Focal therapy for the management of the small renal cortical neoplasm

Abstract In the last 2 decades, the number of incidentally discovered renal cortical neoplasms (RCN) has significantly risen. In response, treatment options have also evolved. The purpose of this paper is to review the details of cryoablation and RFA including patient selection, indications and contraindications, the mechanism of action, and a brief literature review. Additionally, our technique for both laparoscopic cryoablation (LCA) and percutaneous cryoablation (PCA) including management of complications and follow-up protocols will be detailed. A literature search was performed of MEDLINE using PubMed and relevant articles were included in the review. Correct application of either technology requires that the surgeon understands the technology, the mechanism of action, and incorporates the evolving concepts of these young therapeutic options. Emerging data suggests that both RFA and cryoablation are excellent alternatives to extirpative therapy.

Introduction

In the last 2 decades, axial imaging has become a cornerstone of diagnostic testing. As a direct result, the number of incidentally discovered renal cortical neoplasms (RCN) has significantly risen. Until recently, radical nephrectomy was the mainstay of treatment for RCN of all sizes. However, as our understanding of tumor biology improved and the long term sequela of our treatments came to light, the paradigm shifted to a nephron sparing approach for small RCN. In 2009, the American Urological Association (AUA) released a new set of guidelines outlining the management options for RCN. The AUA guidelines focus on a nephron sparing approaches for all T1a tumors and in those T1b tumors where it is surgically feasible. Prior to the release of the AUA guidelines, however, minimally invasive nephron sparing procedures had already begun gaining popularity. Specifically, ablative therapies such as cryoablation and radiofrequency ablation (RFA) have garnered a significant amount of attention as alternatives to partial nephrectomy. There are also several ablative therapies currently considered to be experimental. Specifically, high-intensity focused ultrasound (HIFU), laser interstitial thermal ablation and microwave ablation are investigational options currently being evaluated. Herein, we will focus on the details of cryoablation and RFA including patient selection, indications and contraindications and the mechanism of action. Additionally, we will detail our technique for both laparoscopic cryoablation (LCA) and percutaneous cryoablation (PCA) including management of complications and follow-up protocols.

Patient selection

The small renal mass dilemma

The “small renal mass dilemma,” a phrase first used by Kunkle and colleagues, refers to the interesting paradox in the treatment of the small (T1a) RCN. Contemporary understanding of the biology and epidemiology of the small RCN remains limited, but is far more sophisticated than in prior times. Despite, an improved understanding of the small RCN, choosing the appropriate treatment strategy for the individual patient has never been more challenging. Prior to the advent of widespread axial imaging and the large cohorts of patients on active surveillance, most RCN were discovered due to their symptomatic nature and were treated with radical nephrectomy. While effective, radical nephrectomy
unfortunately did not provide information on the natural history or the metastatic potential of the small RCN, nor did it allow for the evaluation of a variety of treatment options. As the number of small, incidentally discovered RCN increased, treatment remained focused on radical nephronectomy. Soon thereafter, however, the benefits of nephron sparing surgery came to light, and quickly became the gold standard treatment of the T1a RCN. The recent publication of several large intermediate-term active surveillance series has also better defined the natural history of the small RCN. In the largest single center active surveillance series in the world, Rosales and associates demonstrated that most renal masses are indolent, growing only 0.27 cm/year with a metastatic rate of only 1.9% (4 of 212 patients). These data correspond with earlier reports that demonstrate similar growth rates of approximately 0.3 cm/year. A recent review of active surveillance literature similarly reported a low metastatic potential of only 1.4% (12 of 874 patients) and a cancer specific mortality of 0.34% (3 of 874 patients). Moreover, while not absolute, an increased growth rate suggests a higher grade tumor and an increased risk of progression. In light of these new data, the once clear-cut algorithm of diagnosis then extirpation has been irrevocably altered. Patients seeking to avoid surgery can proceed to active surveillance, and ablation techniques are considered acceptable alternatives to extirpative surgery. Furthermore, small recurrences and residual tumors can likely be surveyed without sequelae. With data emerging that active treatment of RCN ≤ 7 cm does not impact overall survival in patients over the age of 75 years, perhaps a period of active surveillance should be instituted in the more elderly population with therapy reserved only for tumors displaying aggressive features. As no therapeutic option is irrefutably superior, the appropriate treatment should be decided solely by the well informed patient.

