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Differences in Patterns of Care: Reablation and Nephrectomy Rates After Needle Ablative Therapy for Renal Masses Stratified by Medical Specialty

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Abstract

Objective: We aimed to study differences in reablation rates, modality utilization, and outcomes after renal tumor cryoablation (CA) and radiofrequency ablation (RFA), stratified by medical specialty.

Methods: A literature review was performed to identify papers reporting renal RFA and CA results. Patient demographics and clinical and pathological variables were collected, as were ablation success and salvage treatment rates.

Results: Interventional radiologists (IR) reported more experience with renal RFA than with CA (31.4% *v* 11.3% of all reported cases, $p < 0.001$). However, the majority of renal RFA and CA are performed by urologists. The percutaneous approach was used far more often with RFA than with CA, reflecting this preference by radiologists (80.9% *v* 23.4%, $p < 0.01$). The mean tumor size, cancer-specific survival rates, mean follow-up duration, and salvage nephrectomy rates were not statistically different between CA and RFA. Tumor reablation rates were significantly higher for RFA than for CA (7.4% *v* 0.9%, $p = 0.009$). RFA reablation rate correlated closely to surgeon specialty, such that 72% of reablations were reported by IR, while only 28% were performed primarily by urologists ($p < 0.0001$). This was despite IR being primary surgeons in only 31.4% of first tumor ablations. Salvage nephrectomy was performed more after CA than after renal RFA, probably because 89% of CA were done by urologists. There were no reablations in the laparoscopically approached cases.

Conclusions: Cancer-specific outcomes after renal tumor CA and RFA are similar. However, RFA has required more reablations to achieve 95% cancer-specific survival rates. IR reported more experience with RFA, and urologists reported more experience with CA. Overall, RFA and CA reablation rates are significantly higher when a percutaneous approach is used and seemed to correlate with surgeon specialty.

Introduction

Due to the increasing use of cross-sectional imaging, there has been a significant rise in the incidence of incidentally detected renal masses.[3] During the last decade, there has been a 30% increase in the number of renal cell carcinoma (RCC) cases in the ultrasonography (US), and a nearly 100% increase since the 1950s.[1–2] Further, this has lead to a significant stage migration, resulting in most renal masses being identified in the early stages of the disease. While about 20% of the renal masses <4 cm in size are benign, the remaining tumor masses exhibit variable malignant potential.[4]

Because many of these masses are detected in the elderly population, many of whom have significant comorbidities such as diabetes mellitus and hypertension (HTN), efforts to preserve functional nephron units are paramount. Thus, a demand for nephron-sparing surgery, particularly in the minimally invasive fashion, has risen to the forefront of the developments in urological surgery techniques.[5] Although surgical removal of renal tumors remains the primary therapeutic approach for curative intent, several ablative therapies have been investigated and proposed for the management of small renal masses.

Although the long-term cancer control data are still evolving, needle ablative therapies for small renal masses have emerged as an alternative to traditional extirpative surgery. Radiofrequency ablation (RFA) and cryoablation (CA) are the two most thoroughly studied modalities for treatment of theses lesions. While the literature reports the use of RFA and CA in both the urology and radiology subspecialties, the frequency of

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Table 1. Study Demographics

	RFA	*CA*	p-*Value*
Studies	12	12	ns
Patients (*n*)	283	337	ns
Mean tumor size (cm)	2.4	2.5	ns
Approach			
Open	0	22	
Laparoscopic	54	236	<0.01
Percutaneous	229	59	<0.01

The majority of CA cases were performed laparoscopically. Conversely, the majority of RFA cases were performed percutaneously. These differences in the use of laparoscopic versus percutaneous approach reached statistical significance between the two modalities ($p < 0.01$).

ns = not significant; CA = cryoablation; RFA = radiofrequency ablation.

Table 2. Reablation Rates for Each Modality by Approach

	RFA (%)	*CA (%)*	p-*Value*
Open	0	4.5	ns
Laparoscopic	0	0	ns
Percutaneous	8.8	2.5	<0.05
Total	7.4	0.9	<0.05

We stratified the reablation rates for each modality and found a 7.4% reablation rate in the RFA series and a 0.9% reablation rate in the CA series.

ns = not significant.

use and management of residual tumor between the two specialties has not been quantified. In this study, we aimed to evaluate differences in outcomes after renal tumor CA and RFA, stratified by the treating medical specialty.

Materials and Methods

A literature review was performed using PubMed to identify all papers reporting renal RFA and CA results spanning from 2000 to 2006. Patient demographics, clinical and pathological variables, ablation success, and salvage treatment rates were collected.

