Role of Cryoablation for the Treatment of cT1b Kidney Lesions: Outcomes of a Systematic Review

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Abstract

Introduction The American Urological Association (AUA) and the European Association of Urology (EAU) currently recommend partial nephrectomy (PN) over ablation for cT1b lesions. However, recent series have shown comparable outcomes for cryoablation (CA) when compared to PN, making it an appealing alternative for a select group of patients. The objective of this manuscript is to assess treatment outcomes and complications of CA for cT1b lesions.

Methods Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a comprehensive search was done on MEDLINE and Cochrane Library electronic databases identifying studies that reported on outcomes and complications of CA for kidney tumors. Inclusion criteria included cT1b lesions between 4 cm and 7 cm, excluding treatment of other sizes.

Results A total of 347 patients with cT1b lesions identified on imaging underwent percutaneous or laparoscopic CA. The average age was > 65 years, the median size of lesions and RENAL score ranged between 4.3–4.8 cm and 8–9, respectively. The majority of patients had a Charlson comorbidity index (CCI) of 2, and median follow-up ranged between 13 months and 95 months. Across all the series, primary and secondary success rates were between 84%–98% and 92%–98%, respectively. The local recurrence ranged from 2.8% to 27%. For patients with documented RCC on biopsy, the 5-year overall survival (OS), cancer-specific survival (CSS), recurrence-free survival (RFS), and metastasis-free survival (MFS) ranged from 56%–91%, 85%–100%, 70%–96.4%, and 90%–96%, respectively. The major complication rate (Clavien-Dindo III-V) was low, at 6.2%.

Conclusion With promising survival outcomes and low complication rates perioperatively, CA is acceptable in a select group of patients with T1b renal tumors, including those who are older, have multiple comorbidities, or have relative or absolute contraindication to surgery.

Introduction

The increased use of medical imaging over the past decades, especially computerized tomography (CT) scans, has increased the detection of renal masses including renal cell carcinoma (RCC)[1]. Partial nephrectomy remains the gold standard for treatment of cT1 lesions[2]. The currently available treatment modalities for cT1 tumors include radical nephrectomy, partial nephrectomy, and ablative therapy.

Key Words

Cryoablation, kidney tumor, renal cell carcinoma, partial nephrectomy

Competing Interests

None declared.

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Abbreviations

AUA American Urological Association
CA cryoablation
CCI Charlson comorbidity index
CSS cancer-specific survival
EAU European Association of Urology
MFS metastasis-free survival
NOS Newcastle Ottawa scale
OS overall survival
PN partial nephrectomy
PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCC renal cell carcinoma
RCT randomized controlled trial
RFS recurrence-free survival

While the use of ablative therapy such as CA has become more widely accepted and is endorsed in treatment guidelines with comparable outcomes to partial nephrectomy (PN) for tumors classified as cT1a (less than 4 cm)[3,4], the data on its efficacy and long-term outcomes remains controversial for tumors classified as cT1b (between 4 cm and 7 cm)[5–8]. Radical or partial nephrectomy is the preferred treatment modality for cT1b lesions[8]. Nevertheless, for patients with cT1b tumors with multiple comorbidities, those who are unfit for general anesthesia, or those who have concomitant underlying chronic kidney disease, secondary therapies such as cryoablation could prove useful in the urologist armamentarium. For this reason, practitioners have recently extended the use of CA to a select group of patients with cT1b lesions.

Generally, cryoablation for large tumors whether performed percutaneously or laparoscopically has been associated with higher risk for recurrence and complications[9,10]. Recent data for cT1b tumors is clinically promising; however, most of the series are single-center series with a limited number of patients, making it difficult to appreciate CA efficacy in this select group of patients. The goal of this paper is to compile the data on cryoablation therapy for cT1b tumors. Specifically, we report outcomes such as primary success, need for repeat ablation, local recurrence, complications, and survival data.

