Society of Interventional Radiology Position Statement on the Role of Percutaneous Ablation in Renal Cell Carcinoma

Endorsed by the Canadian Association for Interventional Radiology and the Society of Interventional Oncology

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ABBREVIATIONS

AUA = American Urological Association, CI = confidence interval, CSS = cancer-specific survival, EAU = European Association of Urology, HR = hazard ratio, MW = microwave, NCCN = National Comprehensive Cancer Network, PA = percutaneous ablation, PN = partial nephrectomy, RCC = renal cell carcinoma, RCT = randomized controlled trial, RF = radiofrequency, RN = radical nephrectomy, SEER = Survival, Epidemiology, and End Results, WMD = weighted mean difference

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Appendices A and B and Figure E1 can be found by accessing the online version of this article on *www.jvir.org* and clicking on the Supplemental Material tab.

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BACKGROUND

It is estimated that, in 2019, 73,820 new cases of kidney cancer will be diagnosed in the United States, resulting in 14,770 new deaths (1). Renal cell carcinoma (RCC) is the most common type of kidney cancer, accounting for approximately 9 out of 10 kidney cancers (2). Owing to the increasing use of cross-sectional imaging and improving life expectancies, the incidence rates of RCC have substantially increased in developed countries over the past 20 years (3). More than 50% of RCCs are detected incidentally on noninvasive imaging (4). Most of these incidentally detected masses are small and localized within the renal capsule. These small renal masses, measuring <4cm (stage T1a), account for 48%–66% of all RCCs (5). In contrast, metastatic RCC accounts for about 17% of all RCCs at diagnosis (6).

For small (≤4 cm in diameter) renal tumors, treatment options have traditionally included active surveillance, radical nephrectomy (RN), and nephron-sparing partial nephrectomy (PN). Nephron-sparing therapies have become popular to preserve renal function, particularly since oncologic outcomes from PN are equal to those from RN, thus making PN widely accepted as the standard of care for the management of clinically localized RCC (7–12). However, many patients are not candidates for surgery. For these patients, percutaneous image-guided ablation (radiofrequency [RF] ablation), cryoablation, and microwave (MW) ablation are available as validated options for tumor control. These have been established as important management options and are recommended by multiple societal guidelines (**Appendix A** [available online on the article's Supplemental Material page at *www.jvir.org*]), both nationally and internationally.

In this document, the Society of Interventional Radiology (SIR) states its position on the use of ablation for the management of RCC, with a focus on small renal masses, biopsy, and cases of oligometastatic disease. An Executive Summary of recommendations in this document may be found in **Appendix B** (available online on the article's Supplemental Material page at *www.jvir.org*).

METHODS

Panel Formation

Under the direction of SIR, a multidisciplinary group of experts, representing Interventional Radiology, Urology, and Interventional Oncology, was convened to review the current literature on the use of ablation for the management of RCC.

Literature Review

A comprehensive literature search was conducted in June 2019 in MEDLINE via PubMed using a combination of the following search terms: "renal cell carcinoma," "renal tumors," "RCC," "metastatic renal cancer," "oligometastatic," "biopsy," "thermal ablation," "radiofrequency ablation," "cryoablation," "cryosurgery," "microwave ablation," "ablative therapy," and "ablation." The search was limited to 1995 to present, with 1995 representing the publication of the first cryoablation case series of renal tumors. After removing duplicative cohorts, primary studies included in existing systematic reviews, case reports, technical papers, letters or commentaries, and unrelated papers, a total of 27 studies remained for inclusion in this review.

Currently, the evidence base for this topic does not include any randomized controlled trials (RCTs) comparing ablative versus surgical therapies or ablative versus active surveillance for renal tumors. The highest-quality evidence comes from population-based registry studies. Several systematic reviews of small-cohort studies also make up the evidence base.

Recommendation Development and Consensus Achievement

Recommendations were drafted and graded according to the updated SIR evidence grading system (**Figure E1** [available online on the article's Supplemental Material page at *www.jvir.org*]) (13). A modified Delphi technique was used to achieve consensus agreement on the recommendation statements. Consensus is reached when 80% of the panelists are in agreement with each statement.

