EVALUATING GLOMERULAR FILTRATION RATE IN LIVING KIDNEY DONORS IN VIET DUC HOSPITAL

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ABSTRACT

Summary: One of the most important goals of kidney transplantation from a living kidney donor is to ensure that the function of the transplanted kidney as well as to preserve the function of the kidney donor. An ideal GFR test that ensures high accuracy, simplicity, safety, and economic efficiency is 24-hour Creatinine clearance in the assessment of living kidney donor. **Objective:** To achieve that, the evaluation of GFR in living kidney donors. **Patients and Methods:** Retrospective study (retrospective from January 2022 to December 2022. Research variables : sex, age, age group, BMI, arterial blood pressure. Evaluating Glomerular Filtration Rate in living kidney donors. CrCl 24h of each age group, CrCl 24h distribution by age groups in percentiles, Serum creatinine concentration, CrCl 24h distribution by BMI, Height, Weight groups. **Results:** in this study including 65 male and 73 female, accounts for 47.1% and 52.9%, respectively. the average age of 34.283 ± 7.605. The age groups distribution of this study population is mostly focused on the under 40 age groups (82.6%). The differences of height, weight, BMI, BSA between the two sexes are statistically significant ($p < 0.05$). The BMI difference is not a statistically significant between male and female ($p > 0.05$). CrCl24h (ml/min) (uncorrected after BSA) average is 106.964 ± 11.106 (minimum: 77.845, maximum: 136.503). The differences in ClCr24h by sexes, BMI groups, height groups, and weight groups of living kidney donors are statistically significant when CrCl24h (ml/min) is not corrected after BSA ($p < 0.05$). After corrected, the average CrCl24h is 113.071 ± 9.747 (ml/min/1.73m^2) (minimum: 91.000, maximum: 140.000), The differences in ClCr24h by sexes, BMI groups, height groups, and weight groups are not statistically significant anymore ($p > 0.05$). The difference of CrCl 24h between age groups is not statistically significant ($p > 0.05$). **Conclusion:** CrCl24h (ml/min) average is the average CrCl24h is 113.071 ± 9.747 (ml/min/1.73m2) (minimum: 91.000, maximum: 140.000), The differences in ClCr24h by sexes, BMI groups, height groups, and weight groups are not statistically significant anymore.

Keywords: *kidney living donor nephrectomy, GFR*

I. INTRODUCTION:

Kidney transplant is a modern surgery treatment to replace the diseased kidney of end-stage renal disease (ESRD) patients. It is considered as one of the most major contributions to modern medicine. In the present-day, the sources of kidneys vary from the brain-dead donors to donors whose hearts have stopped beating, especially those who have died of trauma to living donors. But there are too few deceased donors to meet the demand, and a living donor transplant, offers many advantages, including superior graft and patient survival, shorter wait times, and lower health care costs[1,2,3]. One of the most important goals of kidney transplantation from a living kidney donor is to ensure that the function of the transplanted kidney as well as to preserve the function of the kidney donor[4]. To achieve that, the evaluation of GFR in living kidney donors

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must be the most necessary and important steps in assessing suitable kidney donors. An ideal GFR test that ensures high accuracy, simplicity, safety, and economic efficiency is 24-hour Creatinine clearance in the assessment of living kidney donor. Despite there are much research conducted on deceased donors, still little evidence of GFR has been evaluated in this living kidney donors in Viet Duc Hospital. Therefore, with the goal of determining the GFR in living kidney donors, in order to ensure kidney function for both donors and the recipients in the future, we conduct this research with objectives : "Evaluate glomerular filtration rate in living kidney donors in Viet Duc Hospital from 01/2022 to 12/2022"

II. PATIENTS ANH METHOD

2.1. Research patients: 138 living kidney donors in Viet Duc Hospital from 01 to 12/2022, aged 25 to 64, voluntary kidney donation.

Selection criteria**:** All the pre-donation living kidney donors met all the screening criteria from examining and sub-clinical testing shown above in the normal living kidney donors' criteria. These living kidney donors have a complete record of preoperative screening data and test. CrCl 24-hour > 90 ml/min/1.73m2.