**Indications and contraindications**

Currently, nephron sparing extirpative therapy is the gold standard treatment for the small RCN. However, partial nephrectomy is still associated with significant morbidity and not all patients are candidates for the procedure. The ablative therapies are generally considered to be less invasive and less morbid, and are therefore appropriate alternatives for the elderly or in those patients with competing co-morbidities. With improvements in technique and advancements in instrumentation, the indications for ablation have expanded to include younger, healthier patients desirous of foregoing the risks of a partial nephrectomy. Furthermore, the intermediate-term data beginning to emerge in the literature supports its use in the informed population.

The major contraindication to the ablation therapies is tumor size: specifically, RCN ≥ 3 cm in largest diameter. In a recent retrospective series by Lehman and co-workers, LCA of small (<3 cm) vs. large tumors resulted in a greater complication rate (0% vs. 62%, p=0.0007, respectively) and longer hospital stay (1.65 vs. 3.52, p=0.02, respectively). Furthermore, LCA on large tumors also resulted in a higher blood loss (78 mL vs 398 mL respectively, p=0.13). In the same study, stratification by exophytic, mesophytic and endophytic identified a decreasing relationship with blood loss as the tumor resided deeper in the renal parenchyma (103 mL, 62.5 mL, and 53 mL respectively). It should be noted that the complications associated with renal cryoablation for tumors over 3 cm in diameter all occurred in laparoscopic cryoablation procedures. Percutaneous cryoablation of larger tumors has been successfully described with low morbidity and reasonable efficacy.

**The guidelines**

In 2009, the AUA published a set of guidelines meant to guide urologist in managing clinical stage 1 renal tumors. The proposed algorithm stratifies T1 RCN patients into 4 index patients. This form of division is certainly convenient, but is an oversimplification of the clinical challenges faced by urologists. Index patients 1 and 2 are T1a patients of good and poor health respectively while index patients 3 and 4 are T1b of good and poor health respectively. Treatment options are similarly stratified into 3 priority tiers, the highest of which is titled a treatment “standard,” followed by a treatment “recommendation” and the weakest tier a treatment “option.” The 4 treatment modalities with sufficient evidence for inclusion in the algorithm are partial nephrectomy (PN), radical nephrectomy (RN), thermal ablation (TA), which includes only RFA or cryoablation, and active surveillance (AS). Fig. 1 summarizes the AUA guidelines along with the author’s comments detailed below.

For index patient 1, PN by any method is the reference standard. RN is listed as an alternate standard treatment preferred for those patients in whom PN is not technically feasible. There are no recommendation level treatments for the index 1 patient: TA and AS are listed as options. Similarly, extirpative therapy is the standard in index patient 2 with PN and RN holding equal priority in this population. Both TA and AS are elevated to recommendations and as such there are no option level therapies. RN is the standard of care for index 3 patients with a normal contralateral kidney, while PN is a standard that should be strongly considered in those patients where it is important to preserve renal function. Although recognized as sub-optimal, both TA and AS are considered options. There are no recommendation level therapies offered to index patient 3. Finally, for index patient 4, RN is considered the standard of care in patients with a normal contralateral kidney. PN and AS are both recommendations, although AS should be considered only in patients desirous of avoiding surgery. TA is an option for this patient.