TRENDS AND USE OF ABLATION

The use of ablation as a nephron-sparing treatment option has increased over time. However, uptake and overall use of ablation is still low and varies widely owing to the lack of specific guidelines for appropriate candidate selection and treating physician preferences (14).

Retrospective Studies

In a population-based study using the National Cancer Institute's Survival, Epidemiology, and End Results (SEER) database, the use of thermal ablation in patients with T1a lesions rose from 5.2% (2004–2007) to 9.1% (2008–2011) (15). However, compared to surgery, treatment with ablation was used less frequently (92.9% vs 7.1%). Multivariate analysis examining trends in the use of ablation found that Caucasian ethnicity, higher income, living in metropolitan areas, and having health insurance were independent determinants of treatment with thermal ablation. This suggests under-use, which may be based on regional and sociodemographic disparities that affect access to care.

A population-based cohort study of 6664 patients with small kidney cancers treated between 2001 and 2009 revealed that 90% were treated with surgery, and only 10% were treated with ablation (16). Similar results were found in a more recent study of 75,691 patients from the National Cancer Database, which reported that between 2004 and 2015, ablation was used in only 11.9% of patients (17).

Based on these findings, there is a clear need to promote better access to ablation services through education.

MANAGEMENT OF T1A RENAL MASSES

Cohort and Registry-based Studies

Ablation Versus Surgical Techniques. Limited high-quality evidence is available comparing ablative and surgical therapies for renal tumors, as no head-to-head RCTs currently exist. However, several population-based registry studies have been published comparing ablation to surgical techniques. Although drawing from large patient cohorts, these studies are all inherently limited by their retrospective design as well as by the limited and inconsistent reporting of data in the registry databases from which patient information was drawn.

Three recent studies used the National Cancer Institute's SEER cancer registry to ascertain survival outcomes of ablation compared to surgical techniques for small renal masses (18–20).

Zhou et al (18) used the SEER database in a study comparing ablation (either cryoablation or thermal ablation) to PN in patients from 2004 to 2013. In the propensity-matched cohort, the PN group had significantly increased overall 5-year survival compared to the ablation group (91.0% vs 86.3%; hazard ratio [HR] = 1.442; 95% confidence interval [CI], 1.005–2.068; P = .0457). No significant difference was found in renal cancer-specific survival (CSS) (HR = 1.466; 95% CI, 0.599–3.59; P = .4023).

In another SEER-based study, Talenfeld et al (19) identified patients older than 66 years receiving treatment between 2006 and 2011 with percutaneous ablation (PA), PN, or RN for T1a RCC with primary tumor smaller than 4 cm. After propensity score matching, patients treated with PA had shorter 5-year survival (77%; 95% CI, 74%–81%) than patients treated with PN (86%; 95% CI, 84%–88%) as well as higher mortality (adjusted HR = 1.93; 95% CI, 1.50–2.49; not significant). RCC-specific mortality was also poorer in the PA group than the PN group (HR = 1.99; 95% CI, 0.96–4.14; not significant).

Recently, Xing et al (20) compared survival outcomes in 10,218 T1a RCC patients undergoing PN (n = 2820), RN (n = 4522), thermal ablation (n = 898), or active surveillance (n = 1978) using the SEER database. Patients diagnosed with RCC (node-negative, non-metastatic T1a RCC ≤4 cm) from 2002 to 2011 with at least 1 year of follow-up through 2012 were included. After propensity score matching, they found no significant difference in CSS at 3, 5, and 9 years for thermal ablation compared to PN or RN.

Other registry data have also been used to ascertain outcomes associated with ablation techniques for small renal masses. Uhlig et al (21) conducted a retrospective study using the National Cancer Database including patients diagnosed with T1aN0M0 RCC and treated with either thermal ablation (RF ablation, MW ablation, or cryoablation) or nephrectomy (partial or radical). In the propensity-matched cohort, overall 5-year survival was higher for patients who underwent nephrectomy compared to thermal ablation (82% vs 76.4%; $P < .001$). Subgroup analysis on the older cohort of patients (aged >65 years) showed no difference in 5-year overall survival between ablation and nephrectomy (54% vs 59%; P = .062). CSS was not reported in this study.

