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Body composition in 98 patients awaiting kidney transplantation

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ABSTRACT

Objective: Recent data suggest that the nutritional status of patients who are on the waiting list for kidney transplantation, influence outcomes after renal transplantation. Body composition (BC) analysis is rarely included in pretransplant evaluation. The aim of this study was to determine how alteration of the BC of these patients could influence pretransplant and post-transplant care.
Methods: We compared the BC of French patients on a waiting list for kidney transplantation to a sex- and age-matched healthy, European control population. Patients were included when listed for kidney grafting in a prospective longitudinal study (CORPOS). Biological nutritional parameters, fat free mass (FFM) and fat mass (FM) estimated by dual-energy x-ray absorptiometry (DXA) were assessed on the day of wait-list registration. FFM and FM index (FFMi - FMi) are the ratio of FFM and FM to height squared. Results are expressed as median (range). These indexes were compared with previous study values used as a normal range in nutritional assessment and clinical practice.
Results: The study included 28 women and 70 men aged 25.3 to 65.9 y. Body mass index ranged from 16.8 kg/m^2 to 39.4 kg/m^2. Compared with controls, FMi was higher in women (10.6 kg/m^2 [3.7–18.6 kg/m^2]) than in men (8.1 kg/m^2 [3.5–13.3 kg/m^2] in M) and FFMi was lower in women (14.3 kg/m^2 [11.8–21.4 kg/m^2]) than in men (17.9 kg/m^2 [13.9-24.2 kg/m^2]) ($P < 0.01$), reflecting an abnormal distribution of body compartments. All biological parameters were within the normal range.
Conclusion: BC abnormalities, which can only be detected with the use of DXA, are present in patients on a kidney transplantation waiting list. Detection of these abnormalities could influence the post-transplantation survey in order to prevent the frequent risk for developing metabolic complications after the procedure.

Introduction

End-stage renal failure is strongly associated with body composition (BC) alterations. Increase in abdominal fat mass (FM) and decrease in lean body mass (LBM) represent a constant finding in dialysis patients regardless of the associated comorbidities. Such associations lead to an increased risk for atherosclerosis and the metabolic syndrome [1]. In the general population, obesity confers an increased risk for mortality [1,2]. On the contrary, many reports have suggested that, in dialysis patients an increase in FM is rather protective independently of serum albumin or other nutritional markers [3].

In the dialysis population, both low muscle mass and low FM are associated with high all-cause mortality rate, but only using body mass index (BMI) as an assessment tool is insufficient to evaluate this risk [4,5]. In one early study focused on BC and cardiovascular risk in candidates for kidney transplantation,

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body cell mass was lower than predicted on the basis of only BMI as an assessment tool [6]. After transplantation, early long-term studies on a large cohort demonstrated that both low and high BMI were significant risk factors for graft failure and patient death [2]. A 2011 study using a 5-y database involving more than 10 000 patients who underwent kidney transplantation, demonstrated that obesity was not associated with poor outcome in transplantation but that poor pretransplant muscle mass was associated with high graft loss and mortality rates [7]. The results from these studies have increased the concern about the use of BMI alone in transplant candidates. BMI alone appears to be an imperfect measure of risk related to body composition [8]. In nutritional facts, standards from U.S. literature are not always applicable to other countries because prevalence of comorbid conditions at the initiation of renal replacement therapy varies between Europe and the United States [9]. Moreover, the lowest BMIs were found in France and Italy in the DOPPS (Dialysis Outcomes and Practice Patterns) study [10].

We previously reported that BC was prone to rapid changes after transplantation, with marked weight gain in the early post-transplant period [11,12]. Important post-transplant weight gain and/or post-transplant obesity are associated with various components of the metabolic syndrome such as hypertension, insulin resistance, diabetes mellitus, and dyslipidemia [13]. However, there is no BC data on a representative sample of patients planned for kidney transplantation. Indeed, these patients, unlike those from conventional dialysis cohorts, are free of serious comorbidities. In August 2007, we began a prospective study to assess nutritional status, including BC, in dialyzed patients who were candidates for kidney transplantation. Patients were included consecutively and evaluated while on a waiting list. We report here the complete evaluation of body composition in 98 patients on hemodialysis who were placed on the waiting list before transplantation in comparison with the data obtained from a healthy European population [14].

Methods

Participants

All consecutive patient candidates for kidney transplantation at the Renal Transplant Unit of Pellegrin University Hospital (Bordeaux, France) between August 2007 and January 2010 were enrolled in this observational, longitudinal study (CORPOS study). Inclusion criteria were dialyzed patients ages 18 to 65 y, who are candidates for a first renal transplant. Exclusion criteria were nondialyzed patient; candidate for a second or third kidney graft; candidate for a combined pancreas, heart, or liver and kidney transplantation; patients with amputation or metal implants; candidates who are planning to be or are pregnant.