Methods

This systematic review was conducted according to the recommended Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist guidelines[11] (**online Supplementary Tables 1** and **2**). A computer-assisted systematic literature search of the MEDLINE and Cochrane Library electronic databases was performed (latest search February 23, 2022) to identify eligible studies reporting on the outcomes and complications following cryoablation of kidney tumors. The key word combinations used were as follows: ([“Cryotherapy” {MeSH Terms} OR [“Cryosurgery”{MeSH Terms} OR “Cryoablation* OR Cryosurgery* OR Cryotherapy ”{All Fields including title abstract and keywords}]) AND (“Kidney neoplasms ”[MeSH Terms] OR “Kidney NEXT [cancer* OR tumor*])”(All Fields including title, abstract, keywords) OR “ Renal NEXT (cancer* OR tumor*)”(All Fields including title, abstract, key words). The latter was specifically used in the Cochrane Library. Google Scholar was additionally checked for the most relevant articles.

Study selection and risk of bias

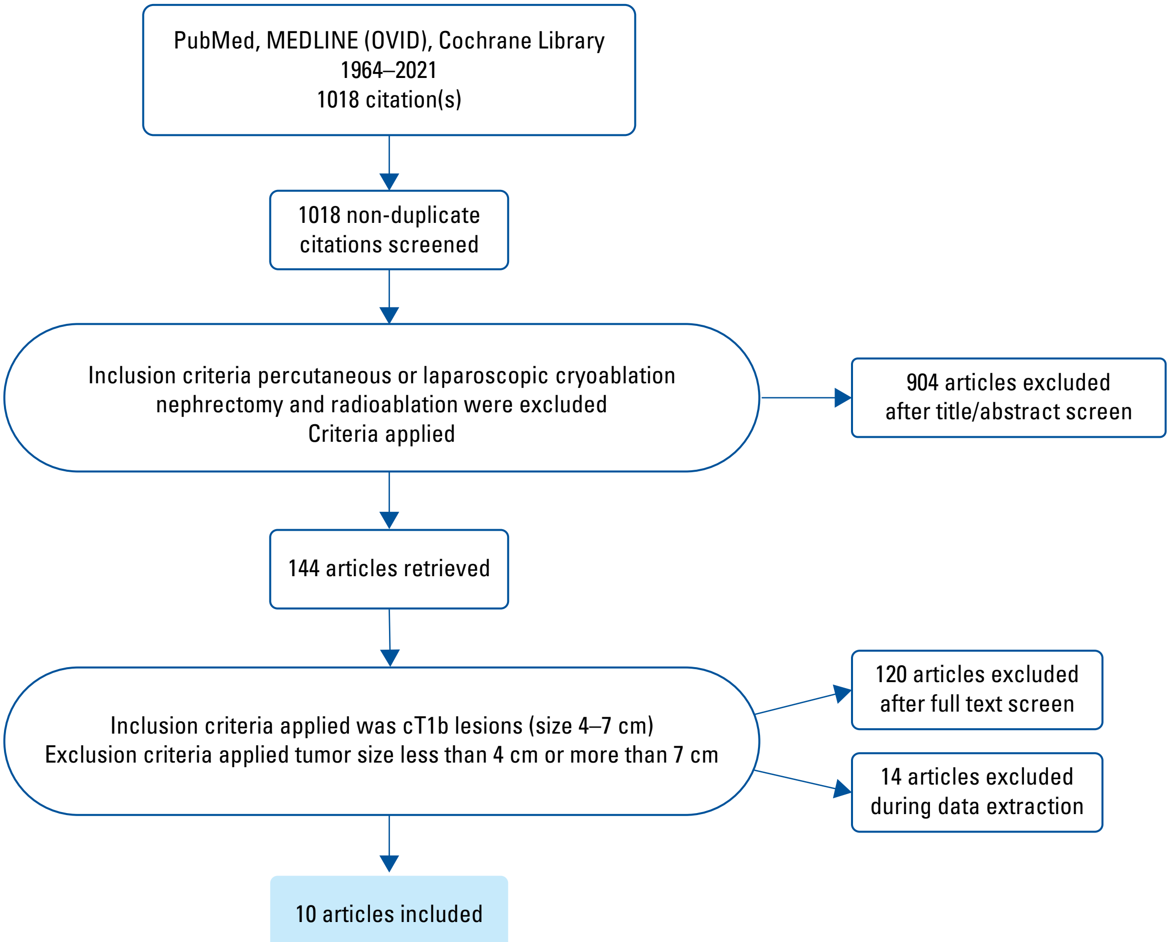
Duplicates were filtered by Endnote X9. Following the exclusion of ineligible articles by title and abstract revision, relevant articles underwent full-text review. The exclusion criteria were set on the following bases: articles not published in English, articles entailing basic science research and conducted on non-human species, letters to the editor, case reports, series with heterogeneous cohort encompassing lesions sizes of < 4 cm and > 7 cm, series lacking required data to be extracted, and lastly series with fewer than 5 treated patients.