Comparison of Ablation Techniques

Uhlig et al (22) analyzed 773 patients from the SEER registry with T1a RCC who were managed with cryosurgery (n = 315), thermal ablation (either RF ablation or MW ablation) (n = 155), or deferred therapy (n = 263). When directly comparing cryosurgery to thermal ablation, no significant difference in CSS was found (HR = 1.03; 95% CI, 0.45–2.33).

Ablation versus Active Surveillance

Ablation has also been compared to active surveillance using the SEER registry data.

Larcher et al (23) included 1860 patients with cT1a kidney cancer treated with either local tumor ablation or observation between 2000 and 2009. After propensity score matching, they found that cancer-specific mortality was higher for active surveillance than for local tumor ablation (9.1% vs 3.5%, respectively; HR = 0.47; 95% CI, 0.25–0.89). Similar results were found in 2 recent population-based SEER registry studies (20,22). Uhlig et al (22) found that patients treated with cryosurgery or thermal ablation had a significantly improved CSS compared to patients who deferred therapy (HR = 0.25, 95% CI, 0.14–0.45; HR = 0.27, 95% CI, 0.13–0.55). Likewise, in the Xing et al study (20), cancer-specific and overall survival rates were higher for thermal ablation than active surveillance.

Systematic Reviews

Several systematic reviews (with overlapping data) have recently been published comparing ablation techniques to surgery, all with similar conclusions (24–31). Most of the studies included in these systematic reviews include retrospective cohorts at high risk of bias (due to patient selection and confounding), ultimately limiting the overall quality of the body of evidence.

A recent and high-quality systematic review by Uhlig et al (31) compared PN to ablative techniques using network meta-analysis, combining direct and indirect evidence into estimates of effect. A total of 47 studies (including 24,077 patients) met the inclusion criteria for their review. Pooled analysis revealed that, compared to PN, all-cause mortality was significantly higher for cryoablation (incidence rate ratio [IRR] = 2.58; 95% CI, 1.92–3.46) and RF ablation (IRR = 2.58; 95% CI, 1.9–3.51). However, no significant difference was found comparing PN and MW ablation (IRR = 3.8; 95% CI, 0.15–93.2). Cancer-specific mortality did not show any difference when comparing any of the ablative techniques to PN. Decline of renal function was lower for RF ablation compared to PN (mean difference [MD] = 5.31; 95% CI, 1.77–8.85), but no significant difference between PN and cryoablation or MW ablation was found. After sensitivity analyses, likelihood of complications was lower for cryoablation and MW ablation compared to PN (odds ratio [OR] = 0.67; 95% CI, 0.48–0.92 and OR = 0.26; 95% CI, 0.11–0.60, respectively). These findings are supported by a more recent, high-quality systematic review and meta-analysis of 20 studies (29).

SAFETY

Complications and post-procedure renal function outcomes have been assessed and synthesized by existing systematic reviews and meta-analyses as well as registry-based studies.

Cohort and Registry-based Studies

Ablation Versus Surgical Techniques. Using the SEER database, Larcher et al (32) determined that local tumor ablation is associated with lower overall complication rates (21% vs 40%; OR = 0.38, 95% CI, 0.28–0.5) and shorter median length of stay (2 days vs 4 days) than PN.

Similarly, Talenfeld et al (19) showed that the ablation group had fewer complications and less long-term renal insufficiency than the RN group and fewer periprocedural complications (30-day non-urologic complication rate of 6% vs 29%) than the PN group and the RN group (6% vs 30%). The ablation group also had lower rates of acute renal failure than the PN and RN groups (3% vs 7% and 11%, respectively).

Similar results were found in the Xing et al (20) SEER-based study. Patients in both the PN and RN groups had significantly increased rates of renal, cardiovascular, and thromboembolic events compared to those in the thermal ablation group.

Systematic Reviews

Systematic reviews of retrospective cohort studies have confirmed the safety results found in the large population-based cohort studies.

