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Impact of Anthropometric Measurements in Clinical Practice

Liidia Kiisk[1], Helje Kaarma[1] and Mai Ots-Rosenberg[2]

[1] University of Tartu, Institute of Anatomy, Centre for Physical Anthropology, Tartu, Estonia
[2] University of Tartu, Department of Internal Medicine, Tartu, Estonia

A B S T R A C T

Anthropometry helps to assess nutritional status which is an important determinant of clinical outcome in many patients, including the number of those suffering from chronic kidney disease (CKD). Weight gain after successful kidney transplantation is a well-known phenomenon, therefore we hypothesized that intensive counseling, based of menu analysis by a dietitian of CKD patients with a kidney transplant, can prevent the significant body weight (BW) gain after the transplant operation. The aim of the investigation was to study long-term anthropometrical, biochemical and dual-energy densitometry changes in the kidney transplant patients, to study correlations between the studied parameters and to compare those with the follow-up data. The prospective long-term study was carried out in 28 clinically stable renal transplant patients. Control groups consisted both transplant patients (47 patients), receiving ordinary nutritional counseling, and of healthy population subjects (342). Anthropometry and biochemistry were studied in patients twice: the first follow-up (FU1) data were collected 1.3±0.2 years, and the second follow-up (FU2) data were collected 2.7±0.3 years after the transplant. Significant BW gain was found only in renal transplant male patients (FU1 vs. *FU2, p<0.001) but not in females. The mean weight gain in control group patients was significant both in the male and female groups. In males, the mean C-reactive protein was significantly correlated with different body circumferences. But, in females, no clear associations were found. In females, significant correlation was found between mean body weight, body mass index and triglycerides. We conclude that the use of anthropometry in clinical practice, together with intensive and individual counseling by a dietitian, should be regular in the kidney transplant patients' population to prevent overweight. Monitoring of the dynamics of anthropometrical and biochemical parameters are clinically relevant in the post-transplant period together with densitometry.*

Key words: *anthropometry, body composition, chronic kidney disease, nutrition, overweight*

Introduction

Overweight and obesity are widespread, contributing substantially to the global burden of ill health and premature death. These conditions, in most European countries, show rising secular trends and are predicted to continue to increase if not addressed. Policy-makers in the new and candidate European Union countries, as well as other countries of the European Region, can learn from the negative Western European and global experience, act now to stem the obesity epidemic from further development and in so doing reduce the substantial economic loss associated with obesity[1]. Moreover, not only the general population, but patients with different disease types should be under consideration[2]. Nutritional status is an important determinant of clinical outcome in patients with chronic kidney disease. Anthropometry helps to assess nutritional status[3,4] which is an important determinant of clinical outcome in many patients including the chronic kidney disease (CKD) patient's population. Malnutrition, existing prior to transplant, may be associated with an increased risk of infection, delayed wound healing, and muscle weakness. Obesity, which may also be pre-existing or developing after transplantation, can lead to adverse effects, such as increased risk of cardiovascular disease.

Chronic kidney disease develops in the transplanted kidney over the years and represents a progressive, irreversible decline in the glomerular filtration rate (GFR).

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Whereas immunological mechanisms dominate the injury that leads to chronic allograft dysfunction and nephropathy, there is circumstantial evidence that non-immunological factors, such as advanced age, hyperfiltration, overweight, delayed graft function, heavy proteinuria, smoking, arterial hypertension, hyperlipidemia, anaemia, inflammatory status and oxidative stress, play a role as aggravating or progression factors[5]. It is recommended that we prevent or, if possible, consider all these factors to avoid kidney disease progression and the treatment should begin early in the course of chronic renal insufficiency with reno- and vaso-protective medications[6]. An important aspect of the post-transplantation kidney recipient's care and rehabilitation is non-drug treatment and close watching of the evolution of weight and body composition. There are four important components of lifestyle differences where positive changes are especially important for renal patients: smoking, diet, exercise and body weight[7]. Current dietary recommendations, in clinically stable renal transplant patients, do not generally differ from those of the general population, although intense dietary counseling may be indicated in patients with excessive post-transplant weight gain and dyslipidemia as well as with changes in their calcium-phosphate balance.

We hypothesized that intensive counseling, based of menu analysis by a dietitian of kidney transplant patients, can prevent significant weight gain after transplantation. The aim of the investigation was to study long-term anthropometrical, biochemical and dual-energy densitometry changes in the kidney transplant patients, to study correlations between the studied parameters and to compare those with the follow-up data.

Methods

Subjects

The longitudinal study was carried out during four years at the Department of Internal Medicine in the University of Tartu. 28 clinically stable consecutive non-diabetic first cadaver renal transplant patients (glomerulonephritis N=15, pyelonephritis N=6, polycystic kidney disease N=5, other chronic kidney disease N=2) were studied. This comprised 12 males in the mean age of 42.8±16.1 years, and 16 females in the mean age of 47.0±14.9 years. Almost all patients receive an early steroid-withdrawal immunosuppression regimen using only mycophenolate mofetil and cyclosporin as maintenance immunosuppressants after first year post transplantation. Intensive nutritional counseling, based of menu analysis by a dietitian, was carried out on a regular basis: twice during the first year and after that once a year. Patients were advised to consume 1 g/kg/day of protein and 30 to 35 kcal/kg/day.

