaluate the effect of weight loss after bariatric surgery (particularly gastric sleeve) on renal parameters and renal function in 60 obese patients after 5 years of follow-up.

MATHERIAL AND METHODS

This is a prospective study of 60 patients who underwent bariatric surgery for weight loss (the bariatric surgical technique performed was gastric sleeve), ages 16–76 years old, men and women with a follow-up period of 5 years, being consequently evaluated at 1 and 3 months, 1 year and 5 years. At baseline BMI percent of patients was as following: class I of obesity – 15% patients, class II of obesity – 23.3% patients, class III of obesity – 61.7% patients. Patients characteristics are described in Table 1. The mean age at baseline was 41±12 yrs., with predominance of female gender (83.3 %), BMI at baseline was 44.5±9.8 kg/^{2}. At baseline patients met the surgical criteria from IDF 2009 guideline (1) With BMI $\geq$ 40 kg/m^2 or (2). With BMI 35–40 kg/m^2 with co-morbidities in which surgically induced weight loss is expected to improve the disorder – such as metabolic disorders, cardiorespiratory disease, severe joint disease, and obesity related severe psychological problems). At each scheduled visits following parameters were measured: biological (serum creatinine, albumin and ureea), anthropometrical (height, weight, hip and waist circumference, BMI), percent values of muscular, visceral and fat mass measured by bioelectrical impedance, glomerular filtration rate (GFR) (MDRD4 formula was used), body surface area (BSA) (Haycock formula was used), ideal weight and excess weight calculation. GFR was considered within normal range at values 90–139 ml/min/1.73m^2, hyperfitration was considered at values > 140 ml/min/1.73m^2, values between 60–90 ml/min/1.73m^2 need further investigations and values <60 ml/min/1.73m^2 were considered as decreased kidney function (3 consequent determinations are needed to define CKD- chronic kidney disease)[9]. Plasma creatinine, urea, and albumin were determined using a routine clinical chemistry laboratory analyzer.

Statistical analysis: data was analyzed statistically, using SPSS (20th ed.) software. Normally distributed data are expressed as means & SD. Variables with skewed distribution, are expressed as median (range). The significance of differences between different variables was evaluated by one-way ANOVA test. Student's t-test was applied to nonnormally distributed data after log transformation. Pearson correlation coefficients were used to evaluate correlations between variables.

Table 1

Dynamic of the general characteristic of the group

	Baseline	1 month	P value (B*/1m[1])	3 months	P value (B/3 m[2])	1 year	P value (B/1yr[3])	5 years	P value (B/5 yrs[4])
Number	60								
Age	41±12					42±12		46±12	
Gender									
Weight	126±31	115±30	**P<0.001**	100±25	**P<0.001**	87±20	**P<0.001**	84±20	**P<0.001**
BMI	44.5±9.8	40.8±9.5	**P=0.008**	35.6±8.4	**P=0.007**	30.8±7	**P=0.005**	30±6.6	**P=0.005**
Body surface area (m^2)	2.4±0.4	2.3±0.3	**P<0.001**	2.1±0.3	**P<0.001**	2±0.2	**P<0.001**	1.8±0.6	**P<0.001**
RFG (ml/min/m^2)	91.4±29	91.5±33	**P=0.001**	102±27	NS	113.7±33	NS	118.1±35	**P=0.002**
Urea (mg/dL)	31.7±15	32.2±15	NS	26±11	NS	25.8±9	NS	24±7.4	NS
Creatinin (mg/dL)	0.8±0.2	0.8±0.2	NS	0.75±0.1	NS	0.6±0.1	NS	0.6±0.1	NS
Serum albumin (g/dL)	5.1±4.5	4±0.5	NS	4.3±0.5	NS	4.2±0.6	NS	4.9±6	NS
Waist circ.	127.2±20	118±19	**P<0.001**	107±18	NS	97±16	NS	95.8±15	**P<0.001**
Hip circ.	141.4±16	134±16	**P<0.001**	125±15.3	NS	117±12	**P=0.02**	115±12	**P=0.002**
Muscle mass (%)	22.4±2.9	23.5±2.6	**P<0.001**	25.5±2.8	NS	27.4±4	NS	28.1±3.9	**P=0.04**
Visceral mass (%)	13.8±3.5	12.4±3.4	**P<0.001**	12.4±7.9	NS	9.08±3	NS	8.7±2.9	**P<0.001**
Fat mass (%)	47±6.1	45±6.1	**P<0.001**	40.6±9	NS	39±6.2	NS	38±7.1	NS
Excess fat (EW)	65±27	55±26	**P<0.001**	40±22	NS	26±18	NS	24±17	**P=0.005**

