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Role of Tumor Location in Selecting Patients for Percutaneous Versus Surgical Cryoablation of Renal Masses

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Abstract

Purpose—To characterize the relationship between tumor location and choice in selecting surgical cryoablation (SCA) vs. percutaneous cryoablation (PCA) for treatment of renal masses.

Materials and Methods—MEDLINE search was performed to identify studies in which cryoablation was used as therapy for renal masses. Tumor location was stratified as anterior, posterior, or lateral. Lesions were also described by endophycity (endo-, meso-, or exophytic) and polarity (upper, mid, or lower pole). Treating specialty was stratified as urology, radiology, or both. Comorbidity reporting rates were indexed for each manuscript.

Results—37 manuscripts included 2344 lesions treated by SCA or PCA formed the basis for the analysis. Comparing SCA vs. PCA series, anterior/posterior designation was reported in 31 vs. 47% of series; endophycity designation was reported in 17 vs. 40% of series; and polarity designation was reported in 48 vs. 47% of series (all p-values >0.05). Amongst those lesions treated by SCA, 44% were anterior lesions and 28% were posterior, while among PCA-treated lesions 9% were anterior and 81% were posterior. Tumor location description was entirely absent in 32% (14/44) of published series.

Conclusions—Despite data that tumor location is integral to choice of treatment for renal mass, anatomic tumor descriptors are vastly underreported in the cryotherapy literature. Nearly one third of masses treated with SCA are on the posterior surface of the affected kidney, and may be amenable to PCA, thus avoiding risk of general anesthesia and intraabdominal dissection in comorbid cohorts. Better reporting of objective measures of tumor anatomy and location in cryosurgery literature may facilitate standardization of treatment protocols in patients with renal mass.

Keywords

cryoablation; renal mass; percutaneous; laparoscopic; tumor location

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INTRODUCTION

Definitive treatment of renal cell carcinoma (RCC) remains excision. Surgical series for treatment of renal masses have shown excellent outcomes with 5-year survival rates approaching 97%. (1, 2) Ablative techniques such as cryoablation and radiofrequency ablation provide a potentially less invasive, less morbid treatment option with reduced blood loss, shorter hospitalization and reduced pain when compared to surgical therapies. (3) Indeed, treatment patterns for anatomically uncomplicated renal masses have shifted towards ablative technologies at some institutions (4) with acceptable short- and intermediate-term oncologic outcomes. (5, 6)

Cryoablation has been successfully performed by both surgical (SCA) (open and laparoscopic) and percutaneous (PCA) approaches. (4, 7) Comparison of procedure times, narcotic requirements, hospital stay, and expenditures have demonstrated that PCA is more cost-effective and less morbid than SCA (8) with comparable oncologic efficacy in the short and intermediate term follow-up. (6, 9, 10)

Classically, tumor location is the primary determinant of ablation approach, as posterior lesions are ideally suited for PCA, while anterior lesions are more often approached surgically to avoid visceral injury. (8, 11, 12) Yet, to date, a formal assessment of how tumor location affects clinical decision-making is lacking. In this study, we reviewed the contemporary literature to investigate the impact of tumor anatomy on the decision to perform percutaneous versus surgical cryoablation.

MATERIALS and METHODS

A MEDLINE search was performed using the National Center for Biotechnology Information Pubmed® Internet site to identify studies reporting outcomes for cryoablation of renal masses. Published series analyzing clinically localized renal masses that were managed by surgical or percutaneous cryoablation were included. Series consisting of patients with hereditary or metastatic RCC as well as case reports were excluded from this analysis. In instances where multiple published series from the same institution or overlapping cohorts were available, the most updated or inclusive dataset was analyzed to avoid redundant data indexing.

Series were reviewed and anatomic tumor descriptor data, when available, were extracted. Tumor anatomic description data were stratified by tumor location (anterior, posterior, and lateral), degree of endophycity (exo-, meso-, endophytic), and/or polarity (upper, mid, lower pole). Comorbidity reporting rates were determined. Reporting medical discipline was identified for each series based on the primary and lead authors' department and defined as urology or radiology. Manuscripts that included both SCA performed by urologists and PCA performed by radiologists were designated as combined interdisciplinary urology/radiology authorship. Studies were designated as single or multi-institutional and retrospective vs. prospective. Fisher's exact test was used to assess associations between treatment modality, reporting specialty, and tumor descriptor reporting.