Study selection was performed separately by 2 reviewers (J.H. and A.E.) and disagreement was resolved with the input of a third author (M.S.). The same was done for data extraction. Eligibility assessment was based on the title or abstract and on full-text review if appropriate. Articles were eligible for this systematic review if they documented either in the title or abstract the sequel of the cryoablation of kidney tumors. Article inclusion criteria involved the following: original research, randomized controlled trials (RCTs) or observational studies, published in the past 20 years, systematic reviews, and cohort studies with a minimum of 5 patients. The authors included clinical cT1b lesions, which might also encompass benign lesions as well such as oncocytoma.

The database searches yielded 1018 articles. Using the aforementioned inclusion and exclusion criteria and following abstract review, a total of 904 articles were excluded. The 144 remaining papers were analyzed by 2 independent researchers using an inclusion criterion of only cT1b tumors (size of the tumor between 4 cm and 7 cm) and all other sizes were excluded. This led to the exclusion of 120 articles after full-text screen. Articles with the same set of patients were excluded. Finally, 14 articles were excluded during data extraction due to inadequate data for the review, therefore, yielding 10 papers for this review (**Figure 1**).

FIGURE 1.

PRISMA diagram: The search strategy and the number of articles included and excluded in the systematic review



Primary success was defined as no contrast enhancement observed in imaging at the 3-month follow-up examination after cryoablation session. Persistence was defined as persistent positive enhancement on CT scan at 3-month follow-up. If there was a contrast-enhancing lesion at 3 months, usually a repeat cryoablation was done, and it was not considered recurrence but rather incomplete treatment or early post-treatment changes. Secondary success was defined as no contrast enhancement after repeat cryoablation at 3 months. Local recurrence or progression was defined as new contrast enhancement within the ablation zone on CT after local eradication of all tumor cells using imaging criteria[12]. Deaths from non-RCC causes were censored in the assessment of cancer-specific survival (CSS). CSS, metastasis-free survival (MFS) and recurrence-free survival (RFS) were assessed only for patients with proven RCC.

The Newcastle Ottawa scale (NOS) was used to assess the quality of the cohort studies included. As for the case series, the proposed tool of Murad et al. (2018) was used[13]. The rating was done by 2 authors (A.E. and M.S.). Final decision was reached following consensus with the third author (J.H.). A score of 7 of 9 and 5 of 6 was considered indicative of a high-quality study for each tool, respectively. For the item assessing adequate long-term follow-up for NOS, a cut-off of 60 months was set a priori and adequacy of follow-up to 50% in the first 4 years. For the Murad et al. (2018) tool, items 5 and 6 were removed, as they are relevant to cases of adverse drug events. An adequate long-term follow-up for case series was a cut-off of 3 years[13].

