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Original Article

Renal Function after Nephrectomy: To Examine any Differences Between Kidney Cancer and Kidney Donation

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ABSTRACT:

Objective: To evaluate renal function after radical nephrectomy (RN) and donor nephrectomy (DN), and the differences in changes and identify factors that lead to chronic renal failure.

Material and Methods: A retrospective review of patients diagnosed with renal cell carcinoma, who received RN and donors of living kidney transplantation. Kidney function in both groups was measured before and after surgery. We assessed the donors' kidney functions using an estimated Glomerular filtration rate (eGFR), through a Modification of Diet in Renal Disease (MDRD) formula [GFR = 186 x serum creatine−1.154 age−0.203 x 0.742 (if the patient was female). Kidney function after surgery was evaluated at 1, 3, 6 and 12 months. Rates of renal function decline were analyzed compared with baseline.

Results: A total of 249 patients were included in the study, 50 in the DN group and 199 in the RN group. The mean eGFRs before surgery were 68.6 ml/min/1.73m2 and 88.8 ml/min/1.73m2 in the RN and DN groups, respectively. During the first year postoperatively, renal function in the RN and DN groups decreased by approximately 25.6% and 27.2% from baseline, respectively.

Conclusion: Renal function after surgery declined after both RN and DN, but the pattern of changes in renal function was different between the groups, possibly due to the patients in the DN group being younger and healthier. There were no differences in percentage of change in eGFR between the groups at the 1 year follow up.

Keywords: donor nephrectomy, radical nephrectomy, renal cell carcinoma, renal function,

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INTRODUCTION

Nephrectomy is a common procedure in urologic surgery. However, the reasons for this procedure may differ; such as, due to infection, malignancy or transplantation. Removal of the ipsilateral kidney leads to reduced overall kidney parenchymal function, and may progress to chronic kidney disease (CKD). Renal cell carcinoma (RCC) accounts for 2-3% of all adult malignancies, and about 90.0% of malignant renal tumors.[1] In Thailand, the overall RCC incidence and mortality of kidney cancer are 1.6:100,000 and 1.0:100,000, respectively.[2] Surgical management of RCC has evolved deeply during the past decade,[3] and presently patients usually present with localized RCC that can be cured by partial or radical nephrectomy. Nephron-sparing surgery has become a standard procedure for the management of patients with a small renal mass.[4] Over the past few years, a lot of retrospective reviews have mentioned that radical nephrectomy (RN) has increased in cardiovascular events due to the loss of kidney function.[5] The prevalence of patients with end stage renal disease (ESRD) showed an increasing trend. The best treatment for these patients is kidney transplantation. However, at the same time the waiting list for cadaveric donor kidney transplantation continues to grow. Living donor kidneys may be an alternative for patients to receive kidneys for transplantation. Living donor kidney transplantation (LDKT) has clear benefits for the recipient, including better renal function and longer patient quality of life,[6] although the effects of a kidney donation on the donor's physical well being is also an important issue. After a nephrectomy, the remaining kidney will normally increase its filtration rate 70% of its pre-donation level.[7] In contrast, many studies have suggested that living kidney donor patients rarely develop postoperative CKD. This is most likely due to the fact that donor candidates are chosen based on good health and have few or no comorbidities. The aim of this present study was to compare LDKT subjects with RN patients to analyze any differences between the immediate post-operative renal function and the percentages of change in the estimated Glomerular filtration rate (eGFR).

MATERIAL AND METHODS

Ethical approval for this study was obtained from the Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University (REC. 62-123-10-4). The medical records of all patients who underwent RN from RCC and LDKT in Songklanagarind Hospital from 2008 to 2015 were reviewed. We excluded patients whose pre-operative and postoperative analysis data were unavaiable. Fifty DN patients and 199 RN patients were identified and included in the study. We assessed kidney function using the estimated glomerular filtration rate (eGFR), through the Modification of Diet in Renal Disease (MDRD) formula [GFR = 186 x serum creatine-1.154 age-0.203 x 0.742 (if the patient was female). The eGFR was assessed preoperatively and at 1, 3, 6, and 12 months post-operatively. Gender, age and renal function were recorded. The statistical analysis was carried out using the R software v3.5.1 (R Foundation for Statistical Computing, Vienna, Austria), and p-value < 0.050 was considered to be statistically significant. The variable data were tested with the Shapiro-Wilk test to find abnormal distributions and the Wilcoxon rank-sum test was used to assess differences between the groups. Variable data are shown as median and interquartile range (IQR), due to abnormal distributions. Pearson's chi-square test was used to assess differences between genders.