Control group patients received normal nutritional counseling. The group consisted from 47 clinically stable consecutive non-diabetic first renal transplant patients (glomerulonephritis N=20, pyelonephritis N=14, polycystic kidney disease N=7, other chronic kidney disease N=6): 27 males (mean age 45.6±9.4 years) and 20 females (mean age 48.7±12.8 years). Population controls consisted from 86 males (mean age 45.0±4.0 years) and 256 females (mean age 45.0±4.0 years).

Anthropometry

Anthropometry and biochemistry were performed in patients twice: the first follow-up (FU1) data were collected 1.2±0.3 years and the second follow-up (FU2) data were collected 2.7±0.3 years after the transplantation. The anthropometrical variables were taken following the rules of R. Martin that consider classical measures[8,9]. The measured anthropometric variables were the following: body weight (BW, kg), body height (BH, cm), 8 breadths (cm), 2 depths (cm), 13 circumferences (cm) and 11 skin fold thicknesses (mm). For the study of BW each patient was weighed with a SECA (USA) electronic platform scale in kg (Precision to 0.05). Body fat mass (BF, %) and total body fat mass (TBF, kg) were measured by the OMRON® BF 300 body fat monitor (Omron Matsusaka Co., Japan)[10]. The height and weight-based equation (body mass index, BMI) was calculated as kg/m^2.

Biochemistry

The following biochemical parameters were studied in patients in the fasting state: serum total protein (S-TP, g/L), serum albumin (S-Alb, g/L), C-reactive protein (CRP, mg/L), serum creatinine (S-Crea, mmol/L), serum ionized calcium (S-i-Ca, mmol/L) and serum phosphate (S-P, mmol/L). Analyses were compared between baseline and follow-up data. Studied lipid profile was the following: total cholesterol (S-CHL, mmol/L), serum high density lipoprotein-cholesterol (S-HDL-Chol, mmol/L), serum low density lipoprotein-cholesterol (S-LDL-Chol, mmol/L), triglyceride (TG, mmol/L).

Densitometry

In the study there were used the dual-energy X-ray absorptiometry (DXA) method and also the GE LUNAR DPX-IQ (Lunar Corporation, Madison, Wisconsin, US, software version 4.7e) densitometer by a certified technician at the second follow-up. The data of total body composition, total and regional bone mineral density (BMD, g/cm^2) as well as T-scores were shown. The reference values used in DPX software are supported by a large database from the population research studies in the USA, the UK and Northern Europe[11,12]. Individual data in kidney transplant patients were presented in absolute values and in percentages (%) by three T- score categories: normal, osteopenia and osteoporosis. Data comparison with WHO criteria were used to distinguish normal bone mineral density, osteopeny (low bone mass) and osteoporosis[13]: T-scores measured criteria as follows: above –1: bone density is considered normal; between –1 and –2.5 this T-score is a sign of osteopenia; below –2.5 bone density indicated osteoporosis.

Statistical analyses

The data were processed using the Statistical Package System (SAS). For all the anthropometric measurements and biochemical blood characteristics, basic statistics means (X), standard deviations (SD), minimum (min) and maximum (max) for the initial and the final observation period. Data were compared between group means at different studied time-points. The data were analyzed using the paired two-tailed t-test, Bonferroni exact test, Pearson correlation and multiple regression analysis**.**

Ethics

The study has been approved by the Ethics Committee on Human Research of the University of Tartu, Tartu, Estonia (protocol no 141/30; 2005).

Results

Anthropometric characteristics

Basic anthropometric parameters evaluation data in the renal transplant male and female patients are given in Table 1 and 2. Post transplant body weight gain was found both in studied male, (mean BW 75.1±20.7 kg at FU1 and mean BW 83.3±19.9 kg at FU2, p<0.001) and female patients (mean BW 74.4±22.3 kg at FU1 and mean BW 76.6±22.7 kg at FU2, p=0.101). Body weight gain was seen in control renal transplant patients as statistically significant both in males (BW at FU1 75.7±11.1 kg and at FU2 81.0±13.3 kg, p<0.001) and females (at FU1 68.3±12.8 kg, at FU2 71.2±12.6 kg, p<0.01). BW was significantly lower in males at FU1 compared with population controls (p<0.009) but at FU2 BW was not different (p<0.470). In females, BW did not differ significantly from the population control group at FU1 (p< 0.851) or FU2 (p<0.593). The data of body height measurement differences between FU1 and FU2 were found significantly decreased both in male and female patients (Table 1, 2). Body mass index increased significantly both in male and female patient groups between the FU1 and FU2 (in males FU1 24.7±7.2 kg/m^2 and the FU2 27.7±6.8 kg/m^2, p<0.001; in females the FU1 mean 27.3±7.5 kg/m^2 and the FU2 28.5±7.7 kg/m^2, p>0.013). The control group individuals' BMI were the following: in males FU1 24.4±3.5 kg/m^2 and the FU2 26.0±4.3 kg/m^2, p<0.001; in females the FU1 25.0±4.0 kg/m^2 and the FU2 26.0±4.2 kg/m^2, p<0.01. BMI was significantly lower in males at FU1 compared with the population controls (p<0.009) but at FU2 BMI was not different (p<0.935). In females, BMI did not differ significantly from population controls at FU1 (p<0.941) either FU2 (p<0.552).