Results

We identified 12 studies using RFA literature and 12 studies using CA literature. A total of 283 and 337 renal masses were treated with RFA and CA, respectively. The mean tumor size was 2.4 cm (Table 1). The majority of RFA cases (80%) were performed percutaneously, and no open cases were reported in the RFA series. Conversely, the majority of CA cases (76%) were performed laparoscopically. These differences in the use of laparoscopic versus percutaneous approach reached statistical significance between the two modalities ($p < 0.01$).

Figure 1 illustrates the cases reported in the two series by specialty. A total of 24 studies were identified during our search. Interventional radiologists (IR) performed 11.2% of CA and 31.4% of the RFA cases reported in our literature review. When stratifying the reablation rates by the modality used, we found a 7.4% reablation rate in the RFA series and a 0.9% reablation rate in the CA series (Table 2). When comparing the overall reablation rates by specialties, we found that 72% were performed by IR, when confronted with a suspicion for recurrent disease or residual tumor (Fig. 2).

During percutaneous ablations, needle placement and ablation monitoring were most frequently performed with the use of computed tomography (CT) (64%). CT was also the most used modality for surveillance of recurrent disease. A combination of CT and US was used in 28% of the percutaneous ablations, while magnetic resonance imaging (MRI) alone was used in an equal amount of cases. Intraoperative US was used in all laparoscopic and open cases.

As illustrated in Table 3, comparisons between mean tumor size, cancer-specific success rate, and mean follow-up time were not significantly different. However, the overall reablation rate in the RFA series was significantly higher than that seen in the CA series (7.4% *v* 0.9%, $p = 0.009$). Salvage nephrectomy reported more on CA series versus RFA recurrence (2.4% *v* 1.1%, $p = 0.009$).

Tables 4 and 5 summarize the literature on renal tumors for RFA and CA, respectively. Among the previously mentioned findings, the cancer-specific success rate was 94.8% with a mean follow-up of 19.5 months. For the RFA series, three nephrectomies were reported for either persistent enhancement or complications.

Discussion

RFA and CA are the two most thoroughly studied needle ablative modalities for the treatment of small renal masses. Both the urologist and radiologist have published results on laparoscopic and/or percutaneous approaches. However, the frequency of the management of residual tumor between the two specialties has yet to be quantified. Here, we aimed to study differences in reablations rates, modality utilization, and outcomes after renal tumor CA and RFA, stratified by

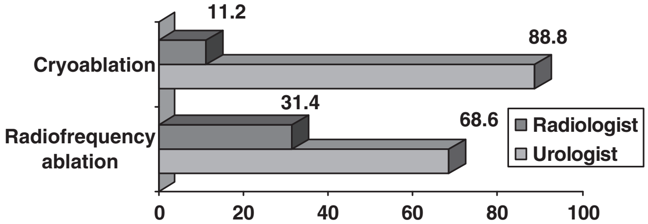

FIG. 1. Cases reported in RFA and CA series by specialty.

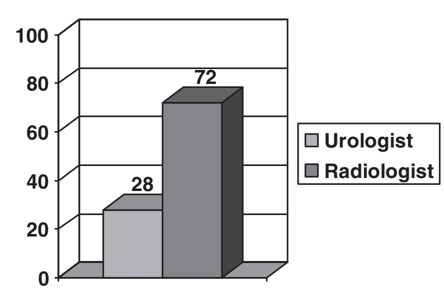

FIG. 2. Correlation of reablation rates with specialty.

Table 3. The Clinical Characteristics of the Radiofrequency Ablation and Cryoablation Series

	RFA	*CA*	p-*Value*
n	283	337	ns
Mean tumor size	2.4 cm	2.5 cm	ns
Cancer-specific success	95%	95%	ns
Mean follow-up	20 months	20 months	ns
Reablation rate	7.4%	0.9%	0.009
Salvage nephrectomy	1.1%	2.4%	ns

Comparisons between mean tumor size, cancer-specific success rate, and mean follow-up time were not significant. However, the overall reablation rate in the RFA series is significantly higher than that in the CA series, and there is a trend toward a higher rate of salvage nephrectomy in the CA series.

ns = not significant.

medical specialty. In doing so, we observed a couple of interesting findings that deserve attention in this discussion.

When evaluating the differences in the approach used, we found that a majority of the CA cases were performed laparoscopically. Conversely, the majority of RFA cases were performed percutaneously, which is the preferred modality and approach by IR (80.9% *v* 23.4%, $p < 0.01$). This difference reached a statistical significance.