While recognizing that the intent of the AUA Guidelines Panel was to create an evidence based algorithm for the treatment of the T1 renal mass that can be employed by all urologists, our experience has led us to slightly different conclusions than that of the Panel.
Fig. 1
First, the AUA suggests that in index 1 patients, TA is only an option level therapy only after the patient refuses PN or RN. However, we believe that the complication and failure rates of TA are sufficiently low that ablation can be offered as a primary treatment in lieu of PN or RN. In addition, the AUA lists AS as a recommendation for index 2 patients only after RN and PN have been discussed. In our experience and considering updated active surveillance results, index 2 patients, especially those with significant comorbidities, should be offered active surveillance as the first line therapy, followed by TA in those who refuse or fail AS. Due to the high complication rate, PN and RN should be used sparingly in this population. Finally, the AUA guidelines contend that TA is a viable, albeit suboptimal, treatment option for index patients 3 and 4. However, due to the high local recurrence rates and the higher complication rates associated with treating tumors >3 cm, we felt that TA should not be offered as a treatment option to this population of patients.

Approach

Of the ablation modalities, the most popular and best characterized are cryoablation and RFA, both of which can be performed either laparoscopically or percutaneously. The choice to proceed with either a laparoscopic or percutaneous approach largely depends on the location of the renal mass (Fig. 2). Neoplasms located on the posterior aspect of the kidney are suitable for either a percutaneous or a retroperitoneal laparoscopic approach, while anteriorly located masses are best approached using transperitoneal laparoscopy. The choice of approach for lateral masses largely depends on surgeon experience and preference. The current manuscript will focus on techniques to improve the outcome of transperitoneal and percutaneous cryoablation.

Patient preparation

The standard pre-operative workup includes a complete history and physical, laboratory evaluation including a complete metabolic panel and cell blood count, chest x-ray, electrocardiogram and either computed tomography (CT scan) or magnetic resonance imaging (MRI) of the abdomen and pelvis. Abnormal neurological findings should prompt the physician to obtain a head CT or MRI to rule out brain metastases. Similarly, findings suggestive of boney metastasis (bone pain, elevated serum alkaline phosphatase or calcium) are ominous and should be followed up with a nuclear bone scan. Finally, anticoagulants, including aspirin, should be stopped 7–10 days prior to surgery when possible.

For each patient emphasis should be placed on obtaining a recent high quality axial imaging study. Low quality imaging can compromise patient outcomes, and should be repeated prior to discussing management strategies and treatment options. Tumor characteristics such as size, location in relation to the upper or lower pole, hilum and collecting system (especially the ureter) should be recorded (Fig. 3). Furthermore, the nature of the tumor, whether exophytic, mesophytic, or endophytic, solid or cystic, abnormalities of shape or contour, and degree of enhancement should similarly be noted. The aspects of tumor targeting will be discussed later, but it should be noted that clear, accurate pre-operative axial imaging is one of the three components of a “critical targeting trifecta” which is critical to optimize patient outcomes.

Principles of ablation

Prior to performing any ablative technique, the surgeon should have a full understanding of how the technology produces tissue destruction. Each relies on thermal destruction but utilize unique energy delivery systems.

Cryoablation

Modern cryoablation systems produce rapid decreases in temperature at the probe tip by exploiting the Joule-Thomson principle.\(^\text{16, 17}\) Highly pressurized argon in the liquid state is allowed to rapidly expand into a gaseous state across a small orifice. The resultant phase change causes rapid cooling near the cryoprobe tip inducing iceball formation. The dimensions of the iceball largely depend on probe characteristics although local tissue properties also affect the ultimate size and shape as well as the effective ablation zone. Cell death is brought about through a number of different mechanisms as the rapid cooling produces intracellular crystal formation, microcirculatory failure and cellular dehydration.\(^\text{16}\) Localized microcirculatory failure leads to thrombosis, coagulation necrosis and apoptosis. The iceball is not of
Fig. 3 Mass location. A. Mass is exophytic an laterally located in the right kidney; B. Mass is exophytic but centrally located and abutting the renal vein; C. Mass is mesophytic and posteriorly located; D. Mass is anterior and endophytic, abutting the renal sinus fat and collecting system.

