Original Study

Does Ureteral Catheter Insertion Decrease the Risk of Urinary Leakage After Partial Nephrectomy in Patients With Renal Cell Carcinoma?

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Abstract

We evaluated the impact of ureteral catheter insertion on urinary leakage after partial nephrectomy (PN) in 893 patients. Ureteral catheter insertion does not appear to reduce the risk of urinary leakage after PN, and visibility during PN with meticulous bleeding control is important for preventing urinary leakage after the procedure.

Introduction: We aimed to evaluate the impact of preoperative ureteral catheter insertion on urinary leakage after partial nephrectomy (PN) in patients with renal cell carcinoma. **Methods:** We reviewed the data of 893 patients with renal cell carcinoma who underwent PN and divided them according to ureteral catheter placement. The impact of ureteral catheter placement on postoperative urinary leakage was evaluated by using multivariate analysis. **Results:** Ureteral catheters were inserted in 397 (44.5%) patients. Patients with ureteral catheter insertion had larger tumors (2.4 vs. 2.6 cm; $P = .031$); however, the RENAL nephrometry scores were comparable ($P = .131$). Robotic PN was more common in patients with ureteral catheters (11.1 vs. 53.9%; $P < .001$). Urinary leakage did not differ according to ureteral catheter placement (3.4 vs. 3.5%; $P = .936$). Although tumor size ($P = .002$), ureteral catheter insertion ($P < .001$), and operative methods ($P < .001$) were significantly different according to surgeons, the rate of urinary leakage was similar (surgeon A: 4.0%, surgeon B: 4.6%, surgeon C: 1.5%, others: 2.9%; $P = .294$). In multivariate analysis of preoperative variables, age and RENAL nephrometry scores were associated with urinary leakage. In multivariate analysis of preoperative and intraoperative variables, the operative method, collecting system status, and intraoperative transfusion, but not ureteral catheter insertion, were related to urinary leakage. **Conclusions:** Ureteral catheter insertion does not appear to reduce the risk of urinary leakage after PN, and visibility during PN with meticulous bleeding control is important in preventing urinary leakage after PN.

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Introduction

Partial nephrectomy (PN) has been considered the standard treatment for T1a renal cell carcinoma (RCC).[1] Moreover, PN has been reported to be a feasible treatment option for more complex or larger renal masses.[2] However, patients undergoing PN are generally considered at a higher risk for postoperative complications than those treated with radical nephrectomy.[3] Tumor size and complexity are considered reliable predictors of the development of postoperative complications after PN.[4,5]

Urinary leakage is a unique postoperative complication associated with PN, and is reported to occur in 0.8% to 15.2% of patients who undergo this procedure.[6-8] Although most PN-induced urinary leakage resolves with conservative management,[9,10] patients with urinary leakage generally require longer hospital stays. Moreover, surgical treatment needs to be considered in some patients. In a previous study, certain tumor characteristics and operative factors were determined to be risk factors for urinary leakage after PN.[8]

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Nonetheless, there is a need for surgical techniques or perioperative interventions aiming at reducing the risk for urinary leakage after PN.

Preoperative ureteral catheter (UC) placement is considered an attractive method for detecting defects in the collecting system during surgery, and thus might be useful in preventing urinary leakage.[9] If the UC is located at the proper site before surgery, injuries to the collecting system during renal tumor resection could be easily identified by means of infusion of saline-diluted methylene blue through the UC. Moreover, maintenance of UC placement after surgery could improve the passage of urine in the kidney in which PN was performed, and might lower the pelvicalyceal pressure. These factors might influence the risk of urinary leakage after PN. Similarly, in patients with major renal trauma who experience urinary leakage, ureteral stent insertion is considered a safe and effective treatment for urinary leakage.[11] However, the impact of UC insertion on urinary leakage after PN has not been fully established. In this study, we evaluated the impact of preoperative UC insertion on postoperative urinary leakage after PN. In addition, we describe here the management and outcome of urinary leakage.

Methods

This study was approved by the institutional review board of the relevant institution. The medical records of 1081 patients with RCC who underwent PN from 1998 to 2012 at Asan Medical Center were reviewed. From this initial sample, 177 patients with no information about preoperative UC insertion and 11 patients who underwent resection of synchronous multiple renal masses were excluded before the analysis. Finally, 893 patients with RCC who underwent PN were included in the analysis.

