Percutaneous endoscopic treatment of benign and malignant renal pelvis carcinoma: A single-center experience

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Abstract

Background Percutaneous nephrolithotomy (PCNL) is a safe and efficient treatment for intro-renal diseases, most of which are calculus disease. In this study, we carried out percutaneous endoscopic nephron-sparing ablation for renal carcinoma in carefully selected patients. Our aim was to evaluate whether percutaneous endoscopic nephron-sparing operation was feasible for patients with renal cell carcinoma.

Methods A total of 15 patients with renal pelvis carcinoma were treated with laser evaporation under percutaneous endoscopy between January 2015 and September 2019 (group I). Another 13 patients who received standard radical nephroureterectomy were recruited as the control group (group II). We recorded demographic data of the patients, the indication for surgery, tumor pathological grade, size and side of tumor, and the intraoperative and postoperative outcome, including the duration of surgery, length of hospital stay, and complication rate, as well as progression-free survival (PFS).

Results In both groups, all of the patients received flexible ureteroscopy. In group I, 14 patients had transitional renal cell carcinoma (UCC), four had pathological grade I, nine had grade II, and one had hemangiopericytoma. In group II, all patients had UCC, five had pathological grade I, and eight had grade II. In group I, the mean operation time was 118 min (65–236 min), the mean blood loss was 110 ml (55–220 ml), and the mean hospital stay was 9 days (7–12 days). During follow-up, two patients died and two had recurrence; among them, one had systematic bone metastasis. The PFS rate was 66.7% (10/15). In group II, the mean operation time was 265 min (185–436 min), the mean blood loss was 133 ml (85–240 ml), and the mean hospital stay was 13 days (9–16 days). During the follow-up, two patients died and there was no local or systematic metastasis. The PFS rate was 84.6% (11/13). There was no significant difference in blood loss between the groups. However, the operation time and mean hospital stay were significantly shorter in group I compared with that in group II ($P < 0.05$). But the PFS rate was significantly higher in group II than in group I ($P < 0.05$).

Conclusions This study shows that laser evaporation under percutaneous endoscopy for renal pelvis carcinoma is a safe, effective, and technically feasible procedure for treating benign and malignant renal pelvis carcinoma.

Introduction

Upper urinary tract urothelial cell carcinoma (UUT-UCC) is still a life-threatening disease. Among UUT-UCCs, renal pelvis carcinoma, which evolves from the renal pelvis and renal calyces, comprises 10% of malignant carcinoma in the kidney. The estimated annual incidence of UUT-UCCs in Western countries is 1–2 new cases/100,000⁽¹⁾, and the frequency of urothelial tumors of the upper tract is increasing^(2,3). Most of the pathological types are transitional cell carcinoma (TCC), and squamous cell carcinoma and adenocarcinoma comprise a small portion. Clinically encountered urothelial cell carcinoma (UCC) can evolve from any location covered by transitional cells and it should be treated as a whole instead of that

separately. UCC is usually found in patients aged older than 40 years, and UUT-UCC is three times more prevalent in men than in women^(4, 5). There is no difference in the morbidity of UUT-UCC between the left and right kidneys. UUT-UCC can involve both sides in approximately 2–4% of patients^(6, 7). The morbidity of renal pelvis TCC is not as high as that for bladder TCC, but the high recurrence rate and progressive trend are similar in the two types of TCC. A total of 60% of UUT-UCCs are invasive at diagnosis compared with only 15–25% of bladder tumors. In 17% of cases of UUT-UCC, concurrent bladder cancer is present. Recurrence of disease in the bladder occurs in 22–47% of patients with UUT-UCC, whereas recurrence in the contralateral upper tract is observed in 2–6% of patients. In upper urinary tract UCC, a large portion is high grade and invasive cases. Furthermore, in high-grade upper urinary tract UCC, 10–40% of muscle invasive UCC and lymph metastasis are ignored⁽⁸⁾.

The prognosis of UTCC is closely related to tumor grading and staging⁽⁹⁾. Typical treatment for renal pelvis TCC is radical nephroureterectomy, including removal of the ipsilateral ureter orifice. Before wide use of laparoscopic surgery, open radical nephroureterectomy was widely applied with either one or two separate incisions. The ureterovesical junction is dissected either from inside of the bladder or outside. For a long time, TCUCC was considered a life-threatening disease and the 5-year overall survival rate was only 50%.