Fig. 4 Ablation zones: Central necrosis zone is characterized by uniform cellular destruction. The middle indeterminate zone is characterized by areas of cell death with pockets of viable cells. The outermost zone is mostly comprised of viable cells with little to no necrosis present.

one consistent temperature, but actually increases from $-140^\circ C$ to $-190^\circ C$ at the cryoprobe tip to $0^\circ C$ at the iceball edge. While cellular death does occur at $-20^\circ C$, it is not consistent and uniform until temperatures reach $-40^\circ C$. The increasing temperature gradient creates 3 "zones" within the iceball (Fig. 4): the centrally located necrosis zone where temperatures have consistently reached $-40^\circ C$ or less, the intermediate zone where temperatures are between $-40^\circ C$ and $-20^\circ C$, and the outer zone where temperatures are greater than $-20^\circ C$. The central zone is characterized by consistent necrosis, the intermediate zone by both necrotic and viable tissue, and the outer zone by mostly viable tissue. With temperatures reaching $>-20^\circ C$ within 3.1 mm of the iceball edge, the current standard is to extend the iceball to 1 cm beyond the tumor edge to ensure uniform ablation of
the mass and a small margin of normal renal parenchyma. During LCA, iceball size can be monitored real-time with a laparoscopic ultrasound probe. The expanding iceball creates a hyperechoic zone that clearly delineates the iceball perimeter (Fig. 5).

**Radiofrequency Ablation**

Although RFA had been successfully used in other solid organs, its first application in the human kidney wasn’t until 1997. RFA creates thermal injury by exploiting resistive heating. As high-frequency electrical current is delivered to the target tissue, high electrical resistance causes the current to be transformed into heat. Coagulative necrosis results when temperatures rise above 60–100°C. The ablation zone is limited mostly by tissue properties such as blood flow and local resistive properties. Tissue injury does not significantly occur until temperatures reach 50°C and similar to cryoablation, the expected RFA ablation zone is extended 1 cm beyond the periphery of the mass to ensure adequacy of treatment. Unfortunately, this method of monitoring can at times be unreliable. Eschar formation near impedance probes falsely elevates readings, and temperature probe readings often differ from local tissue temperatures. While RFA can be performed both laparoscopically and percutaneously, the majority are performed percutaneously.

**Laparoscopic cryotherapy – tips and tricks**

Successful cryoablation depends in large part to understanding and correctly applying the technology, initial probe placement, and accurate iceball monitoring. After patient positioning and colon reflection, we often place a 5 mm laparoscopic retractor (Jarit® Padro Endoscopic Exposing Retractor (P.E.E.R.), Integra, Plainsboro, NJ) just anterior to the mid-axillary line. The retractor not only elevates the kidney allowing the surgeon to use both hands during dissection, but also stabilizes it during the ablation preventing iceball fracture.

It is well known that larger (>3 cm) exophytic lesions are more prone to fracture than smaller, endophytic lesions. If pre-operative imaging demonstrates that the lesion is exophytic or ≥ 3 cm in greatest diameter, it is our routine practice to completely dissect the hilum prior to the ablation so that clamping and partial nephrectomy can be performed if bleeding is difficult to control. Additionally, Gerota’s fascia is dissected off the tumor and a generous rim of adjacent normal parenchymal tissue. In this manner, should bleeding occur that cannot be conservatively managed, the renal artery is easily accessible for clamping and the tumor completely exposed. The surgeon can quickly proceed to laparoscopic partial nephrectomy without the need to operate in a bloody field.

Ideally, the cryoprobes should pass percutaneously and enter the tumor perpendicular to the surface. If the probes are placed tangentially, accurate targeting is much more difficult and viable residual tumor can result. In order to ensure perpendicular placement, the skin entry point and tract should be established prior to probe placement. To accomplish this, the tumor is identified and with the help of the P.E.E.R. retractor, the kidney is carefully positioned. A BD™ Spinal Needle (BD Medical, Franklin Lakes, NJ) is used as a “finder” needle by making several percutaneous passes until an ideal, perpendicular trajectory is identified. A skin incision is made adjacent to the finder needle and several core biopsies of the mass are performed using a Bard® MaxCore Disposable Core Biopsy Instrument (18 G × 25 cm, Bard Peripheral Vascular, Inc/Bard Biopsy Systems, Tempe, AZ). The cryoprobes are then similarly
deployed through the established tract and can now be placed at right angles to the mass. Several cryoprobes with a variety of iceball shapes are commercially available, however we most commonly use the IceRod cryoprobe (Galil Medical, Minneapolis, MN) due to the diminutive size of the probes (1.47mm) and the large ablation zone created.