Mid-arm muscle circumference (MAMC) increased significantly during the study in males (at FU1 27.6±4.5 and at FU2 28.4±4.1, p=0.011), but remained unchanged in females (at FU1 25.9±3.7 and at FU2 25.8±3.4, p=0.100). The hip circumference significantly increased in males (at FU1 99.2±13.0 and at FU2 103.0±11.8, p=0.012) but not in females (at FU1 107.8±15.4 and at FU2 107.8±15.4, p=0.869). The waist circumference was found significantly decreased in female patients after the second follow-up (at FU1 88.6±15.8 and at FU2 86.6± 16.3, p=0.032) but not in males (at FU1 89.5±13.0 and at FU2 94.0±12.8, p=0.070).

Biochemistry

Mean S-Alb (Table 3) level improved after the transplant in studied patients and further significantly improved in comparison with FU1 and FU2 both in males (at FU1 41.0±4.1 and at FU2 44.8±3.2, p=0.008) and females (at FU1 40.4±4.1 and at FU2 43.0±3.0, p=0.011). Significant positive changes of mean S-Crea levels were found after the transplantation in the FU1. Inflammatory status (CRP) decreased significantly after the transplantation in both males and females and remained lower also after the FU2 (Table 3). Both in male and female patients the blood fat content indicators were almost at a normal level at the beginning of the observation and after the transplantation. However, the increase of mean S-TG level was noticed in males after the FU1 (p<0.044) but the level remained in between the reference values (Table 3). In females, the mean S-TG level was above the reference value in the baseline and FU1, but fall significantly lower by FU2 (p<0.034).

Densitometry

Total body mean BMD (male: X=1.15±0.12; min 1.03, max 1.34 g/cm^2; female: X=1.12±0.10; min 0.94, max 1.30 g/cm^2) after the second follow-up both in male and female renal transplant patient groups were in the lower than normal range[14]. Individual measures of total body BMD revealed osteopeny in 50% of males and 18% of females but anterior-posterior (AP) lumbar spine (L2-L4) measured T-scores showed osteopeny in 33% of males and in 25% of females. Osteoporosis was not found using total body measurements but in region AP lumbar spine (L2-L4) osteoporosis was found in 8% of male and 25% of female patients.

Correlation analysis

In males (Table 4), the mean CRP was significantly correlated with different body circumferences (waist r= 0.710, hip r=0.770, arm relaxed r=0.790, arm flexed r=0.737). In females, no clear associations were found between inflammation status and anthropometrical parameters as in male patients. But, significant correlation was found between mean body weight, body mass index and triglycerides (Table 4). Mean S-TG was significantly correlated with the fat % (r=0.504) and the amount of body fat in kilograms (r=0.653), BMI (r=0.650).

Discussion

Anthropometrics is central to the study of the body composition and physical fitness in chronic kidney disease patients, including transplant patients, in addition to other methods. In the current study, we found a weight gain after the kidney transplantation both in

TABLE 1
CHARACTERISTICS OF BASIC ANTHROPOMETRIC MEASUREMENTS IN MALES (N=12)

