CLINICAL STUDY

Tumor Growth Kinetics and Oncologic Outcomes of Patients Undergoing Active Surveillance for Residual Renal Tumor following Percutaneous Thermal Ablation

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ABSTRACT

Purpose: To evaluate growth kinetics and oncologic outcomes of patients with renal tumors undergoing active surveillance (AS) for residual viable tumor following percutaneous ablation.

Materials and Methods: Following percutaneous thermal ablation, residual tumor was detected in 21/133 (16%) patients on initial follow-up imaging, and AS was undertaken in 17/21 (81%) patients. Initial tumor volumes and volumes after ablation were assessed from cross-sectional imaging to calculate volumetric growth rate (VGR) and volume doubling time (VDT) of residual tumor. The rate of metastasis, overall survival, and renal cell carcinoma (RCC)–specific survival were compared between patients in the AS group and in the routine follow up group of patients who did not have residual tumor.

Results: Median tumor volume prior to ablation, after first ablation, and at final follow-up were 25 cm^3, 6 cm^3, and 6 cm^3, respectively, in patients with residual tumor. Stable, mild, and moderate VGR occurred in 8/17 (47%), 4/17 (24%), and 5/17 (29%) cases, respectively. The 4 cases with fastest VDT underwent delayed intervention with ablation (n = 1) and nephrectomy (n = 3) without subsequent residual, recurrence, or metastasis. There was no significant difference in the rates of RCC metastasis, overall survival, or RCC-specific survival between AS and routine follow-up groups. Metastatic RCC and subsequent death occurred in 1 patient in the AS group, after the patient had refused offers for retreatment for local progression over 60.7 months of follow-up.

Conclusions: In cases when patients are not amenable to further intervention, AS of residual tumor may be an acceptable alternative and allows for successful delayed intervention when needed.

ABBREVIATIONS

AS = active surveillance, CCI = Charlson Comorbidity Index, RCC = renal cell carcinoma, VDT = volume doubling time, VGR = volumetric growth rate

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Percutaneous thermal ablation is increasingly used to treat organ-confined renal cell carcinoma (RCC) in patients who are poor surgical candidates because of comorbidities or poor renal functional reserve. Complete tumor necrosis can be achieved in most cases using adequate ablation margins (1), with high technical success rates even in larger T1b/T2 tumors (2,3). However, incomplete ablation with residual viable tumor occurs, particularly in cases with renal sinus invasion, involvement of the ureter or renal vessels, or large tumor burden (4). Although some of these patients can undergo short-term repeat ablation, others may be poor candidates because of loss of renal function or worsening medical comorbidities or may choose not to undergo additional intervention. Technical factors and challenging location of residual tumor can also preclude adequate and safe retreatment. In these patients, active surveillance (AS) for residual tumor offers an alternative to more aggressive short-term retreatment.

The feasibility of AS for renal tumors is predicated on the indolent physiology of many of these lesions and relatively long interval between local growth and development of systemic metastases, during which curative therapy can still be achieved. A growing body of evidence on AS for small renal masses ($\leq$ 4 cm) has demonstrated low rates of tumor growth, with mean linear growth rates of 0.28–0.44 cm/y (5–8) and no interval growth in 10%–33% of tumors (5,8,9). The main concern for using AS is the development of extrarenal metastases during the follow-up period, converting a patient who could have been treated curatively with good survival outcome to one requiring palliation with much poorer survival outcome. Although studies have evaluated the natural history of renal masses undergoing AS before intervention, the natural history of residual viable tumor after intervention has not been as well described. Assessment of growth kinetics of residual tumor is challenging because linear growth rates used in untreated tumors are of limited utility—residual tumor is often crescentic in shape and inadequately represented by a single length measurement. Oncologic outcomes for partially treated tumors are also limited, given the high rates of technical success with ablation. A meta-analysis of 6,471 renal tumors treated with partial nephrectomy or percutaneous thermal ablation demonstrated higher local recurrence rates after ablation (8.5%) versus surgery (4.6%), implying the presence of residual viable tumor after ablation, but did not demonstrate a significant difference in rate of metastases (1.8% for ablation vs 5.6% for surgery) (10). Other studies of AS (5) and thermal ablation for renal masses (4) have reported low but nonneglible rates of metastases of 1%–3%, even in series with high rates of complete tumor necrosis (3,11). Imaging features to distinguish the tumor population with propensity for metastasis from the more indolent counterpart are not fully elucidated. An additional challenge of AS is the lack of universally accepted criteria on the degree of local progression that necessitates intervention (9); the decision to retreat is consequently based on a combination of physician and patient preference and qualitative thresholds for extent of tumor growth. The purpose of this study was to evaluate the tumor growth kinetics and oncologic outcomes of patients undergoing AS for residual viable tumor after percutaneous thermal ablation of renal tumors.

MATERIALS AND METHODS

Patient Population and Definition of AS Group

An institution review board–approved database of renal tumors treated with percutaneous cryoablation and radiofrequency ablation at a single tertiary care center between January 2004 and December 2013 was retrospectively reviewed. Patients were excluded from evaluation if they had metastatic RCC before ablation (n = 10), underlying genetic syndrome with predisposition for renal malignancy (von Hippel-Lindau disease; n = 1), other metastatic malignancy (n = 3), biopsy demonstrating benign tumor histology (n = 6), or lack of available clinical and imaging follow-up for review (n = 6) (**Fig 1**). Patient demographics were assessed from electronic medical records. Medical comorbidities were scored using the Charlson Comorbidity Index (CCI) and age-adjusted CCI. Cryoablation and radiofrequency ablation were performed using protocols described in prior studies (12). Ablation outcomes were assessed and reported in accordance with current consensus standardized reporting criteria for image-guided tumor ablation (13).

Imaging performed after ablation was reviewed for all patients with residual tumor after initial or repeat ablations (n = 21). Patients who underwent at least 6 months of imaging follow-up after the most recent ablation or between initial and repeat ablations were designated the AS group (n = 17). Indications for AS were classified as relative if the patient wanted to avoid potential renal replacement therapy and elective if the patient did not want additional ablation despite being at low risk for periprocedural morbidity or renal function loss (8). Patients with stable disease on follow-up studies were maintained on AS. Patients with increasing residual tumor or changes in clinical status affording the option to retreat underwent delayed intervention ($>$ 6 mo after most recent prior ablation). Patients without residual tumor on the first imaging study after ablation (n = 112) or with residual tumor that was successfully treated with short-term ($<$ 6 mo after initial ablation) repeat ablation (n = 4) were designated the routine follow-up group.

Imaging and Surveillance Protocol

Before ablation, patients underwent renal mass protocol computed tomography (CT) (including imaging without