Precise initial probe placement is paramount for a successful ablation. It is important to recognize that the iceball does not appreciably extend beyond the tip of the cryoprobe, but instead extends laterally. If the mass has cystic components, the probes are juxtaposed to the outer edge of the mass avoiding rupture of the cystic portion. If the mass is solid, the probes are placed just within the tumor’s outer margin border, ensuring both central overlap of the iceballs and marginal ablation. A recent study evaluating isotherms in gel, ex vivo, and in vivo porcine kidneys demonstrated warmer temperatures, especially near the tip, in the in vivo porcine kidney when compared to the other models. As such, the probes should be positioned 5 mm beyond the deep margin of the mass in order to prevent residual tumor there. Visualization of the deep margin is obscured once the iceball begins to form, therefore correct initial probe position is essential, especially at the deep margin (Fig. 6).

Our technique employs 2 freeze-thaw cycles. However, rather than focus on freeze times, we focus on appropriate iceball extension beyond the tumor margins. After probes are positioned, and repeat intraoperative ultrasound verifies correct position, the freeze cycle is started. Active monitoring with the laparoscopic ultrasound probe (8666-RF Laparoscopic Ultrasound Transducer, BK Medical Systems Inc, Peabody, MA) is performed and the freeze cycle is stopped only after the iceball extends 1 cm beyond the tumor margins. An active thaw cycle is performed until the gross ice has melted, and the cryoablation process is repeated. Typically, the second freeze cycle is shorter than the first although the iceball is often slightly larger. A second thaw cycle is performed until the probes can be removed without resistance. Following probe removal, the ablation zone is monitored for a short period of time.

**Percutaneous cryoablation - tips and tricks**

Percutaneous cryoablation (PCA) is unique in that optimal successful outcomes require collaboration between interventional radiology and urology. The former provides expertise in imaging and targeting modalities, while the latter provides the experience and insight into the treatment of renal malignancies. As aforementioned, PCA is reserved for posteriorly located tumors (Fig. 2): the percutaneous ablation of anteriorly located tumors requires traversing significant amounts of renal parenchyma and is not recommended.

The patient is positioned prone on a CT scanner and a percutaneous targeting grid or a marker is placed over the expected needle entry site on the flank. A non-contrast CT is then performed. Previously obtained contrasted images are then compared to the new study in order to delineate the tumor borders using local landmarks. It is paramount to accurately identify the deep and lateral margins. If there is doubt, either administer a small bolus of IV contrast agent and repeat the scan, or place the cryoprobes beyond the expected location of the margin to ensure an adequate ablation zone. When placing the probes, the principles outlined for LCA still hold true in that the needles should enter the mass at a perpendicular angle and should be positioned approximately 5mm beyond the deep margin. Using the grid for estimating trajectory the cryoprobes are then advanced into position. In order to obviate confusion and ensure accurate probe placement, only one probe should be positioned at a time. Deployment of multiple probes at once can cause a disorienting loss of the intracorporeal spatial relationships among the probes which may lead to a loss of precision. Unfortunately, deploying probes individually may also lead to an increase in the number of CT passes and therefore an increased amount of radiation exposure. To combat this, imaging should be limited only to the kidney.

Real time monitoring of the iceball can be accomplished with transcutaneous ultrasound. However, it is not as accurate as intraoperative ultrasound and is seldom employed. The best method of demonstrating ablation success is to perform a post-ablation CT scan with IV contrast. Residual enhancement near or within
the intended ablation zone suggests residual tumor that is best treated by deployment of additional cryoablation probes.

