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Predictive factors of chronic kidney disease stage V after partial nephrectomy in a solitary kidney: a multi-institutional study

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Abstract

Objective: Partial Nephrectomy (PN) in a solitary kidney is at risk of chronic kidney disease (CKD) stage V and/or haemodialysis (HD). Our objective was to determine predictive factors of CKD stage V in this population.

Material & Methods: Data from 300 patients were retrospectively collected from 16 tertiary centres. Clinical and operative parameters, tumor characteristics and renal function before surgery were analyzed. Patients with and without CKD stage V (defined as MDRD <15 ml/min) were compared using $\chi 2$ and Student-t tests for qualitative and quantitative variables, respectively. Predictive factors of CKD stage V were evaluated with a multivariable analysis using a Cox regression model.

Results: Median age and BMI were 63 years old and 26 kg/m^2, respectively. Most of the patients (65%) were male with an anatomic solitary kidney (88.3%). Median tumor size was 4 cm and 98% were malignant tumors. Median operative time, blood loss and clamping time were 180 min, 350 ml and 20 min respectively. Renal cooling was used in 19.3% and clamping of the pedicle was performed in 61.6%. Twenty five patients (8.5%) presented post operative CKD stage V at last follow-up and 18 underwent HD (6%) post-operatively because of acute renal insufficiency. There was no difference between CKD stage V and non CKD stage V patients concerning Charlson index, operative time (180 min vs 179 min, $p = 0.39$), blood loss (475 ml vs 350 ml, $p = 0.51$), use of renal cooling and type of clamping. Patients with CKD stage V were older (70 vs 63 years old, $p = 0.005$), had a lower baseline renal function (clearance MDRD 41 vs. 62 ml/min, $p < 0.0001$) and an increased tumor size ($p = 0.02$). Complications occurred in 91 patients (30%) with 16% of minor (Clavien 1–2) and 14% of major (Clavien $>$ 2) complications, respectively. In multivariable analysis, baseline MDRD, BMI, and the occurrence of a minor complication were independent predictive factors of post operative CKD stage V.

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Conclusion: PN in a solitary kidney is at risk of post-operative CKD stage V and HD. Pre-operative altered renal function and post operative complications are the main predictive factors of permanent CKD stage V.

Keywords: Renal cell carcinoma; Conservative surgery; Kidney cancer; Renal failure

1. Introduction

With the widespread use of abdominal imaging over the last decades, the detection of small incidental renal tumors has significantly increased. The management of patients with a tumor in a solitary kidney is particularly challenging. In that situation, the potential benefits have to be balanced against the morbidity associated to partial nephrectomy (PN). Less invasive options such as surveillance or thermo-ablation are available. Many factors, including tumor characteristics and patient's competing risks should be taken into consideration.

Besides ensuring optimal oncological control, the preservation of renal function is a major goal of PN. Those patients with a tumor in a solitary kidney (whether anatomical or functional) are at risk of renal insufficiency and/or HD (HD) [1]. It has been demonstrated that a decreased renal function was an independent predictive factor of mortality [2] and patients who require HD have a 35% 5-year survival rate, and a life expectancy that is decreased fourfold compared to healthy subjects [3]. Additionally, preoperative renal insufficiency is more common than originally thought in patients with a renal tumor [4].

The objective of this study was to identify predictive factors of post-operative CKD stage V in patients undergoing PN for a renal tumor in a solitary kidney in order to assist the clinicians in their decision in this particular situation.

2. Material & Methods

2.1. Patient selection

This was a retrospective study that included 300 patients who underwent PN for a tumor in a solitary kidney between 1985 and 2010. After local approval, data was extracted from kidney cancer databases from 16 tertiary urological centres with common practice of PN in France, Netherlands, Sweden, Italy, Israel and in the United States.

2.2. Variables

Clinical parameters included age, gender, body mass index (BMI), Charlson comorbidity index, history of hypertension or diabetes mellitus, Eastern Cooperative Oncology Group (ECOG) performance status (PS), ASA score, immediate and/or transient and/or permanent post operative HD, and delay to HD. Data regarding kidney function outcome included pre and post-operative glomerular filtration rate (GFR) estimated by the abbreviated Modification of Diet and Renal Disease (MDRD) equation [5]. CKD stage V was defined as a MDRD level < 15 ml/min at last follow-up [6]. Pathological features included tumor size, histology (benign vs. malignant), TNM stage, and Fuhrman grade. The following peri-operative parameters were recorded: type of surgery (open or laparoscopic), operative time, renal cooling, blood loss and transfusion rate, clamping time and type of renal clamping (parenchymal, pedicle, no clamping), location of the tumor, complications (graded according to Clavien's classification), and length of hospital stay.

2.3. Statistical analyses

The selection process began with univariate analysis of each variable. For nominal, ordinal, and continuous variables, we performed a contingency table of outcome versus the k levels of the independent variable. The Fisher exact test and Exact Cochran-Armitage Trend Test were used and individual odds ratios along with 95% confidence interval using one of the levels as a reference group were estimated using a logistic regression model. For continuous variables, we used two-sample Wilcoxon test. Any variable which univariate test had a p-value <0.25 was considered as a candidate for the multivariate model. We began with a model containing all selected variables. Following the fit of the multivariate model, the importance of each variable was verified by examining the Wald statistics and comparing each estimated coefficient with the coefficient from the univariate model. For continuous scaled variables we checked the assumption of linearity in the logit. We broke the range of the continuous independent variable into 5 groups (quintiles) and we treated the grouped independent variable as if it were categorical with the lowest group serving as the referent group. We plotted the estimated coefficients versus the midpoint of the groups and chose the most logical shape for the model through simple eyeball assessment. Since CKD stage V was the endpoint of the study, it was not considered as a complication in the statistical analysis.

3. Results

3.1. Patients' characteristics, operative and pathological parameters

All the characteristics are listed in Table 1. Most of the patients were male (65%) with a median age of 63 years old. They had an anatomical solitary kidney in 88.3% of the cases. Charlson index comorbidity was ≥ 3 in 55.7% of the patients.