Tumor reablation rates were significantly higher in the RFA group than in the CA group (8.8% *v* 0.9%, $p < 0.0001$). RFA reablation rates correlated closely to medical specialty, 72% radiologists versus 28% urologists ($p < 0.0001$). Further, when comparing between cases reported by the two specialties, radiologists report more experience with RFA versus CA (31.4% *v* 11.3% of all reported cases, $p < 0.001$). This further mitigates the higher reablation rate in the percutaneous treatment group. A finding such as this should not be surprising given the, seemingly, lower morbidity sustained with repeat percutaneous procedures, as compared to the higher morbidity potential from a repeat laparoscopic procedure, including the risk associated with a general anesthetic.

There was a trend toward higher salvage nephrectomy rates in the CA group. This is probably due to the fact that 88% of the CA were performed by urologists who are more prone to perform an open nephrectomy for recurrent disease, especially considering that a repeat laparoscopic procedure would be fraught with more difficulty.

Interestingly, there were no reablations after the laparoscopic approached cases in either the RFA or CA series. However, three nephrectomies were reported, in the percutaneous RFA cases, for persistent enhancement and/or complications.

The question arises, "Why are the reablation rates higher when the percutaneous approach is used?" We learned from the shockwave lithotripsy data that stone treatments are more successful when the patient is placed under a general anesthetic because it eliminates patient movement, thus resulting in more accurate treatment targeting. This may, in part, explain the decreased reablation rates seen in the CA, as nearly all of the CA treatments were performed via a laparoscopic approach. Further, a better ablation may be afforded as a result of mobilization of the kidney, allowing one better access to the contour of the mass and optimizing the angle for positioning the probe perpendicular to the short axis of the mass. In addition, this approach allows continuous assessment of depth of the mass via intraoperative real-time US to achieve a three-dimensional perspective of the tumor and ice ball, in the case of CA.

In the general surgery literature, RFA of solid organs have been well documented. In a fairly recent metaanalysis evaluating the outcomes of RFA of liver lesions, two predictors of treatment failure were determined: tumor size and percutaneous treatments.[25] It will be interesting to see if we find similar predictors of treatment success or failure as our experience with renal ablations becomes more robust.

Determining whether to use a percutaneous versus a laparoscopic approach is based on tumor position and patient factors. It is recommended that anterior tumors be treated via a transperitoneal approach and done laparoscopically, while the retroperitoneal approach, be it laparoscopically or percutaneously, is reserved for posterior/lateral tumors, and in patients with a hostile abdomen. It would have been informative to correlate tumor location with the approach used and/or ablation success rates. However, this information was not readily available.

Thus far, the literature demonstrates that CA and RFA have similar specific outcomes (94.4% *v* 94.8%, respectively) after

Table 4. Radiofrequency Ablation

References	*No. pts.*	*Approach*	*Mean tumor size (cm)*	*Mean follow-up (month)*	*CA-specific success (%)*	*Salvage nephrectomy*	*Reablation rate*	*Imaging*
Gervais et al[41] (Rad)	20	Perc	3.2 (1.1–7.1)	55.2 (48–60)	94	0	5/16	80% CT, 20% US
Mayo-Smith et al[28] (Rad)	32	Perc	2.6 (1–5)	9 (1–36)	N/A	0	6/32	CT, US
Farrell et al[27] (Rad)	35	Perc	1.7 (0.9–3.6)	9 (1–23)	100	0	0	19% CT, 81% US
Zagoria et al[30] (Rad)	24	Perc	3.5 (1–7)	7 (1–35)	83	0	2/24	CT
Hwang et al[31] (Uro)	9	Perc	2.2 (1.8–2.7)	13(12–23)	100	0	0	CT, US
Lewin et al[47] (Rad)	10	Perc	2.3 (1–3.6)	23 (1.6–41.7)	100	0	0	MRI
Park et al[32] (Uro)	55	Perc	2.4 (1–4.1)	24.3 (12–48)	97	1	2/38	CT
Varkarakis et al[33] (Uro)	56	Perc	2.2 (1–4)	27.5 (12–48)	96	1	5/56	CT
Sabharwal et al[34] (Rad)	18	Perc	2 (1–4.3)	11 (1–24)	92	0	3/13	CT
Memarsadeghi et al[36] (Rad)	24	Perc	2 (N/A)	11.2 (0.2–31.5)	90	1	2/10	MR
Hwang et al[31] (Uro)	15	Lap	2.2 (1.5–2.9)	13 (12–23)	93	0	0	US
Park et al[32] (Uro)	39	Lap	2.3 (1–4.2)	26 (12–36)	96	0	0	US

Rad = radiologist; Uro = Urologist; Perc = percutaneous; Lap = laparoscopic; N/A = not available.

