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The Assessment of Long-term Clinic and Laboratory Data of Living Related Kidney Donors

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ABSTRACT

Living-donor kidney transplantations are more common in Turkey. The present study, therefore, investigated the structural changes in the remaining kidney and their impacts on the outcomes of 71 donors who underwent nephrectomy. Among 123 screened living-donor transplantations performed between 2001 and 2008, information was available on 71. The study group included 37 female and 34 male donors with ages ranging between 20 and 68 years (mean, 45 ± 9 years). The donors had a median follow-up of 7.2 years. We investigated renal function and creatinine clearance as well as the presence of proteinuria and/or hypertension before versus after nephrectomy. Healthy individuals referred to our blood center were included as the control group. A comparison of pre- versus post-nephrectomy with control group data did not show any significant correlations between serum creatinine levels, creatinine clearances, and the presence of proteinuria relative to post-donation years. In contrast, we identified an increased prevalence of hypertension: Stage 1 in 4 patients before versus 22 subjects after nephrectomy. A key finding of this study was the slight increase in the number of hypertensive donors. Hypertension is, therefore, the most critical parameter to monitor donors in countries with a high proportion of living donors.

THERE are two options to manage end-stage renal failure—dialysis and transplantation. Renal transplantation is the desired alternative for end-stage renal disease (ESRD);[1–4] with the opportunity to maintain a usual life.[5] Patients, however, must await a matched kidney from a living or a cadaveric donor to undergo transplantation. Although living-donor transplantation has several advantages for the recipient, the donor may experience perioperative morbidity and mortality as well as other potential long-term negative effects.[6,7] The perioperative mortality rate is 0.03%[8,9] with less than 10% major and minor complications.[10]

Despite encouraging cadaveric donors, the proportion of transplantations from living donors is still high worldwide. These donors provide superior long-term graft survival.[11] Because the proportion of transplantations from living individuals is high in Turkey, the present study sought to monitor the short-and long-term health risks to donors. Although the literature suggests that donors experience a high quality of life at least equal to that among the normal population, there is a need to identify, monitor, and manage even minimally negative effects. Based upon the follow-up data of our healthcare center, we reviewed the clinical outcomes and laboratory results before versus after nephrectomy among 71 donors compared with the relevant literature.

METHODS

We reviewed the patient files of 123 individuals who had undergone nephrectomy between 2001 and 2008. They all underwent an open nephrectomy via a flank incision. Blood pressures, renal function, and protein intake of 71 patients whose records were available and who could be contacted were examined in 2011.

They had a median of 7.2 years follow-up. The donors were contacted by phone using information retrieved from donor and recipient files. After a brief explaination of the objective of the study, we administered a brief questionnaire regarding their cur-

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rent health status and invited them to the center for examination (Table 1).

We compared pre-nephrectomy complaints of the study of 37 female and 34 male donors with the data in their files. The patients were divided according to the time post-nephrectomy: 5 to 10 (n = 50) versus 3 to 5 years (n = 21). We reviewed previous laboratory results and performed outpatient physical examinations on all 71 donors (including three blood pressure measurements—spine, sitting and upright postures) during the first and at a follow-up examination 1 week later, recording the arithmetic mean values. They were questioned for any previous history of hypertension or medications. Systolic blood pressure >140 mm Hg and/or diastolic blood pressure ≥90 mm Hg were considered to be hypertension. Newly diagnosed hypertensive donors were referred to the polyclinic.

Protein levels in 24-hour urines and spot samples were analyzed twice on alternate days, recording measurements as +1, +, +3 versus negative for the spot and g/d for the 24-hour urinalysis. Urinary albumin-creatinine ratios were measured as milligram/gram with values greater than 30 μg/g considered to be albuminuria and values 30 to 299, microalbuminuria, and those greater than 300 μg/g, macroalbuminuria.[12]

Additionally, creatinine clearance in 24-hour urine collections was calculated using the modification of diet in renal disease (MDRD) formula [GFR(mL/min/1.73 m^2): $(175 \times Scr)^{-1.154} \times Age^{-0.203} \times (0.762$ if woman$) \times (1.12$ if African American)].[13] The last portion of the formula was not used because the present study did not include any African Americans. Creatinine and electrolyte concentrations were studied in venous blood samples.