Nephron-sparing procedures are performed for some selected patients with localized early-stage renal pelvis TCC, for some patients with a solitary or functional solitary kidney with renal pelvis TCC, or for those who are reluctant to receive nephrectomy. These procedures include bench surgery and autotransplantation, flexible ureteroscopy, and percutaneous percutaneous endoscopic surgery.

In this prospective study, we used laser evaporation under percutaneous endoscopy in some carefully selected patients and compared them with a control group to study the efficacy and safety of this nephron-sparing procedure.

Methods

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Research Ethics Committee of Beijing Chaoyang Hospital(No. 2015-3-17-102).Written informed consent was obtained from all patients.

Selection of patients

This study gained approved of ethnic committee of Beijing Chaoyang Hospital. In this prospective study, 28 patients with renal pelvis carcinoma were recruited from June 2016 to September 2019. Recruitment criteria included all of the following: a unifocal tumor, no evidence of an infiltrative lesion on computed tomography of urology, and the patients provided consent for close follow-up after the operation. Among them, 15 patients had percutaneous endoscopic laser ablation and were classified as group I (study group). These included eight patients who were unwilling to receive nephrectomy, three with diabetes and elevated blood creatinine levels, one with a congenital solitary kidney, two with a functional solitary kidney with atrophy, and one in whom the pathology result was benign renal pelvis carcinoma. The other 13 patients with renal pelvis TCC who received radical nephroureterectomy were classified as group II (control group).

Procedure

In both groups, specimens for a pathological examination were obtained with flexible ureteroscopy before the operation.

In group I, 15 patients were treated with endoscopic laser evaporation under percutaneous endoscopic laser ablation. A percutaneous tunnel was established under ultrasound guidance and then dilated to F24(Figure 1 ,2). The tumor was evaporated with laser under percutaneous nephroscopy(Figure3,4,5). And then regular follow up with flexible ureteroscopy(Figure 6). In group II, 13 patients received laparoscopic radical nephroureterectomy. Among them, two patients were transferred to open surgery because of serious adhesion.

We collected data on demographics of the patients, the indication for surgery, tumor pathological grade, tumor size and side, and intraoperative and postoperative outcome, including the duration of surgery, length of hospital stay, and complication rate, as well as the patient's progression-free survival (PFS).

Statistical analysis

Analysis was carried out using SPSS software version 20 for Windows (IBM Corp., Armonk, NY, USA). Comparative t-test analysis was used between the two groups. A P value <0.05 was considered statistically significant.

Results

Among the patients with renal pelvis carcinoma, there were 21 men and seven women, with mean age of 56 years (range from 33–78). All patients received flexible ureteroscopy at 7–22 days before tumor ablation or nephrectomy. The tumor size ranged from 1.0–4.5 cm. With regard to pathology, 27 patients had epithelial cell carcinoma, 14 had grade I, 13 had grade II, and one in group I had benign hemangiopericytoma.

There were no significant differences in age, sex, tumor size, and pathological grading between the two groups. Postoperation, the follow-up time was 1–56 months, with a mean follow-up of 32 months.

In group I, the mean operation time was 118 min (65–236 min), the mean blood loss was 110 ml (55–220 ml), and the mean hospital stay was 9 days (7–12 days). During follow-up, two patients died and two had recurrence; among them, one had systematic bone metastasis. The PFS rate was 66.7% (10/15).

In group II, the mean operation time was 265 min (185–436 min), the mean blood loss was 133 ml (85–240 ml), and the mean hospital stay was 13 days (9–16 days). During the follow-up, two patients died and there was no local or systematic metastasis. The PFS rate was 84.6% (11/13).

There was no significant difference in blood loss between the two groups. However, the operation time and mean hospital stay were significantly shorter in group I than in group II (both $P < 0.05$). The PFS rate was significantly higher in group II than in group I ($P < 0.05$). (See table 1 and 2)

Discussion

UUT-UCC is a frequently encountered disease that urologists have experienced for a long time. Like UCC of others evolved from other location, the etiology of UUT-UCC is still unclear. Among possible factors involved in UUT-UCC, the most clearly related factor is smoking⁽¹⁰⁾. Other involved factors include those associated with the workplace, such as dye manufacturing, rubber chemistry, pharmaceutical producing, painting, and leather manufacturing^[11]. Additionally, chronic infection, including human papillomavirus and schistosome infection, can be responsible for UUT-UCC. Another possible factor related to UUT-UCC is inheritance. Absence or loss of heterozygosity of tumor suppressor genes, such as P53, Rb, and p21, can lead to susceptibility.