Results

After reviewing the literature using the PRISMA guidelines, 10 studies were included in this review (Figure 1). The sample size ranged from 23 to 52 patients, with a total of 347 patients. The average age was between 67 and 77 years. The median tumor size ranged from 4.3 cm to 4.8 cm, as only cT1b tumors were assessed, with a median renal score of 8 to 9. In 2 of the 10 cohorts, patients also had a biopsy taken during the procedure, while in the other series this was done preoperatively. Additionally, 5 series used embolization concurrently or preoperatively with cryoablation, and a total of 48 patients underwent embolization concomitantly during the CA procedure. Of the 10 studies, 7 used percutaneous CA, 1 used laparoscopic CA, and 1 used a mixture of both methods (**Table 1**).

The primary and secondary success rate was high at 84%–98% and 92%–100%, respectively. Most cohorts had a median of 5 probes to ablate the tumor. The median follow-up time ranged from 13 months to 95 months. During follow-up for patients with biopsy-proven RCC, the local recurrence ranged from 2.8% to 27%. The 5-year OS, CSS, RFS/progression-

TABLE 1.
Patient and tumor demographics in all studies

Study	Study sample	Inclusion criteria	Exclusion criteria	Cryoablation method	Median tumor size (cm)
Atwell et al. (2015)[42]	N = 46	Biopsy-proven RCC	None mentioned	Pc	4.8
Caputo et al. (2017)[21]	N = 31	Renal Imaging	Not mentioned	25 Lp 6 Pc	4.3
Hebbadj et al. (2018)[6]	N = 27	Biopsy-proven RCC	Coagulation disorder	Pc	4.8
Hasegawa et al. (2018)[36]	N = 23	Biopsy-proven RCC	Hereditary RCC Multiple tumors	Pc	4.6
Rembeyo et al. (2020)[43]	N = 55	Renal mass on imaging N0M0	Multiple, bilateral and metastatic RCC ASA > 4	Pc	4.6
Gunn et al. (2019)[44]	N = 37	Biopsy-proven RCC	None mentioned	Pc	4.73
Grange et al. (2019)[45]	N = 23	Biopsy-proven RCC	None mentioned	Pc	4.56
Andrews et al. (2019)[17]	N = 52	Renal mass on imaging	Extrarenal spread	Pc	4.8
Bhagavatula et al. (2020)[46]	N = 25	Suspicious mass on renal imaging	Lack of pathology, multiple and prior RCC	Pc	Not mentioned, all tumors ablated between 4–7 cm
Shimizu et al. (2021)[47]	N = 28	Biopsy-proven RCC/ and renal mass image	Metastasis or vascular invasion	Pc	4.6

BMI: body mass index; CCC: clear cell carcinoma; CCI: Charlson comorbidity index; ECOG: Eastern Cooperative Oncology Group; IQR: interquartile range; Lp: laparoscopic; n/a: not assessed; Pc: percutaneous; PN: partial nephrectomy; pRCC: papillary renal cell carcinoma; RCC: renal cell carcinoma; RN: radical nephrectomy.

free survival (PFS), and MFS ranged from 56%–91%, 85%–100%, 70%–96.4%, and 90%–96%, respectively (Table 2).

Nine studies reported complications using the Clavien-Dindo classification system. A total of 74 (23%) complications were reported, with a higher complication rate of grade III–IV noted in 6.2%. The majority of complications (73%) were grade I–II, with 20.2% grade III, and 6.75% grade IV. No grade V complications were encountered (Table 3).

Nine studies included were considered high quality, with a mean NOS score of 7.8 (standard deviation [SD],

