Original Research Paper Medical Science

Reserve capacity of remaining kidney function after living-related donor unilateral nephrectomy

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ABSTRACT

Objective: To investigate early postoperative renal function changes and its infuence factors after living-related dono unilateral nephrectomy. **Method:** 109 cases of living-related kidney donors were enrolled in this study. Estimated glomerular filtration rate (eGFR) was calculated using the abbreviated Modification of Diet in Renal Disease (aMDRD) formulae. Emission computed tomography (ECT) equipment was applied to detect the GFR of both kidneys and GFR of each kidney before nephrectomy was estimated in proportion. Observe eGFR changes and compensatory rate of the retained kidney in the first month after donor nephrectomy and at the same time observe the influence factors,eg, gender, age, body mass index (BMI) and preoperative GFR. **Results**: The eGFR of the retained kidney increased gradually and reached a peak at 4 days after nephrectomy. The average eGFR increased from 70.60 ml/min before nephrectomy to 88.15 ml/min at the endpoint with the average compensatory rate 24.86%. The eGFR of the male group and the female group increased with the compensatory rate 22.89 % and 24.69%. For donors over 50 years and doners less than 50 years old, the eGFR increased with compensatory rate 13.81% and 28.21%. For doners BMI above 23.0 kg/m2 and below 23.0 kg/m2 the average eGFR increased with the compensatory rate 25.56% and 25.46%. For doners GFR above 60 ml/min and below 60 ml/min before surgery, the average eGFR increased with the compensatory rate 16.44 % and 35.79%. **Conclusion:** The eGFR of the retained kidney increased significantly after unilateral nephrectomy. Gender, age and preoperative GFR produced significant impact on the renal recovery of the retained kidney after nephrectomy.

KEYWORDS Living-related kidney transplant, Donor, Glomerular filtration rate (GFR) , Influence factor

Introduction

Kidney transplantation from living donors is important to reduce organ shortage. Living donation provides a better patient and allograft survival when compared with deceased-donor transplantation [1,2,3] . However, a living donor transplant does have one serious disadvantage: the donor needs to have a major operative procedure that is associated with morbidity, mortality, and the potentially negative shot-term and long-term consequences of living with a remaining kidney. At present, many centers studies only maximize the benefits of the recipients, more attention to the prognosis of recipients [4,5] . Numerous studies of living donors have noted no evidence of early recovery of the remaining kidney's function. We are concerned about the health status, quality of life and complications of the donor in the selection of donor. Currently, many centers with a living donor program rely on creatinine-based estimates of renal function, we evaluated the predictive value of pre-donation Cockcroft-Gault and modified modification of diet in renal disease (MDRD) estimated clearances [6] . This study was to investigate the predictive potential of pre-donation glomerular filtration rate (GFR) and renal reserve capacity for post-donation eGFR in kidney donors.

MATERIALS AND METHODS

Patient enrollment

Total of 109 consecutive living kidney donors were enrolled in this study from March 2008 to December 2015. Donors provided a complete history and underwent a physical examination, as well as renal and vascular imaging. They underwent a comprehensive laboratory assessment to rule out liver disease, active infections and systemic illnesses. No potential donor with any albuminuria (defined as a urinary albumin to creatinine ratio of >0.02 on more than one occasion) was accepted. Donor selection criteria to follow the United Kingdom Guidelines for Living Donor Kidney Transplantation- Second Edition April 2005 [7] . The study was approved by the committee of ethics at Jinling Hospital. All of donors and recipients gave their written informed consent.

Assessment of renal function and renal reserve capacity

Renal function and renal reserve capacity were measured as part of the screening protocol at a mean of 139 ± 89 days before donation as the clearance of constantly infused. Record all living donors of gender, age, preoperative weight and serum creatinine(SCr). With 99 MTC-DTPA method were determined donor bilateral glomerular filtration rate (GFR) both before and after donor nephrectomy. Residual renal eGFR accounted for the proportion of the total bilateral GFR (I) calculation method for: I = Residual renal eGFR/double total GFR [6] .

A creatinine-based estimate of renal function was made by Cockcroft-Gault's and the modified MDRD equations glomerular filtration rate (eGFR ml/min/1.73m^2) = 186 x [SCr (mg/dl)] $^{-1.154}$ x age(years)$^{-0.203}$ x (0.742, female) [8,9] .

The donor SCr was regularly reviewed, according to the donor's gender, age and the lowest SCr value in the first month after unilateral nephrectomy, and the eGFR value of the kidney was calculated by aMDRD formula. Comparison with retained kidney eGFR in the first month after unilateral nephrectomy and preoperative renal GFR, eGFR compensation rate(%) after unilateral nephrectomy = (eGFR in the first month after unilateral nephrectomy - preoperative GFR) / preoperative GFR x 100 [10,11] .