Standard treatment of UUT-UCC is radical nephroureterectomy. In past decades, organ-sparing surgery or precise surgery in other surgical fields has rapidly developed and dramatically changed the surgeon's concept. However, because of the high malignancy of UUT-UCC, it is still regarded as a lethal disease. Therefore, kidney-sparing surgery is not commonly considered for this disease.

In our clinical practice, we first carried out this nephron-sparing procedure in patients with a special condition, such as those with a congenital solitary kidney or functional solitary kidney, or those unwilling to receive radical nephrectomy. Local re-occurrence or the metastasis rate is still high during the postoperation follow-up in these patients. In recent years, based on evidence-based medicine, many guidelines have recommended strict criteria for kidney-sparing surgery in patients with UUT-UCC. These include a unifocal tumor, tumor <1 cm, low-grade tumor, no evidence of an infiltrative lesion on CTU, and understanding of strict follow-up after surgery. A laser should usually be used for endoscopic treatment and flexible ureteroscopy is preferred to rigid ureteroscopy, regardless of whether the tumor is in the renal pelvis, or distal-, mid-, or proximal ureter.

In previous reports, most of these procedures were finished by laser via flexible ureteroscopy. This retrograde pathway is often affected by the condition of the ureter and a large portion of patients require placement of the ureteral sheath first before a second-stage treatment. When using a flexible ureteroscope, several factors, such as a narrow and confined space, make tumor ablation difficult and slow, and increase the chance of infection. Additionally, tumors are sometimes not accessible, especially for tumors at the inferior calices. With wide application of percutaneous endoscopic surgery, it is no longer only suitable for kidney stone treatment. The percutaneous approach has advantages, including a wide lumen space, sufficient liquid outflow, and accessibility to target calices. Percutaneous endoscopy surgery can provide a better view, and more importantly, it can lower renal pelvic pressure by free liquid outflow and significantly reduce occurrence of postoperation sepsis compared with flexible ureteroscopy. Furthermore, bladder chemotherapy can also be applied via a renal fistula tube after this procedure. After removal of the fistula, bladder instillation therapy can be performed when ureter double-J stent was still kept.

In previous research, no report using percutaneous endoscopy laser ablation patients with UCC was reported. In our study, we compared patients with renal pelvis carcinoma who were treated with laser evaporation under percutaneous endoscopy and those who had standard radical nephroureterectomy. This is the first prospective study to compare these treatments in Chinese patients with UUT-UCC. Our preliminary study showed that laser evaporation under percutaneous endoscopy for renal pelvis carcinoma was a safe, effective, and technically feasible procedure for treating benign and malignant

renal pelvis carcinoma. However, our findings require further confirmation with a larger number of samples.

Declarations

Consent for publication

All data and images in the article have been consent to publish from related patients.

Availability of data and material:

All data and operation video can be searched from data base in Dept. of Urology , Beijing Chaoyang Hospital

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none

Conflicts of interest

There are no financial conflicts of interests to disclose.

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Author Contributions:

Dr. Zhang,Xin and Xiuwu Han performed the operations

Yansheng Li , Yuanhao Chen contributed significantly to post-operation follow up

Yuzhe Tang performed statistics analysis

Peng Zhang, Tao Li and Siyuan Wang contributed to data collection

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Tables

Table 1 Baseline characteristics of patients in groups I and II

Characteristics	Group I	Group II	P values
Number of patients(n)	15	13	
Age	54(33-75)	57(35-78)	0.432
Male gender	11	10	0.525
Tumor location(left vs right)	7 vs 8	9 vs 4	
Tumor size(cm)	2.0(1.5-3.2)	3.2(2.5-4.5)	0.737
Pathology grade I	4	5	
Pathology gradeII	9	8	

Table 2 Treatment characteristics of groups I and II

Characteristics	Group I	Group II	P value
mean operation time(min)	118(65-236)	265(185-436)	0.35
average blood loss(ml)	110(55-220)	133(85-240)	0.78
mean hospital stay(days)	9(7-12)	13(9-16)	0.03
PFS during follow up period	10/15	11/13	0.02

Figures

Figure 1

Photograph showing puncture and dilation to establish PCNL access.

Figure 2

Ultrasound-guided PCNL to establish access.

Figure 3

Endoscopic view of renal carcinoma in PCNL.

Figure 4

Biopsy of a tumor via PCNL.

Figure 5

Laser evaporation under PCNL.

Figure 6

Follow-up 3 months after laser evaporation under PCNL.

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