Renal Doppler Resistance Indices in Kidney Transplant Recipients With Proteinuria

M. Boran[a,*], E. Boran[b], M. Boran[c], and M. Tola[d]

[a]Department of Internal Medicine, Division of Nephrology, Bozok University, Yozgat, Turkey; [b]Department of Anesthesiology and Reanimation, Duzce University, Duzce, Turkey; [c]Department of Thoracic Surgery, Duzce University, Duzce, Turkey; and [d]Department of Radiology, Turkiye Higher Education Hospital, Ankara, Turkey

ABSTRACT

Background. The onset of proteinuria in renal transplant recipients may be associated with an increased risk of allograft failure. Little is known about the relationships between factors influencing proteinuria and the Doppler ultrasound (DU) intrarenal resistive index (RI) and pulsatility index (PI) among donor recipients with proteinuria <1000 mg/24 h.

Methods. We assessed correlations between the DU RI and PI and protein content in 93 selected renal transplant recipients: 62 patients with proteinuria 100 to 299 mg/24 h, 16 patients with proteinuria 300 to 499 mg/24 h, and 15 patients with proteinuria 500 to 999 mg/24 h. All patients underwent transplantation in a single center and were monitored by DU for at least 28 months post-transplantation.

Results. The DU RI values of the proteinuria 100 to 299 mg/24 h, 300 to 499 mg/24 h, and 500 to 999 mg/24 h groups were 0.67 ± 0.05; 0.65 ± 0.04, and 0.64 ± 0.07, respectively, and the PI values were 1.21 ± 0.20, 1.10 ± 0.14, and 1.15 ± 0.22, respectively. Multivariate logistic regression analysis revealed a correlation between group 100 to 299 mg/24 h and RI values, serum creatinine, living donor ($R^2 = 19.6\%$, $P = .05$); group 300 to 499 mg/24 h and the RI, PI values, cadaver donor ($R^2 = 17.5\%$, $P = .001$); and group 500 to 999 mg/24 h and the RI, PI values, serum creatinine, graft survival ($R^2 = 15.4\%$, $P = .005$).

Conclusions. Among donor recipients with proteinuria <1000 mg/24 h, DU RI values were <0.72 and PI values were <1.41 and correlations were revealed between the incidence of proteinuria and factors such as the RI, PI, and serum creatinine level.

THE USE of calcineurin inhibitors (CNIs) in kidney transplant recipients has led to a progressive decrease in acute rejection rates in recent years. With the success of kidney transplantation in the short term firmly established, the focus of transplant clinicians has shifted toward improving long-term outcomes. Proteinuria is frequently seen after kidney transplantation, and 11% to 45% of recipients develop pathologic proteinuria at 1 year after transplantation [1–4]. In some series, transplant physicians only considered proteinuria exceeding 1000 mg/24 h as pathologic, whereas other physicians consider proteinuria >500 mg/24 h, or even those with proteinuria >150 mg/24 h [1–4]. The degree of proteinuria is a reliable predictor of allograft outcome. However, even recipients with low-grade proteinuria may show a poor outcome [3]. Amer et al reported that a 1000 mg/24 h increase in proteinuria increases the risk of graft loss by 27% [4]. The renal Doppler ultrasound (DU) intrarenal resistive index (RI) and pulsatility index (PI) can be used as complementary diagnostic tools to predict the severity of allograft damage [5]. The purpose of the current study was to assess the factors that affect proteinuria and the correlation between proteinuria 100 to 299 mg/24 h, proteinuria 300 to 499 mg/24 h, proteinuria 300 to 499 mg/24 h and the DU RI and PI resistance indices.

*Address correspondence to Mediha Boran, Çetin Emeç Blv 101/41 Balgat, Ankara, Turkey. Fax: +903124736850. E-mail: drmedihaboran@yahoo.com

0041-1345/18
https://doi.org/10.1016/j.transproceed.2018.02.064

Table 1. Demographic and Clinical Characteristics of the Kidney Recipients and Donors, and their Post-transplantation Laboratory Results Immediately Prior to the Doppler Ultrasound Examination