Statistical Technique

The data are expressed as mean values ± standard deviations. We considered *P* values from ground reaction force (GRF) measurements less than .10 to be statistically significant; for all other analyses, statistical significance was set at $P < .05$. Paired Student *t* test was used to compare glomerular filtration rate (GFR), systolic and diastolic blood pressures, protein-creatinine ratios, and serum creatinine changes. We compared donor pre-and post-nephrectomy data with those of the controls. We sought correlations between times post-nephrectomy and measurements of serum creatinine, creatinine clearance, and urinary protein-creatinine ratio.

RESULTS

Donor pre- and post-nephrectomy as well as control group measurements are presented in Table 2. Mean serum creatinine values were 1.1 ± 0.1 before and 1.2 ± 0.2 mg/dL after nephrectomy (range, 0.8 to 1.4 mg/dL). In donors whose procedures occurred 5–10 years before (n = 50), the mean creatinine level was 1.2 ± 0.04, whereas in the other group (3 to 5 years, n = 21) it was 1.3 ± 0.1. The pre- and post-nephrectomy changes by time were not significant.

Table 1. Information on 123 Donors Residing in Ankara Region

Data	Number
Donors who moved from the region	7
Donors who were unwilling to report	12
Donors who could not be contacted to	29
Resulting donors	71
Female donors	37
Male donors	34

Variations in creatinine clearance before versus after nephrectomy ranged within normal laboratory ranges in 65 of 71 (91%) donors. The remaining 6 donors showed changes in creatinine clearance that were not significant. No correlation was noted between time post-nephrectomy and reduced creatinine clearance. Mean creatinine clearance was 93 ± 12.3 mL/min/1.73 m^2 for the whole group and 86 ± 9.7 mL/min/1.73 m^2 after nephrectomy. (Creatinine change was 9.3 mL/min/1.73 m^2 for the whole group and 5.9 mL/min/1.73 m^2 in median.) which did not differ significantly from the normal range ($P = .3125$).

Proteinuria was not noted in the spot urine sample of any donor. Pre- versus post-nephrectomy proteinuria screening in 24-hour urine analyses showed values within normal laboratory ranges. The change from 80 ± 20 mg/d pre- to 96 ± 12 mg/d post-nephrectomy was not significant. Compared with the control group (78 ± 13 mg/d) the change did not correlate with time and was insignificant ($P < .0001$). Protein-creatinine ratios were 150 ± 23 μg/mg before versus 24 μg/mg after nephrectomy were not significant ($P = .003$).

Analyses of blood pressure revealed 4 donors with stage 1 hypertension before nephrectomy versus 22 with the disorder in the final analysis. With respect to age, there was an increasing trend among the older group. Among the 4 hypertensive donors before nephrectomy, 2 were females and 2 were males (average ages, 44 and 48 years, respectively), whereas the subsequent analysis showed 7 female and 15 male donors with hypertension (average ages, 54 and 57 years, respectively).

DISCUSSION

This study presented the longitudinal follow-up data on 71 donors whose information was recorded for 10 years with completion 3 years ago. These data were obtained at various times after donor nephrectomy (Table 3).

Renal function before versus after nephrectomy as determined using creatinine clearances (by the MDRD formula) showed good levels after 3 to 10 years. The results were comparable to those of healthy control individuals group and consistent with previous studies in the literature.[14,15]

The insignificant 7 mL/min/1.73 m^2 difference between pre- and post-nephrectomy values suggested the role of compensatory mechanisms that prevented a significant reduction. There was no correlation with time from surgery.