A systematic review including 107 studies showed ablation to have superior perioperative outcomes compared to PN with moderate strength of evidence (26). Ablation was associated with decreased median hospital length of stay and decreased median blood loss. The rates of urine leak, acute kidney injury, and "other urologic complications" were higher in PN versus ablation. The median percentage of urine leak and acute kidney injury were 0% and 0%, respectively, for ablation, and 2.6% and 2.1%, respectively, for PN. Renal function outcomes were similar between PN and ablation, with low strength of evidence. Compared to PN, ablation offers similar CSS with fewer complications for the treatment of stage T1a RCC.

A recent systematic review by Hu et al (29) found similar results. Of the 15 included studies, the incidence of perioperative complications (defined as the sum of intraoperative and postoperative complications) was lower in the ablation group than the PN group (12.53% vs 17.0%). Compared to PN, ablation was associated with a decreased risk of perioperative complications (OR = 0.76; 95% CI, 0.60–0.97). Eight of the included studies in the review assessed renal function. Compared to PN, ablation had similar change in renal function at 3-month follow-up. However, at 6-month and 1-year follow-up, the decrease in renal function in the ablation group was lower than in the PN group (weighted mean difference [WMD] = 3.32, 95% CI, 0.04–6.60; WMD = 2.75, 95% CI, -1.0–-6.54).

CURRENT GUIDELINES ON THE MANAGEMENT OF T1A RENAL MASSES

Current society guidelines (**Appendix A** [available online on the article's Supplemental Material page at *www.jvir.org*]) on the management of small renal tumors suggest the use of thermal ablation in select patient groups (7,12,33–36). Of the techniques available, only RF ablation and cryoablation are specifically mentioned in select guidelines (American Urological Association [AUA], European Association of Urology [EAU], and National Comprehensive Cancer Network [NCCN]) as appropriate ablation modalities (7,34,37).

BIOPSY

Most solid enhancing renal lesions should be considered to be RCC unless proven otherwise. However, large surgical and renal mass biopsy series have found that 10%–33% of these lesions are benign (38). Because imaging modalities alone cannot accurately distinguish malignant from benign masses, percutaneous renal biopsy has been used to aid in the diagnosis and management of these lesions, which ultimately reduces overtreatment. Percutaneous renal biopsy has been proven to be a safe and effective diagnostic modality. A recent systematic review of 57 studies showed that renal tumor biopsy has an overall median diagnostic rate of 92% with a sensitivity and specificity of 99.1% and 93.2%, respectively (39). Percutaneous renal tumor biopsy is associated with a low complication rate, with significant bleeding (perinephric and subcapsular hemorrhage or hematuria) occurring in less than 2% of cases (40). The overall kidney biopsy bleeding complication rate, requiring transfusion or intervention, has been described to occur in 0.5% to 6.6% (41).

Retrospective Studies

Biopsy can be used either before or during ablative therapy to obtain histology. Optimal timing of biopsy has not been widely studied. Only 1 single retrospective study has compared whether renal mass biopsy should be performed before or during the ablation procedure (42). Wells et al (42) reviewed the medical records of 284 patients treated with percutaneous thermal ablation with renal mass biopsy either as a separate session 2 weeks before ablation or during the same session obtained immediately before ablation. They found that a histologic diagnosis was achieved more frequently during the separate session cohort (98.6% vs 84.3%, $P < .0001$), and the rate of ablation for benign tumors (19.7% vs 2.8%, $P < .0001$) was higher in the same session cohort. No high-grade complications occurred in either cohort, therefore showing that renal mass biopsy before the day of ablation is safe and increases the rate of histologic diagnosis and reduces the rate of ablation for benign tumors.

Current Guidelines

Guidelines from the EAU and the AUA have recommended percutaneous biopsy of small renal masses to obtain histology before PA with a coaxial needle system, to decrease the chance of percutaneous seeding of tumor cells (7,8). Use of the coaxial needle system can reduce the number of needle punctures and allow track ablation, if performed as part of a heat-based ablation procedure. The biopsy can be performed earlier, during the diagnostic workup of the patient, or as part of the PA procedure. It can provide prognostic information after histopathologic analysis, while guiding specific chemotherapy protocols, if necessary.

