Section: Radiation Oncology

Research

LIVE RENAL DONORS –A FOLLOW-UP STUDY

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Abstract

Background: This study has been conducted to assess the impact of kidney donation on renal function, renal size, urinary protein excretion, creatinine clearance and blood pressure of renal donors. **Materials and Methods:** From 1999-2005,123, live donor kidney transplantations were performed at Calicut Medical College. All renal donors were contacted by post, and the reported 40 donors were assessed by renal function, creatinine clearance and kidney dimensions and were compared with preoperative values. **Result:** The mean follow-up was 3.5 years, ranging from 1 to 7 years. Systolic blood pressure was significantly increased statistically but not up to clinically significant levels. Compensatory hypertrophy had set in and was completed in one year. Mean 24-hour urine protein excretion had increased postoperatively but not to clinically or statistically significant levels. **Conclusion:** We conclude that the creatinine clearance is well preserved with a single kidney. However, extended follow-up studies are warranted to check the trend of gradual increase in creatinine clearance over the extended follow-up to check for or prevent renal hyperfiltration and glomerulosclerosis.

INTRODUCTION

As the number of patients with end-stage renal disease requiring transplantation continue to increase, there is no dearth of enthusiasm for obtaining organs from living donors. In addition, the long-term graft outcomes of living unrelated kidney donors have continued to rise over time.

Ever since the recognition of hyperfiltration injury in animals undergoing renal ablation, there have been concerns about the renal consequence of donation. Hyperfiltration injury in humans after renal ablation has only been documented to occur with extended follow-up after renal ablation and after partial nephrectomy in a solitary kidney, primarily in the patient in whom 75% of renal tissue is removed.[1]

Most of the published studies in the west examining renal function and blood pressure after donor nephrectomy failed to demonstrate progressive renal injury or dysfunction..[2-4] Kidney transplantation has been performed at Calicut Medical College since December 1985, which is exclusively living donor transplantation. Therefore, we assessed the impact of donor nephrectomy on glomerular filtration rate (GFR), urinary protein excretion, and development of hypertension postoperatively to gauge the occurrence of renal dysfunction with extended follow-up.

MATERIALS AND METHODS

All 123 donors who underwent donor nephrectomy at Calicut Medical College from 1999-2005 were intimated by post to report to the institution to undergo a battery of tests. Out of these, 40 donors reported and were willing to take part in the study and undergo the necessary examination and investigations.

All donors underwent routine physical examinations, including blood pressure. All routine surgical complications were assessed. Quality of life after surgery and morbidity following surgery were assessed. Other medical problems were also screened. Blood pressure was compared with that of pre-op value and age-matched population.

They all underwent renal function tests viz., blood urea and serum creatinine, 24-hour urine excretion of total protein, and creatinine clearance were assessed [(Urinary creatinine x urine volume) ÷ plasma creatinine]. Creatinine clearance values were corrected based on body surface area to ml/mt/1.73m². These values were compared with an

age-adjusted estimate of the glomerular filtration rate for a solitary kidney.

The value is calculated based on age expected GFR for patients

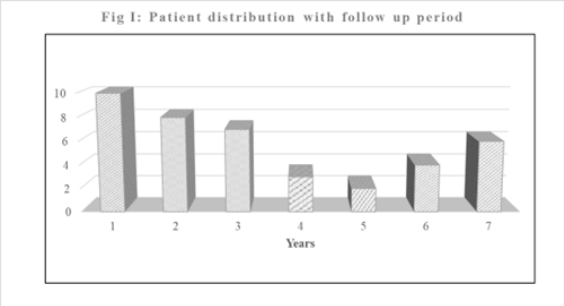
Younger than 45 years = (127- 0.37 x age) or

Older than 45 years = 153-(1.07 x age)

And expected single kidney value was calculated as 75% x age-adjusted glomerular filtration rate. Patients also underwent ultrasonography of kidney, ureter and bladder areas and renal size was assessed in 2 dimensions. All these values, viz., blood pressure (systolic and diastolic) serum creatinine, urine creatinine clearance and 24-hour urine protein excretion, were compared with the preoperative values. Post-op creatinine clearance was also compared with age-adjusted age-expected single kidney value. All pre- and post-op values were compared using paired sample T-tests. Using Pearson's correlation tests, the GFR (creatinine clearance) was correlated with age-adjusted GFR for a single kidney.