The surgical approach was selected on the basis of the tumor characteristics, socioeconomic status of patients, and surgeon's preference after sufficient consultation. During PN, all renal tumors were generally excised with sufficient resection margin. Enucleation was seldom performed regardless of the operative method and surgeon. All surgeries were performed by 10 surgeons, including 3 surgeons with an extensive experience in PN (> 200 cases). Preoperative UC insertion was performed according to the clinician's preference and judgment about the tumor characteristics, including tumor size and complexity. Cystoscopic-guided UC placement was performed under fluoroscopic guidance before PN. The tip of the UC was located at the ureteropelvic junction and ligated to a Foley catheter to prevent spontaneous removal of the UC. During the surgery, the status of the collecting system was evaluated (not opened vs. opened vs. unknown) and recorded by the surgeons. If any collecting system defect was suspected, saline-diluted methylene blue was intraoperatively infused though the UC during and/or after collecting system repair to ensure that the repair was complete. In patients without UC placement, defects in the collecting system were only visually evaluated and repaired. In these patients, the completeness of the collecting system was not intraoperatively evaluated with saline-diluted methylene blue infusion.

A single surgical drain (Jackson-Pratt drain) was generally inserted at the operative site. On postoperative day 1, the creatinine level in the postoperative drainage fluid was generally measured according to operative findings, and this level was compared with the serum creatinine level. If urinary leakage was suspected according to the creatinine level or the amount of drainage fluid, the creatinine level in the postoperative drainage fluid was monitored until normalization. In these cases, double J (DJ) stent and/or percutaneous drainage (PCD) insertion was performed according to the clinician's judgment. Urinary leakage was defined as follows: significantly elevated creatinine levels in the postoperative drainage fluid compared with serum creatinine levels at any time point before surgical drain removal, and/or visible urinary leakage on retrograde pyelography generally performed on postoperative day 2 by using the preoperatively inserted UC. If there was no evidence of urinary leakage, the UC was generally removed on postoperative day 2, and postoperative drains were generally removed between postoperative days 2 and 4.

The patients were divided into 2 groups according to preoperative UC placement (inserted vs. not inserted), and clinicopathologic characteristics were compared by using the Pearson χ^2 test for categorical variables and the Student t test for continuous variables. Categorical variables were expressed by using a frequency table, and continuous variables were expressed as means $\pm$ standard deviation. The preoperative glomerular filtration rate was calculated by using the Modification of Diet in Renal Disease equation.[12] Perioperative outcomes, including urinary leakage, presence of intraoperative transfusion, day of postoperative drain removal, length of postoperative hospital stay, need for postoperative angioembolization because of bleeding, and 90-day readmission rate were evaluated according to UC insertion. In addition to tumor characteristics and surgical variables including UC insertion, the operative methods and rate of urinary leakage were also evaluated according to the surgeon after dividing the patients into 4 groups (each surgeon with extensive experience [surgeon A-C.S.K., B-H.A., and C-C.S.] and the other surgeons). Furthermore, univariate and multivariate logistic regression analyses were performed to determine the variables associated with urinary leakage after PN, by comparing with preoperative variables. Multivariate analyses of preoperative and intraoperative variables were also performed. Variables with a P value of $< .05$ on univariate analysis were selected for multivariate analysis. All statistical comparisons were performed with IBM SPSS Statistics version 21 (IBM Corporation, Armonk, NY). A P value of $< .05$ was considered statistically significant.

Results

Among 893 patients who underwent PN, UCs were inserted in 397 (44.5%) patients (Table 1). Although patients with preoperative UC placement were younger than those without UC insertion (54.8 vs. 52.7 years; $P = .008$), there were no differences in clinical characteristics between the 2 groups, including gender, body mass index, American Society of Anesthesiologists performance status, and past medical history including diabetes and hypertension. Tumor size was larger in patients with UC placement (2.4 vs. 2.6 cm; $P = .031$); however, the RENAL nephrometry scores were comparable between the 2 groups. Robotic PN was more commonly performed (11.1% vs. 53.9%; $P < .001$), and ischemia time was longer (19.3 vs. 24.6 minutes; $P < .001$) in patients with UC insertion than in those without. Intraoperative transfusion was more frequently performed in patients without UC placement (7.9% vs.