*B = baseline; [1]B/1m = baseline compared to 1 month; [2]B/3m = baseline compared to 3 months; [3]B/1yr = baseline compared to 1 year, [4]B/5yrs = baseline compared to 5 years; NS = no statistical significance

RESULTS

From total of 60 patients, 16.6 % are males and 83.3% females; mean age was 41.6±12.5 years old. At baseline BMI was 44.5 ± 9.8 kg/m^2 and GFR was 92±29 ml/min/m^2.

Changes at one month after sleeve gastrectomy: One month after surgery all evaluated parameters except serum urea, creatinine and albumin were statistically significant comparing to baseline. BMI statistically significant decreased (p = 0.008). BMI at 1 month correlated positively with serum creatinin value at the same measurement time (the higher the value of BMI the higher the value of serum creatinin – Table 3). GFR statistically significant increased comparing to baseline (p=0.001) at 1 month measurement and also GFR was negative correlated with visceral mass percent from baseline (r = – 285, p = 0.002, Figure 2). But visceral mass at 1 month was positively correlated with fat mass at 1 month, this could mean that visceral mass can be associated with central obesity and a decrease in fat mass lead to a proportionate decrease in visceral mass. This supports the fact that a decrease in fat mass leads to an improvement in GFR. Weight had a significant decrease (p<0.001), body surface area (BSA) decreased significant (p<0.001) and also waist and hip circumference, visceral mass, fat mass and excess fat level statistically significant decreased while muscle mass significantly statistical increased from baseline to 1 month. Figure 1 shows that at baseline the number of cases with highest BMI (>40 kg/m^2 –>15 cases) had the lowest GFR (<80 ml/min).

Table 2

Evolution of number of cases according to GFR values from baseline to 5 years

GFR values	Baseline	1 month	3 months	1 year	5 years
<60 ml/min/1.73 m^2	3	9	4	2	0
60–89 ml/min/1.73 m^2	28	22	15	10	11
90–139 ml/min/1.73 m^2	24	22	34	36	35
>140 ml/min/1.73 m^2	5	7	5	10	14

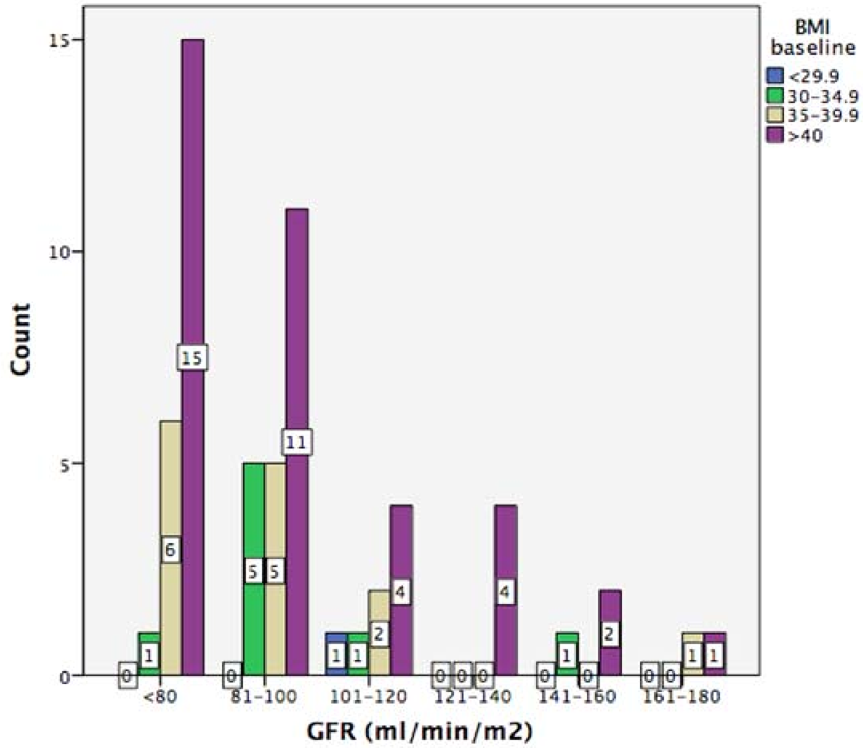

Fig. 1. Distribution of GFR (number of cases) according to BMI at baseline.

