Is Pretransplantation Overweight and Obesity still a Nightmare for Kidney Transplantation Outcomes?

Serão o Excesso de Peso e a Obesidade Pré-Transplante ainda Considerados um Pesadelo para a Transplantação Renal?

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Abstract

Introduction: *Obesity is an increasingly common disease in patients with end-stage chronic kidney disease candidates for renal transplantation. It is an important factor that should be addressed in the period before renal transplantation. The aim of this study is to evaluate the impact of pretransplantation body mass index (BMI) in graft and recipient outcomes.*

Material and Methods: *An observational retrospective analysis of 913 kidney transplantations was performed between September 2010 and May 2017. Recipients were categorized in groups: obesity (group 1), overweight (group 2) and normal BMI (group 3). A preoperative protocol was used: recipient and donor characteristics, perioperative data, graft and patient survival were evaluated. The software used was IBM SPSS Statistics 23: p value of < 0.05 was considered statiscally significant.*

Results: *Overweight was observed in 36.2% and obesity in 12.3%. In groups 1 and 2, there was a higher prevalence of type II diabetes mellitus compared with group 3 (17.9%, 16.4%, 6.6%, respectively, p < 0.001). Recipient creatinine serum levels at first and third months were also statistically different. Both groups 1 and 2 showed higher surgery duration and postoperative length of stay. It was noticed a lower immediate diuresis rate in group 1 (63.2%) and in group 2 (80.4%), p < 0.0001. Perioperative complications were more prevalent in groups 1 and 2, especially lymphocele formation (21.4% and 7.7%, respectively, versus 3.6%) and wound dehiscence (21.4% and 5.8%, respectively, versus 1.2%), p < 0.05. No statistically differences were seen in graft and patient survival.*

Conclusion: *Pretransplantation weight is important in renal transplantation: worse renal function in the first and third months, longer surgery duration and postoperative length of stay, higher delayed graft function rate and a higher prevalence of lymphocele formation and wound dehiscence were noticed in both non-normal weight groups. However, obese and overweight groups showed similar survival and long-term outcome comparing with normal BMI recipients.*

Keywords: *Body Mass Index; Kidney Transplantation; Obesity; Overweight; Treatment Outcome*

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Resumo

Introdução: A obesidade é uma doença cada mais comum nos doentes com doença renal crónica terminal candidatos a transplantação renal. É um factor importante que deverá ser considerado no período prévio ao transplante renal. O objectivo deste estudo é avaliar o impacto do índice de massa corporal (IMC) pré-transplante no enxerto renal e nos recetores.

Material e Métodos: Foi realizado um estudo observacional retrospectivo de 913 doentes submetidos a transplante renal entre Setembro de 2010 e Maio de 2017. Os recetores foram divididos em grupos: obesidade (grupo 1), excesso de peso (grupo 2) e IMC normal (grupo 3). Um protocolo pré-operatório foi utilizado: as características do receptor e do dador, dados perioperatórios, sobrevivência do enxerto e dos doentes foram avaliados. O *software* utilizado foi o IBM SPSS Statistics 23: valor de $p < 0,05$ foi considerado estatisticamente significativo.

Resultados: Excesso de peso foi observado em 36,2% e obesidade em 12,3%. Nos grupos 1 e 2, houve maior prevalência de diabetes *mellitus* tipo II em relação ao grupo 3 (17,9%, 16,4%, 6,6%, respectivamente, $p < 0,001$). Os níveis séricos de creatinina no primeiro e terceiro meses também foram estatisticamente diferentes. Ambos os grupos 1 e 2 apresentaram maior tempo de cirurgia e maior tempo de internamento. Verificou-se uma menor taxa de diurese imediata no grupo 1 (63,2%) e no grupo 2 (80,4%), $p < 0,0001$. Verificaram-se mais complicações perioperatórias nos grupos 1 e 2, especialmente linfocelos (21,4% e 7,7%, respectivamente, *versus* 3,6%) e deiscência da ferida (21,4% e 5,8%, respectivamente, *versus* 1.2%), $p < 0,05$. Não se verificaram diferenças estatísticas na sobrevivência do enxerto e do doente.

Conclusão: O peso corporal pré-transplante é um dado importante no transplante renal: verificou-se pior função renal no primeiro e terceiro mês, maior tempo de cirurgia e de internamento, maior taxa de função do enxerto tardia e maior prevalência de linfocelo e de deiscência de ferida nos doentes com excesso de peso e com obesidade. No entanto, as taxas de sobrevivência e os resultados a longo prazo foram semelhantes entre todos os grupos.