Mean age	Sex M/F	BMI Mean ± SD Or Median (IQR)	CCI/ ECOG/ASA	Tumor complexity: RENAL score or descriptive (endophytic, exophytic, central, etc.)	Timing of Biopsy	Biopsy results
73	28/11	Not mentioned	CCI: Mean 3 ± 2 Median 2	Central: 34/46 Exophytic: 10/46 Intraparenchymal: 2/46	Preop	44 RCC 2 RCC unclassified
68	25/6	30.6 (26.3–37.4)	Median CCI (IQR) 6 (5–7)	Median 8 (6–9)	Preop	17 CCC 1 pRCC 4 RCC unclassified
72.3	15/12	Not mentioned	n/a	Median 8 (7–9)	12/27 (44.4%) SS 15/27 (55.6%) Preop	25 CCC 1 chromophobe 1 oncocytoma
66.5	11/12	Not mentioned	ECOG=0 (61%) ECOG =1–4 (39%)	Central: 1 (4%) Non-central:22 (96%)	Preop	14 CCC 1 papillary 1 chromophobe
72	37/18	27.0 (24.0-29.0)	CCI: Low:13 Intermediate:10 High: 32	RENAL: (4–6)à 12 (21.8%) (7–9)à24 (41.6%) (10–12)à19 (34.6%)	Preop	44 malignant 39 CCC 2 pRCC
66.5	22/15	34.8 ± 8.8	CCI mean: 7.1 ± 2.4	Median 9 (7–10)	23 (62%) preop biopsy	12 CCC 5 pRCC 6 RCC unclassified
74.9	17/6	Not mentioned	CCI mean: 4.1 ± 1.9	Mean 8.1 ± 1.8	Preop	17 CCC 4 pRCC 2 chromophobe
77 (69.5–83)	35/11	Not mentioned	CCI median (IQR): 2 (1–4)	Not mentioned	both	35 RCC: 24 CCC 4 pRCC 7 RCC unclassified 16 benign 1 unknown
68	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Preop	Not specified for cT1b
73.9	22/6	Not mentioned	CCI median (IQR): 6 (2–9)	Median 9 (5–11)	Preop	17 CCC 1 papillary 1 unknown 9 no biopsy

TABLE 2.
Outcomes of cryoablation including need for embolization, repeat cryotherapy, recurrence, metastasis, and salvage treatment

Study	Primary Success	Secondary success rate	Number of intraop embolization done	Number of probes used	Repeat cryoablation vs. other modality (after technique failures)
Atwell et al. (2015)[42]	45/46 (98%)	98%	7	Not mentioned	1 RN
Caputo et al. (2017)[21]	27/31 (87%)	93.5%	0	Median 2	2 rCA 2 observed
Hebbadj et al. (2018)[6]	3/27 (88%)	92.5%	0	Mean (range) 5.3 (3–9)	1 PN, 1 rCA
Hasegawa et al. (2018)[36]	1/23 (96%)	100%	13/23 patients (56.5%) (Preop)	Median (range) 4 (3–5)	1 rCA
Rembeyo et al. (2020)[43]	9/55 (84%)	98%	0	Mean 5	9 rCA
Gunn et al. (2019)[44]	4/37 (88%)	92%	3 (preop)	Median (range) 3 (1–7)	4 rCA
Grange at al. (2019)[45]	3/23 (86.3%)	100%	0	Mean ± SD 4.9 ± 1.3	3 rCA
Andrews et al. (2019)[17]	Not assessed	Not assessed	7	Not mentioned	-
Bhagavatula et al. (2020)[46]	2/25 (92%)	99%	-	Range (1–7)	2 rCA
Shimizu et al. (2021)[47]	1/28 (96.4%)	100%	18	5.0 ± 1.5	1 rCA

CRD: cancer-related death; CSS: cancer-specific survival; MFS: metastasis-free survival; n/a: not assessed; OS: overall survival; PFS: progression-free survival; PN: partial nephrectomy; rCA: repeat cryoablation; RN: radical nephrectomy.

1.3) for the cohort arm. One cohort study was considered fair, and all the case series were of high quality. There were no RCTs on the subject. (**Supplemental Tables 1** and **2**).