Clinical observations

Blood urea nitrogen (BUN), SCr, blood glucose, blood lipids, peripheral hemogram, hematocrit, and urine analysis were measured each day for the first month after unilateral nephrectomy, and then every 3 months. Observe all donors before and after nephrectomy to retain the kidney changes and characteristics of eGFR. Respectively to observe about gender, age, body mass index(BMI) and eGFR after nephrectomy. The endpoint of the study was 4 months post nephrectomy.

Statistical analysis

Analyses were performed using SPSS software version 12.0 (SPSS Inc.,Chicago, IL, USA). Data are given as mean ± standard deviation. Pearson's correlation coefficients were calculated to account for univariate correlations. Student's paired t-test was used to compare eGFR and stimulated GFR values, as well as post-donation to pre-donation values. The v2 test was used for categorical variables.

RESULTS

In the study, 109 cases of living-related donor, male 36 (33.0%), female 73 (67.0%). Donor age 39 to 61 (45.48± 7.65) years, average BMI) 22.67 ±1.78 kg/m^2, preoperative average GFR (ml/per minute per 1.73 m^2 of body-surface area) 73.39±17.88 ml/min. The donaor relationships were parental(n=100,91.7%), brothers and sisters(n= 4,3.7%), spousal(n= 5,4.6%).

Changes of preserving eGFR after unilateral nephrectomy in the donors

Preserving renal eGFR gradually increase from preoperatively 70.60 ml/min to 88.15 ml/min, reach a peak at fourth days after donor nephrectomy. The average compensation rate was 24.86% after unilateral nephrectomy in the donors (Figure 1).

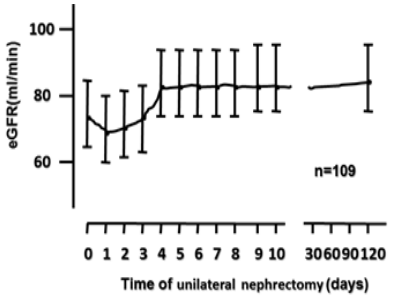

Figure 1. Preserving renal eGFR changes after unilateral nephrectomy in donors

Effect of gender on eGFR in donation

All the donor can be divided into the male group and the female group(Table 1). Preserving eGFR were all reached the peak at fourth days after unilateral nephrectomy in two groups. In the male group, 7 donors with serum creatinine did not return to normal in the first month after unilateral nephrectomy, while there was no one donor in the female group.

Table 1. Effect of gender on eGFR of kidney in donors

	Male group (n=36)	Female group (n=73)	P valure
Average age (years)	44.50 ± 9.83	44.64± 8.64	>0.05
GFR before nephrectomy (ml/min)	65.49 ±11.21	70.72±19.99	<0.05
eGFR after nephrectomy(ml/min)	80.48±12.91	88.18±21.01	>0.05
Compensatory rate(%)	22.89	24.69	>0.05

Effect of age on the reserve of eGFR in donors

All donors were divided into over 50 years (including 50 years old) group and lessthan50 years old group. GFR is not significant in two groups before unilateral nephrectomy (Table 2). The age of donor was negatively correlated with the compensatory rate of eGFR after unilateral nephrectomy in the donors. There are the older the age and the lower the rate of compensation.

Table 2. Effect of age on eGFR after unilateral nephrectomy in donors

	Over 50 years old group (n=21)	Less than 50 years old group (n=88)	P valure
GFR before nephrectomy(ml/min)	72.82±11.21	72.18±19.99	>0.05
eGFR after nephrectomy(ml/min)	82.66±12.91	92.54±21.01	<0.05
Compensatory rate(%)	13.81	28.21	<0.001

Effect of BMI on eGFR in donors

There was no correlation with the BMI and the eGFR compensatory rates. All donors were divided into over 23.0 kg/m2 group(including 23.0 kg/m2) and less-than 23.0 kg/m2 group(Table 3).

Table3. Effect of BMI on eGFR in donors

	Over 23.0 kg/m2 group (n=23)	Less than 23.0 kg/m2 group (n=86)	P valure
Average age (years)	47.47 ±7.87	42.32 ±8.60	>0.05
GFR before nephrectomy(ml/min)	67.21±11.21	68.50±19.99	>0.05
eGFR after nephrectomy (ml/min)	84.39±12.91	85.94±21.01	>0.05
Compensatory rate(%)	25.56	25.46	>0.05

Effect of preoperative GFR level on eGFR after unilateral nephrectomy Preoperative GFR was negatively correlated with the compensatory rates of eGFR after unilateral nephrectomy. According to preoperative GFR level, all donors were divided into over 60 ml/min group(including 60 ml/min) and less-than 60 ml/min group(Table 4).