Palavras-chave: Excesso de Peso; Índice de Massa Corporal; Obesidade; Resultado do Tratamento; Transplantação Renal

Introduction

Obesity is a chronic disease characterized by an increase of body fat stores. In clinical practice, the body fatness is usually estimated by body mass index (BMI). Obesity is defined by a BMI ≥ 30 kg/m^2 and overweight by a BMI between 25 and 29.9 kg/m^2.[1] There is some controversy about kidney transplant in obese patients: Bardonnaud *et al*[2] showed that obese patients had higher delayed graft function (DGF) and longer hospitalization time after the kidney transplant but with no differences in perioperative complications. Furriel *et al*[3] showed that obese patients had an higher incidence of lymphoceles and wound dehiscence with no statiscally difference in graft survival rates among the groups considered. Hill *et al*[4] showed in his meta-analysis an increased risk of DGF and a small but statiscally significant increase risk of graft loss in obese patients.

Obese patients had more risk of developing chronic kidney disease (CKD) and end-stage renal disease (ESRD). The relative risk of end-stage renal disease is 1.87 for a BMI 25 to 29.9 kg/m^2 increasing to 7.07 for greater than 40 kg/m^2.[5] One of the predisposing factors could be the greater metabolic demand, which may lead to glomerulopathy from glomerular hyperfiltration. Renal injury is also associated with high circulating free fatty acids, which increases the production of reactive intermediates and causes renal cell apoptosis and damage.[6]

The reason that could explain graft loss in obese patients may be the modification of the metabolism and bioavailability of immunosuppressive medications caused by obesity, leading to a potentially exposition of the renal allograft to chronic immunological injury.[4]

Careful patient selection is crucial for the success of renal transplantation and the BMI must be evaluated. Some transplantation centers refuse to transplant obese patients because of the increasing risk of complications[2] – arguing that patients with higher BMI had better survival with hemodialysis ("the obesity paradox").[7] Others prefer to consider renal transplantation in non-normal weight groups because some data shows a survival benefit[8] and no difference in patient or graft survival comparing with normal weight groups.[3]

The aim of this study is to evaluate the impact of pretransplantation overweight and obesity in graft and recipient outcomes, comparing with those with normal BMI.

Material and Methods

Between September 2010 and May 2017, an observational retrospective analysis of 913 kidney transplantations was performed. Recipients were divided in groups: obesity (group 1), overweight (group 2) and normal body mass index (BMI) patients (group 3), accordingly with the World Health Organization definitions. Obesity and overweight were defined as BMI of ≥ 30 kg/m^2 and between 25-29.99 kg/m^2, respectively. These patients were compared with those with normal BMI (18.5-24.9 kg/m^2). Among obese patients, 92.4% presented as type I obesity (BMI 30-34.9 kg/m^2), 6.6% presented as type II obesity (BMI 35-39.99 kg/m^2) and 0.9% presented as type III obesity (BMI ≥ 40 kg/m^2).

A preoperative standard protocol was used for all patients. Recipient characteristics such as age, gender, BMI, time on dialysis and obesity comorbidities (arterial hypertension, type II diabetes mellitus) were evaluated. Donor characteristics were also compared such as age, gender, type, serum creatinine before harvesting and cold ischemia time.

Perioperative data such as surgery duration, postoperative length of stay, perioperative complications, acute and chronic rejection rates, creatinine serum levels and graft and patient survival were evaluated and compared between the three groups.

Renal function was evaluated in every 15 days in the first month, in every week in the second and third month and in every month from the fourth until twelfth month. After that, kidney transplant patients were usually evaluated on a quarterly basis.

Surgical complications were analyzed: vascular (renal artery or venous thrombosis, artery stenosis or bleeding), urinary (urinary leaks, ureteral obstruction or symptomatic reflux complications caused by double-J stent), wound dehiscence or lymphocele, significant hemorrhage and abscess. Kidneys were placed either in the right or left iliac fossa through an extraperitoneal approach. Double-J stents were removed 1 month after kidney transplantation. Transurethral catheters were placed during 7 days. Initial immunosuppression protocols are shown in Table 1 and were not different between groups, reflecting the department preferences at that time. The etiology of end-stage renal disease was not different too. The medium follow-up time after kidney transplant was of 40.3 ± 23.89 months.