RESULTS

A total of 37 manuscripts describing 2344 renal masses treated with cryoablation met inclusion criteria. 7 manuscripts described both an SCA and a PCA cohort for a total of 44 reported cohorts. Thus, there were 29 reported cohorts employing SCA as the treatment approach, accounting for 66% (1540/2344) of all reported lesions. For the PCA group, there were 15 published cohorts, comprising 34% (804/2344) of all non-redundant published lesions. A minority of reported cohorts (4/44, 9%) were multi-institutional, and for nearly all manuscripts data was collected retrospectively (Table 1). Although cryoablation is currently largely reserved for comorbid and frail patients, reporting of patient comorbidity profiles was omitted in the vast majority (33/44, 75%) of the reported literature (Table 1).

Table 1 summarizes and compares how tumor location descriptors were reported in the SCA and PCA literature. Tumor location descriptor of any type was omitted in 32% (14/44) of reported cohorts and was just as likely to be omitted in the SCA as in the PCA literature (p=0.34). Only 31% of SCA manuscripts (9/29) and 47% of PCA manuscripts (7/15) reported whether a tumor was on the anterior, posterior, or lateral aspect of a renal unit (p=0.34). Meanwhile, description of tumor exo/endophycity appeared in 17% (5/29) of the SCA cohort descriptions vs. in 40% (6/15) of reports describing PCA (p=0.14). For upper/mid/lower pole tumor location descriptor, reporting rates were 48% (14/29) for SCA vs. 47% (7/15) for PCA (p=1) (Table 1). Only 2 reports (5%) employed standardized scoring systems to report tumor anatomic complexity. (13, 14)

Table 2 describes the types of tumors treated with SCA and PCA as stratified by tumor descriptors for lesions with available data. PCA literature was more likely to report the anterior/posterior/lateral descriptor (42% vs. 36%, p=0.003) and the exo/meso/endophytic descriptor (23% vs. 58%, p<0.001) when compared to the SCA literature. The upper/mid/lower pole descriptor was just as likely to be reported in the PCA as in the SCA cohorts (31% vs 32%, p=0.9). Of the tumors in the SCA cohort with a reported location descriptor, 56% were non-anterior tumors. Meanwhile, of the tumors treated with PCA that had the anterior/posterior/lateral descriptor reported, 91% were located either laterally or posteriorly on the affected renal unit. Furthermore, meso and endophytic tumors were more likely to be treated with PCA than with SCA, while tumor polarity was distributed similarly between the PCA and SCA cohorts (Table 2).

Figure 1 depicts the manuscript contribution by specialty. When reporting rates for tumor location descriptors were stratified by the specialty of the presenting authors (Table 3), no statistically significant differences in reporting rates between urologist, radiologists, and multidisciplinary teams were observed. When further examining specific comparisons between reporting rates of urologist vs. radiologist vs. interdisciplinary authors, only radiology reporting of any (at least one of the 3) tumor location descriptors when compared to the interdisciplinary authors reached statistical significance (p=0.03). Comparisons of reporting rates for any location descriptor and the exo/meso/endophytic descriptor between radiologist and urologists approached but did not reach statistical significance (p=0.05, 0.06, respectively).

DISCUSSION

Cryoablation can be performed both surgically—largely laparoscopically—and percutaneously. Surgical cryoablation facilitates direct tumor visualization via tissue mobilization and subsequent probe insertion, while percutaneous cryoablation obviates the need for general anesthesia. (11, 12, 15) Utilization of each approach currently largely depends on institutional traditions and surgeon preference. (11, 16) For instance, some institutions utilize a purely laparoscopic approach, modifying it only by treating anterior lesions transperitoneally and posterior lesions retroperitoneally. (5, 8, 17, 18) An alternative strategy is to treat anterior lesions laparoscopically and posterior lesions percutaneously. (6, 15) In the meantime, other centers largely avoid laparoscopic focal therapy and perform only percutaneous cryoablations (19, 20)