RESULTS

The total number of subjects available was 40, with a mean follow-up of 3.5 years (1-7).



Mean age at donation -44

Male patients were 7 in all, and females were 33

Age at donation Male-mean 42 (range 26-60)

Female-mean 44.3 (range 26-60)

Blood Pressure

The mean post-op systolic BP was 123 ± 14.3 mmHg, higher than the pre-op value of 117 ± 11.08 but not to statistically and clinically significant levels[Table 1]. The mean post-op diastolic BP was 78 ± 6 compared to 77.15 ± 6 preoperatively, which was also not to statistically significant levels. Hypertension was defined as BP ≥ 140/90mm of Hg. The total number of hypertensives was 8, the incidence of which was comparable to age-adjusted incidence of hypertension in the general population. Males had a slightly higher systolic and diastolic BP value, which was not statistically significant. Diastolic pressure was raised in 3 subjects. Values did not change among patients older than or younger than 50 years.

Renal Function Tests

S. creatinine

None of the follow-up donors had raised value of or abnormal value of creatinine. Both the pre-op and post-op values were comparable [Table 1].

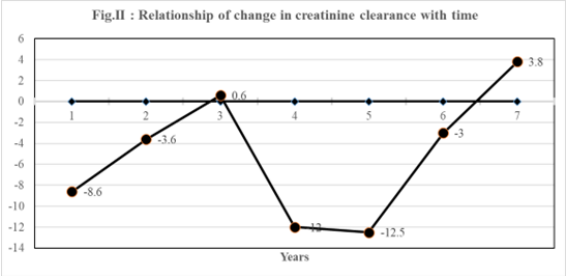
Mean pre-op Cr. → 0.81 ± 0.17 mg%

Mean post-op Cr. → 0.93 ± 0.02 mg%

Creatinine Clearance

Mean pre-transplant, i.e., two kidneys GFR calculated by creatinine clearance was 92 ± 13 ml/mt/1.73m², and post-transplant creatinine clearance was 85 ± 14 (range 61-118), which were comparable. The difference was not statistically significant. The corrected GFR and age-adjusted GFR for a single kidney also correlated positively with the pretransplant value. (Single kidney GFR – mean 77.2 ± 8.2 range (65-87.4)) (Pearson's correlation test).

Males had higher post-transplant creatinine clearance, 94.3 ± 17, compared to females. 82.7 ± 13.3 [Table 2], and significantly, post-transplant creatinine clearance in subjects less than 50 years recorded higher values, 89.2 ± 15 compared to subjects>50 years – 75.4 ± 6.67 [Table 3]. Moreover, there is a gradually increasing trend for the creatinine clearance to move to the baseline on extended follow-up by 7 years [Figure 2].



24 hr Urinary Protein

The pre-op mean value was 102.2 ± 46 mg/24h, and the post-op was 121 ± 76. The post-op value was higher, but the rise was not statistically or clinically significant. Four patients had proteinuria between 200-300mg/24 hr, and 2 patients had >300mg/24 hr [Table 4. Table 5].