Statistical analysis was completed using IBM SPSS Statistics version 23 (New York USA): categorical parameters were compared using chi-square test and continuous parameters were evaluated using ANOVA test. Graft and patient survival analysis was done using the Kaplan-Meier test and difference was tested using the Mantel-Cox log-rank test. A p value of < 0.05 was considered significant. Data is shown as means ± standard deviation (SD).

Results

Overall recipient mean age at transplantation was 49.5 ± 12.9 years with a mean BMI of 25.2 ± 4.0 kg/m^2. Obese and overweight patients were older than normal BMI patients (group 1: 53.8 ± 10.1 years; group 2: 52.5 ± 11.2 years; group 3: 46.6 ± 13.5 years, $p < 0.001$). Obesity was observed in 12.3% (n = 113), overweight in 36.2% (n = 330) and normal BMI in 51.5% (n = 470). Overall recipient gender was mainly male (70.8% versus 29.2%). This predominance was seen in every group (group 1: 2.4:1; group 2: 2.7:1; group 3: 1.7:1). Only 11.7% (n = 106) of all recipients had type II diabetes mellitus preoperatively and the majority of them belonged to non-normal weight groups (group 1: 17.9%; group 2: 16.4%; group 3: 6.6%, $p < 0.001$). A percentage of 78.2% (n = 714) of all recipients had arterial hypertension preoperatively not statistically different between groups (group 1: 83.0%; group 2: 80.1%; group 3: 76.0%; $p = 0.19$). The majority of patients had no previous kidney transplant (not statistically different between groups). The dialysis

Table 1: Recipients characteristics between groups

Recipients characteristics	Group 1	Group 2	Group 3	*p* value
Recipient age (years)	53.8 ± 10.1	52.5 ± 11.2	46.6 ± 13.5	< 0.001
Initial Imunosupression				0.14
M/MY+P+CsA	2 (1.9%)	8 (2.6%)	9 (2.0%)	
THYMO+M/MY+P+CsA	14 (12.3%)	48 (14.5%)	42 (8.8%)	
M/MY+P+FK with/without SIR	8 (7.5%)	19(5.8%)	28 (5.9%)	
THYMO+M+P+SIR/EVRL	1 (0.9%)	1 (0.3%)	0 (0%)	
THYMO +M/MY+P+FK	85 (74.5%)	219 (66.2%)	345 (73.5%)	
EVRL+CsA	0 (0%)	0(0%)	1 (0.2%)	
EVRL+FK	3 (2.8%)	35 (10.6%)	45 (9.5%)	
Etiology of end-stage renal disease (%)				0.23
Glomerular disease	28 (25.5%)	78 (23.5%)	109 (23.3%)	
Tubulointerstitial disease	23 (19.8%)	66 (19.9%)	134 (28.3%)	
Cystic congenital disease	1 (0.9%)	2(0.6%)	4 (0.9%)	
Systemic disease	27 (23.6%)	78 (23.8%)	88 (18.8%)	
Undetermined or unknown	34 (30.2%)	106 (32.2%)	135 (28.8%)	
Previous kidney transplant				0.21
0	109(96.2%)	313 (94.9%)	434 (92.3%)	
≥1	4 (3.7%)	17 (5.1%)	36 (7.7%)	
Dialysis modality				0.007
Hemodialysis	96 (84.9%)	273 (82.6%)	380 (80.8%)	
Peritoneal	17 (15.1%)	57 (17.4%)	74 (15.6%)	
Preemptive	0 (0%)	0 (0%)	16 (3.6%)	
Time on dialysis (months)	44.9±22.1	45.3±22.1	47.9±29.6	0.3
Time on dialysis (years)				0.02
<1y	4 (3.8%)	10 (2.9%)	29 (6.3%)	
1-5y	78 (68.9%)	227 (68.8%)	296 (62.9%)	
5-10y	31(27.4%)	92 (28.0%)	132 (28.0%)	
>10y	0 (0%)	1 (0.3%)	13 (2.8%)	
Number HLA matches	2.35±1.1	2.19±1.3	2.21±1.2	0.5

Group 1 – obese patients; Group 2 – overweight patients; Group 3 – normal body mass index patients; MY – mychophenolic acid; M – mycophenolate mofetil; P – prednisolone; CsA – cyclosporine; THYMO – thymoglobulin; FK – tacrolimus; SIR – sirolimus; EVRL – everolimus; HLA – human leucocyte antigen

modality was statistically different between groups although the majority of patients did hemodialysis. Preemptive kidney transplantations were only done in normal BMI patients. However, the percentage of normal BMI patients submitted to preemptive kidney transplantation was low (3.6%): 93.8% of these were from a living donor. Time on dialysis was not different between groups but, in each group, the majority did dialysis for one to five years and no obese patient did dialysis for more than 10 years (Table 1).