Protein clearance before nephrectomy was 80 ± 20 mg/d versus 96 ± 12 mg/d thereafter, with no significant difference between the measurements. Protein-creatinine rations in spot urine samples were 23 μg/mg and 24 μg/mg before versus after nephrectomy, respectively ($P = .003$). In a number of previous studies, levels of proteinuria (<1 g/L) at 12 years after donation were reported among 9% of

Table 2. Comparative Renal Functions and Blood Pressure Measurements of Live Donor Before and After Nephrectomy

Measure	Pre-nephrectomy Values	Post-nephrectomy Values	*P*	Control Group (n = 42)
Serum creatinine Level (mg/dL)	1.1 ± 0.1	1.2 ± 0.2	.001	1.0 ± 0.1
Proteinuria (mg/d)	80 ± 20	96 ± 12	.001	78 ± 13
Urinary albumin-creatinine ratio (μg/g)	23	24	.003	22
GFR (mL/min/1.73 m^2)	93 ± 12.3	86.1 ± 9.7	.3125	86.1 ± 16.5
Systolic blood Pressure (mm Hg)	121.3 ± 16.1	126.9 ± 15.8	.02	126.9 ± 15.8
Diastolic blood Pressure (mm Hg)	72.5 ± 10.5	75.8 ± 9.7	.16	75.8 ± 9.7

donors, with significant proteinuria in 3% of them. Several studies have concluded that proteinuria did not progress over time after donation.[16,17]

Post-nephrectomy glomerular hyperfiltration has been associated with damage to the remaining kidney.[18] In two relevant studies, hypertension was defined as treatment with an antihypertensive agent or a blood pressure greater than 140/90 mm Hg. Fehrman-Ekholm[19] demonstrated hypertension in 3.8% of donors at 12 years. Gossman et al reported a 7% rate with hypertension before increasing to 30% at 11 years after donation.[20] The prevalence in these studies was lower compared than that in the general population as expected because donors are chosen among individuals with normal blood pressure. In the present study, the 0.5% incidence before increased to 30% after nephrectomy.

Although the literature does not suggest a major increase in serum creatinine levels at 30 years after donation, cross-sectional studies have not shown an increased risk of ESRD among donors, although the follow-up periods and numbers of the studied individuals have been limited among studies that investigated GFRs and serum creatinine concentrations.[14,21–24]

Compared with these results, the ESRD risk did not seem to be increased among donors in the present study and comparable with that among the general population. The prevalence of hypertension and albuminuria were similar between controls and kidney donors after donation. GFRs by the remaining kidney were unchanged due to the compensatory increase after nephrectomy. According to the literature, compensatory increases in GFR occur in 70% of remaining kidneys.[25]

Table 3. Donors' Serum Creatinine and Proteinuria Measurements by Time After Donation

Measure	Time After Follow-up Donation	
	5 to 10 y	3 to 5 y
N	50	21
Age (y)		
Mean	45 ± 9	39 ± 7
Range	20 to 68	22 to 54
Serum creatinine Level (mg/dL)		
Mean	1.2 ± 0.04	1.3 ± 0.1
Scr Interval	0.8 to 1.4	0.8 to 1.6
Proteinuria		
n (%)	1 (0.2%)	1 (0.4%)
Proteinuria level	1, 1+	1, 1+
Hypertension n (%)	10 (10%)	12 (50%)

Previous studies have rather focused on the damage to the remaining kidney after nephrectomy. The exact association of other comorbidities with nephrectomy was not assessed. Schostak et al have studied donors after an average of 7 years post-surgery; reporting that 41.5% of them were negatively affected by the surgery although there were few somatic (abdominal, respiratory, and scar) complications.[26] In the present study, 12 female donors complained about the scar. Excluding examination of visible scars, our study did not investigate effects on the quality of live or the mental health of individuals who had undergone nephrectomy, which could have been possible through more frequent follow-ups over a more extended time. The literature data indicates a better quality of life and longer lifetimes because the donors are chosen from healthy individuals and tend to report for health examinations more frequently.[17,27]

In conclusion, renal function appeared to be maintained among live donors after nephrectomy, data that are reassuring for candidates. The slightly increased number of hypertensive donors in our study group is key information for follow-up examination. Although there have been changes in our techniques of nephrectomy in last 10 years decreasing the ratio of complications in our donors during this time, there is no obvious difference in the result of the renal functions.

Based on our data, living-kidney donation did not produce a major deterioration of donor health. However, a better, more systematic follow-up protocol covering a longer period is needed for living donors.

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