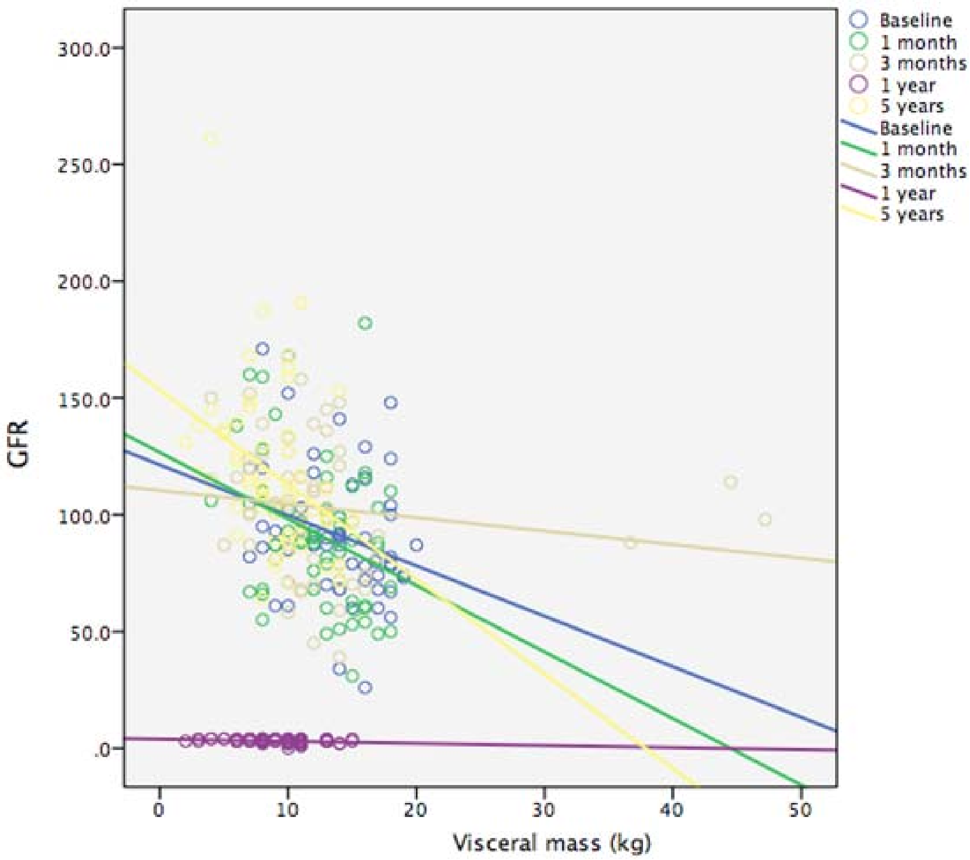

Fig. 2. Corellation between GFR values and visceral mass percent.

Table 3

Corellation between BMI, serum urea and serum creatinin

BMI i		BMI 1 month		BMI 3 months		BMI 1 year		BMI 5 years	
U_i	C_i	U_{1m}	C_{1m}	U_{3m}	C_{3m}	U_{1y}	C_{1y}	U_{5y}	C_{5y}
NS	NS	NS	P = 0.01 r = 0.313	ns	P = 0.04 r = 0.266	NS	NS	NS	NS

U = urea, C= creatinin, i = initial, 1m =1 month, 3m = 3 months, 1y = one year, 5y = 5 years, NS = no statistical significant correlation

Changes three months after sleeve gastrectomy: BMI at 3 months positivley correlated with serum creatinin value at 3 months (Table 3).

Changes one year after sleeve gastrectomy: hip circumference statistically significant decreased one year after bariatric surgery (p=0.02); GFR was negative correlated with visceral mass percent from baseline 1 year (r = –0.342 (strong correlation), p = 0.009), (this translates that visceral fat percent increasing is associated with a decrease in GFR, resulting a lower kidney function – according to literature) (Figure 2).

Changes five years after sleeve gastrectomy: GFR continued to rise at 5 years comparativ to baseline showing a statistically significant growth (p = 0.002). GFR growth is illustrated in Figure 3. Also the weight loss at 5 years from baseline was significant with a medium weight 84±20 kg with a medium decrease of 30 kg comparing to baseline. Number of cases according to GFR and BMI distribution at 5 years showing the improvement of kidney function with loss of weight (Figure 4).

