Percutaneous Renal Cryoablation After Partial Nephrectomy: Technical Feasibility, Complications and Outcomes

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Purpose: Treatment of locally recurrent or de novo tumors in the ipsilateral kidney after partial nephrectomy represents a management dilemma. Percutaneous renal cryoablation offers a minimally invasive treatment option in such cases. We review our single institution experience with percutaneous cryoablation of renal tumors after partial nephrectomy for technical feasibility, complications and outcomes.

Materials and Methods: Between March 2003 and January 2012, 48 patients underwent percutaneous cryoablation for the treatment of 68 ipsilateral renal tumors after previous partial nephrectomy. Oncologic outcomes, complications (Clavien-Dindo classification system) and renal function were evaluated.

Results: Median maximal diameter of the treated renal tumors was 2.5 cm (range 1.2 to 5.4). All cryoablation procedures were considered technically successful. Of the 54 biopsy proven or suspected renal cell carcinomas with 3 or more months of computerized tomography/magnetic resonance imaging followup after cryoablation (median 19, range 3 to 61), 5 cases (9.3%) had local tumor recurrence. Major (grade 3 or greater) complications developed after 3 (5.7%) cryoablation procedures and there were no perioperative deaths. Median change in patient estimated glomerular filtration rate after renal cryoablation was −1.5 ml per minute. No patients required dialysis in the perioperative period, while 2 with stage 4 chronic kidney disease at the time of ablation became dialysis dependent at 5 and 23 months after treatment, respectively.

Conclusions: Percutaneous renal cryoablation after ipsilateral partial nephrectomy is technically feasible, has a low rate of major complications, provides relative preservation of renal function and demonstrates acceptable short-term oncologic outcomes in this challenging population.

Key Words: kidney, ablation techniques, outcome assessment, treatment outcome

Abbreviations and Acronyms

CT = computerized tomography

eGFR = estimated glomerular filtration rate

MRI = magnetic resonance imaging

RCC = renal cell carcinoma

Accepted for publication October 22, 2012.

Study received institutional review board approval.

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Partial nephrectomy represents an excellent treatment option for patients with small renal tumors, with low associated complication rates as well as exceptional oncologic and renal functional outcomes.[1,2] Although rare, locally recurrent or de novo tumors may arise in the ipsilateral renal unit. Treatment of these tumors is challenging since repeat renal exposure and partial nephrectomy are technically difficult, and associated with relatively higher perioperative complications, renal loss and local tumor recurrence rates.[3,4]

0022-5347/13/1894-1243/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2012.10.066
Vol. 189, 1243-1248, April 2013
Printed in U.S.A.

Percutaneous cryoablation has been found to be an effective and safe treatment option for select patients with small renal tumors.[5–10] The long-term efficacy of this technique has yet to be established. However, percutaneous cryotherapy does represent an attractive option for the management of locally recurrent or new ipsilateral renal tumors after partial nephrectomy. With this approach the need for repeat renal exposure and the potential associated complications of surgical dissection in a previously operated field are avoided. To our knowledge, percutaneous cryoablation in such patients has not been previously reported. Therefore, we reviewed our institutional experience with percutaneous cryoablation of renal tumors after partial nephrectomy for technical feasibility, complications and outcomes.

MATERIALS AND METHODS

Study Design and Population

This study was approved by the Mayo Clinic institutional review board. Retrospective review of our renal cryoablation database demonstrated that 378 patients underwent 399 separate cryoablation procedures for the treatment of 430 renal masses between March 2003 and January 2012. Of these patients 48 (12.7%) were treated for 1 or more new or locally recurrent tumors in the same kidney that had been previously treated with partial nephrectomy. Prior excised tumor pathology for these patients is detailed in table 1. Notably 5 of the 77 (6.5%) originally resected RCCs had positive surgical margins. These 48 patients who underwent 53 separate cryoablation procedures for the treatment of 68 renal tumors represented the study population.

Cryoablation Procedure

Percutaneous renal cryoablation was performed as previously described.[5,9,10] All patients underwent formal consultation at the Department of Urology before treatment. All renal masses were treated in a single cryoablation session by 1 of 5 ablation radiologists with the patient under general anesthesia. No staged ablation treatments were performed. The Endocare cryoablation system (Endocare Inc., Irvine, California) and Perc-24 cryoprobes were used in all cases. A median of 2 (range 1 to 5) cryoprobes were placed in the tumors using ultrasound and/or CT guidance. A typical freeze-thaw-freeze cryoablation cycle was performed for the treatment of each mass, with a duration of freezing based on coverage of the tumor by the ice ball using CT monitoring every 2 to 4 minutes. Median freeze times were 10 minutes (range 4 to 14) for the first freeze and 8 minutes (range 4 to 12) for the second freeze. An approximately 5-minute passive thaw was performed between the 2 freeze cycles. After the second freeze an approximately 10-minute active thaw was performed before removal of the cryoprobes.

Core biopsies of the masses were obtained from 42 of 68 (61.7%) renal masses at the time of ablation using an 18 gauge × 2 cm biopsy device (Bard Monopty®). The ablation was performed immediately after the biopsy, before biopsy review. The 26 tumors that were not biopsied were assumed to represent malignancy based on imaging appearance and patient history of 1 or more previously resected, biopsy proven RCCs in the ipsilateral kidney.

Hydrodisplacement was required in 17 of 53 (32.1%) procedures to protect the adjacent bowel using the technique described by Bodily et al.[11] Externalized ureteral stents were placed and pyeloperfusion was performed during 9 (16.9%) procedures due to proximity of the ureter using a technique similar to that reported by Cantwell et al.[12]

Table 1. *Original excised tumor pathology*

	Grade 1	Grade 2	Grade 3	Grade 4	Not Specified	Totals
No. RCC:						77
Clear cell	5	40	8	0	4	57
Papillary	3	12	1	0	0	16
Mixed	1	1	0	0	0	2
Chromophobe	1	1	0	0	0	2
No. oncocytoma						13
No. angiomyolipoma						3

Followup and Outcome Analysis

As adapted from the International Working Group on Image-Guided Tumor Ablation,[13] technical success was defined as extension of the ice ball at least 0.5 cm beyond the tumor margins on monitoring noncontrast CT performed during the procedure and/or extension of the ablation zone beyond the tumor margins on contrast enhanced CT or MRI performed within 3 months of the ablation. Contrast enhanced CT or MRI of the abdomen was obtained within 24 hours of the ablation after 45 of the 53 (84.9%) ablation procedures. Local tumor recurrence was defined as an enhancing or enlarging soft tissue nodule within or immediately adjacent to the ablation zone on contrast enhanced CT or MRI performed 3 or more months after ablation. Followup CT or MRI beyond 3 months was available for evaluation of 63 of 68 (92.6%) treated renal masses (fig. 1).

Complications were assessed using the revised Clavien-Dindo classification system.[14] Any grade 3 or greater complication was considered a major complication. Renal function outcomes were assessed by glomerular filtration rate estimated from serum creatinine levels using the Modification of Diet in Renal Disease equation.[15] All patients were treated by the Department of Urology after the ablation procedure, including overnight observation.

Statistical Methods

Standard descriptive statistics were used to summarize the sample data. Overall survival was estimated from the date of cryoablation to the date of last clinical followup or date of death, whereas local recurrence-free survival was estimated from the date of ablation to the date of last imaging followup or when followup imaging detected a locally recurrent tumor. The product limit (Kaplan-Meier) estimator was used to estimate each survival function after ablation. Survival curves were displayed with a step-