Discussion

There are multiple treatment options available for cT1b renal tumors including radical nephrectomy, partial nephrectomy, cryoablation, radiofrequency ablation, or active surveillance. The selection of a personalized treatment option is based on many variables including but not limited to patient characteristics, patient preference, and aggressiveness of the tumor at hand. The European Association of Urology (EAU), American Urological Association (AUA), and National Comprehensive Cancer Network (NCCN) guidelines currently recommend partial nephrectomy for cT1b tumors when PN is deemed feasible by the surgeon[14–16]. CA is proposed as an alternative to PN in cT1a patients with comparable outcomes. However, its role in cT1b remains controversial. Historically, it has been considered only in patients with contraindications to surgery, those who are unfit for surgery, or those who refuse surgery[17]. In this systematic review, we reported the patient and

Median follow-up (months)	Local recurrences	Type of salvage treatment	Progression to metastasis	Death	OS	CSS	RFS/ PFS	MFS
24	1/36 (2.8%)	1 RN	2/36 (6%)	2	5-yr 94%	5y 94%	5-yr 96.4%	5-yr 94%
13	5 (16%)	1 RN, 2 rCA	Not assessed	1 CRD 5 all-cause mortality	5-yr 60%	5-yr 85%	5-yr 70%	–
20.0	3 (11.1%)	1 PN 2 active surveillance	1	1 CRD	3-yr 96%	3-yr 95.7%	3-yr 97%	3-yr 96%
23.0	2 (9%)	Active surveillance	2/21 (9%)	3 All-cause mortality	5-yr 82%	5-yr 100%	5-yr 91%	5-yr 91%
19.9	12 (27%)	[total 12] 5 rCA 2 monitoring 1 PN 2 RN	0	2 CRD 1 all-cause mortality	2-yr 93%	2-yr 95%	2-yr 72%	2-yr 93%
25.1	8 (21.6%)	1 chemo, 1 RN after second cryotherapy attempt	Not assessed	1	3-yr 77.6%	3-yr 100%	3-yr 62.6%	–
13.9	2 (8.7%)	1 RN	1/23 (4%)	1 CRD	-	2-yr 85.7%	2-yr 81.8%	–
72	3/48 (6.3%)	-	2/35 (6%)	2	5-yr 56%	5-yr 91%	5-yr 92.7%	5-yr 90%
95	2 (8%)	2 rCA	-	1	5-yr 91%	5-yr 95%	5-yr 85%	5-yr 96%
42	2 (7.1%)	2 rCA	2/18 (11%)	3 deaths	5-yr 79.1%	5-yr 96%	5-yr 92.7%	5-yr 93%

tumor characteristics of laparoscopic or percutaneous (image-guided) CA for such tumors, and the outcomes and complications of each series.

Our review consists of 10 cohorts where the authors recruited a total of 347 patients who underwent CA for their cT1b renal tumor. It is important to highlight that the demographic of the cohorts consists of an older and more comorbid group of patients. The average age ranges from 66.5 years to 75 years. The majority of patients had a Charlson comorbidity index (CCI) of ≥ 2. On the other hand, a large series on patients undergoing PN for cT1b kidney tumors showed that patients had an average age of 59 years, and the majority had a CCI of 0–1[18,19]. Despite being an older and a more comorbid cohort, the 5-year OS, CSS, and RFS across all the cohorts ranged from 56%–91%, 85%–100%, 70%–96.4%, respectively. Only a few patients (28/295; 9.5%) required repeated cryotherapy for recurrence at 3 months for incomplete treatment or technical failure, or for an unspecified reason. 23 of the 28 patients had repeat cryoablation, with an excellent primary and secondary success rate of > 90% and > 95%, respectively. In addition, the risk for metastasis was low, with 5-year MFS ranging from 90%

TABLE 3.
Complications using the Clavien-Dindo classification system across all studies*

Study	Number of complications	Grade I	Grade II	Grade III	Grade IV	Grade V
Atwell et al. (2015)[42]	8	1	3	3	1	0
Caputo et al. (2017)[21]	7	1	5	0	1	0
Hebbadj et al. (2018)[6]	13	9	1	2	1	0
Hasegawa et al. (2018)[36]	2	0	0	2	0	0
Rembeyo et al. (2020)[43]	13	12	1	0	0	0
Gunn et al. (2019)[44]	17	11	1	4	1	0
Grange et al. (2019)[45]	5	4	1	0	0	0
Andrews et al. (2019)[17]	8	1	3	3	1	0
Bhagavatula et al. (2020)[46]	_	_	_	_	_	0
Shimizu et al. (2021)[47]	1	0	0	1	0	0
TOTAL	74	39	15	15	5	0