Exclusion criteria: Abnormal urinary system. Glomerular filtration rate < 80ml/min/1.73m².Recent malignancies or cancers at risk of recurrence (e.g., breast cancer), heart diseases, kidney diseases, infectious diseases: HBV, HCV, HIV, psychology disorder... That makes the living kidney donors cannot donate their kidney. Refusal to give informed consent.

2.2. Research Methods:

2.2.1. Research design: Retrospective study (retrospective from January 2022 to December 2022):

Study sample size: convenient sample size, data collected through electronic medical records and kidney transplant reports stored in Viet Duc Hospital.

Research variables : Clinical features of living kidney donors sex, age, age group, BMI, arterial blood pressure. Evaluating Glomerular Filtration Rate in living kidney donors. CrCl 24h of each age group, CrCl 24h distribution by age groups in percentiles, Serum creatinine concentration, CrCl 24h distribution by BMI, Height, Weight groups

eGFR MDRD (ml/min/1.73m^2):

$$CCr = \frac{(140 - age) \times weight}{0.814 \times SCr\ (\mu mol/L)} \quad \text{in males}$$

$$CCr = \frac{(140 - age) \times weight \times 0.85}{0.814 \times SCr\ (\mu mol/L)} \quad \text{in females}$$

Cockcroft–Gault formula

$$GFR\ (mL/min/1.73\,m^2) = 186 \times \left[\frac{SCr\ (\mu mol/L)}{88.4}\right]^{-1.154} \times age^{-0.203} \times \underset{\text{(if female)}}{0.742} \times \underset{\text{(if black)}}{1.210}$$

MDRD equation

2.2.2. Data collected, analyzed: The data of these study subjects was collected based on variables in the questionnaires. The data was inputted to Microsoft Excel, processed, and analyzed by using SPSS 20.0 software.

III. RESULTS

Table 1: ***General characteristics of the study population.***

	Total (n=138)	Male (n=65)	Female (n=73)	p value
Age (year)	34.283 ± 7.605 (25-64)	32.985 ± 7.066 (26-56)	35.438 ± 7.925 (25-65)	0.058 > 0.05
Height (cm)	161.137 ± 6.787 (146-178)	165.846 ± 4.708 (155-178)	156.945 ± 5.487 (146-178)	0.0000 < 0.001
Weight (kg)	56.906 ± 7.235 (42-80)	59.800 ± 6.858 (42-70)	54.329 ± 6.596 (45-80)	0.0000 < 0.001
BMI (kg/m^2)	21.911 ± 2.453 (17-28.7)	21.749 ± 2.4123 (17.6-28.7)	22.054 ± 2.497 (17-28)	0.468 > 0.05
BSA (m^2)	1.637 ± 0.105 (1.419-1.898)	1.703 ± 0.083 (1.524-1.898)	1.577 ± 0.232 (1.419-1.898)	0.0000 < 0.01
Arterial SBP (mmHg)	111.52 ± 4.340 (100-130)	111.69 ± 4.531 (110-130)	111.37 ± 4.188 (60-95)	0.665 > 0.05
Arterial DBP (mmHg)	70.98 ± 4.135 (60-95)	70.62 ± 2.998 (100-130)	71.30 ± 4.932 (60-80)	0.333 > 0.05

Table 2: ***CrCl 24h 1st time passing the threshold of living kidney donors.***

24-hour CrCl	Frequency	Percentage %
% 24-hour CrCl 1st time pass	126	91.3
% 24-hour CrCl 1st time does not pass	12	8.7
% 24-hour CrCl 2nd time pass	138	100

Observation: living kidney donors in this study had 24-hour CrCl 1st time pass the threshold for kidney donation standard was 91.3%, 24-hour CrCl 1st time does not pass the threshold is 12%. 24-hour CrCl 2nd time pass the threshold is 100%.