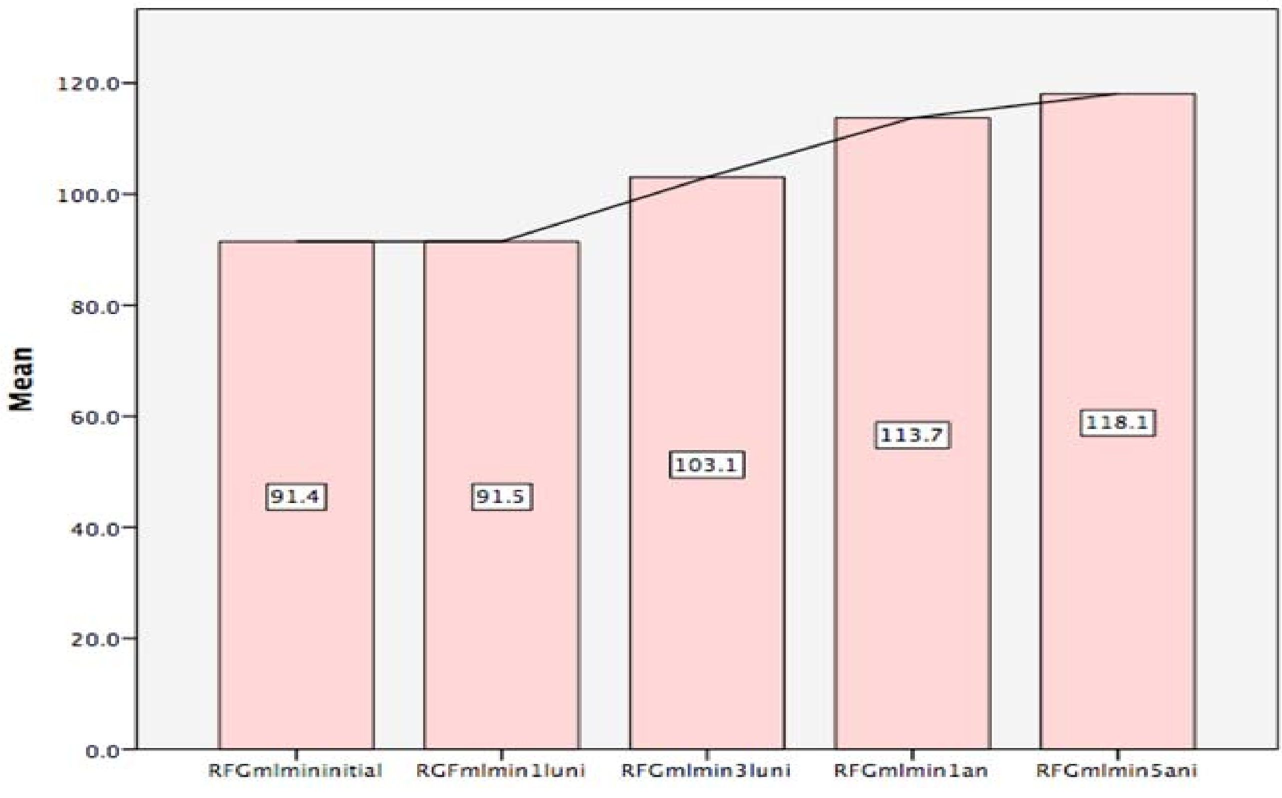

Fig. 3. Evolution of GFR (mean value).