Table 1: Comparison of renal function, blood pressure

Parameter	Before	After	P value
Systolic BP	117 ± 11	123 ± 14.5	0.018
Diastolic BP	77 ± 1.5	78 ± 6	0.482
Sr. creatinine	0.81 ± 0.17	0.93 ± 0.02	
Creatinine clearance	92 ± 13	85 ± 14	0.1
Urine protein	102 ± 46	121 ± 6	0.193
Renal dimension			

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Length	9.5 ± 0.5	10.3 ± 0.8	0.001
Breadth	4.04 ± 0.1	4.2 ± 0.398	0.253

Table 2: Effect of gender on protein excretion and BP

Parameter	Before	After	P value
Urine protein excretion			
Male	83.29 ± 45	106 ± 66	0.72
Female	101 ± 42	129 ± 80	
Systolic BP			
Male	117 ± 9	126 ± 14	0.127
Female	116 ± 11	77 ± 14	
Diastolic BP			
Male	77 ± 7.56	82 ± 3.7	0.823
Female	77 ± 5.9	77 ± 6.02	
Creatinine clearance			
Male	94.07 ± 9	94.3 ± 17	0.60
Female	87.83 ± 13	82.7 ± 13.3	

Table 3: Effect of subject age at donation on renal function

Parameter	Before	After	P value
S. Creatinine			
<50 yrs	0.81 ± 0.2	0.91 ± 0.02	0.762
>50 yrs	0.8 ± 0.1	0.969 ± 0.13	
Creatinine clearance			
<50 yrs	92 ± 12	89.26 ± 15	0.74
>50 yrs	82 ± 12	75.4 ± 6.67	
Urease			
<50 yrs	93 ± 37	127 ± 84.7	0.8
>50 yrs	120 ± 58	107.9 ± 57	
Systolic BP			
<50 yrs	118 ± 12	122.3 ± 13.56	0.74
>50 yrs	114 ± 9	124 ± 16.18	
Diastolic BP			
<50 yrs	77 ± 6.6	78 ± 6.56	0.27
>50 yrs	76 ± 5	78 ± 4.79	

Table 4: Outcome in renal function –BP + proteinuria

Creatinine clearance after donation	85 ± 14
Age-adjusted single kidney GFR	77.2 ± 8.2
No. of new-onset hypertensive ≥ 140/90mm	8
Proteinuria: 200-300	4
>300mg	2
No. of pyelonephritis	1

Table 5: Proteinuria with hypertension

24 hr Urine protein	Systolic		Diastolic	
	Normo tensive	Hypertensive	Normotensive	Hypertensive
0-200	27	7	32	2
200-300	4	0	4	0
300-500	1	1	1	1

Only one person with hypertension >140/90 had proteinuria >300mg/24hrs. Other subjects with proteinuria did not have hypertension or any change in creatinine clearance. The hypertensive and the proteinuric patient were a middle-aged female who significantly increased body weight post-donation. Significantly the patient also had c/o B/L mild pedal oedema. She was put on ACE inhibitors and is now under follow-up. Urine protein value did not change significantly among sexes or subjects more than or less than 50 years.

USG size

USG was done for these subjects with dimensions of the kidney taken in 2 axis-length and breadth.

Length increased significantly from 9.5 ± 0.5 cm to 10.3 ± 0.8 cm and with a mild increase in breadth from 4.04 ± to 0.4 to 0.2 ± 0.398.

This dimension increase was evident within 6 months after donation and did not progress beyond. The increase was evident in almost all patients and did not differ among patients younger than 50 or older than 50 or males and females.

General Observation

Females were at the forefront among organ donors. Post-op complications were few, and only 2 patients among 123 had to be reoperated on an emergency basis for bleeding. We had no perioperative mortality during 123 consecutive renal donation surgeries. One patient among the followed-up donors developed a lumbar hernia. One patient had acute pyelonephritis, had a renal failure for a short period and completely recovered with no hypertension. None had regrets about renal donation; most of them were still motivated and

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ready to undergo the procedure once more if called upon.