Table 4. Effect of preoperative GFR level on eGFR after unilateral nephrectomy

	Over 60 ml/min group (n=90)	less-than 60 ml/min group (n=19)	P valure
Average age (years)	43.82 ±8.95	43.32 ± 7.98	>0.05
GFR before nephrectomy (ml/min)	81.95±11.21	54.90±19.99	<0.05
eGFR after nephrectomy (ml/min)	95.42±21.91	74.55±21.01	<0.05
Compensatory rate(%)	16.44	35.79	<0.00

Discussions

With the renal source of increasingly scarce, living-relative donation has gradually become one of the main sources of kidney transplantation〔12,13〕and many centers also used the older relatives donation to expand for source [4,14,15]. Living-related donation is not only related to the renal function recovery, but also the health benefits of the donation [16,17,18]. Previous studies have shown that unilateral nephrectomy in healthy living donors usually does lead to clinically significant short- or long-term renal damage in the remaining kidney [19,20]. Nevertheless, in a small number of kidney donors, signs of renal damage have been reported, in some cases even leading to the need for renal replacement therapy for the donors themselves [21]. Fehrman-Ekholm [22] reviews the research of Stockholm single center for 40 consecutive years in the implementation of nephrectomy, the end-stage renal disease (ESRD) incidence rate was 0.5%, and 36 years with no donor ESRD.

Ramcharan and Matas [21] showed that about 2% of the donor had kidney disease or had received a kidney transplant. In order to ensure living related donation after unilaterl nephrectomy, in the preoperative assessment of safety, it is very important before unilaterl nephrectomy. We need more prospective studies to determine the exact and quantitative risk, potential donors to give more accurate information, but the current conditions of the donor without a specific unified standard.

This study was the first to observe the early renal function recovery and its influencing factors after unilaterl daonor nephrectomy. The results showed that the eGFR level of the donor was increased and the peak was reached to fourth days after unilaterl nephrectomy. The average compensation rate was 24.86%. Literature reported a number of factors are impact on the recovery of renal function after unilaterl nephrectomy. In order to better protect donors postoperative renal function recovery, we choose the donor these factors should be used as a reference.

Effects of donor gender on eGFR after unilateral nephrectomy This study showed that was no significant difference in the compensatory rate of eGFR after unilaterl donor nephrectomy between the male and the female group,respectively,22.89% and 24.69%. Preoperative GFR level in male group was lower than that in female group (80.48±12.91 ml/min and 88.18±21.01 ml/min). In the male group, 7 patients with serum creatinine did not return to normal in the first month after unilateral nephrectomy, while there were no one donor in the female group.

Effect age of donation on postoperative eGFR This study found that the age of donation was negatively correlated with the compensatory rate of eGFR. With the increase of age, the compensatory ability of eGFR decreased gradually. The age over 50 years group and less-than 50 years group before GFR is similar,respectively,72.82±11.21 ml/min and 72.18 ml/min. The over 50 years group the compensatory rate of eGFR was significantly lower than that of less-than 50 years group (13.81% and 28.21%). This study showed that compensation ability of kidney eGFR was limited in elderly donation after unilaterl daonor nephrectomy. In this study, the majority of donors with serum creatinine were normal range in the first month after unilateral nephrectomy. Although the elderly donor eGFR compensatory ability is poor, but its own basic metabolism is relatively low [23] .

Effect of donor BMI on postoperative eGFR This study found that there was no correlation between the donor BMI and the compensatory ability of the eGFR. But BMI will be divided into the > 23kg/m^2 and <23kg/m^2 group, we can still find the greater the BMI, the higher the rate of compensation [24] . Perhaps,the formula for calculating eGFR may be used without the consideration of the BMI.

Effect of preoperative GFR on postoperative eGFR This study showed that preoperative GFR levels were negatively correlated with the rate of postoperative eGFR, the lower the preoperative level, the higher the rate of eGFR after unilateral nephrectomy. The rate of compensation eGFR was significantly increased in less-than 60 ml/min group more than over 60 ml/min group at preoperative GFR, respectively,35.79% and 16.44%. Therefore, Preoperative GFR is at least greater than 60 ml/min.

In addition, the study also found that 7 male donors had lower GFR than 60 ml/min at prooperation, the serum creatinine level was not normal in 6 cases. Five female patients with eGFR< 60ml/min before unilateral nephrectomy had no abnormal serum creatinine after unilateral nephrectomy. It shows that the male and the female donors for preserving renal compensatory rate is similar, but in males with eGFR below 60 ml/min, the compensatory ability of the kidney has reached its maximum,the serum creatinine level was still not returned to normal in the first month after after unilateral nephrectomy. Female donor nephrectomy with renal function was normal, the main reason may be related to female donor after pregnancy factors such as kidney compensatory ability is enhanced. In addition, it is also related to the low basal metabolism of the female donor.

Conclusion Factors such as gender, age, BMI and preoperative GFR levels could have a signi_cant impact on the recovery of renal function after living-related unilateral donor nephrectomy. The female for early renal function recovery after unilateral nephrectomy is better than that of male, male relatives as kidney donors compared with age-matched female preoperative eGFR level is low, the GFR should be the choice of a higher level. This study showed that GFR should be more than 60 ml/min in order to facilitate the early renal function recovery after male donor nephrectomy. For more than 50 years old and BMI value of the larger donor, careful consideration should be given to their retention of the maximum compensation of the kidney is very limited, in the preoperative assessment should also be the donor's GFR level at a higher level, in order to facilitate the early recovery of remaining renal function in donors.

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