ABLATION FOR THE TREATMENT OF OLIGOMETASTATIC DISEASE IN RCC

Up to 17% of all RCCs have distant metastases at the time of diagnosis, and of patients with localized RCC treated with nephrectomy with curative intent, approximately a quarter have relapses in distant sites (6,43). Distant metastases occur most frequently in the lungs, lymph nodes, liver, bone, and brain (43). Surgical metastasectomy as a treatment option has been shown to have a survival benefit in select patients (44). However, for patients who are not candidates for metastasectomy, PA may potentially have a role to play in treatment.

Cohort Studies

Only few single-arm prospective and retrospective series have studied the use of ablation in patients with metastatic RCC.

Bang et al (45) assessed the role of multisite cryoablation of oligometastatic RCC on local recurrence and survival. A total of 27 patients (with 72 tumors) were included in the study with procedural sites including the lung, liver, and 6 soft tissue sites: nephrectomy bed, adrenal gland, paraaortic, superficial, intraperitoneal, and bone. Local recurrence occurred in 2 of the tumors (1 procedural recurrence and 1 satellite recurrence). Median overall survival was 2.69 years, and the estimated 5-year survival rate was 27%. This study was limited by its small patient population and uncontrolled confounding factors.

Similar results were found in a study by Welch et al (46). They found that overall local tumor control was achieved in 70 of 80 (87.5%) tumors treated with ablation. Estimated overall survival rates at 1, 2, and 3 years after ablation were 87% (95% CI, 79%–97%), 83% (95% CI, 73%–94%), and 76% (95% CI, 63%–90%), respectively.

A more recent retrospective study also found similar results. Gardner et al (47) retrospectively reviewed a cohort of patients who underwent cryoablation for bone metastases in the setting of RCC. They found that the overall local tumor control rate per lesion was 82%. For patients with oligometastatic disease ($\leq$5 metastases), local tumor control was better (96%) compared to patients who had >5 metastases (53.3%).

Current Guidelines

The most recent NCCN kidney cancer guidelines include the use of ablative techniques for the treatment of stage IV oligometastatic disease in select patients who are not candidates for metastasectomy (35).

MANAGEMENT OF T1B RENAL TUMORS

Traditional treatment for T1b renal tumors has been RN. However, in recent years, with the publication of updated guidelines, there has been a shift toward the use of PN as the treatment of choice in select patients. More recently, treatment has further expanded to include ablation to treat these tumors in select patients who are unfit for surgery.

Ablation Versus Surgical Techniques

Only small, single-center retrospective studies have been published assessing the efficacy of cryoablation or RF ablation compared to PN or RN (48–51).

In a matched analysis of 62 patients undergoing either cryoablation or PN for cT1b tumors, Caputo et al (48) found no significant difference in cancer-specific mortality ($P = .48$) and overall mortality ($P = .155$) between the 2 treatment groups. However, the rate of local recurrence at 1-year follow-up was significantly higher for cryoablation than for PN ($P = .019$), and the total postoperative complication rate was higher for PN than for cryoablation (42% vs 23%; $P = .10$).

Thompson et al (50) identified 376 cT1b patients from the Mayo Clinic Tumor Registry who underwent either cryoablation (n = 52) or PN (n = 324), with median clinical follow-up of 6.0 and 8.7 years, respectively. Comparisons of cryoablation with PN showed no significant differences between the 2 groups with respect to local recurrence, metastases, and death from RCC. Five-year CSS was 91% and 98% for cryoablation and PN, respectively.

Chang et al (49) assessed the efficacy of RF ablation compared to PN in a retrospective review of 56 patients. Overall 5-year survival and CSS were higher in the PN group than the RF ablation group (85.5% vs 96.6% and 92.6% vs 96.6%, respectively), but these differences were not found to be significant.

Only 1 retrospective study has compared RF ablation to RN (51). In a retrospective study, 60 patients with T1b RCC underwent either RF ablation (n = 21) or RN (n = 39). Overall survival at 10 years was significantly lower in the ablation group than the RN group (48% vs 97%, respectively; $P < .009$), but RCC-related survival was similar between groups (100% vs. 94%, respectively).