Mean donor age was lower in the normal BMI recipients. Globally, the majority of grafts were harvested from cadaveric donors (95.3%). When considering each group, the majority of living donors (7.5%) were done in normal BMI recipients. Donor serum creatinine levels were not different between groups. Overall cold ischaemia time was 17.5 ± 5.37 hours, not different between groups as well as the other evaluated donor characteristics (Table 2).

The majority of patients were submitted to kidney transplantation in the afternoon (morning: 11.8%; afternoon: 51.9% and night: 36.4%). When looking at every group, it was realized that obese patients were submitted to renal transplantation mainly at night (48.6%) (Table 3). Overall mean surgery duration of time was 2.1 ± 0.7 hours. However, non-normal weight patients had a more lengthy surgery ($p < 0.001$). Immediate diuresis occurred in the majority of patients (n:742; 81.3%). However, only 63.2% of obese recipients had immediate diuresis. A delayed graft function was seen in 14.7% (n = 124) of all patients: 30.2% of all obese patients, 14.8% of all overweight patients and 9% of all normal BMI patients had delayed graft function.

Overall mean post-operative length of stay was 15.1 ± 13.0 days, higher in obese patients (Table 3). Recipient creatinine serum levels at the first and third month were statistically different between groups and no other statistical association was realized after this time (Table 4). At the first month, creatinine values were higher in obese and overweight groups comparing with normal BMI groups (1.7 ± 0.8 mg/dL; 1.6 ± 0.6 mg/dL versus 1.4 ± 0.6 mg/dL, respectively). In the third month, those values dropped in every group (1.5 ± 0.6 mg/dL; 1.5 ± 0.5 mg/dL versus 1.3 ± 0.4 mg/dL). In the sixth month, only overweight patients maintained a downward tendency. At 12th month, serum

Table 2: Donor characteristics between groups

Donor characteristics	Group 1	Group 2	Group 3	*p* value
Age	53.0 ± 11.9	53.5 ± 13.2	49.8 ± 13.5	< 0.001
Gender Male Female	 69 (61.3%) 44 (38.7%)	 186 (56.3%) 114 (43.7%)	 284 (60.4%) 186 (39.6%)	0.5
Type Cadaver Living	 111 (98.1%) 2 (1.9%)	 321 (97.4%) 9 (2.6%)	 435 (92.5%) 35 (7.5%)	0.003
Donor serum creatinine (mg/dL)	0.97±0.40	0.96±0.37	0.97±0.41	0.9
Kidney Used Right Left	 58 (51.4%) 55 (48.6%)	 159 (48.1%) 171 (51.9%)	 247 (52.6%) 223 (47.4%)	0.5
Number of graft renal arteries 1 2 ≥3	 97 (85.8%) 15 (13.2%) 1 (0.9%)	 269 (81.7%) 54 (16.4%) 7 (1.9%)	 376 (80%) 82 (17.5%) 12 (2.5%)	0.4
Cold ischaemia time (hours)	18.1 ± 5.3	17.8 ± 4.9	17.1±5.8	0.1

Group 1 – obese patients; Group 2 – overweight patients; Group 3 – normal body mass index patients