Cryoablation – management of complications

In general, complications with cryoablation are less common compared to extirpative procedures such as partial nephrectomy. The most common complication after cryotherapy is iceball fracture and subsequent bleeding. Bleeding is managed conservatively with hemostatic agents such as FloSeal (Baxter, Glendale, CA) and Surgicel® (ETHICON™ Biosurgery, Cincinnati, OH) along with gentle direct pressure. Conservative management is usually adequate but in the event that bleeding persists, a partial nephrectomy should be performed. If the hilum and tumor were previously dissected, immediate renal artery clamping provides quick hemostasis and the surgeon can proceed to extirpative surgery without delay.

Urine leaks after cryotherapy are extremely uncommon as involvement of the collecting system with the iceball is generally safe. However, the iceball should not be allowed to extend into the extrarenal components of the renal pelvis or the ureter as this will disrupt the fragile blood supply of the ureter resulting in stricture formation.

Cryoablation – post-operative care

After the procedure, the patient should be admitted for overnight observation during which routine blood counts and metabolic panels are drawn both in the recovery room and in the morning of post-operative day 1. The patient is subsequently seen in the office at 6 weeks for routing follow-up. However, repeat contrasted axial imaging is not performed until 3 months after surgery looking for residual tumor. An ablation is deemed successful if there are no peripheral or central enhancing elements within or adjacent to the ablation zone: any degree of enhancement in the ablation zone should be considered a treatment failure. Contrarily, an ablation zone that does not demonstrate enhancement likely does not contain viable tumor.

If enhancement suggestive of residual tumor is identified on the 3-month post-operative CT scan, the patient should be counseled on several options including active surveillance, repeat ablation, partial nephrectomy and less commonly, radical nephrectomy. It is important to recognize that while ablation zone enhancement is indicative of treatment failure, it does not necessarily signify the presence of viable tumor. Other causes of enhancement include inflammation, volume averaging discrepancies during imaging and increased metabolic activity among cells injured during the ablation. For example, in the study by Hegarty and colleagues, of 164 LCAs, more than 20% demonstrated peripheral enhancement during imaging at 3 months. However, by 1 year, the peripheral enhancement rate fell to less than 5%. In a second study, 5 of 32 patients (15.6%) demonstrated residual enhancement during imaging at 3 months post LCA. However, by 9 months, only 1 patient (3.1%) had persistent enhancement. Interestingly, the specimen obtained after partial nephrectomy in that patient demonstrated no viable tumor.

While patients can certainly opt to proceed directly to repeat ablation if enhancement is discovered on the 3 month post-operative imaging, it is our current practice to encourage a period of surveillance. A CT scan with and without IV contrast, or alternatively an MRI with and without gadolinium, is performed every 3 months until the lesion ceases to enhance. Repeat imaging is then performed every 6 months for 2 years and yearly thereafter. If enhancement persists beyond 1 year, enlarges, or becomes significantly more suspicious during the observation period, the patient is offered a repeat ablation (preferably) or a partial nephrectomy. In this scenario, radical nephrectomy is rarely necessary.

Cryoablation – brief summary of the literature

The current established belief is that cryoablational provides active therapy for small RCN with less blood loss and fewer complications than extirpative therapy, but that these results come at the expense of a greater recurrence rate. The ideal patient therefore is older or has significant comorbidities and cannot tolerate extirpative therapy. However, the role of LCA is expanding as long term data is beginning to emerge and retreatment rates continue to fall. In an early comparative series, Desai and colleagues compared laparoscopic partial nephrectomy (LPN) (n = 153) to LCA (n=78). As expected, the partial nephrectomy group was younger (mean age 60.6 versus 65.6 years, respectively, p=0.005), had better renal function (serum creatinine 1.02 vs. 1.2 mg/dL, respectively, p=0.01), and had larger tumors (23 vs. 21.1 cm, respectively, p=0.02). Total operating time was similar between the LPN and LCA groups (32 vs. 31 hours, respectively, p=0.77) as was hospital stay (23 vs. 21 days, respectively, p=0.13). However, the patients who underwent LPN had a greater estimated blood loss (211 mL) compared to the LCA group (101 mL) (p<0.0001) and although not significantly different, the LPN group also had a higher intraoperative complication rate of 5.2% vs. only 1.1% in the LCA group (p=0.1). After hospital discharge, the number of delayed complications were significantly greater in the LPN group (16.3% vs. 2.2%, p=0.001). Follow-up in the study was unfortunately both short and disproportionate in the groups with mean follow-up of 5.8 months in the LPN group and 24.6 months in the LCA group (p<0.001).