DISCUSSION

Of the 123 live-related kidneys at our institution, the perioperative mortality rate is nil (0) which corresponds to that of world literature compared to that of 0.03% in the US and Canada by Najarian et al. in Lancet 1992.[4]

We have evaluated renal function, urinary protein excretion, blood pressure and renal size in 40 renal donors, with a mean follow-up time of 3.1 yrs (1-7 yrs) after nephrectomy. The study population represents around 33% of the live donors at our institution from 1999-2005. Because those patients who were not evaluated are similar to those who were, it is reasonable to generalize conclusions for the entire group. But this may bias the results also.

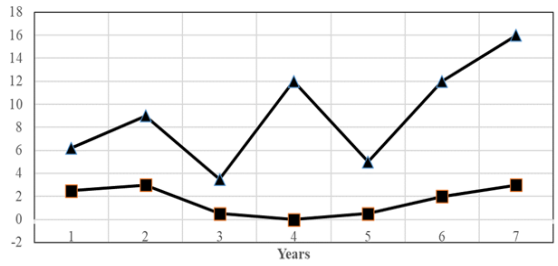
We found no evidence of renal functional deterioration within a follow-up of 1-7 years. Furthermore, estimating GFR by urinary 24-hour urine creatinine clearance correlated positively with the expected age-adjusted single kidney GFR. These findings are comparable with other studies [2], [4] , and even with extended follow-up studies of 25 years by Novick et al,[5] 2001, mean creatinine clearance was 90% of the value before donation and came to 85 ± 15ml/mt/1.73m², which was not statistically different from the preoperative value with two kidneys. However, an ominous finding of gradually increasing mean creatinine clearance observed above the basal pre-op level by 7 years of follow-up was observed [Figure 1]. This may be due to the establishment of glomerular hyperfiltration by this period. This calls for the institution of measures like protein restriction and salt restriction to prevent hyperfiltration.

Protein excretion increased marginally but was not statistically or clinically significant. Four persons had more than 200-300mg/24 hr proteinuria, and 2 donors had more than 300mg/24hr and none more than 350mg%. Proteinuria did not correlate with renal function, blood pressure or subject age at donation. Though at a mean follow-up of 3.5 years, these findings follow long-term studies (Najarian et al in 1992, and Novick et al in 2001).[4,5]

One female donor developed proteinuria of >300mg% and hypertension. In addition, this donor had a significant increase in weight after organ donation, again underscoring the need to curb weight gain and high protein intake after nephrectomy. The prevalence of proteinuria in the range >200mg/24 hrs is similar to that of the age-adjusted general population. But the, extended follow-up is needed for these patients with borderline proteinuria.

The prevalence of hypertension in the study was 8/40 (20%). The mean increase in systolic pressure was 7mm, and that of diastolic pressure was 2mm. The prevalence of hypertension was comparable to that of an age-matched population, following findings highlighted by Anderson et al in 1991,[2] Najarian et al,[4] in 1992 and Hakim et al in 1984.[3] Mean systolic BP increases with time [Figure 3]. It may be due to the age-related change or the effect of nephrectomy, which must be followed up. All these patients were put on ACE inhibitors, which will benefit hypertension and proteinuria.[3,6]

Fig III: Change in Systolic and Diastolic BP with time



The mean increase in renal size was 9mm in length and 2mm in breadth. The increase in size was completed in 6 months. Compensatory hypertrophy did not differ significantly in males or in subjects more than or less than 50 years. These results follow other series (Anderson et al).[2]

CONCLUSION

Live organ donation is unique to the kidney as humans are endowed with a surfeit of nephrons. We embarked upon this study to evaluate the outcome of renal function after live renal donation. During our follow-up period, renal function is well preserved in donors. There was a marginal rise in urine protein excretion amount, but not to clinically or statistically significant levels.

Creatinine clearance is well preserved with a single kidney. Extended follow-up studies are warranted to check on the trend of gradual increase in creatinine clearance over the extended follow-up to check for or prevent renal hyperfiltration and glomerulosclerosis. There was no increase in the incidence of hypertension compared to the age-adjusted population incidence rate. Still, extended outcome studies are needed to establish the safety of renal donation among our population.

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