Measurements period	FU1 after kidney transplantation			FU2 after kidney transplantation			p value FU1 *vs.* FU2
Variable	$\overline{X}$±SD	Min	Max	$\overline{X}$±SD	Min	Max	
Weight (kg)	75.13±20.70	57.10	134.10	83.34±19.88	61.15	138.10	0.001*
Height (cm)	174.82±7.37	166.50	190.00	173.53±7.62	164.00	189.30	0.001*
Breadths, depths (cm)							
Biacromial breadth	40.76±3.41	37.50	49.50	40.29±3.55	37.00	49.50	0.044*
Chest breadth	30.56±2.99	26.80	37.00	30.48±2.84	27.00	37.00	0.637
Waist breadth	30.03±3.20	25.80	37.00	29.74±3.44	23.50	37.00	0.382
Pelvis breadth	31.62±3.44	27.50	39.00	34.09±3.03	30.50	39.50	0.021*
Chest depth	23.45±3.63	19.50	33.00	23.78±3.59	19.50	33.00	0.138
lAbdomen depth	24.75±4.63	19.50	36.00	25.04±4.63	19.00	36.00	0.414
Humerus breadth	7.30±0.62	6.20	8.50	7.32±0.49	6.50	8.50	0.864
Wrist breadth	5.87±0.51	5.10	6.80	5.85±0.54	5.10	6.80	0.658
Femur breadth	10.14±0.55	9.10	11.00	10.19±0.61	9.00	11.00	0.572
Ankle breadth	7.35±0.87	6.00	8.50	6.93±0.76	6.00	8.50	0.014*
Circumferences (cm)							
Head	58.00±1.47	55.00	60.30	57.59±1.54	55.00	60.00	0.118
Neck	40.37±2.71	37.00	46.30	39.49±2.33	36.80	43.50	0.108
Chest	102.56±8.44	88.20	122.00	102.13±9.11	85.80	122.00	0.545
Waist	89.47±12.98	77.60	124.00	93.95±12.77	78.50	126.00	0.070
Hip	99.19±12.95	86.70	138.00	103.04±11.84	93.00	138.00	0.012*
Proximal thigh	56.26±5.63	51.10	71.00	56.11±6.72	46.00	71.00	0.859
Middle thigh	49.07±4.09	45.00	60.00	50.44±5.03	43.00	60.00	0.279
Calf	34.26±1.80	32.10	38.00	36.73±3.11	32.20	43.00	0.005*
Ankle	23.10±1.93	20.20	27.00	23.33±1.94	20.50	27.00	0.225
Mid-arm, relaxed	30.96±5.83	24.90	47.50	32.49±5.15	27.50	47.50	0.035*
Mid-arm, flexed/tensed	32.81±5.05	25.80	46.00	34.73±4.11	29.80	46.00	0.022*
Forearm	28.09±1.94	26.00	31.70	28.17±2.33	24.50	31.70	0.781
Wrist	18.78±2.25	16.30	23.80	18.88±2.32	16.00	24.00	0.275
Skinfolds (mm)							
Chin	7.88±5.27	2.50	22.00	10.67±5.24	5.00	22.00	0.008*
Chest	11.17±5.76	5.00	26.00	14.13±5.78	7.50	26.00	0.030*
Side	14.13±7.45	5.50	28.00	13.75±5.93	6.00	28.00	0.785
Waist	13.83±6.45	5.00	26.00	14.21±6.19	5.00	26.00	0.755
Suprailiacal	9.41±5.59	4.00	23.00	10.94±7.12	4.00	30.00	0.332
Umbilical	18.23±11.44	7.00	42.00	18.98±10.14	7.50	42.00	0.612
Subscapular	10.17±7.96	4.50	33.00	13.82±8.65	5.00	38.00	0.011*
Biceps	4.93±3.13	1.50	12.00	7.66±3.94	3.00	16.00	0.027*
Triceps	10.67±6.29	3.30	24.20	13.13±5.56	5.00	26.00	0.038*
Thigh	16.46±9.07	6.80	40.00	18.31±8.85	7.00	40.00	0.167
Calf	8.88±6.29	2.00	24.00	11.08±6.14	2.50	24.00	0.069
Indices							
BF by OMRON (%)	18.19±8.68	7.80	39.40	23.50±8.09	8.40	39.40	0.003*
BF by OMRON (kg)	14.92±12.75	5.30	52.80	20.44±12.10	6.60	54.40	0.002*
BMI (kg/m^2)	24.66±7.19	19.40	46.10	27.73±6.77	22.00	47.50	0.001*
WHR (m)	0.90±0.06	0.81	1.03	0.91±0.09	0.80	1.13	0.281

* Statistically significant difference p≤0.05; $\overline{X}$ – mean; SD – standard deviation; FU1 – follow-up1; FU2 – follow-up2; BF – body fat; BMI – body mass index; WHR – waist to hip ratio

TABLE 2
CHARACTERISTICS OF BASIC ANTHROPOMETRIC MEASUREMENTS IN FEMALES (N=16)

Measurements period	FU1 after kidney transplantation			FU2 after kidney transplantation			p value FU1 *vs.* FU2
Variable	$\overline{X}$±SD	Min	Max	$\overline{X}$±SD	Min	Max	
Weight (kg)	74.35±22.33	40.00	126.50	76.58±22.74	46.20	124.90	0.101
Height (cm)	164.88±6.51	150.00	171.50	163.50±6.82	147.30	169.50	0.000*
Breadths and depths (cm)							
Biacromial breadth	35.89±2.91	32.00	42.80	35.50±2.79	32.00	42.80	0.166
Chest breadth	27.73±3.43	23.00	34.50	27.89±3.89	23.00	37.00	0.627
Waist breadth	28.46±4.71	23.00	39.00	27.46±3.02	22.00	35.00	0.255
Pelvis breadth	31.58±2.63	26.00	35.50	33.01±4.30	26.00	42.00	0.035*
Chest depth	21.54±3.19	17.00	28.00	21.59±3.32	17.00	28.00	0.758
Abdomen depth	24.68±6.68	16.50	40.00	24.38±6.47	16.80	40.00	0.343
Humerus breadth	6.56±0.73	5.70	8.40	6.43±0.65	5.70	8.40	0.134
Wrist breadth	5.28±0.38	4.70	6.20	5.30±0.35	4.70	6.00	0.790
Femur breadth	9.53±0.96	8.20	11.70	9.31±0.90	8.20	11.50	0.141
Ankle breadth	6.33±0.98	4.20	7.60	6.11±0.82	4.20	7.10	0.258
Circumferences (cm)							
Head	55.59±1.93	53.00	59.50	55.31±1.65	53.00	58.30	0.029*
Neck	35.86±3.90	29.50	42.50	35.04±3.29	29.50	40.20	0.036*
Chest	95.06±10.54	76.80	114.20	94.50±11.04	77.00	117.50	0.494
Waist	88.55±15.75	62.00	124.00	86.57±16.29	62.00	129.00	0.032*
arHip	107.75±15.36	86.00	140.00	107.57±15.48	86.00	142.00	0.869
Proximal thigh	59.19±9.43	45.80	73.00	58.09±8.30	45.00	72.00	0.045*
Middle thigh	51.74±8.44	38.00	65.10	50.80±7.20	37.00	62.50	0.149
Calf	37.28±6.85	29.70	53.80	37.41±6.87	28.80	53.80	0.714
Ankle	23.58±4.04	17.80	32.50	23.01±3.25	18.00	28.80	0.402
Mid-arm, relaxed	31.74±5.23	22.00	39.00	31.13±4.93	22.00	37.60	0.135
Mid-arm, flexed/tensed	32.61±5.78	23.50	40.10	32.08±4.91	23.50	40.50	0.178
Forearm	25.28±3.69	20.50	32.50	24.80±3.13	20.50	30.00	0.035*
Wrist	16.49±1.92	14.00	21.00	16.39±1.52	14.00	19.00	0.630
Skinfolds (mm)							
Chin	9.31±4.46	1.80	18.00	10.03±4.54	2.40	18.00	0.099
Chest	12.16±5.04	3.00	20.00	11.28±5.35	3.00	26.00	0.413
Side	12.77±6.96	2.80	30.00	12.83±7.24	2.80	33.00	0.941
Waist	14.75±9.96	4.50	36.00	13.94±9.23	4.00	35.00	0.089
Suprailiacal	14.55±9.56	3.00	35.00	15.64±8.63	3.00	35.00	0.432
Umbilical	18.38±11.17	2.50	42.00	19.00±10.85	5.00	42.00	0.533
Subscapular	14.56±6.43	4.10	28.00	15.48±7.95	5.20	36.00	0.208
Biceps	8.68±4.14	2.20	17.50	10.18±5.15	2.40	20.00	0.099
Triceps	18.59±6.95	6.00	28.00	16.94±6.64	6.50	30.00	0.201
Thigh	21.59±9.68	7.00	36.00	20.25±8.34	7.50	35.50	0.106
Calf	15.91±8.34	5.50	31.00	15.03±7.92	2.50	33.00	0.488
Indices							
BF by OMRON (%)	33.06±10.80	9.90	44.80	34.80±11.11	10.50	48.00	0.005*
BF by OMRON (kg)	25.74±12.57	4.20	46.50	28.36±14.99	4.90	60.00	0.040*
BMI (kg/m^2)	27.26±7.48	14.90	43.80	28.53±7.71	17.20	44.50	0.013*
WHR (m)	0.82±0.10	0.70	0.96	0.80±0.10	0.67	0.93	0.037*

