EVIDENCE-BASED REVIEW

Partial Nephrectomy versus Thermal Ablation for Clinical Stage T1 Renal Masses: Systematic Review and Meta-Analysis of More than 3,900 Patients

J. Ricardo Rivero, MD, Jose De La Cerda, III, MD, MPH, Hanzhang Wang, MD, MPH, Michael A. Liss, MD, Ann M. Farrell, MLS, Ronald Rodriguez, MD, PhD, Rajeev Suri, MD, and Dharam Kaushik, MD

ABSTRACT

Purpose: A systematic review and meta-analysis of clinical trials was undertaken to compare percutaneous thermal ablation versus partial nephrectomy (PN) for stage T1 renal tumors.

Materials and Methods: A comprehensive search of major databases was conducted from October 2000 to July 2016. Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines were followed. Incidences of all-cause mortality (ACM), cancer-specific mortality (CSM), local recurrence (LR), and metastases, as well as complication rates and changes in estimated glomerular filtration rate (eGFR), were evaluated.

Results: Inclusion criteria were met by 15 of 961 papers. These studies represented 3,974 patients who had undergone an ablative procedure (cryoablation or radiofrequency ablation; n = 1,455; 37%) or PN (n = 2,519; 63%). ACM and CSM rates were higher for ablation than for PN (hazard ratio [HR], 2.11; 95% confidence interval [CI], 1.54–2.87 [$P < .05$]; HR, 3.84; 95% CI, 1.66–8.88 [$P < .05$], respectively). No statistically significant difference in LR rate or risk of metastasis was seen between ablation and PN (HR, 1.32; 95% CI, 0.79–2.22 [$P = .22$]; HR, 1.83; 95% CI, 0.67–5.01 [$P = 0.23$], respectively). Complication rates were lower for ablation than for PN (13% vs 17.6%; odds ratio, 0.49; 95% CI, 0.25–0.94; $P < .05$). A significantly greater decrease in eGFR was observed after PN (13.09 mL/min/1.73 m^2) vs ablation therapy (4.47 mL/min/1.73 m^2).

Conclusions: Thermal ablation showed no significant difference in LR or metastases compared with PN. Thermal ablation was associated with a lower morbidity rate and a lesser reduction in eGFR compared with PN, but with higher ACM and CSM rates.

ABBREVIATIONS

ACM = all-cause mortality, CA = cryoablation, CI = confidence interval, CSM = cancer-specific mortality, eGFR = estimated glomerular filtration rate, GFR = glomerular filtration rate, HR = hazard ratio, LR = local recurrence, OR = odds ratio, PN = partial nephrectomy, RCC = renal cell carcinoma, RF = radiofrequency

With the widespread use of abdominal imaging, including computed tomography and magnetic resonance imaging, there has been an increase in reports of renal cell carcinoma (RCC) as an incidental finding (1). This increase in incidental detection has been notable for a shift toward small renal masses, favoring clinical stage T1 classification (2). Partial nephrectomy (PN) is considered to be the gold-standard approach for stage T1 tumors (3). However, PN comes with the risk of renal hypoperfusion during resection and surgical complications.

As RCC is primarily a disease of the elderly population, presenting most often in the sixth to seventh decades of life, it is common for patients with the disease to have comorbidities, which may create a surgical dilemma given the

From the Department of Urology (J.R.R., J.D.L.C., H.W., M.A.L., R.R., D.K.), University of Texas Health, San Antonio, Texas; Cancer Therapy and Research Center (M.A.L., R.R., D.K.) and Department of Radiology, Division of Interventional Radiology (R.S.), University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Dr., San Antonio, TX 78229-3900; and Plummer Library (A.M.F.), Mayo Clinic, Rochester, Minnesota. Received December 28, 2016; final revision received and accepted August 7, 2017. **Address correspondence to** D.K.; E-mail: kaushik@uthscsa.edu

None of the authors have identified a conflict of interest.