Some authors have suggested that treatment modality as well as tumor location can have an impact upon treatment efficacy, as upper pole lesions treated percutaneously result in more local failures, likely due to concerns for thermal injury and subsequent incomplete tumor ablation. (15, 21) Two recent series have also demonstrated that larger tumor size (a 4-fold increase for each 1 cm increase in diameter) and a greater degree of endophycity are associated with tumor recurrence. (11, 22) Likewise, small, single-center series directly comparing SCA to PCA suggest similar efficacy, but higher retreatment rates in the PCA cohort. (10, 11, 15) Nevertheless, a recent pooled-analysis of all published reports demonstrated that oncologic efficacy of therapy appears equivalent regardless of the modality utilized. (9)

Analyses of treatment morbidity as well as cost of care appear to strongly favor PCA over SCA. (8) Link et al developed a model comparing patient cost between partial nephrectomy and laparoscopic and percutaneous cryoablation. This model found that PCA was significantly less costly than the surgical options, although this difference varied depending upon the number of cryoablation probes utilized. (23) These findings have been substantiated by several other series reporting that the percutaneous approach is less costly, results in shorter hospital stays, and exposes patients to fewer complications when compared to SCA. (11, 15, 24–26)

Since the modality for delivering cryosurgical treatment appears to have implications for cost and morbidity, it is important to better understand how the choice of PCA vs. SCA is made in clinical practice. Moreover, because focal therapy is reserved for our elderly and most comorbid patients, it is essential to develop evidence-based guidelines that establish when the use of SCA and its inherent risks are justified over PCA or other management options such as active surveillance. Interestingly, 2/3 of the reported cryotherapy cohorts omitted reporting of patient comorbidity data. Tumor location data was also notably lacking in the published literature (Table 1, Table 2). Notably, 64% (28/44) of published series lacked any information on tumor anterior/posterior location, while 32% (14/44) failed to report tumor location of any type. When location was reported, information provided varied between series and was rarely complete. Meanwhile, radiology-driven manuscripts were generally less likely to omit tumor location descriptors altogether when compared to urologists and interdisciplinary authors. (Table 3).

In the published series that reported anterior vs. posterior vs. lateral tumor location, 28% of lesions treated with SCA were on the posterior surface of the kidney – the anatomic location that is generally considered ideal for the percutaneous approach and would have potentially obviated the need for general anesthesia and intraabdominal surgical manipulation. Meanwhile, only a small percentage of tumors (9%) that were treated with PCA were reported to be on the anterior surface of the affected renal unit, the location classically considered unfavorable for PCA. Nevertheless, PCA too may not be ideal for every patient. In fact 26% and 25% of lesions treated with PCA in the literature were reported to be either upper pole or endophytic – the type of tumors that some have suggested are poorly suited for the percutaneous ablative approach. (10, 15, 23, 27, 28) A tumor's polar location did not correlate with cryotherapeutic modality, while non-exophytic tumors were more likely to be treated with PCA (Table 2). As such, our data demonstrate vast underreporting of tumor location descriptors in the cryotherapy literature, and delineates previously unreported treatment trends with regard to tumor characteristics treated with SCA vs. PCA.

Furthermore, tumor location descriptors in the cryotherapy literature are not only underreported but are also largely non-standardized. Our institution recently introduced the R.E.N.A.L. Nephrometry Scoring system to objectively characterize salient anatomic features of renal tumors.(9) The system quantifies renal mass features such as size (R), endophycity (E), nearness collecting system (N), anterior/posterior location (A), and location relative to the renal poles (L). We recently reported that tumor attributes, as captured by R.E.N.A.L. nephrometry, correlate both with surgical treatment choice (29) and complication rates (30) for patients who undergo kidney surgery. We believe adoption of this or similar system (31, 32) to report and compare lesions that undergo focal therapy would assure more meaningful comparisons between treatment modalities for renal masses.

CONCLUSIONS

Cryoablation has gained acceptance as an alternative treatment modality for the renal mass. Tumor location has long been identified as a driver for selecting surgical over percutaneous cryoablation, yet our analysis demonstrates that data regarding tumor location is underreported, rendering meaningful comparisons of treatment selection criteria and treatment outcomes difficult. Standardization of outcome reporting employing detailed and standardized anatomic tumor characteristics may facilitate study of outcomes and assist in appropriate treatment selection for patients diagnosed with renal mass.