In that time, there was 1 recurrence (0.6%) in the LPN group and 2 (3%) in the LCA group.

In a study by Aron and colleagues on 80 patients with a minimum follow-up of 5 years (range 8-11 years), there were 11 (14%) recurrences and 6 (7%) cancer related deaths. The 5-year and 10 year overall, disease specific and recurrence free survival was 84%.
92%, and 81%, and 51%, 83% and 78%, respectively. As with all new technologies, cryoablation has continued to evolve: the single large 4.8 mm cryoprobe utilized in those patients has since been largely replaced with multiple ultrathin probes (1.47 mm). How this new probe and alterations in delivery systems will affect outcomes remains to be seen.

Radiofrequency ablation – brief summary of the literature

It is currently held that RFA and cryoablation have similar benefits (decreased blood loss, fewer complications) when compared to LPN, however, RFA has traditionally been considered to have higher recurrence and re-treatment rates than cryoablation. A recent meta-analysis examined 47 studies representing 1,375 renal lesions treated by either cryoablation (n=600) or RFA (n=775).36 There were no differences between the cryoablation and RFA groups with respect to age (67.2 vs. 66.3 years-old, respectively, p=0.17), mean tumor size (2.58 vs. 2.69, respectively, p=0.12) or mean follow-up (22.5 months vs. 13.8 months, respectively, p=0.58). However, treatment with RFA was associated with higher re-treatment rate (8.5% vs 1.3%, p<0.0001), higher rate of local progression (12.9% vs. 5.2%, p<0.0001) and a trend towards a higher rate of metastatic progression (2.5% vs. 1%, p=0.06). However, one of the confounding factors when directly comparing RFA and cryoablation is the surgical approach. In the meta-analysis, 94% of RFA were performed percutaneously, compared to only 35% of the cryoablations. The importance of this fact is further illustrated by the multi-institutional study comparing RFA and cryoablation by Matin and associates.37 Matin found that in 616 patients treated with either RFA or cryoablation, RFA was associated with a 13.4% residual or recurrent disease rate vs. only 3.9% for cryoablation. However, 83% of the RFA were performed percutaneously compared to only 1% of the cryoablations. Furthermore, in the subset of RFA that were performed laparoscopically, the recurrence/residual rate was only 4%, a rate similar to that of the cryoablation group which were essentially all performed laparoscopically. This suggests that the surgical approach and not the technique affected residual disease rates. The approach may also be a major confounding factor in traditional data comparing the 2 modalities.

Although long term data on RFA is generally lacking, refinement in techniques has recently produced very promising data. Ji and colleagues report on their experience performing laparoscopic RFA on 106 patients.38 Mean patient age was 58.1 years (range 25-81 years), mean follow-up was 32 months (range 12-48 months) and mean tumor size 2.9 cm (range 0.9-5.5 cm). In patients with tumor size ≤ 2.5 cm there were no residual or recurrent lesions and only 2 patients had residual (n=1) or recurrent (n=1) lesions. Local tumor control was therefore 98.1% (104/106) and the period cancer specific and overall survival rates were 100%.

Conclusion

In the current climate of minimizing invasiveness for the treatment of small renal cortical neoplasms, RFA and cryoablation have expanding roles. Although long term data is starting to emerge, much of it is based on early techniques and technology that have since been refined. It is paramount that the surgeon understands the technology, the mechanism of action, and incorporates the evolving concepts of these young therapeutic options.

References


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