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Risk Factors of Long-term Oncological Outcomes and Renal Function after Renal Organ Sparing Surgery in Solitary Kidney

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Risk factors for oncological outcomes and long-term renal function after partial nephrectomy remain controversial. Our aim was evaluating the effect of warm ischemia time (WIT), preoperative renal function, comorbidities, tumor stage, tumor number and volume of resected normal parenchyma on oncological outcomes and long-term renal function in patients with a solitary kidney. Using the Heidelberg urooncological databases, we identified 118 patients with a solitary kidney who underwent open partial nephrectomy. For all patients oncological and renal function data were included into our database. After exclusion of not appropriate datasets, analysis of survival time included 87 patients undergoing 98 procedures of partial nephrectomy. Analysis of long-term renal function included 75 patients undergoing 83 procedures of partial nephrectomy. For analysis of oncological outcome Kaplan-Meier survival analysis was used using log rank tests. For the study of long-term renal function a mixed effect model was used. To test the association and risk of various variables with oncological outcome and renal insufficiency univariate and multivariate analysis was performed.

In this study, mean preoperative estimate glomerular filtration rate (eGFR) was 58.72 mL/min per 1.73m² and mean ischemia time was 16.10 min (range: 0–65 min). Mean tumor size was 3.46 cm (range: 1–18 cm) and mean tumor number was 1.44 (range: 1-5). Mean follow-up time was 67.16 months (0.3-259 months). Mean overall survival (OS), progression-free survival (PFS) and cancer specific survival (CSS) time was 67.16, 50.28 and 67.16 months, respectively. On multivariable analysis using regression modelling, cardiovascular disease (CVD) was a risk factor of overall survival time (P=0.044, HR=2.41, 95%CI: 1.03-5.67). Additionally, total tumor number was a risk factor of progression-free survival time (P=0.001, HR=1.73, 95%CI: 1.26-2.37). Warm ischemia time and preoperative chronic kidney disease (CKD) stage showed no association with oncological outcomes. Analyzing renal function in the functional study cohort, mean preoperative eGFR was found to be 57.41 mL/min per 1.73m². Mean ischemia time was 18.04 min (range: 0–65 min). Mean tumor size was 3.38 cm (range: 1–12 cm) and mean tumor number was 1.36 (range: 1-5). Mean follow-up time was 69.39 months (12-247 months). Mean postoperative eGFR (the rate of change compared to baseline eGFR) was 48.92 mL/min per 1.73m² (85.76%), 48.84 mL/min per 1.73m² (83.73%), 52.82 mL/min per 1.73m² (88.92%) and 52.19 mL/min per 1.73m² (91.94%) at 12, 36, 60 and 120 months, respectively. On multivariable analysis, adjusting for age and comorbidities factors, perioperative acute renal failure (ARF) event was significantly associated with renal function loss at postoperative 12 months period (P<0.01). Only resected volume of normal parenchyma was significantly associated with renal function change during the whole follow-up period (P=0.03 at 12 months, P<0.01 at 36 and 60 months). The preoperative CKD stage was significantly associated with renal function at postoperative 12 months (P=0.01). Perioperative ARF event significantly affected postoperative renal function at postoperative 12 months (P=0.001) and 60 months (P=0.03) period. Warm ischemia time was not a direct risk factor of long-term postoperative renal function. Limitations include the retrospective nature of the study.

In conclusion, partial nephrectomy (PN) is suitable not only in T1a, but also in T1b renal cell carcinoma (RCC). The procedure is also acceptable for multifocal RCC in solitary kidney.

The CVD as a comorbidity and resected tumor number are an independent risk factor for OS after PN. Additionally, the quantity of preserved functional parenchyma volume was the main determinant for long-term kidney recovery. Moreover, the quality of preoperative kidney primarily determines recovery of renal function. Furthermore, WIT was indirectly associated with postoperative renal function leading to a higher rate of perioperative ARF. Acute renal failure was an independent risk factor influencing both recovery capacity and renal function level in long-term postoperative duration.