Body Mass Index and the Development of New Onset Diabetes Mellitus or the Worsening of Pre-existing Diabetes Mellitus in Adult Kidney Transplant Patients

Tysen J. Cullen, MS, RD[1], Maureen P. McCarthy, MPH, RD, CSR, LD[1,2], Michael R. Lasarev, MS[3] ,John M. Barry, MD[4], Diane D. Stadler, PhD, RD, LD[1,5]

[1]Graduate Programs in Human Nutrition, [2]Food and Nutrition Services, [3]Department of Public Health and Preventative Medicine, [4] Division of Abdominal Organ Transplantation, [5] Division of Health Promotion & Sports Medicine, Oregon Health & Science University, Portland, OR

Introduction

Kidney transplantation is the preferred treatment for end-stage renal disease . Patients who are obese at the time of kidney transplantation are considered to be at increased risk for developing new-onset diabetes mellitus after transplant (NODAT) or worsening of pre-existing diabetes mellitus.

Objective

To determine the relationship between body mass index (BMI) and

1. The development new-onset diabetes after transplant (NODAT)
2. The worsening of pre-existing diabetes mellitus in adults after kidney transplantation.

Methods

Design and Subjects

Medical record review of 204 adult patients who underwent a first renal transplant between September 2009 and February 2011 at OHSU.

Patients were excluded if they received simultaneous transplantation of another organ, were immunosuppressed for non-transplant reasons, or were less than 18 years of age.

Data Collection

Baseline data included age, gender, ethnicity, weight, height, BMI, diagnosis of pre-existing diabetes mellitus and medications used to treat the condition.

Main Outcome Measures

Development of NODAT and the components of diabetes mellitus treatment regimens were collected at hospital discharge and 3, 6, and 12 months after kidney transplantation.

Statistical Analysis

Logistic regression was used to determine the relationship between BMI at admission and the development of NODAT at specified times within 1 year of kidney transplantation.

McNemar's test for correlated proportions was used to assess whether a patient whose diabetes status worsened during one time interval post-transplant was likely to continue to worsen during subsequent time intervals.

Fisher's exact test was used to determine if change in pre-existing DM treatment regimen following a kidney transplant was related to BMI.

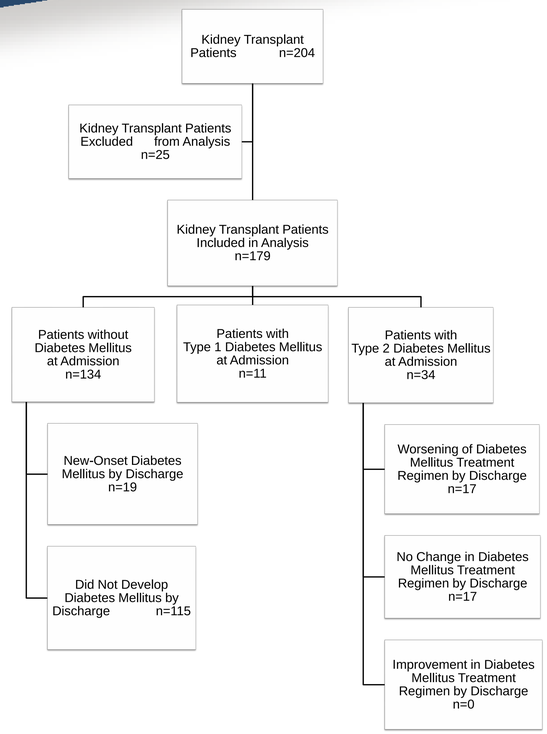

Figure 1. Distribution of adult kidney transplant patients based on presence of diabetes mellitus at admission and change in diabetes mellitus status or treatment regimen at discharge.

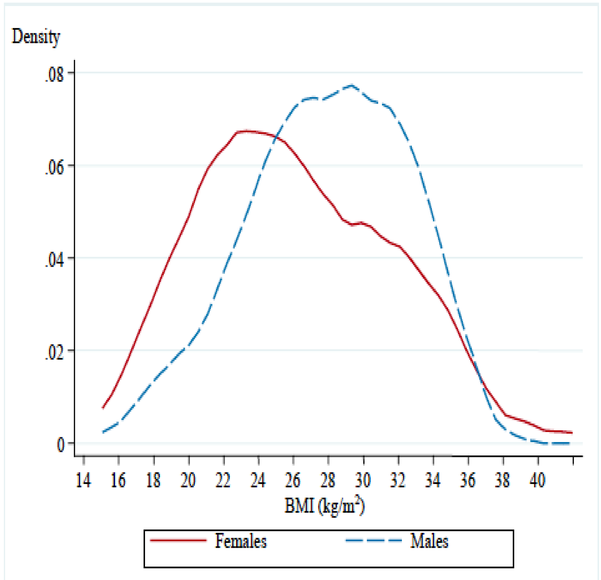

Figure 2. Pre-transplant BMI of male and female adult kidney transplant patients. The distribution curve was shifted 1.78 kg/m^2 (95% CI: 0.30—3.25 kg/m^2; p value = 0.02) for males (27.9 +/- 4.4 kg/m^2) compared to females (26.2 +/- 5.3 kg/m^2).