Comparison of Ablation Techniques

Only 1 retrospective cohort study has compared 2 different ablation techniques in patients with T1b renal cell carcinoma. Hasegawa et al (52) compared RF ablation and cryoablation in 46 patients with T1b RCC. Five-year overall survival rates were similar between RF ablation and cryoablation (78% vs 82%, respectively; $P = 0.82$), and the 5-year RCC-related survival rate was 100% for both groups.

Additional high-quality, prospective randomized trials in this area are warranted to ascertain the true efficacy of ablation for T1b tumors.

Current Guidelines

Current society guidelines do not directly address the use of ablation as a management option for T1b renal tumors. The EAU currently recommends PN over RN for T1b RCC, whereas the NCCN states that either PN or RN is acceptable (8,35,37).

DISCUSSION

Despite the absence of high-quality studies comparing percutaneous thermal ablation of small renal tumors to surgical therapies (PN and RN), a substantial body of literature confirms the low complication rates and acceptable 5-year RCC-specific survival rates of PA. In many non-risk-adjusted retrospective studies of small renal tumors that have been synthesized through systematic reviews and meta-analyses, older patients with more comorbidities have been treated with PA, whereas younger and healthier patients have been treated with surgery. This introduces selection bias favoring surgery. Population-based studies that have used propensity score matching and compensated for comorbidities have found more positive results for PA.

The best specific ablation modality for image-guided PA of renal tumors is unknown. Each modality has advantages and disadvantages that must be considered, such as efficacy and complication rates, as well as local expertise, operator familiarity, comfort with each device, ease of use, preferences of referring physicians, cost, institutional agreements, and contracts with device manufacturers. Currently, most experience with PA has occurred with thermal modalities, cryoablation, RF ablation, and MW ablation. Future RCTs comparing PA to surgical treatment of small renal tumors should also consider randomizing different ablation techniques. Currently, only 1 systematic review using network meta-analytic methods has synthesized the evidence comparing individual ablation techniques (RF ablation, cryoablation, and MW ablation) (31). However, this review is limited by the small patient cohorts and high risk of bias in the included retrospective studies.

The Reporting Standards for Percutaneous Thermal Ablation of Renal Cell Carcinoma, published in 2009 by SIR, does mention MW ablation but states that most recent reports have involved RF ablation (53).

CONCLUSION

In accordance with multidisciplinary and society guidelines (7,12,33,34,37), SIR considers thermal PA to be an acceptable treatment option for stage T1a RCC neoplasms ($\leq$4 cm in diameter) in carefully selected patients and can be offered over active surveillance. PA may also have a potential beneficial role to play in the treatment of T1b tumors as well as oligometastatic RCC. However, future research in this area is warranted before strong recommendations can be made. SIR also recommends further investigation directly comparing ablation modalities, as well as comparing PA to surgical therapies with RCTs or other prospective study designs with adherence to standardized reporting of trials.

Recommendations

1. In patients with small renal tumors (stage T1a), percutaneous thermal ablation is a safe and effective treatment with fewer complications than nephrectomy and acceptable long-term oncological and survival outcomes. (Level of Evidence: C; Strength of Recommendation: Moderate)
2. In selected patients with suspected T1a RCC, percutaneous thermal ablation should be offered over active surveillance. (Level of Evidence: C; Strength of Recommendation: Moderate)
3. Percutaneous biopsy of small renal masses is recommended before or during PA, whenever possible. (Level of Evidence C; Strength of Recommendation: Moderate)
4. In high-risk patients with T1b RCC who are not surgical candidates, percutaneous thermal ablation may be an appropriate treatment option; however, further research in this area is required. (Level of Evidence D; Strength of Recommendation: Weak)
5. PA of oligometastatic RCC may be appropriate in patients with surgically resectable primary RCC who are not candidates for metastasectomy. (Level of Evidence D; Strength of Recommendation: Weak)
6. Radiofrequency ablation, cryoablation, and MW ablation are all appropriate modalities for thermal ablation, and method of ablation should be left to the discretion of the operating physician. (Level of Evidence: D; Strength of Recommendation: Weak)

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Appendix A. Current Society Clinical Practice Guidelines on Small Renal Masses