	Patient Group			
	100–299 mg/24 h (n = 62)	300–499 mg/24 h (n = 15)	500–999 mg/24 h (n = 16)	*P* Value
Recipient sex, male, n (%)	24 (38.7)	9 (56.3)	9 (60)	.20
Donor sex, male, n (%)	32 (51.6)	8 (50)	9 (60)	.80
Recipient age, y	34.2 ± 11.7	31.7 ± 9.7	32.9 ± 10.2	.69
Donor age, y	42.6 ± 9.9	40.1 ± 12.6	41.4 ± 12.4	.69
Graft follow-up, mo	89 ± 53.35	86 ± 39.79	117.6 ± 60.36	.13
HLA mismatch (median ± SD)	3.00 ± 1.18	3.00 ± 1.49	3.00 ± 0.86	.95
Creatinine, mg/dL (median ± SD)	1.10 ± 0.35	0.96 ± 0.81	1.20 ± 0.55	.021
Cholesterol, mg/dL	192.5 ± 54.12	199.25 ± 35.97	201.3 ± 49.63	.76
Triglycerides, mg/dL	137 ± 93.2	160 ± 64.8	135 ± 71.2	.67
eGFR, mL/min/1.73 m^2	73.91 ± 24.32	80.23 ± 27.43	59.58 ± 20.33	.027
Resistive index	0.67 ± 0.05	0.65 ± 0.04	0.64 ± 0.07	.18
Pulsatility index	1.21 ± 0.20	1.10 ± 0.14	1.15 ± 0.22	.073
Living donor, n (%)	56 (90.3)	10 (62.5)	12 (80.0)	.024

Values are mean ± SD.
Abbreviations: eGFR, estimated glomerular filtration rate; SD, standard deviation.
The significance value was set at $P < .016$.

METHODS

Patient Selection

A total of 93 selected renal transplant recipients with proteinuria, who underwent transplantation at a single center, were divided into 3 groups according to the degree of proteinuria: 62 patients (65.5%; 32 male and 30 female subjects, 58 living donors) had proteinuria of 100 to 299 mg/24 h (100–299 mg/24 h group), 16 patients (17.2%; 8 male and 8 female subjects, 10 living donors) had proteinuria of 300 to 499 mg/24 h (300–499 mg/24 h group), and 15 patients (16.1%; 9 male and 6 female subjects, 12 living donors) had proteinuria of 500 to 999 mg/24 h (500–999 mg/24 h group). The study was performed in accordance with the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the local Institutional Review Board. Written informed consent was obtained from all patients.

Clinical and Biochemical Measurements

The 93 renal transplant recipients were prospectively monitored by DU for at least 28 months after transplantation (range: 28–256 months). The laboratory data, including serum creatinine, cholesterol, and triglyceride levels, and target tacrolimus (TAC), cyclosporine (CyA), and sirolimus (SRL) trough levels, were determined just before the DU evaluation. The creatinine clearance rate (mL/min/1.73 m^2 body surface area, by the Cockcroft formula), and rates of urinary protein excretion over 24 hours were measured 24 hours prior to the DU examination. The investigated variables were the DU resistance indices, age and sex of the recipients and donors, number of HLA mismatches, allograft follow-up time, creatinine clearance rate, and serum creatinine, cholesterol, and triglyceride levels. All DU measurements were obtained using a single ultrasound system and were performed by a single radiologist, as in our previous studies [6].

Statistical Methodology

Statistical analyses were performed using SPSS for Windows (version 15.0; SPSS Inc, Chicago, Ill, United States). Continuous variables are expressed as means (standard deviation) or medians (range); categorical transplantation variables are expressed as counts and percentages. The normality of the numerical variables was analyzed by the Kolmogorov-Smirnov test, and homogeneity of variances was examined by the Levene test. Differences between more than 2 groups were analyzed by one-way analysis of variance, Welch analysis of variance, or the Kruskal-Wallis test. After these tests, binary comparisons were made using the Tukey highly significant differences, Games-Howell, or Dunn test (when appropriate). Categorical variables were compared using the χ^2 test, and numerical variables were compared between the 2 groups with the independent sample *t* test. The correlations between numerical variables were tested using Pearson or Spearman correlation coefficient analysis. Factors affecting the RI and PI were assessed by stepwise multiple linear regression analysis. The significance value was set at $P < .05$, and the Bonferroni correction was applied when multiple comparisons were made.

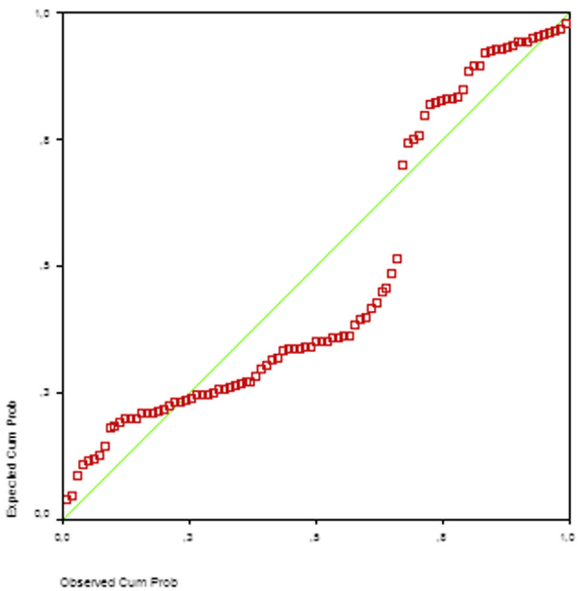

Fig 1. Logistic regression histogram of the group with proteinuria 100 to 299 mg/24 h.