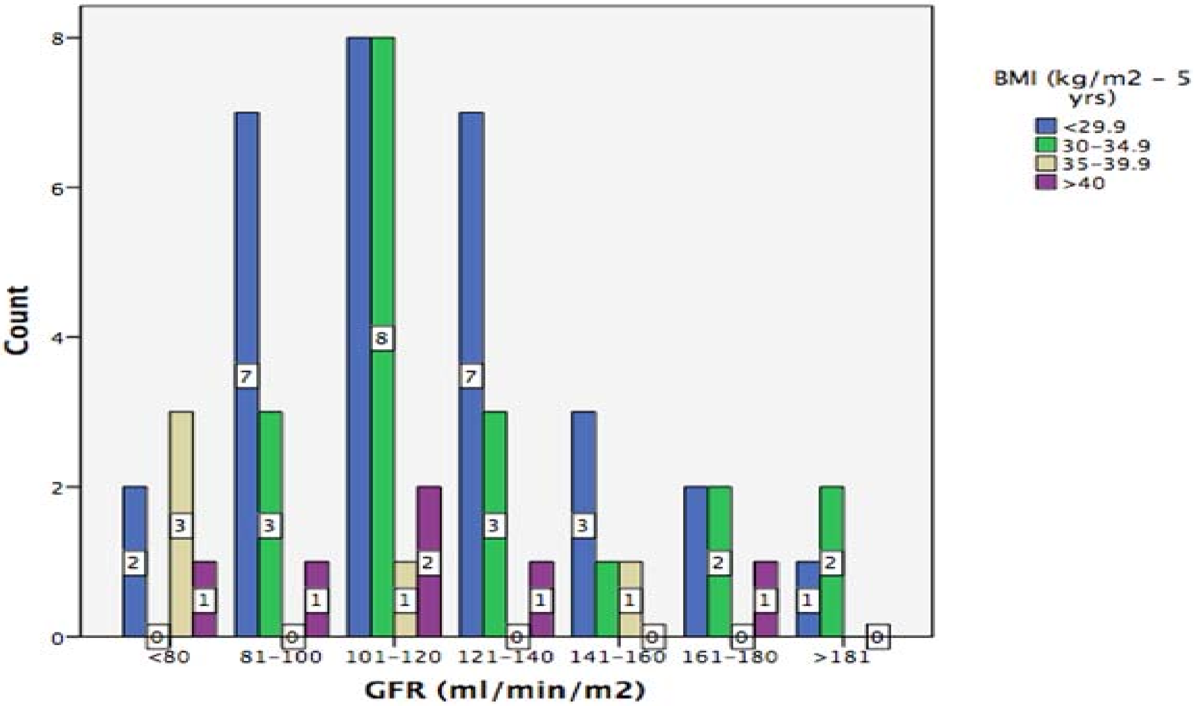

Fig. 4. Distribution of GFR (number of cases) according to BMI at 5 years.

BSA did not correlate statistically significant with GFR, but correlated with visceral fat percent at all scheduled visits. GFR did not correlate statistically significant with excess weight at any of the target measurements.

Throughout the 5 years of follow up were no significant correlations between GFR and other parameters folowed in the study.

DISCUSSIONS

The rising popularity of bariatric surgery is atribuited in principal to its beneficial effects on multiple obesity-related comorbidities such insulin resistance, hypertension, dyslipidemia, obstructive sleep apnea, and a significant reduction in mortality that is maintained up to 18 yr postoperatively[10]. In addition, there has been substantial support over the past several years for a favorable effect of bariatric intervention in improving all parameters of kidney function. Brochner and colab. demonstrated for the first time in the 1980s that the GFR decreased in extremely obese patients who had undergone intestinal bypass surgery[11]. A controlled prospective trial on 61 extremely obese patients whereby drastic weight loss 1 yr after bariatric surgery led to a important improvement in albuminuria/proteinuria and an increase in creatinine cleareance[12]. Another retrospective study of 25 morbidly obese CKD patients who underwent bariatric surgery showed the same results. The estimated GFR improved from an baseline average of 47.9 ml/min/1.73 m^2 to 56.67 ml/min/1.73 m^2 at 6 month, and to 61.67 ml/min/ 1.73 m^2 at 1 yr[13].

In the another study, Fenske and colab. evalueted 34 obese patients who were randomized according to the type of bariatric surgery:sleeve gastrectomy, ajustable gastric banding or roux-en-Y gastric bypass. The estimated average GFR increased from 78.2 ml/min/1.73 m^2 at baseline to 86.7 ml/min/1.73 m^2 at 12 month[14].

A retrospective study in patients with CKD stage 3 undergoing bariatric surgery shown after 12 months that BMI and blood pressure had decreased and the mean GFR had even increased from 47.9 to 61.1 ml/min/1.73m^2 [15].

Importantly, GFR increase induced by weight loss is not fixed, with studies documenting improvement in hyperfiltration after gastroplasty[16, 17]. Part of the decline in GFR that occurs with aging may also not be pathological but represent the decreasing metabolic/excretory needs of the aging individual.

CONCLUSION

The results of our study show that after sleeve gastrectomy and weight loss, kidney function improves. The improvement is most significant at 1 month and 5 years after surgery. One potential limitation of the present study is a relative small sample size. In addition, other two limitations of the study are the lack of information regarding proteinuria and/or microalbuminuria and regarding values of systolic and diastolic blood pressure of these patients, which can give an complete picture of the degree of renal damage. Hereby this information could help complete evaluation of the consequence of weight loss in this regard.

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