The clinical, biochemical, and anthropometric data have been collected between two dialysis sessions, on the day of wait-list registration. Hospital ethics committee approved the study (Comité de Protection des Personnes de Bordeaux A, number 2006/28, June 2006) and all patients gave informed consent.

Biochemical measurements

After an overnight fast, before starting dialysis on a midweek dialysis day, serum total proteins, electrolytes, urea, and creatinine were assessed by standard techniques. Albumin was measured using green bromocresol technique, prealbumin using an immunoturbimetric test, and C-reactive protein (CRP) an immunoturbimetric test. The concentrations of total cholesterol (TC), high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides were determined using enzymatic tests. Free testosterone in men was measured by immunometric chemiluminescent assay.

Normal laboratory values of all the biological parameters are reported in Table 1.

Body composition analysis

Body weight was measured twice to the nearest 0.1 kg using precision scales, with participants wearing light clothing and no shoes. Patients' height was measured without shoes, while standing straight with feet together and head against a vertical wooden traditional height gauge with horizontal cursor (Robé medical, France). Height was recorded to the nearest millimeter.

Body composition was assessed using the dual-energy x-ray absorptiometry (DXA) fan-beam technology (Hologic QDR 4500A) the day after dialysis, using the weight measured on the same day. For peritoneal dialyzed patients, measurement was made with empty peritoneal cavity. A standardized procedure for patient positioning was used. The DXA scans were acquired with the most recent software version, which was APEX 2 with analysis version 8.26 for QDR 4500A. It uses the "Classic" calibration method for BC calculation, which refers to fat and lean soft tissue calibration introduced with the QDR systems [15]. In 2009, new software was developed upgrading the APEX 2 version by providing a slightly different approach of BC calibration named "NHANES" calibration [16]. All the scans acquired in this later version were reanalyzed in the classic version. This choice was imposed by the necessity to keep the continuity in the following of data and to be consistent with the method used by the authors of the Caucasian reference data.

The values of BC were obtained after a segmentation of the whole-body image into six subregions. Results are expressed as FM and fat-free mass (FFM) in absolute values, as a percentage of body weight (kg) and indexed for height squared (FMI and FFMI, kg/m^2), as BMI. The values we obtained were compared with those measured in a healthy Italian population taken as a model of the Caucasian population in the Mediterranean area [14]. Reference values used were sex- and age-specific.

Physical activity was estimated using the Baecke self-administered questionnaire [17]. The French version was used in this study [18]. In summary, physical activity was separated into three components (work, leisure time, and sport). For each component, duration and intensity were estimated with the calculation of scores. Global physical activity level is the sum of the scores obtained for each component.

Statistical analysis

Statistical analysis was performed with the SAS system (9.2, SAS Institute Inc., Cary, NC USA).

Results are expressed as median [range] for continuous variables and frequency for categorical variables.

Body composition of the study population was compared with published control populations by a one-sample *t* test (Student's test). Associations between BC and continuous factors were evaluated with Pearson's correlation coefficients and compared with 0 by a Pearson's correlation test. Medians of BC factors were described in each group of categorical factors and compared by Student's *t* test or analysis of variance, with the Welch's correction in case of non-homogeneous variances. Multivariable analyses were performed using multiple regression analysis.

Table 1
Biochemical laboratory values

	Normal value	Men	Women
Albumin (g/dL)	3.5–4.8	4.6 [3.8–5.3]	4.5 [3.6–5.2]
Prealbumin (mg/dL)	22–39	45 [24–74]	39 [28–50]
CRP (mg/L)	0–5	3 [1–57]	3 [1–21]
Total cholesterol (mg/dL)	135–232	177 [76–333]	210 [151–275]
HDL cholesterol (mg/dL)	39–66	39 [25–160]	49 [29–104]
LDL cholesterol (mg/dL)	77–159	97 [19 –235]	117 [62–164]
Triglycerides (mg/dL)	40–151	165 [68–802]	163 [62–337]
Testosterone (ng/dL)	0.66–3.00	1.08 [0.27–2.53]	NA

CRP, C-reactive protein; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NA, non-applicable
Conversion factor for units: albumin in g/dL to g/L, ×10; prealbumin in mg/dL to g/L, ×0.01; cholesterol (total, HDL, LDL) in mg/dL to mmol/L, ×0.02586; triglycerides in mg/dL to mmol/L, ×0.01129; testosterone in ng/dL to nmol/L, × 0.03467. Results are expressed as median [min–max]

Results

Participants' characteristics

One hundred consecutive patient candidates for kidney transplantation at the Renal Transplant Unit of Pellegrin University Hospital (Bordeaux, France) between August 2007 and January 2010 who met the inclusion criteria were enrolled in this observational, longitudinal study, among them, two who were