* Statistically significant difference p≤0.05; $\overline{X}$ – mean; SD – standard deviation; FU1 – follow-up1; FU2 – follow-up2; BF – body fat; BMI – body mass index; WHR – waist to hip ratio

TABLE 3
BIOCHEMICAL CHARACTERISTICS IN KIDNEY TRANSPLANT PATIENTS

Variables	Baseline	Follow-up1	Follow-up2	Baseline *vs.* FU1	FU1 *vs.* FU2	Laboratory data
	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	p	p	Reference values
Male (N=12)						
S-Albumin (g/L)	38±3	41±4	45±3	0.423	0.008*	35–50
S-CRP (mg/L)	18.2±34.2	5.0±3.4	6.7±7.9	0.232	0.444	<5.0
S-Crea (μmol/L)	806±149	138±52	142±52	0.0001*	0.626	<120
S-ALP (U/L)	127±66	115±60	110±33	0.001*	0.773	40–129
S-iCa (mmol/L)	1.05±0.04	1.33±0.10	1.35±0.08	0.001*	0.379	1.17–1.29
S-P (mmol/L)	1.98±0.58	1.04±0.52	0.98±0.30	0.305	0.707	0.87–1.45
S-CHL (mmol/L)	4.3±0.5	5.8±1.1	5.9±1.3	0.012*	0.772	<5.0
S-HDL-Chol (mmol/L)	1.4±0.3	1.5±0.4	1.5±0.4	0.414	0.848	>1.0
S-LDL-Chol (mmol/L)	2.3±0.2	3.6±0.9	3.9±1.3	0.021*	0.655	<3.0
S-TG (mmol/L)	1.2±0.2	1.6±0.5	1.8±0.9	0.044*	0.224	<2.3
Female (N=16)						
S-Albumin (g/L)	39±3	40±4	43±3	0.270	0.011*	35–50
S-CRP (mg/L)	8.5±5.4	3.8±3.1	3.7±2.6	0.013*	0.974	<5.0
S-Crea (μmol/L)	628±190	116±35	116±35	0.0001*	0.946	<103
S-ALP (U/L)	181±76	86±32	84±31	0.001*	0.722	35–104
S-iCa (mmol/L)	1.11±0.14	1.37±0.08	1.40±0.10	0.058	0.531	1.17–1.29
S-P (mmol/L)	2.23±0.06	1.13±0.39	1.05±0.28	0.176	0.381	0.87–1.45
S-CHL (mmol/L)	6.0±1.1	6.3±1.4	6.5±1.2	0.387	0.188	<5.0
S-HDL-Chol (mmol/L)	1.0±0.2	1.4±0.4	1.6±0.4	0.143	0.106	>1.0
S-LDL-Chol (mmol/L)	4.1±1.1	4.0±1.2	4.4±0.9	0.395	0.066	<3.0
S-TG (mmol/L)	2.8±1.1	2.3±1.4	1.7±1.1	0.223	0.034*	<2.3

