CLINICAL STUDY

Disappearance of Renal Cysts Included in Ice Ball During Cryoablation of Renal-Cell Carcinoma: A Potential Therapy for Symptomatic Renal Cysts?

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ABSTRACT

Purpose: To retrospectively evaluate the effect of cryoablation of renal-cell carcinoma on nearby renal cysts with the goal to investigate the potential for an alternative therapy to treat symptomatic renal cysts.

Materials and Methods: The study population comprised 46 cysts (mean size, 12 mm; range, 5–43 mm) that were within or near the ice ball during cryoablation in 22 patients. Size change of each cyst was evaluated via enhanced CT or MR imaging before and 1, 3, 6, and 12 months after cryoablation. Forty-one cysts were also followed after 12 months. Variables including positional relationship between the cyst and the ice ball were evaluated via linear regression analysis using generalized estimating equation models to determine which factors affected cyst shrinkage rate at 12 months.

Results: Fifteen, 12, and 19 cysts were completely included in, partially included in, or excluded from the ice ball, respectively. The overall shrinkage rate was 62%, and 57% of cysts (26 of 46) had disappeared at 12 months. Only the relationship between the cyst and the ice ball was significantly ($P < .001$) associated with cyst shrinkage rate. Cyst disappearance rates at 12 months were 100% (15 of 15), 67% (8 of 12), and 16% (3 of 19) for cysts completely included, partially included, and excluded from the ice ball, respectively. Among the 22 cysts that disappeared at 12 months and continued to be followed, none recurred after 12 months.

Conclusions: All renal cysts that were completely included in the ice ball disappeared after cryoablation, demonstrating the potential utility of cryoablation as an alternative therapy for symptomatic renal cysts.

ABBREVIATIONS

GEE = generalized estimating equation, RCC = renal-cell carcinoma

Although renal cysts are common in elderly patients, the vast majority of them are asymptomatic and clinically unimportant. However, approximately 2%–4% of renal cysts may become symptomatic (1). The most common symptom is abdominal pain, followed by hypertension secondary to renal segmental ischemia (2,3). In addition, cysts may be complicated by infection (4), rupture (5), or the compression of pelvicalyceal collecting systems (6,7). When renal cysts become symptomatic, treatments including surgical and percutaneous interventions are required. Less invasive percutaneous interventions are usually preferred to surgical ones that require general anesthesia. However, simple percutaneous aspiration is followed by recurrence in 30%–80% of cases (1,8); aspiration followed by sclerotherapy is therefore recommended. Nevertheless, reported recurrence rates are still 23%–77% after a single session of sclerotherapy

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(9–11). Although multiple sessions may be more effective (12), they are time-consuming and may be associated with increased risk of leakage of sclerosing agent and additional patient discomfort (13–15). Therefore, a technique to provide more powerful ablation in a single session is required.

Cryoablation for renal-cell carcinoma (RCC) was first reported in 1995 (16). Recent studies showed that cryoablation is safe and highly effective, with associated major complication rates of 2%–7% (17,18) and local control rates of 87%–97% (17–20). Therefore, it was hypothesized that cryoablation may also be effective for renal cyst treatment. However, the effect of cryoablation on renal cysts is unknown. Therefore, we investigated the effect of cryoablation on renal cysts by retrospectively evaluating the subsequent size change of renal cysts close to RCCs that were treated with cryoablation.

MATERIALS AND METHODS

Approval from the institutional review board and informed consent from the patients were obtained to perform cryoablation for RCC. The ethics committee at our institution provided approval for this retrospective study (approval number 1509-007) and did not require that informed patient consent be obtained to perform the study.

Study Population

Between May 2012 and August 2014, 109 patients with RCC underwent cryoablation at a single institution. The inclusion criteria for this study required renal cysts (*i*) included in or located close to (< 5 mm) the ice ball during cryoablation and (*ii*) at least 5 mm in maximum diameter and (*iii*) the availability of computed tomography (CT) or magnetic resonance (MR) images obtained before and 1, 3, 6, and 12 months after cryoablation. Patients who underwent other local therapies (eg, surgery and transarterial embolization) for RCC within 6 months before or 12 months after cryoablation were excluded. A total of 46 cysts (mean maximum diameter ± standard deviation, 12 mm ± 8.7) in 22 patients (19 men and three women; mean age, 70.1 y ± 13.7) were included in the study. Characteristics of patients and cysts are summarized in **Table 1**.

Table 1. Characteristics of 46 Renal Cysts in 22 Patients

Characteristic	Value
Age (y)	
Mean ± SD	70.1 ± 13.7
Range	39–86
Sex	
Male	19 (86)
Female	3 (14)
Maximum diameter of cysts (mm)	
Mean ± SD	12 ± 8.7
Range	5–43
Location of cysts	
Exophytic	16 (35)
Parenchymal	23 (50)
Central	6 (13)
Mixed	1 (2)
Laterality	
Right	27 (59)
Left	19 (41)
Insertion of cryoprobes through cysts	
Yes	5 (11)
No	41 (89)
Relationship between cysts and ice ball	
Complete inclusion	15 (33)
Partial inclusion	12 (26)
Exclusion	19 (41)

Note–Values in parentheses are percentages.
SD = standard deviation.

Cryoablation Techniques

Cryoablation was always performed in an inpatient setting. Intraprocedural pain was treated with a combination of local anesthesia and conscious sedation with fentanyl. The procedure was percutaneously carried out with CT fluoroscopy guidance (Aquilion; Toshiba, Tochigi, Japan) and used IceRod or IceSeed cryoprobes with a CryoHit cryoablation system (Galil Medical, Yokneam, Israel).

After administration of local anesthesia, two to five cryoprobes were placed into the RCC. The number of cryoprobes used was mainly determined based on tumor size. The treatment consisted of two cycles of freezing and thawing. Each freezing cycle was 10–15 minutes. To evaluate the ice ball, CT scans were performed at the end of each cycle. Images with section thicknesses of 3–5 mm were reconstructed in the axial, coronal, and sagittal planes. Ablation was performed in an attempt to treat RCCs with at least 6-mm margins.

Pre- and Postablation Imaging Follow-up

All patients underwent abdominal CT or MR imaging before and 1, 3, 6, and 12 months after cryoablation. These examinations were also available in 41 cysts at time points after 12 months. Noncontrast and dynamic contrast-enhanced CT scans with two or three phases were performed; images were reconstructed in the axial plane with 5-mm-thick sections and in the coronal plane with 3-mm-thick sections. MR imaging examinations included T2-weighted images (repetition time, 2,000 ms; echo time, 89.0 ms) with 4-mm-thick sections in the axial and coronal planes.

Study Endpoint

The endpoint measurement of the study was the serial size change of the cysts after cryoablation. The shrinkage rate of each cyst was calculated at each follow-up. In addition, cyst disappearance rates were estimated at each follow-up. Then, to determine the factors that affected cyst shrinkage rates at 12 months, several variables were evaluated: age, sex,

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