**Not considering hematuria for > 24 hours as a complication and allowing 2 asymptomatic hematomas.*

to 96%. The data at hand shows that cryotherapy may be a valid alternative to partial or radical nephrectomy for a select group of patients with encouraging oncological outcomes.

Only small, single-center retrospective studies have been published in the literature that compare the efficacy of ablation therapies (cryoablation or radiofrequency) compared to their surgical counterparts (partial nephrectomy or radical nephrectomy) in this group of patients (cT1b)[20]. Caputo et al. published a matched analysis of 62 patients comparing partial nephrectomy to cryoablation in the treatment of T1b tumors and they found no significant difference in both overall mortality (P = 0.155) or cancer-specific mortality (P = 0.48) between the 2 studied samples[21]. In another cohort, Thompson et al. compared long-term outcomes of cryoablation to partial nephrectomy in T1b tumors. Those authors retrospectively followed 376 patients from the Mayo Clinic Tumor Registry, 14% (N = 52) underwent cryoablation and 86% (N = 324) underwent partial nephrectomy. The median follow-up in that study was 6 years and 8.7 years, respectively, for each of the 2 groups. The authors found no significant difference between both groups in relation to local recurrence, metastases, and death of patients from their tumor. In addition, 5-year cancer-free survival was 91% for the cryotherapy group and 98% for the partial nephrectomy group[5,17]. While some found comparable survival data between both techniques, others have found a higher odds of survival when comparing CA to PN after propensity matching (hazard ratio [HR], 2.74; 95% CI 1.611–4.66; P < 0.001). However, this study didn't account for tumor complexity using nephrometry score and had a clear selection bias between those treated with PN and those with cryoablation.

Two of the major concerns for cryoablation remain the local tumor control rate and the local recurrence rate[6,22]. One series by Gunn et al. had the highest recurrence rate at 21%; however, this cohort had the highest mean body mass index (BMI) (34.8 ± 8.8), mean CCI (7.1 ± 2.4), and median RENAL score 9 (range, 7–10) of all the patients[23]. Higher BMI and higher tumor complexity are additional predictors of recurrence, as seen by Caputo et al., who found significant differences in the rate of local recurrence at 1-year follow-up (P = 0.019), with recurrence rates significantly higher for the cryoablation group compared to PN. Predictor of recurrence included tumor size, BMI > 30, and endophytic lesions[24]. While tumor complexity is a clear predictor of recurrence[25–28], the effect of BMI on recurrence and success remains controversial, with some series showing no effect of BMI or obesity on survival and recurrence[29,30]. Across all series, only 12.1% of the subjects (N = 42) experienced local tumor recurrence, with progression to metastasis only ranging from 4% to 11%. It is important to note that these comparative series have short-term follow-up, with a median follow-up time between 13 months and 31.6 months. Recent data after long-term follow-up have shown no difference in 5-year local recurrence-free survival between cryoablation and PN (91.6% vs. 92.7%; HR, 1.46; $P = 0.6$)[17]. One reason could be the late recurrence of patients who underwent PN.

With regard to postoperative complications, grade III and above complications were low, at 6.2% across all the series. When comparing CA to PN, Caputo et al. (2017) showed a higher incidence of postoperative complications with PN (PN 42% vs. CA 23%; $P = 0.10$)[21]. A recent systematic review showed a significant increase in postoperative complication of PN compared to CA (OR, 2.97; 95% CI, 2.13–4.14; $P < 0.001$)[29]. Cryoablation can be performed either laparoscopically or percutaneously, and this review included both these techniques. The majority of the procedures were done percutaneously; however, some institutions do still use the laparoscopic approach[21,31]. Multiple studies have been published comparing outcomes of both techniques. While some series have shown similar complication rates, and similar OS, CSS, and RFS between percutaneous and laparoscopic cryoablation[24], a meta-analysis has shown that percutaneous cryoablation (PCA) had shorter hospital stay and laparoscopic cryoablation (LCA) had lower incidence of perirenal hematoma. PCA is favored for older patients and those with posterior tumors[32].