American Urological Association (AUA), 2017[7]	• Physicians should consider thermal ablation as an alternate approach for the management of clinical T1a renal masses <3 cm in size. For patients who elect thermal ablation, a percutaneous technique is preferred over a surgical approach whenever feasible to minimize morbidity (class IIB recommendation; level of evidence C). • Both radiofrequency ablation and cryoablation are options for patients who elect thermal ablation (class IIB recommendation; level of evidence C). • A renal mass biopsy should be performed before ablation to provide pathologic diagnosis and guide subsequent surveillance (expert opinion). • Counseling about thermal ablation should include information regarding an increased likelihood of tumor persistence or local recurrence after primary thermal ablation relative to surgical extirpation, which may be addressed with repeat ablation if further intervention is elected (class I recommendation; level of evidence B).
Cardiovascular and Interventional Radiology Society of Europe (CIRSE), 2017[33]	Overview of cT1a renal cell carcinoma (RCC) percutaneous ablation treatment • Percutaneous ablation represents an alternative to surgery for the treatment of T1a RCCs. • The technical and functional outcomes of the procedure are excellent. • The rate of complication is very low. • The procedure is minimally invasive and may be performed under sedation and as a day case. • The patients who may undergo treatment with percutaneous ablation are those with American Society of Anesthesiologists scores of 1–3. • >5-year oncological data are available and are also excellent.
European Association of Urology (EAU), 2014[43]	Key recommendations on diagnosis, staging, classification, and prognosis in patients with renal tumors: • A renal tumor biopsy is recommended before ablative therapy and systemic therapy without previous pathology. Key recommendations for treatment of localised RCC and local treatment of metastatic RCC: • Nephron-sparing surgery is recommended in patients with T1a tumors (grade A) • Nephron-sparing surgery should be favored over radical nephrectomy in patients with T1b tumors when technically feasible (grade B). • Owing to the low quality of the available data, no recommendation can be made on radiofrequency ablation or cryoablation (grade C). • In the elderly and/or comorbid patients with small renal masses and limited life expectancy, active surveillance, radiofrequency ablation, and cryoablation can be offered (grade C).
European Association of Urology (EAU), 2017[34]	• Owing to the low quality of available data, no recommendation can be made on radiofrequency ablation and cryoablation (grade C). • In the elderly and/or comorbid patients with small renal masses and limited life expectancy, active surveillance, radiofrequency ablation, and cryoablation may be offered (grade C).
European Association of Urology (EAU), 2019[36]	• Offer active surveillance, radiofrequency ablation, and cryoablation to elderly and/or comorbid patients with small renal masses (Strength rating: Strong). • Offer partial nephrectomy (PN) to patients with T1 tumors (Strength rating: Strong).
American Society of Clinical Oncology (ASCO), 2017[12]	• Recommendation 2.0: Active surveillance should be an initial management option for patients who have substantial comorbidities and limited life expectancy (type: evidence based; evidence quality: intermediate; strength of recommendation: moderate). Qualifying statement: absolute indication: high risk for anesthesia and intervention or life expectancy <5 years; relative indication: significant risk of end-stage renal disease if treated, small renal mass (SRM) (<1 cm), or life expectancy <10 years. • Recommendation 3.1: PN for SRMs is the standard treatment that should be offered to all patients for whom an intervention is indicated and who have a tumor that is amenable to this approach (type: evidence based; evidence quality: intermediate; strength of recommendation: strong). • Recommendation 3.2: Percutaneous thermal ablation should be considered an option for patients who have tumors such that complete ablation will be achieved. A biopsy should be obtained before or at the time of ablation (type: evidence based; evidence quality: intermediate; strength of recommendation: moderate). • Recommendation 3.3: Radical nephrectomy for SRMs should be reserved only for patients who have a tumor of substantial complexity that is not amenable to PN or where PN may result in unacceptable morbidity even when performed at centers with expertise. Referral to a surgeon and a center with experience in PN should be considered (type: evidence based; evidence quality: intermediate; strength of recommendation: strong).
National Comprehensive Cancer Network (NCCN), 2019[35]	Active surveillance or ablative techniques (eg, cryosurgery or radiofrequency ablation): • Can be considered for selected patients with clinical stage T1 renal lesions • Biopsy of small lesions may be considered to obtain or confirm a diagnosis of malignancy and guide surveillance, cryosurgery, and radiofrequency ablation strategies. • Ablative techniques are associated with a higher local recurrence rate than conventional surgery.