Table 3: Perioperative data between groups

Perioperative data	Group 1	Group 2	Group 3	*p* value
Time of kidney transplantation (m/a/n)	5.7%/45.7%/48.6%	10.6%/51.8%/37.6%	14.5%/51.8%/33.7%	0.02
Surgery length of time (hours)	2:25 ± 0.7	2:18±0.6	2:01 ± 0.7	<0.001
Immediate diuresis	71 (63.2%)	265 (80.4%)	413 (87.8%)	<0.001
Delayed graft function	34 (30.2%)	48 (14.8%)	42 (9.0%)	<0.001
Postoperative length of stay (days)	18.7±15.6	14.9±10.6	13.8±11.2	0.001
Perioperative complications Vascular Urinary Lymphocele Hemorrhage>500 cc Wound dehiscence Abscess	 28 (25.0%) 32 (28.6%) 24 (21.4%) 8 (7.1%) 24 (21.4%) 4 (3.6%)	 139 (42.3%) 127 (38.5%) 25 (7.7%) 50 (15.4%) 19 (5.8%) 0 (0%)	 158 (33.7%) 158 (33.7%) 16 (3.6%) 143 (30.5%) 5 (1.2%) 5 (1.2%)	 0.3 0.7 0.01 0.02 0.001 0.4
Never-functioning kidney rate	7 (6.6%)	15 (4.8%)	15 (3.2%)	0.2
Graft loss	16 (14.3%)	39 (12.1%)	54 (11.5%)	0.7
Acute rejection	2 (1.9%)	8 (2.6%)	10 (2.3%)	0.9
Chronic rejection	2 (1.9%)	4 (1.3%)	11 (2.5%)	0.5
Transplantectomy	8 (7.5%)	15 (4.8%)	21 (4.5%)	0.4

Group 1 – obese patients; Group 2 – overweight patients; Group 3 – normal body mass index patients; m – morning; a – afternoon, n – night

Table 4: Serum creatinine values (mg/dL) between groups

Serum creatinine (mg/dL)	Group 1	Group 2	Group 3	*p* value
1 month	1.7 ± 0.8	1.6 ± 0.6	1.4 ±0.6	0.049
3 months	1.5 ± 0.6	1.5 ± 0.5	1.3 ± 0.4	0.007
6 months	1.8 ± 0.8	1.4 ± 0.5	1.5 ± 0.9	0.1
12 months	1.6 ± 0.7	1.6 ± 0.9	1.4 ± 0.6	0.36
Group 1 – obese patients; Group 2 - overweight patients; Group 3 - normal body mass index (BMI) patients				

Table 5: Follow-up data between groups

Follow-up data	Group 1	Group 2	Group 3	*p* value
Cause of death				
Cardiovascular	2 (1.9%)	1 (0.6%)	4 (0.9%)	0.5
Infectious disease	1 (0.9%)	7 (2.3%)	2 (0.5%)	0.08
Cancer progression	1 (0.9%)	3 (1.0%)	3 (0.7%)	0.9
Graft survival (months)	75.9 ± 2.0	76.7 ± 1.1	77.0 ± 0.8	0.18
Patient survival (months)	77.2 ± 1.9	77.9 ± 1.0	78.2 ± 0.7	0.2
Group 1 – obese patients; Group 2 - overweight patients; Group 3 - normal body mass index patients				

creatinine values were nearly the same in obese and overweight (1.6 ± 0.7 mg/dL; 1.6 ± 0.9 mg/dL; respectively) comparing with normal BMI patients (1.4 ± 0.6 mg/dL).

Perioperative complications were more prevalent in non-normal weight groups, especially lymphocele formation and wound dehiscence. However, more hemorrhage was seen in normal BMI groups. These changes were statistically significant ($p < 0.05$) (Table 3).

No differences were seen in never-functioning kidney rate, graft loss, acute and chronic rejection rate, need for transplantectomy (Table 3) and cause of death (Table 5). No differences were noticed concerning graft and patient survival (Fig.s 1 and 2, respectively, and Table 5).

Cumulative graft survival rates among normal, overweight, and obese groups were 94%, 93% and 90% at 1 year, respectively; 91%, 92% and 90% at 2 years; and 83%, 84% and 79% at 5 years.

Discussion

Obesity is a disease that must be taken in account before kidney transplantation. Our series showed that obese patients were older and had a higher incidence of type II diabetes mellitus. In fact, obesity creates a state of insulin resistance, promoting the appearance of chronic medical conditions such as type II diabetes mellitus and cardiovascular diseases.[4] The incidence of renal failure in these patients could be explained by the characteristic pattern of insidious glomerulopathy, explaining why obese patients were older.[2] The donors were also older in the non-normal weight groups and only 1.9% of obese and 2.6% of overweight patients were living donors. However, our department had few living donors in that period of time.