One final aspect of CA to be raised is the timing of renal mass biopsy (RMB), and whether to do it concomitantly or in a separate session prior to ablation. Each institution has a different protocol, hence some of the series had RMB before the procedure while others concomitantly during the ablation procedure. The EAU guidelines recommend a percutaneous renal biopsy done prior to ablation therapy rather than concomitantly because biopsy reduces the number of unnecessary ablations of benign lesions, where historically 32% to 45 % of patients undergoing ablation therapy had benign lesions[33–35]. In addition, oncological outcome of patients might differ based on the RCC subtypes detected on biopsy, which will help in better patient counseling and on the best treatment course[36].

Comparing the 2 ablative methods (cryoablation vs. radiofrequency), the literature is especially lacking in studies for cT1b lesions. Only one published study, performed by Hasegawa et al., compared the efficacy of the 2 ablative methods in 46 patients with T1b stage RCC. Those authors found that the 5-year OS rates were similar between cryoablation and radiofrequency ablation (82% vs. 78%, respectively; $P = 0.82$), and the 5-year RCC-related survival rate was 100% for both groups[37]. Cryoablation is preferentially used in centrally located lesions, for tumors between 3 cm and 7 cm, and for those near the ureter[34,38]. For now, radiofrequency ablation remains reserved for tumors smaller than 3 cm[38]. The EAU guideline panel proposal still limits ablative therapy to lesions between 3 cm and 7 cm in patients where surgery is not feasible or contraindicated[40].

Long-term oncological effectiveness about cryoablations remains hard to ascertain, as these series are not without limitations. These series are mostly retrospective, observational studies with short-term follow-up. No prospective RCT exists that compares outcomes of PN to CA for cT1b kidney tumor. Even matching was poor in some comparative series that compared CA and PN. Moreover, these series have small sample sizes, and the authors fail to mention the reason for cryoablations or the criteria used to treat these patients with CA, both of which are causes of a selection bias. In addition, the median lesion size ranges from 4.3 cm to 4.8 cm. While this size range falls within the range of cT1b tumors (4 cm to 7 cm), it targets a subset of patients within that group, and these findings may not be generalizable to the larger population of cT1b. Currently, there is no consensus on the number and size of probes that are used in the ablative techniques, and this causes some variability between treating centers. Lastly, some centers elected to do preoperative or intraoperative embolization of tumor prior to cryoablation. Embolization can decrease complications such as hemorrhage and renal collecting system injury in large tumors without affecting renal function. However, its definitive effect on recurrence rate and survival remains to be determined[41,42].

Conclusion

While partial nephrectomy remains the preferred method to treat cT1b kidney tumors, cryoablation is a feasible alternative with good survival and recurrence-free survival outcomes. Cryoablation for T1b tumors might be considered in a select group of patients—those who are older, have multiple comorbidities, or cannot tolerate surgery. It can also serve as a suitable alternative for patients who refuse surgery.

Acknowledgments

Availability of data and material

All data generated or analyzed during this study are included in this article and its supplementary material files. Further enquiries can be directed to the corresponding author.

Authors contributions

M. Shahait and A. El-Achkar conceived the study and its design; A. Farkouh, J. Hassanieh, A. El-Achkar, and M. Khader performed data collection; A. El-Achkar, M. Khader, and A. Farkouh performed data analysis and interpreted the results; A. El-Achkar, M. Khader, and M. Shahait prepared the manuscript draft; and all the authors reviewed the results and approved the final version of the manuscript.

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