RESULTS

A total of 249 patients were included in the study, 50 patients in the donor nephrectomy (DN) group and 199 patients in the radical nephrectomy group (RN). One hundred and sixty-one (64.7%) patients were male. The median ages of the patients in the RN and DN groups were

60.0 (51.5, 68) and 39.5 (31, 48.5) years, respectively. The baseline characteristics of all patients are shown in Table 1. The pre-operative eGFRs were 68.6 ml/min/ 1.73m^2 and 88.8 ml/min/ 1.73m^2 in the RN and DN groups, respectively. During the first year postoperatively, renal function in the RN and DN groups decreased by approximately 25.6% and 27.2% from baseline, respectively. Post-operative renal function trends are shown in Figure 1. The changes in eGFR and percentages of change after the nephrectomies are shown in Table 2. None of the DN patients developed ESRD and received RRT.

DISCUSSION

The renal loss assessments after both RN and DN nephrectomies revealed a reduction of renal function over the long term follow ups. The degree of deterioration of renal function may depend on patient factors such as comorbidity, patient age or baseline eGFR. In our study, we evaluated renal function after RN and DN. The results suggested that both procedures decreased eGFR in long term follow up. The difference in decrease of eGFR between the RN and DN groups was not significant during the

Table 1 Baseline characteristics of radical nephrectomy and donor nephrectomy patients

Variable	All	Radical nephrectomy	Donor nephrectomy	p-value
Median age	55 (47.0, 65.0)	60 (51.5, 68.0)	39.5 (31.0, 48.5)	<0.001
Sex				
Male	161 64.7)	138 (69.3)	23 (46.0)	0.003
Female	88 (35.3)	61 (30.7)	27 (54.0)	
eGFR pre-operative	73.2 (57.5, 89.1)	68.6 (54.1, 83.7)	88.8 (80.5, 100.5)	<0.001

eGFR = estimated Glomerular filtration rate

Table 2 Comparison of post-operative trends and percentage of change in renal function after radical nephrectomy and donor nephrectomy

Period	eGFR			% change		
	Tumor	Donor	p-value	Tumor	Donor	p-value
Baseline (median IQR)	68.6 (51.5, 68)	88.8 (80.5, 100.5)	<0.001	0.0	0.0	–
1 month	52.5 (39.6, 71.1)	59.7 (52.9, 65.8)	0.067	-18 (-34.0, -0.2)	-35.2 (-39.5, -30.0)	<0.001
3 months	51.1 (36.8, 64.3)	57.6 (52.6, 66.4)	0.043	-23 (-36.8, -4.4)	31.3 (-36.7, -26.8)	0.058
6 months	52.3 (38.2, 67.1)	59.7 (57.2, 71.2)	0.005	-21.2 (-36, -1.6)	-27.7 (-31.6, -23.5)	0.192
12 months	51.3 (36.2, 64.4)	65.9 (57.9, 74)	<0.001	-25.6 (-36.8, -3.7)	-27.2 (-32.6, -17)	0.529

eGFR = estimated Glomerular filtration rate; IQR = interquartile range

first year of follow up (–25.6% in RN VS –27.2% in DN), but the pattern of changes in renal function was different between the groups. In the first month following the operations, the RN patients had a decrease of renal function of approximately 18%, while the donor patients had a decrease of 35.2%. During follow up patients with RCC will experience gradual decrease in function, but in the DN group eGFR will slightly increase overtime. A number of studies have explained the different patterns of renal function between living donors and patients following RN. The main reason for the difference is that donor patients tend to be younger and healthier than RCC patients. In addition, donors generally do not have significant comorbidities such as hypertension, obesity or diabetes mellitus.[8] The decline in renal function after RN has been reported in multiple studies. Kong et al. reported that the incidence of CKD after RN was 39.8% in their Korean cohort.[9] Huang et al. also reported that RN was a significant risk factor for the development of CKD, and concluded that RN might no longer be considered a standard treatment for small renal masses.[10] For this reason, for DN patients, the risk of CKD after donation is still controversial. Most studies have demonstrated that after DN the chance of developing ESRD is as low as the probability of ESRD among the general population. A Swedish group reported that six out of 1,112 kidney donors developed chronic renal insufficiency, which was just 0.5%.[11] However, chronic renal insufficiency can develop after DN, although the incidence is very low.

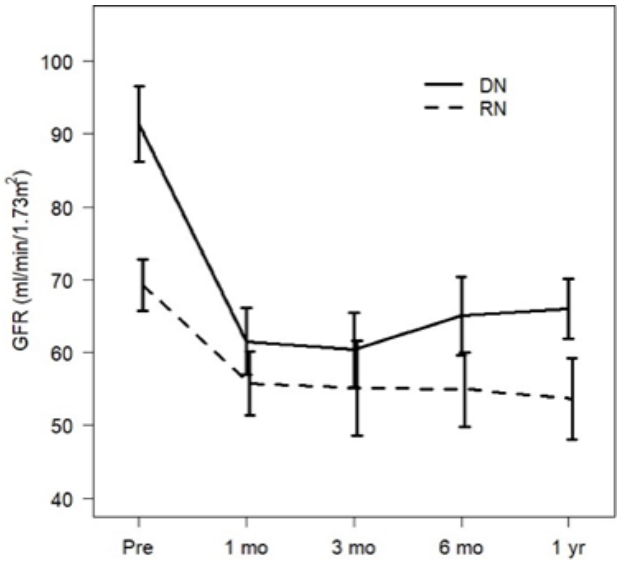

Figure 1 Preoperative and postoperative trends in renal function for radical nephrectomy and donor nephrectomy groups