* Statistically significant difference ($p \leq 0.05$); $\bar{X}$ – mean; SD – standard deviation; FU1 – follow-up1; FU2 – follow-up2; S-CRP – serum C-reactive protein; S-Crea – serum S-Creatinine; S-ALP – serum alkaline phosphatase; S-i-Ca – serum ionized calcium; S-P – serum phosphorus; S-HDL – serum high-density lipoprotein; S-LDL – serum low-density lipoprotein; S-TG – serum triglyceride

males and females. However, in our study, the weight gain in females was not significant and that may be explained partly by the fact that together with the improvement in their health, women probably cared more about their body-shape and followed the dietitian's advice. On the other hand, the mean weight gain in control group patients was significant both in male and female groups. Therefore, our hypothesis confirmed that in the female group intensive counseling by a dietitian for kidney transplant patients did prevent significant weight gain after transplantation. Similarly, several authors[15,16] have shown that after the kidney transplant the patient's general state improves together with the nutritional indicators and the early post-transplantation period is associated with weight gain. Other studies have shown different results where mainly female patients had a significant increase of weight during 1 and 2 years after the transplantation[17]. Body weight gain gender differences in our study may be explained by the fact that uremic status disappeared and patients felt themselves much healthier and began probably to eat more. However, female patients probably followed better the dietitian's guidelines than male patients and no significant increase of body weight and BMI was found after the kidney transplantation. This was further confirmed by the significant WHR decrease in females.

Diet adherence assessment was studied in our patient groups intensively and published separately[18]. In short, we found that there was a tendency to increased consumption of proteins and carbohydrates after kidney transplantation but by FU2 patients' nutritional habits were improved. On the other hand, male patients in our study displayed, in the beginning of the study, almost normal weight and however, after the transplantation a significant weight gain appeared. Also, male patients did not very closely follow the dietitian's advice compared with females. However, comparing the body weight and BMI of the studied patients at FU1, with the Estonian population data by Saluste, we can see that there were no differences between our male and female mean data compared with the population data[19].

El Haggan et al. 2002 have shown that the body composition, during the first year after renal transplanta-

TABLE 4
CORRELATION ANALYSIS BETWEEN SELECTED ANTHROPOMETRICAL AND BIOCHEMICAL VARIABLES IN KIDNEY TRANSPLANT PATIENTS

Variables	S-CRP m/L	S-iCa mmol/L	S-P mmol/L	S-CHL mmol/L	S-TG mmol/L
Male (N=12)					
Follow-up1					
Weight (kg)	0.256	–0.087	–0.178	–0.196	0.220
BF by OMRON (kg)	0.396	–0.077	–0.054	0.065	0.143
BMI (kg/m^2)	0.307	–0.057	–0.078	–0.023	0.211
WHR (m)	–0.206	–0.608*	–0.412	0.370	0.136
Follow-up2					
Weight (kg)	0.747*	–0.227	0.207	–0.044	0.092
BF by OMRON (kg)	0.723*	–0.298	0.159	0.126	0.003
BMI (kg/m^2)	0.779*	–0.298	0.164	0.115	0.096
WHR (m)	0.103	–0.207	–0.163	0.198	–0.142
Female (N=16)					
Follow-up1					
Weight (kg)	0.039	0.301	0.042	0.221	0.571*
BF by OMRON (kg)	0.210	0.342	–0.128	0.418	0.518*
BMI (kg/m^2)	0.251	0.361	–0.016	0.332	0.563*
WHR (m)	0.397	–0.015	–0.042	0.365	0.482
Follow-up2					
Weight (kg)	0.086	0.486	–0.647*	0.096	0.622*
BF by OMRON (kg)	0.080	0.557*	–0.679*	0.299	0.653*
BMI (kg/m^2)	0.090	0.530*	–0.711*	0.209	0.650*
WHR (m)	0.004	0.384	–0.386	0.586*	0.250

* Statistically significant difference ($p \leq 0.05$); BF – body fat by OMRON; BMI – body mass index; WHR – waist to hip ratio.

tion, showed that the female patients' body weight and total fat increased probably with higher dietary caloric and protein intake and in male patients total fat decreased[20]. However, in the early post transplantation period the anthropometric measurement changes are different from patient to patient, especially regarding their body weight. In male patients, before transplantation, there were under-nutritional data in some patients and during the study their body weight and body fat content increased. We can confirm that our study also showed similar individual differences. The weight gain in our male patients was mainly because of an increase in fat mass. In female patients no significant increase of body weight and BMI was found but fat mass also increased. Significant body fat mass increase in both genders, and comparison of changes in their anthropometric measures, can indirectly explain that probably this was connected with the increase of visceral body fat. Statistically significant differences were seen between some breadths and circumferences both in males and females comparing FU1 and FU2, and this can be explained by better status of soft tissues. Thus, the individual and regular anthropometric measurements are important in the management of patients after kidney transplantation. In the other study it was also demonstrated that before transplantation female patients had normal body status and after transplantation their body weight and body fat content increased significantly[21]. In the Coroas study, body weight increase in men was accompanied by an increase in bone mass, muscle mass and body fat mass[22] and this was also noticed in our study. Decreased body height during the follow-up can be explained with regard to a certain extent of chronic kidney disease-associated mineral and bone disease disorder as well as by the patient's posture. Our study revealed that male patients gained BW in the post-transplant period because of an increase in bone, muscle and fat mass. These changes appeared to correlate with the inflammatory status. Similar association was not noticed in female patients where BW had not increased significantly.