Table 1. Distribution by Category of Body Mass Index at Admission for Adult Kidney Transplant Patients (n=134) Who Did or Did Not Have New-Onset Diabetes After Transplant by Discharge, 3, 6, or 12 Months*.

Body Mass Index (kg/m^2)	Discharge	Three Months	Six Months	Twelve Months
New-Onset Diabetes After Transplant	n=19 (14.2%)	n=26 (19.4%)	n=27 (20.1%)	n=26 (19.4%)
< 18.5	0 (0)	0 (0)	0 (0)	0 (0)
18.5-24.9	5 (26.3)	5 (19.2)	5 (18.5)	4 (15.4)
25.0-29.9	5 (26.3)	8 (30.8)	9 (33.3)	8 (30.8)
30-0-34.9	7 (36.8)	11 (42.3)	11 (40.7)	11 (42.3)
35.0-39.9	2 (10.5)	2 (7.7)	2 (7.4)	3 (11.5)
> 40.0	0 (0)	0 (0)	0 (0)	0 (0)
No Diabetes Mellitus	n=115	n=108	n=107	n=108
< 18.5	4 (3.4)	4 (3.7)	4 (3.7)	4 (3.7)
18.5-24.9	44 (38.3)	44 (40.7)	44 (41.1)	45 (41.7)
25.0-29.9	35 (30.4)	32 (29.6)	31 (30.0)	32 (29.6)
30-0-34.9	29 (25.2)	25 (23.1)	25 (23.4)	25 (23.1)
35.0-39.9	2 (1.5)	2 (1.9)	2 (1.9)	1 (0.9)
> 40.0	1 (0.8)	1 (0.9)	1 (0.9)	1 (0.9)

*Data presented as frequencies and (percentages).

Table 2. Change in Diabetes Mellitus Treatment Regimen and Pre-Transplant Body Mass Index of Adult Kidney Transplant Patients with Type 2 Diabetes Mellitus*.

Change in Treatment Regimen	n=34	Body Mass Index (kg/m^2)
Admission to Discharge		
Worsening	17 (50.0%)	29.2 ± 4.7
No change	17 (50.0%)	29.4 ± 3.8
Improvement	0 (0%)	-
Discharge to Three Months		
Worsening	3 (8.8%)	29.4 ± 7.8
No change	30 (88.2%)	29.1 ± 3.9
Improvement	1(2.9%)	34.3
Three to Six Months		
Worsening	0 (0%)	-
No change	33 (97.1%)	29.3 ± 4.3
Improvement	1(2.9%)	30.7
Six to Twelve Months		
Worsening	0 (0%)	-
No change	32 (94.1%)	29.4 ± 4.2
Improvement	2 (5.9%)	27.5 ± 4.6

* Data reported as means ± SD and frequencies and (percentages).

Table 3. Relationships among Body Mass Index (BMI) at Admission, Sex, and the Development of New-Onset Diabetes After Transplant (NODAT) at Discharge, 3, 6, and 12 months (n=134).

Assessment Time Point	Odds Ratio for Developing NODAT (95% CI)	
	Body Mass Index (kg/m^2) (adjusted for Sex)	Sex* (adjusted for BMI)
Discharge	1.11 (1.00--1.23)	2.17 (0.79--5.97)
3 months	1.13 (1.03--1.24)	1.79 (0.72--4.49)
6 months	1.15 (1.05--1.27)	2.62 (1.04--6.58)
12 months	-	-
Females	1.10 (0.97--1.24)	-
Males	1.34 (1.12--1.61)	-

*Females relative to males

Results

Mean pre-transplant BMI was significantly higher for males than females (Figure 2).

The cumulative incidence of NODAT at discharge, 3, 6, and 12 months post-transplant was 14.2%, 19.4%, 20.1%, and 19.4%, respectively (Table 1).

The need for more aggressive diabetes mellitus treatment (suggesting a worsening of diabetes mellitus status from admission to discharge) was usually seen between discharge and three months; 50% of patients with pre-existing diabetes mellitus required more aggressive diabetes mellitus treatment post-transplantation (Table 2).

The odds of developing NODAT by discharge, 3, or 6 months post-transplant increased by a factor of 1.11 (95% CI: 1.0-1.23), 1.13 (95% CI: 1.03-1.24), and 1.15 (95% CI: 1.05-1.27) per unit increase in pre-transplant BMI (Table 3).

Conclusions

The odds of developing NODAT at discharge and 3 and 6 months post-transplant increased per unit of pre-transplant BMI.

The most common time for NODAT to develop or for pre-existing diabetes mellitus to worsen was within 3 months of kidney transplantation.

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