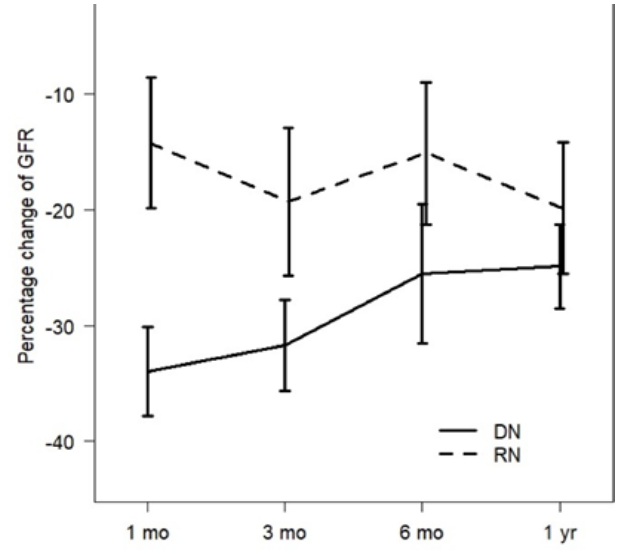

Figure 2 Percentage change or renal function over time

There were several limits to our study. This was a retrospective study, and was dependent on data that may affect the accuracy of the results. Also, there was no consensus program for follow up or imaging protocol for kidney donors after their donations. Additionally, urine protein was not routinely checked or monitored in our cohort. The weakness of this study is the period is not precisely log to observation. We believe these data could be useful to identify risks and decide on the best treatment strategy to protect patients whom are likely to develop kidney function deterioration.

CONCLUSION

Renal function after surgery declined after both RN and DN, but the patterns of changes in renal function were different, possibly due to younger and healthier patients in the DN group. Finally, there was no difference in the percentages of change in eGFR after RN and DN at the 1 year follow ups.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest that could be perceived as prejudicing the impartiality of the research reported.

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REFERENCES

1. Achermann C, Stenner F, Rothschild SI. Treatment, outcome and prognostic factors in renal cell carcinoma – A single center study (2000–2010). J Cancer 2016;7:921–7.
2. Lojanapiwat B. Urologic cancer in Thailand. Jpn J Clin Oncol 2015;45:1007–15.
3. Timsit MO, Nguyen KN, Rouach Y, Elie C, Loupy A, Fournier C, et al. Kidney function following nephrectomy: Similitude and discrepancies between kidney cancer and living donation. Urol Oncol 2012;30:482–6.
4. Escudier B, Porta C, Schmidinger M, Rioux–Leclercq N, Bex A, Khoo V, et al. Renal cell carcinoma: ESMO clinical practice guidelines for diagnosis, treatment and follow–up. Ann Onco 2019;30:706–20.
5. Vergho D, Burger M, Schrammel M, Brookman‐May S, Gierth M, Hoschke B, et al. Matched‐pair analysis of renal function in the immediate postoperative period: a comparison of living kidney donors versus patients nephrectomized for renal cell cancer. World J Urol 2015;33:725–31.
6. Shapiro R. End–stage renal disease in 2010: innovative approaches to improve outcomes in transplantation. Nat Rev Nephrol 2011;7:68–70.
7. Mjøen G, Øyen O, Midtvedt K, Dahle DO, Norby G, Holdaas H. Age, gender, and body mass index are associated with renal function after kidney donation. Clin Transplant 2011;25:E579–83.
8. Lee SH, Kim DS, Cho S, Kim SJ, Kang SH, Park J, et al. Comparison of postoperative estimated glomerular filtration rate between kidney donors and radical nephrectomy patients, and risk factors for postoperative chronic kidney disease. Int J Urol 2015;22:674–8.
9. Kong HJ, Park JS, Kim DY, Shin HS Jung HJ. Renal function following curative surgery for renal cell carcinoma: who is at risk for renal insufficiency? Korean J Urol 2013;54:830–3.
10. Huang WC, Levey AS, Serio AM, Snyder M, Vickers AJ, Raj GV, et al. Chronic kidney disease after nephrectomy in patients with renal cortical tumours: a retrospective cohort study. Lancet Oncol 2006;7:735–40.
11. Fehrman–Ekholm I, Norden G, Lennerling A, Holmdahl J, Kvarnstrom N, Olausson M. Incidence of end–stage renal disease among live kidney donors. Transplantation 2006; 82:1646–8.