Appendix B.

Executive Summary

Clinical Question

What is the utility of ablation for the management of renal cell carcinoma (RCC)?

Target Population

Patients with small renal masses (T1a and T1b) or oligometastatic RCC.

Target Audience

Interventional radiologists and other clinicians who provide care for patients defined by the target population.

Methods

A multidisciplinary expert panel was assembled to develop recommendations for renal ablation for the management of RCC. A comprehensive review of the literature was performed, and relevant evidence was evaluated for inclusion into this document. Evidence was rated according to the updated Society of Interventional Radiology (SIR) evidence grading system. The recommendations represent consensus among the expert writing panel.

Recommendations

1. In patients with small renal tumors (stage T1a), percutaneous thermal ablation is a safe and effective treatment with fewer complications than nephrectomy and acceptable long-term oncological and survival outcomes. (Level of Evidence: C; Strength of Recommendation: Moderate)
2. In selected patients with suspected T1a RCC, percutaneous thermal ablation should be offered over active surveillance. (Level of Evidence: C; Strength of Recommendation: Moderate)
3. Percutaneous biopsy of small renal masses is recommended before or during percutaneous ablation, whenever possible. (Level of Evidence C; Strength of Recommendation: Moderate)
4. In high-risk patients with T1b RCC who are not surgical candidates, percutaneous thermal ablation may be an appropriate treatment option; however, further research in this area is required. (Level of Evidence D; Strength of Recommendation: Weak)
5. Percutaneous ablation of oligometastatic RCC may be appropriate in patients with surgically resectable primary RCC who are not candidates for metastasectomy. (Level of Evidence D; Strength of Recommendation: Weak)
6. Radiofrequency ablation, cryoablation, and microwave ablation are all appropriate modalities for thermal ablation, and method of ablation should be left to the discretion of the operating physician. (Level of Evidence: D; Strength of Recommendation: Weak)

Qualifying Statement

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LEVEL OF EVIDENCE

a

HIGH QUALITY EVIDENCE

Types of Evidence	Characteristics of Evidence
Multiple RCTs Systematic reviews or meta-analyses of high-quality RCTs RCT data supported by high-quality registry studies	Homogeneity of RCT study population Intention-to-treat principle maintained Appropriate blinding Precision of data (narrow CIs) Appropriate follow-up (consider duration and patients lost to follow-up) Appropriate statistical design

b

MODERATE QUALITY EVIDENCE—Randomized Study Design

Types of Evidence	Characteristics of Evidence
$\geq$ 1 RCTs Systematic reviews or meta-analyses of moderate-quality RCTs	RCTs with limitations (eg, < 80% follow-up, heterogeneity of patient population, bias, etc) Imprecision of data (small sample size, wide CIs)

c

MODERATE QUALITY EVIDENCE—Nonrandomized Study Design

Types of Evidence	Characteristics of Evidence
Nonrandomized trials Observational or registry studies Systematic reviews or meta-analyses of moderate quality studies	Nonrandomized controlled cohort study Observational study with dramatic effect Outcomes research Ecological study

d

LIMITED QUALITY EVIDENCE

Types of Evidence	Characteristics of Evidence
Observational or registry studies with limited design and execution Systematic reviews or meta-analyses of studies limited by design and execution	Case series Case-control studies Historically controlled studies

e

EXPERT OPINION

Types of Evidence	Characteristics of Evidence
Expert consensus based on clinical practice	Expert opinion without explicit critical appraisal or based on physiology, bench research, or "first principles"

STRENGTH OF RECOMMENDATION

Strong Recommendation	Moderate Recommendation	Weak Recommendation	No Recommendation
Supported by high quality evidence for or against recommendation	Supported by moderate quality evidence for or against recommendation; new research may be able to provide additional context	Supported by weak quality evidence for or against recommendation; new research likely to provide additional context	Insufficient evidence in the literature to support or refute recommendation

CI = confidence interval; RCT = randomized controlled trial.

Figure E1. Level of Evidence and Recommendation Classification System