Table 3: ***CrCl 24h and related tests in living kidney donors.***

Statistics	Total (n=138)	Male (n=65)	Female (n=73)	p value
CrCl 24h ($ml/min/1.73\ m^2$)	113.071 ± 9.747 (91.000-140.000)	112.289 ± 8.762 (92.530-131.000)	113.795 ± 10.555 (91.000-140.000)	0.126 > 0.05
Serum creatinine concentration (µmol/l)	69.974 ± 14.925 (41.000-107.920)	81.503 ± 9.582 (55.000-107.920)	59.709 ± 10.7423 (41.000-86.000)	0.0000 < 0.01
BUN (mg%)	4.404 ± 1.205 (2.050-8.300)	4.383 ± 1.029 (2.840-7.440)	4.423 ± 1.350 (2.050-8.300)	0.848 > 0.05
Urine urea nitrogen (mmol/l)	105.459 ± 37.891 (30.040-247.900)	112.300 ± 39.314 (54.370-247.900)	99.368 ± 35.751 (30.040-231.000)	0.045 < 0.05
Urine creatinine concentration (mmol/l)	3.985 ± 1.592 (1.640-10.900)	4.624 ± 1.630 (1.827-10.900)	3.415 ± 1.329 (1.640-8.235)	0.0000 < 0.01
CrCl 24h (ml/min)	106.964 ± 11.106 (77.845-136.503)	110.485 ± 9.919 (91.760-136.503)	103.830 ± 11.229 (77.845-133.439)	0.0000 < 0.01

Observation: Serum creatinine concentration, Urine urea concentration, Urine creatinine concentration, CrCl 24h (uncorrected after BSA) have a statistically significant difference between male and female, according to ANOVA table ($p < 0.01$). However, after correcting CrCl24h after BSA, CrCl24h is not statistically significant difference between these 2 sexes ($p > 0.05$). The difference of BUN between 2 sexes is not significant difference, according to ANOVA table ($p > 0.05$).

Table 4: ***CrCl 24h in each age group of living kidney donors.***

Age groups (years)	CrCl 24h (ml/min/1.73 m²)	p value (between age groups)
25-29 (n=45)	112.940 ± 8.861 (94.070-135.650)	0.990
30-34 (n=37)	112.779 ± 9.736 (97.090-135.300)	
35-39 (n=32)	113.549 ± 9.964 (91.000-134.400)	
40-65 (n=24)	113.130 ± 11.536 (94.900-140.000)	

Observation: the difference of CrCl 24h between age groups is not statistically significant according to ANOVA table ($p > 0.05$).

Table 5: ***Comparison of evaluating GFR methods.***

	Total (n=138)	p Value
CrCl 24h (1)	113.071 ± 9.747 (91.000-140.000)	p (1)-(2) = 0.000
eCrCl CG (2)	100.11 ± 19.821 (60 -184)	p (1)-(3) = 0.000
eGFR MDRD (3)	106.55 ± 20.018 (70-165)	p (2)-(3) = 0.000

Observation: CrCl 24h, eCrCl CG and eGFR MDRD in this study have the value of 113.071 ± 9.747 (91.000-140.000) (ml/min/1.73 m^2), 100.11 ± 19.821 (60 -184) (ml/min/1.73 m^2), and 106.55 ± 20.018 (70-165) (ml/min/1.73 m^2), relatively, the differences between these values are statistically significant, with $p < 0.001$, according to T-test.

IV. DISCUSSION

The study on 138 voluntary living kidney donors of Viet Duc Hospital from 01/2022 - 12/2022 including 65 male and 73 female, accounts for 47.1% and 52.9%, respectively, this difference is not statistically significant ($p > 0.05$). This result is as similar as the research of Thai Thanh Tam Tran et al of 100 subjects including 49% male and 51% female5. Meanwhile, another research of Naoki Kohei et all shows a relatively different result in terms of male/female ratio of 141/2846.

The average age of 34.283 ± 7.605 (minimum: 25, maximum: 64) in this study population, this difference is not statistically significant between male and female ($p > 0.05$), the result is as similar as the research of Van Chuong Nguyen et al[7]. The age groups distribution of this study population is mostly focus on the under 40 age groups (82.6%), the result is as similar as the research of Hoang Hiep Tran et al[8]. The average age of this study population is pretty young, proximately 10 age younger compare to average ages of these studies' populations: the research of Thai Thanh Tam Tran et al, this research' population have the average age of 46,2 ± 10,7 (minimum: 21, maximum: 65)[9]; The selection of young kidney donors has many benefits such as higher kidney quality and less risks for the kidney donor. Evaluating GFR in living kidney donors. CrCl24h (uncorrected after BSA) average (ml/min) is 106.964 ± 11.106 (minimum:

77.845, maximum: 136.503). The difference of CrCl24h between 2 sexes of living kidney donors is statistically significant when not corrected after BSA ($p < 0.01$). These results are as similar as the research of Thai Thanh Tam Tran et al[5], due to the differences between muscle mass, BMI, BSA of male and female. After corrected after BSA, the average CrCl 24h (ml/min/1.73m2) is 113.071 ± 9.747 (minimum: 91.000, maximum: 140.000), this difference between 2 sexes of living kidney donors is not statistically significant ($p > 0.05$). The average CrCl 24h on 100 living kidney donors of Thai Thanh Tam Tran is 92,2 ± 15,1 (ml/min/1.73m2) (minimum: 65, maximum: 153,8), which is lower than our research[5]. Perhaps, this difference is due to the lower average age of our study, at the same time, the differences in muscle mass, nutrition, due to the research was being conducted in 2022, 7 years after compared to Thai Thanh Tam Tran's research. The average BUN (mg%) is 4.404 ± 1.205 (minimum: 2.050, maximum: 8.300), the difference of BUN between 2 sexes of living kidney donors is not statistically significant. The difference of CrCl 24h (ml/min/1.73m2) between age groups is not statistically significant. This result is not as similar as the research of Thai Thanh Tam Tran et al[5], where CrCl 24h decrease 9 ml/min in each groups ≤ 40 years, 41-50 years and > 50 years. Perhaps due to the differences between age groups distribution and the average age of this study population is 34.283 ± 7.605 years, which is lower than the research of Thai Thanh Tam Tran. The differences of CrCl24h (ml/min/1.73 m2) by BMI, height, weight groups are not statistically significant ($p > 0.05$), and they are not linearity relative ($p > 0.05$) according to ANOVA table. CrCl 24h, eCrCl CG 24h, and eGFR MDRD are 113.071 ± 9.747 (91.000-140.000) (ml/min/1.73 m2), 100.11 ± 19.821 (60-184) (ml/min/1.73 m2), and 106.55 ± 20.018 (70-165) (ml/min/1.73 m2), respectively, the differences between CrCl24h and eCrCl CG, and eGFR MDRD are statistically significant, with $p < 0.001$ according to ANOVA table. CrCl24h average is higher than the eCrCl CG and eGFR MDRD 12.961 and 6.521, respectively. These results are as similar as the research of Van Chuong Nguyen et al[7] when researching on 116 healthy living kidney donors in Cho Ray Hospital. These results fit the results of Andrew et al research on evaluating GFR on 365 healthy living kidney donors, proved that GFR can't be evaluated accurately using eCrCl CG and eGFR MDRD[10] . This difference is probably due to the fact that MDRD formula was built on subjects with renal failure, while our research on 138 healthy living kidney donors with CrCl 24h of more than 90 ml/min/1.73 m2. About the results of the correlation between CrCl 24h with eGFR calculated by estimation method: there is a low degree of positive linear correlation between CrCl 24h with eCrCl Cockcroft Gault, with $r = 0.178$; $p < 0.000$, The linear regression equation: CrCl 24h = 104.303 + 0.088 x eCrClCG (ml/min/1.73 m2). And there is also a low degree of positive linear correlation between CrCl 24h with eGFR MDRD, with $r = 0.187$; $p < 0.01$, The linear regression equation: CrCl 24h = 103.391 + .091 x eGFR (MDRD) (ml/min/1.73 m2). These results are as similar as the research of Van Chuong Nguyen et al[7] when researching on 116 healthy living kidney donors in Cho Ray Hospital, the study showed the correlation between CrCl 24h and eCrClCG as well as

eGFR MDRD. However, there is quite a large difference between the results of these formulas. This needs to be noted especially in clinical evaluation of living kidney donors because of the large variation between the calculation formulas. This is perhaps because these formulas have different constructs.

V. CONCLUSION

CrCl24h (ml/min) average is the average CrCl24h is 113.071 ± 9.747 (ml/min/1.73m2) (minimum: 91.000, maximum: 140.000), The differences in ClCr24h by sexes, BMI groups, height groups, and weight groups are not statistically significant anymore.

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