Recipients were divided into the 3 groups mentioned before. Few patients had a BMI ≥ 35 kg/m^2, so we preferred not to create groups inside obese patients. Unfortunately, the groups used were still not homogeneous, which could be a limitation to this work. Cacciola *et al*[9] showed that obese recipients (BMI ≥ 35 kg/m^2) displayed a lower survival at 1 (87.5% versus 98.9%, $p = 0.006$) and 5 years (79.2% versus 95.6%, $p = 0.007$), as well as reduced graft survivals (75% versus 98.9% and 63% versus 94.5%, $p < 0.001$).

Another limitation of this study is its retrospective nature: some data could be lost. One interesting issue could be to monitor the difference of BMI in the follow-up and realize if it could have some impact in renal function over time. A study of 1810 transplant recipients in the Netherlands with a follow-up of 8 years found that one-year post-transplant BMI and BMI change were more strongly associated with death and graft failure than pretransplant BMI. Recipients with BMI> 30 kg/m^2 at twelve month after transplant had 39% higher risks of mortality and graft failure compared to normal BMI patients.[10]

Recipient age and comorbidities could make some noise in the results and a longer follow-up and then an adjustment to those variables could lead to other results. Living donor transplantation could lead to better results but our experience was

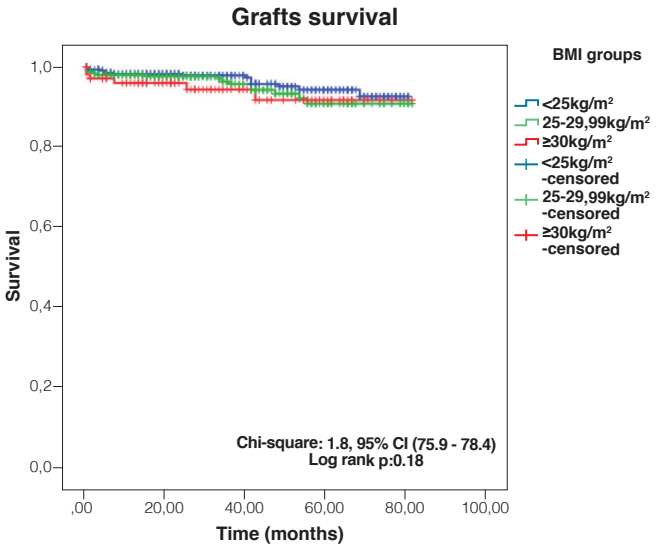

Figure 1: Cumulative graft survival (Kaplan-Meier curve).

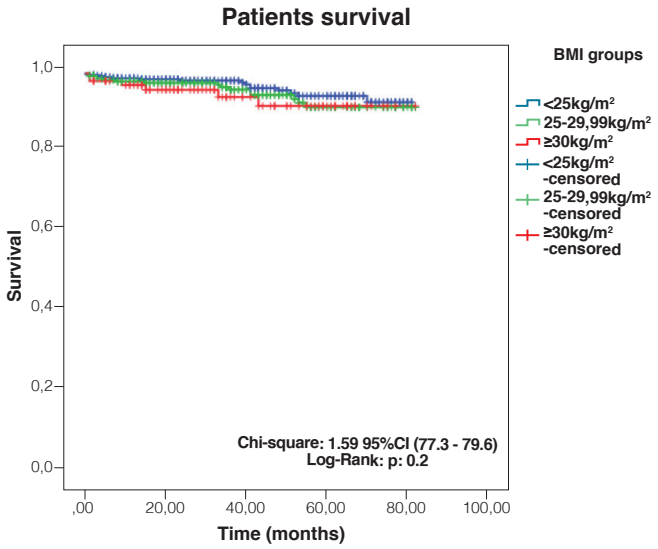

Figure 2: Cumulative patient survival (Kaplan-Meier curve).

limited in that period of time: more experience is needed to make conclusive comparisons. Living donor transplantation could be advantageous in obese patients because it confers the opportunity for perioperative management in a multidisciplinary fashion.[11] Some high-risk obese patients might be only considered for living but not deceased donor transplantation.[12]

Moreover, BMI is considered in some studies[11,13] as an imperfect tool to measure and monitor obesity. In muscular patients, BMI that would indicate overweight or obesity may be false. Better options could be the waist:hip ratio, skinfold thickness or body impedance. Future studies, especially prospective trials, should include one of these variables.