Table 5. Cryoablation Series

References	No. pts.	Approach	Mean tumor size (cm)	Mean follow-up (month)	CA-specific success (%)	Salvage nephrectomy	Reablation rate	Imaging
Rukstalis et al[35] (Uro)	22	Open	2.2 (1–4.7)	16 (1–43)	94	0	0.045	US
Shingleton et al[17] (Uro)	22	Perc	3.0 (1.8–7)	9.1 (3–14)	N/A	0	0.04	MRI
Bassignani et al[48] (Rad)	4	Perc	3.8 (3–6.2)	7.5 (0–13)	100	0	0	US
Silverman et al[38] (Rad)	26	Perc	2.6 (1–4.6)	14(4–30)	92	1	0.041	MRI
Gupta et al[39] (Rad)	27	Perc	2.4 (1.2–4.6)	6 (1.2–10.3)	94	0	0	CT
Lawatsch et al[40] (Uro)	81	Lap	2.5 (1–5)	25.2 (N/A)	95	2	0	US
Lee et al[41] (Uro)	20	Lap	2.6 (1.4–4.5)	14.2 (1–40)	100	0	0	US
Moon et al[42] (Uro)	16	Lap	2.6 (1.5–3.5)	9.6 (1–28)	100	0	0	US
Cestari et al[43] (Uro)	37	Lap	2.6 (1–6)	20.5 (1–36)	97	1	0	US
Gill et al[44] (Uro)	60	Lap	2.3 (1–5)	36(36)	94	2	0	US
Bachmann et al[45] (Uro)	7	Lap	2.6 (1.5–3.5)	13.6 (4–22)	100	0	0	US
Nadler et al[19] (Uro)	15	Lap	2.1 (1.2–3.2)	15.1 (5–27)	80	2	0	US

Rad = radiologist; Uro = Urologist; Perc = percutaneous; Lap = laparoscopic; N/A = not available.

treatments for tumors of similar size and similar follow-up period.[6] However, RFA has required more reablations to achieve 95% cancer-specific success rates. Reablation after RFA is more common, but these numbers are strongly driven by radiologists who tend reablate more often than urologists, despite performing less primary renal RFA.

In a recent report by Bandi et al (2008), they surveyed 68 urologists from a major academic center and found that 51% of ablative cases were performed under collaborative efforts between a urologist and an IR.[24] It is encouraging that the urologists are using the expertise of IR, who historically have experience with the needling of intraabdominal masses—limited not just to the kidney. Likewise, this collaboration is important considering that IR alone may not have the expertise and training in the biology of the disease and the proper selection of patients who should receive ablative therapy versus other treatment options. Further, many argue that it is imperative that urologists have an active involvement in patient selection, postprocedure care, and follow-up. Urologists have historically been the specialists who manage renal tumors from a clinical, biological, and technical standpoint.

This report has its limitations. The results were derived from nonrandomized, retrospective studies. Further, the mainstays of surveillance for recurrence disease in needle ablative therapies should rely upon both no enhancements on follow-up imaging and post-op biopsy. Only one institution presents the postablation biopsy results after ablation. In addition, there is limited follow-up with a mean of 20 months. Despite these limitations, the management of recurrent disease and modalities of choice between the two specialties gives perspective to the future of renal ablative therapies as we develop practice guidelines and protocols.

Conclusion

Ablative therapies continue to evolve as a safe and definitive treatment alternative for small renal masses. Percutaneous and laparoscopic approaches are being performed safely, and its use is encouraging. Overall, reablation rates seem to correlate closely to medical specialty and treatment modality used. IR reported more experience with RFA and urologist CA. Cancer-specific outcomes are similar in both the CA and RFA series. However, RFA has required more reablations to achieve 95% cancer-specific success rates. Reablation after RFA is more common, but these numbers are maybe driven by specialty and/or approach used. Overall, RFA and CA reablation rates are significantly higher when a percutaneous approach is used and correlated with surgeon specialty. Until further prospective data or a randomized trial comparing the two modalities are published, the superiority of RFA or CA remains undetermined.

Disclosure Statement

Dr. Sangtae Park is a speaker for Pfizer, Inc.

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Abbreviations Used

CA = cryoablation
CT = computed tomography
ESWL = extracorporeal shockwave lithotripsy
HTN = hypertension
IR = interventional radiologists
MRI = magnetic resonance imaging
RCC = renal cell carcinoma
RFA = radiofrequency ablation
US = ultrasonography

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