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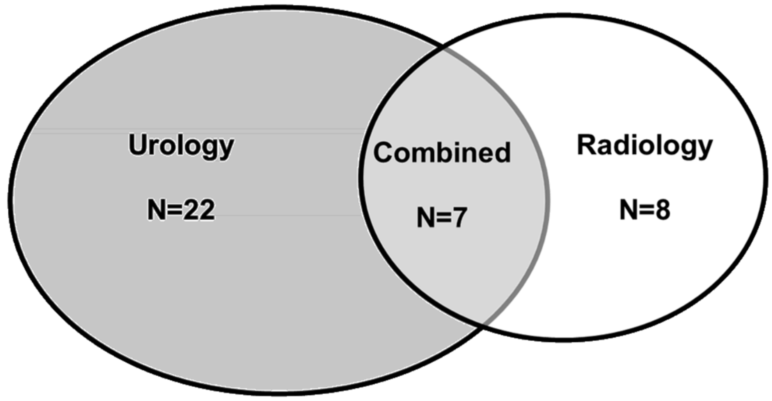

Figure 1.
Venn diagram depicting the contribution to the cryosurgical literature by urologists, radiologists, and multidisciplinary teams. (n= manuscript number).

Table 1

Comparison of reporting rates for tumor location descriptors and other study characteristics for surgical vs. percutaneous cryoablation literature (n= number of cohorts).

	Surgical Cryotherapy Cohorts	**Percutaneous Cryotherapy Cohorts**	**p value**
Reported location descriptor:			
Any Location Descriptor	18/29 (62%)	12/15 (80%)	0.34
Ant/Post/Lat Descriptor	9/29 (31%)	7/15 (47%)	0.34
Endo/meso/exo Descriptor	5/29 (17%)	6/15 (40%)	0.14
Upper/mid/lower pole Descriptor	14/29 (48%)	7/15 (47%)	1
Other Study Characteristics			
Multi-institutional series	2/29 (7%)	2/15 (13%)	1
Retrospective chart review	29/29 (100%)	13/15 (87%)	0.1
Comorbidity reporting rate	8/29 (28%)	3/15 (20%)	0.24

Table 2

Rates of reporting tumor location descriptors and corresponding breakdown of descriptor types by treatment strategy (n = number of tumors).

	Tumors s/p Surgical Cryoablation	**Tumors s/p Percutaneous Cryoablation**	**p value**
Ant/Post/Lat Descriptor Reported	36% (551 / 1540)	42% (339 / 804)	0.003
	Anterior tumors: 44% (245/551)	Anterior tumors: 9% (31/339)	<0.001
	Posterior tumors: 28% (153/551)	Posterior tumors: 81% (273/339)	<0.001
	Lateral tumors: 28% (153/551)	Lateral tumors: 10% (35/339)	<0.001
Exo/Meso/Endo Descriptor Reported	23% (361/1540)	58% (470/804)	<0.001
	Exophytic tumors: 63% (228/361)	Exophytic tumors: 31% (144/470)	0.057
	Mesophytic tumors: 26% (93/361)	Mesophytic tumors: 44% (209/470)	<0.001
	Endophytic tumors: 11% (40/361)	Endophytic tumors: 25% (117/470)	<0.001
Upper/Mid/Lower Pole Descriptor Reported	31% (483 of 1540)	32% (254 of 804)	0.925
	Upper pole tumors: 27% (128/483)	Upper pole tumors: 26% (67/254)	1
	Interpolar tumors: 44% (211/483)	Interpolar tumors: 63% (114/254)	0.7532
	Lower pole tumors: 30% (144/483)	Lower pole tumors: 29% (73/254)	0.8807

Table 3

Reporting rates for tumor location descriptors in the renal cryotherapy literature stratified by specialty of the manuscripts' authors (n = number of manuscripts).

Reported location descriptor:	Urologists as Primary Authors	Radiologists as Primary Authors	Interdisciplinary Authors	p value
Any Location Descriptor	14/22 (64%)	8/8 (100%)	3/7 (43%)	0.05
Ant/Post/Lat Descriptor	6/22 (27%)	3/8 (38%)	4/7 (57%)	0.35
Endo/meso/exo Descriptor	3/22 (14%)	4/8 (50%)	2/7 (29%)	0.12
Upper/mid/lower pole Descriptor	11/22 (50%)	4/8 (50%)	3/7 (43%)	1.0