J Vasc Interv Radiol 2017; ■:1–12

https://doi.org/10.1016/j.jvir.2017.08.013

RESEARCH HIGHLIGHTS

- Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines were applied to published research to compare percutaneous ablation versus partial nephrectomy for stage T1 renal tumors: 3,974 patients, in 15 studies from 2000 to 2016, underwent ablation (cryoablation or radiofrequency ablation; n = 1,455; 37%) or partial nephrectomy (n = 2,519; 63%).
- Partial nephrectomy was associated with lower all-cause mortality and cancer-specific mortality rates but carried a greater reduction in estimated glomerular filtration rate and more complications. There were no statistical differences in complications or distant metastasis between ablation and partial nephrectomy.
- The proportion of patients without pathologic disease confirmation was significantly higher in the ablation group; therefore, the proportion of benign lesions is unknown. Only 3 studies reported complications in a standardized fashion (per Clavien–Dindo classification), limiting analysis of rates of complications (including methodical reporting of blood transfusion during nephrectomies).

competing risk factors for mortality in elderly patients. Ablative therapies in the forms of cryoablation (CA) and radiofrequency (RF) ablation have been suggested as a way to preserve the best possible renal function in patients at high risk who are unable to undergo PN as a result of comorbidities and/or advanced age or are unwilling to undergo the procedure (4,5). Further, the 2009 American Urological Association guidelines (3) state that, even in a healthy patient, thermal ablation remains an option for management of a stage T1 renal mass even though local tumor recurrence is more likely than with surgical excision. However, the slightly decreased success rate of ablation therapy is not a consistent finding in all series, with some larger series reporting a success rate comparable with that of PN (6). In those series, the authors have contended that appropriate patient selection, with an emphasis on curative intent, combined with a conservative ablation technique (only for masses < 3 cm and multiple ablation probes to ensure a 5–10-mm ablative margin) can result in comparable outcomes.

Given the discrepancies among series, the decision was made to perform a meta-analysis of only comparative studies (ie, PN vs CA or PN vs RF ablation). The purpose of this meta-analysis was to aggregate all available data and determine if current PN and ablation practices as reported in the worldwide literature consistently yield similar or dissimilar oncologic outcomes (7,8).

A systematic review and meta-analysis was performed of the literature to determine oncologic outcomes, complication rates, and differences in postprocedural estimated glomerular filtration rate (GFR; eGFR) for patients with stage T1 tumors managed by PN or ablation (CA or RF ablation). Recently, Thompson et al (7) reported a retrospective study comparing PN versus percutaneous ablation for T1 renal masses (7) and provided a large body of data (N = 1,803) for this updated systematic review and meta-analysis.

Table 1. Newcastle Ottawa Scale Scores for Published Studies (4,6,7,9–20)

Study	Selection	Comparability	Outcome	Total
High quality				
Thompson et al (7)	++++	++	+++	9/9
Olweny et al (11)	++++	+	+++	8/9
Chang et al (4)	+++	++	+++	8/9
Chang et al (6)	+++	+	+++	7/9
Tanagho et al (9)	+++	+	+++	7/9
Haber et al (17)	++	++	+++	7/9
Moderate quality				
Takaki et al (15)	++	++	++	6/9
Turna et al (16)	++	++	++	6/9
Sung et al (10)	++	++	++	6/9
Klatte et al (14)	+++	+	++	6/9
Haramis et al (13)	++	++	++	6/9
Lin et al (18)	++	++	++	6/9
Stern et al (19)	+	++	+++	6/9
Guillotreau et al (12)*	+++	++	+	6/9
Desai et al (20)*	+++	++	+	6/9

*Excluded from oncologic outcomes.

MATERIALS AND METHODS

Search Methods

A comprehensive search of the major databases (Ovid MEDLINE, Ovid EMBASE, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews, and Scopus) was conducted from October 2000 to July 2016 with no language restrictions. A librarian (A.M.F.) conducted the search strategy with input from the study team. Controlled vocabulary supplemented with keywords was used to search for randomized controlled trials and cohort studies comparing ablation (CA or RF ablation) versus PN for small renal tumors.

Study Selection

The population of interest included men and women diagnosed with clinical stage T1 renal tumors. Only comparative studies of RF ablation or CA with PN were included in the study selection. Acceptable interventions included laparoscopic or percutaneous CA as well as laparoscopic or percutaneous RF ablation. A control group was considered acceptable if it included patients who had undergone open, laparoscopic, or robotic-assisted PN.

To be included in the meta-analysis, a study had to report at least 1 of the following oncologic outcomes: all-cause