Inflammatory status[23] and hyperlipidemia[24,25] are well-known cardiovascular risk factors. Most of the patients normalized their inflammatory status in our study similarly in studies compared to other authors[17]. As a confirmation of inflammatory status association with body composition, we found a significant number of correlations in males between CRP and different body circumferences and body fat. Previously, it has been shown that the graft survival rate in the recipients with hypercholesterolemia was lower than that in the recipients without hypercholesterolemia[26]. Therefore, lipid profile monitoring is clinically important in the management of patients with kidney transplants. Hyperlipidemia, overweight or obesity, physical inactivity and improved appetite were normalized by dietary intervention and exercise training in stable renal transplant patients[27]. On the contrary, in our study we found that, after the transplant, there was a tendency of an increase in S-CHL in both males and females. Interestingly, in females many significant correlations were found be between mean weight, BMI and triglycerides. Thus, monitoring of the dynamics of bio- chemical and anthropometrical parameters are clinically relevant in the post-transplant period together with densitometry. Nowadays, dual-energy X-ray absorptiometry is used for routine clinical care and can be used to validate other methods of measuring body fat[28,29]. Individual measures of total body BMD revealed osteopeny in 50% of males and 18% of females but anterior-posterior (AP) lumbar spine (L2-L4) measured T--scores showed osteopeny in 33% of males and in 25% of females. Thus, regional BMD measurements are important for adequate interpretation of data especially in chronic kidney disease patients where general factors like age, gender, immunosuppression and physical activity, as well as diet, should also be considered.

The studied patients were generally in a satisfying nutritional status after the transplantation at FU1, which may be associated with regular monitoring, cooperation agreement with treatment and with good collaboration between specialists. Optimal and intensive counseling by a dietitian can prevent significant weight gain after kidney transplantation in the long-term.

Conclusion

Optimal nutritional evaluation, the use of biochemistry together with anthropometry in clinical practice, as well as intensive nutritional education, is of great importance in all chronic kidney disease phases including the post-transplant period. The major nutritional goal is to prevent excessive weight gain.

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REFERENCES

1. KNAI C, SUHRCKE M, LOBSTEIN T, Econ Hum Biol, 5 (2007) 392. DOI: 10.1016/j.ehb.2007.08.002. — 2. BRAJKOVIC AV, GORNIK I, GASPAROVIC V, Coll Antropol, 34 (2010) 1131. — 3. PETERSON J, KAARMA H, KOSKEL S, Anthropol Anz, 65 (2007) 51. — 4. BUBAS M, MILOSEVIC M, DELIC-BRKLJACIC D, ZAHARIEV-VUKSINIC K, Coll Antropol, 36 (2012) 585. — 5. CHERTOW GM, BRENNER BM, MORI M, MACKENZIE HS, MILFORD EL, Kidney Int Suppl, 63 (1997) 84. — 6. SCHWENGER V, ZEIER M, RITZ E, Ann Transplant, 6 (2001) 25. DOI: 10.1007/s11906-001-0063-1. — 7. BRIGGS JD. Long-term medical complications. In: DAVISON AM, CAMERON JS, GRÜNFELD J-P, PONTICELLI C, RITZ, E, WINEARLS CG, van YPERSELE C (Eds) Oxford textbook of clinical nephrology (Oxford University Press, 2005). — 8. KNUSSMANN R. Anthropologie. In: Handbuch der vergleichenden Biologie des Menschen (Verlag von Gustav Fischer, Stuttgart, 1988). — 9. MARTIN R. Lehrbuch der Anthropologie (Verlag von Gustav Fischer, Jena, 1928) — 10. Instruction manual body fat monitor. Omron BF 300, (2003). — 11. WETZEL R, PFANDL S, BODENBURG R, PUHL W, Osteologie, 5 (1996) 71. — 12. MATKOVIC V, JELIC T, WARDKLAW GM, ILICH JZ, GOEL PK, WRIGHT JK, ANDON MB, SMITH KT, HEANEY RP, J Clin Invest, 93 (1994) 799. DOI: 10.1172/JCI117034. — 13. WHO Scientific Group on the Assessment of Osteoporosis. Available from: URL: http://wwwwhoint/chp/topics/Osteoporosispdf. — 14. Reference Population Database. Lunar DPX-IQ Reference Manual.5. — 15. GUIDA B, TRIO R, Laccetti R, LACCETTI R, NASTASI A, SALVI E, PERRINO NR, CAPUTO C, ROTAIA E, FEDERICO S, SABBATINI M, Nephrol Dial Transplant, 22 (2007) 3304. DOI: 10.1093/ndt/gfm345. — 16. COROAS AS, de OLIVEIRA JG, SAMPAIO SM, TAVARES IC, PESTANA M, ALMEIDA MD, Ren Nutr 17 (2007) 151. DOI: 10.1053/j.jrn.2006.12.013. — 17. MOREAU K, CHAUVEAU P, MARTIN S, EL HAGGAN W, BARTHE N, MERVILLE P, APARICIO M, J Ren Nutr, 16 (2006) 291. DOI: 10.1053/j.jrn.2006.04.026. — 18. KIISK L, OTS-ROSENBERG M, KAARMA H, Papers on Anthropology, 19 (2010) 180. — 19. SALUSTE L, KOSKEL S, Yearbook of Estonian Anthropometric Register (2002). — 20. El HAGGAN W, VENDERELY B, CHAUVEAU P, BARTHE N, CASTAING F, BERGER F, de PRECIGOUT V, POTAUX L, APARACIO M, Am J Kidney Dis, 40 (2002) 629. DOI: 10.1053/ajkd.2002.34926. — 21. COROAS A, OLIVEIRA JG, SAMPAIO S, BORGES C, TAVARES I, PESTANA M, ALMEID MD, Transplant Proc, 37 (2005) 2765. DOI: 10.1016/j. transproceed.2005.05.045. — 22. COROAS A, OLIVEIRA JG, SAMPAIO S, BORGES C, TAVARES I, PESTANA M, ALMEID MD, Transpl Int, 18 (2005) 541. DOI: 10.1111/j.1432-2277.2005.00086.x. — 23. OZDEMIR NF, ELSURER R, IBIS A, ARAT Z, HABERAL M, Transplant Proc, 39 (2007) 934. DOI: 10.1016/j.transproceed.2007.02.023. — 24. DUMLER F, KILATES C, J Ren Nutr, 17 (2007) 97. DOI: 10.1053/j.jrn.2006.10.017. — 25. RAMEZANI M, EINOLLAHI B, AHMADZAD-ASL M, NAFAR M, POURFARZIANI V, SAMADPOUR A, MORADI M, ALGHASI M, CHALIAN H, DAVOUDI F, Transplant Proc, 39 (2007) 1044. DOI: 10.1016/j. transproceed.2007.03.035. — 26. AKIOKA K, TAKAHARA S, ICHIKAWA S, YOSHIMURA N, AKIYAMA T, OHSHIMA S, World J Surg, 29 (2005) 249. DOI: 10.1007/s00268-005-7531-8. — 27. VAN DEN HAM EC, KOOMAN JP, VAN HOOFF JP, Blood Purif, 20 (2002) 139. DOI: 10.1159/000046999. — 28. HAAPALA I, HIRVONEN A, NISKANEN L, UUSITUP, KRÖGER H, ALHAVA E, NISSINEN A, Clin Physiol Funct Imaging, 22 (2002) 383. DOI: 10.1046/j.1475-097X.2002.00447.x. — 29. CVIJANOVIC O, LEKIC A, NIKOLIC M, ARABANAS J, BOBINAC D, Coll Antropol, 34 (2011) 161.