Although cold ischemia was not different between groups, it was realized a higher rate of DGF in non-normal weight groups. This fact could be explained either by the technical challenges imposed by the patient's biotype or by the proinflammatory state associated with obesity: the production of high levels of cytokines may mediate immunological reactions and facilitate DGF.[14] Another cause of prolongation of DGF could be the dialysis procedure: a more aggressive dialysis prescription for obese patients in the setting of DGF may be beneficial as clearance of uremic toxins and establishment of euvolemia may reduce the risk of complications.[12]

Vascular and urinary complications were not increased in obese patients. However, there were more wound dehiscence and lymphocele formation. Longer surgeries, longer hospitalization times, larger incisions and reduced resistance of fat tissue to *in situ* infection were some factors that may explain wound dehiscence. Moreover, it is well-known that both sirolimus and corticosteroids may delay or compromise wound healing. Although the risk of wound healing complications is expected to be lower with steroid minimization or avoidance protocols, the magnitude of this benefit must be considered in relation to the risk of rejection.[12] The higher rate of lymphocele formation is also described in the literature: the explanation could be the longer dissections around the iliac vessels of non-normal weight patients, in order to make them more superficial, increasing the risk of lymphatic leakage.[2] For these reasons, obsessive attention to every detail is important: choice of operating table, bariatric equipment and closure techniques are some issues that the surgeon must remember. Closure techniques should be performed in multiple layers to reduce dead-space formation and in obese patients, robotic surgery or other minimally invasive surgeries could confer advantages.[11,15]

Although obesity leads to the development of hyperfiltration and proteinuria leading to glomerulosclerosis and renal damage,[4] statistical difference was only noticed at the first and third months after renal transplantation: renal function of overweight and obese patients was worse than in normal BMI patients. At the third month, renal function improved in every group. After that, conclusions should not be taken because there were no statistical differences. It should be noted that episodes of acute rejection and graft loss were similar between groups, accordingly with the literature too.[16]

Data is conflicting concerning graft and patient survival[17]: in the meta-analysis of Hill *et al*,[4] obesity in the recipient was not associated with poorer survival. Our data pointed out that graft and patient survival were not different as well as chronic rejection rate, leading to the conclusion that long-term outcome was similar in all groups. In the literature, it is reported that obese patients with end-stage renal disease had better survival after renal transplantation compared with dialysis,[18] so it makes sense that renal transplantation could be one option to consider carefully.

Preoperative preparation could make an important role. On the one hand, there is evidence that obese patients have a higher risk of congestive heart failure in the perioperative period and an increased risk of heart failure and atrial fibrillation after transplantation. However, there are no specific guidelines and it is not known whether the presence of obesity alone should be an indication for more aggressive surveillance for occult coronary artery disease card during wait-listing. On the other

hand, peripheral vascular disease may be difficult to evaluate in asymptomatic obese patients. The use of imaging studies and vascular surgical consultation may be useful.[12]

It is known that reducing weight pre-transplantation is less productive than prevent weight gain post-transplantation.[10] However, it should be said to kidney transplant candidates to lose excess body fat and to try to increase lean muscle mass by becoming more physically active and modifying their diet.[19] Orazio *et al*[20] suggested simple exercise advice with nutrition therapy (Mediterranean-style low glycemic index diet) and achieved weight loss in non-normal BMI patients, especially in those with abnormal glucose intolerance with a significant improvement in dietary factors for cardiovascular disease. Zelle *et al*[21] revealed that increase physical activity was associated with a reduced mortality. Antiobesity agents have some important collateral effects: sibutramine was associated with hypertension and orlistat interfered with cyclosporine availability.[13] Another therapeutic option could be bariatric surgery. Bariatric surgery may be useful in patients with short waiting times that are too high risk to proceed with transplantation without weight loss, or in patients with long-waiting times who fail a trial of medical weight loss.[12] Dziodzio *et al*[22] showed that complication rates were slightly higher compared to the non-transplant population, being the sleeve gastrectomy the preferred procedure when done before kidney transplantation. Coordination of care between bariatric surgical teams and transplant centers should be done preoperatively for obese transplant candidates.

As a conclusion, pretransplantation weight status is important in renal transplantation. Patients with non-normal weight status were older and had more comorbidities, had worse renal function in the first and third month, longer surgery duration, postoperative length of stay, higher delayed graft function rate and a higher prevalence of lymphocele formation and wound dehiscence. The greatest effect of higher BMI is seen in the perioperative and early post-transplantation period. Obese and overweight groups showed similar survival and long-term outcome comparing with recipients with normal BMI in our institution. ●

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