L. Kiisk

University of Tartu, Institute of Anatomy, Centre for Physical Anthropology, Tartu, Estonia, Puusepa Street 8, 51014 Tartu, Estonia
e-mail: Liidia.Kiisk@kliinikum.ee

UTJECAJ ANTROPOMETRIJSKIH MJERA U KLINIČKOJ PRAKSI

S A Ž E T A K

Antropometrija pomaže u pristupu nutricijskom statusu koji je važna determinanta kliničkog ishoda kod mnogih pacijenata, uključujući mnoge koji pate od kronične bolesti bubrega (CKD). Povećanje tjelesne mase nakon uspješne transplantacije bubrega poznata je pojava, stoga pretpostavljamo da intenzivno savjetovanje, temeljeno na analizi nutricionista bolesnika s transplantiranim bubregom, može spriječiti značajno dobivanje na tjelesnoj masi nakon transplantacijske operacije. Cilj istraživanja bio je proučiti dugoročne antropometrijske, biokemijske i denzitometrijske promjene kod pacijenata s transplantiranim bubregom, istražiti korelacije između proučenih parametara i usporediti ih s ostalim podacima dobivenim nakon operacije. Prospektivna dugoročna studija provedena je među 28 klinički stabilnih pacijenata s renalnom transplantacijom. Kontrolna grupa sastojala se od pacijenata s transplantacijom (47 pacijenata), koji su dobivali uobičajeno nutricionističko savjetovanje, i od zdravih osoba (342 ispitanika). Antropometrija i biokemija ispitane su dvaput kod svakog pacijenta: prvi podaci (FU1) sakupljeni su 1,3±0,2 godine nakon operacije, a drugi podaci (FU2) sakupljeni su 2,7±0,3 godine nakon operacije. Značajno dobivanje na tjelesnoj masi pronađeno je kod muških pacijenata s renalnom transplantacijom (FU1 naspram FU2, $p<0,001$), ali ne među pacijenticama. Aritmetička sredina nakupljanja tjelesne mase u kontrolnoj grupi pacijenata bila je značajna i među muškarcima i među ženama. Među muškim pacijentima, aritmetička sredina C-reaktivnih proteina značajno korelira s različitim tjelesnim odnosima. Međutim, među pacijenticama nije pronađena niti jedna jasna asocijacija. Među pacijenticama pronađena je značajna korelacija između aritmetičke sredine tjelesne mase, indeksa tjelesne mase i trigicerida. Zaključujemo da korištenje antropometrije u kliničkoj praksi, zajedno sa intenzivnim i individualnim savjetovanjem nutricionista, treba postati redovno među pacijentima nakon transplantacije bubrega, kako bi se spriječila pretilost. Praćenje dinamike antropometrijskih i biokemijskih parametara klinički je važno za period nakon transplantacijske operacije, zajedno sa denzitometrijom.