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# Thermal Ablation for Renal Cell Carcinoma: Expert Consensus from the Asian Conference on Tumor Ablation

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#### INTRODUCTION

Incidental detection of renal cell carcinoma (RCC) has become more frequent in patients who undergo ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI) for unrelated reasons. Since 2000, thermal ablation has become more widely available in clinical practice. Recently, radiofrequency ablation (RFA), cryoablation, and microwave ablation (MWA) have become the main thermal ablation modalities. However, experts' consensus for Asian patients with renal tumors has not been established, although the Asian Conference of Tumor Ablation (ACTA) has been held for many years. A total of four Asian doctors, who were selected from Korea, Taiwan, Japan, and China, participated in gathering their experience on thermal ablation of RCC to draw an ACTA expert consensus for the treatment of Asian patients with RCC.

# **Consideration before Thermal Ablation**

#### **Indications to Thermal Ablations**

Despite the lack of strong evidence, the American and European Urologic Associations recommend thermal

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ablation as a primary treatment option for patients with RCC who cannot undergo surgery because of the high risk of postoperative morbidity [1,2]. These conditions include poor cardiopulmonary function, chronic kidney disease, bleeding tendency, coagulopathy, and other severe comorbidities. Furthermore, thermal ablation can be a good alternative treatment option for hereditary [3,4], single kidney [5-7], central [8-10], and recurrent [11-13] RCCs following surgery or thermal ablation. Prior to thermal ablation, fever should be detected and controlled. Platelet count should be more than 50000/µL and the internalized normalized ratio should be maintained at less than 1.5 [14].

# Pre-Ablation Imaging: Advantage, Disadvantage, and Preference

The advantage of pre-ablation imaging is to perform pre-ablation plans, such as characterizing or localizing the renal mass, and determining how to approach/prevent complications [15,16]. The disadvantages are increased medical costs and radiation exposure to patients [17,18]. CT is preferred over MRI because of its shorter scan time, lower medical cost, fewer imaging artifacts, and greater availability [15,16,19]. Generally, US cannot replace CT or MRI because it is not sufficient to perform pre-ablation plans.

# **Preparations for Thermal Ablations**

Patients must fast for 6–8 hours prior to thermal ablation. Otherwise, aspiration may occur when patients vomit during the ablation procedure. Urethra catheterization is useful for predicting the amount of urine produced or detecting gross hematuria. Antibiotic treatment is not mandatory if aseptic techniques are performed.



### Types of Anesthesia

Local anesthesia is frequently performed during cryoablation because most patients tolerate pain [20]. General anesthesia is useful during RFA or MWA because pain is more severe in these procedures [21,22]. However, the type of anesthesia should be chosen based on the clinical situation.

#### Percutaneous versus Laparoscopic Approaches

The percutaneous approach is less invasive than the laparoscopic approach because of a smaller amount of bleeding or lack of a skin scar (Figs. 1, 2). Subsequently, percutaneous thermal ablation requires a shorter hospital stay than laparoscopic thermal ablation [23,24]. Laparoscopic thermal ablation can be used to remove as many RCCs as possible in patients with von Hippel?Lindau disease (Fig. 3).

#### **Avoiding Thermal Damage**

Ureter catheterization and pyeloperfusion are necessary to reduce thermal damage during thermal ablation for RCC that is close to the ureteropelvic junction [15,25-27]. Hydrodissection is necessary to avoid thermal damage to bowel loops if the RCC-to-bowel distance is < 0.5 cm (Fig. 1) [15,25,28].

# **Renal Mass Biopsy**

Prior to ablation, percutaneous biopsy is mandatory to avoid unnecessary treatment for benign tumors [15,16], including angiomyolipoma and oncocytoma [29,30]. However, knowing the subtypes of RCC or metastasis is useful for further management after thermal ablation.

#### **Choosing Thermal Ablations**

The size or location of the RCC influences the choice of thermal ablation due to different oncologic outcomes. If the RCC size is > 3 cm, cryoablation or MWA is useful because these techniques can create a larger ablation area than RFA using a single electrode [31,32]. If an RCC is centrally located or protruding into the renal sinus, cryoablation is more useful for reducing urothelial damage than RFA [9,33,34] or MWA. If an RCC is less than 3 cm, all types of thermal ablations provide acceptable oncologic outcomes.

# **Choosing Guiding Modalities**

CT is preferred to guide an ablation needle because interventional oncologists are familiar with CT-guided

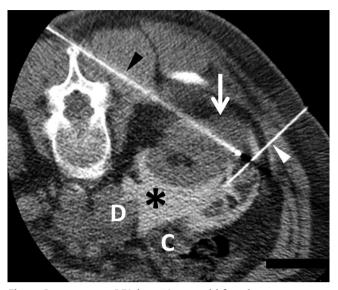


Fig. 1. Percutaneous RFA in a 70-year-old female. Non-contrast axial CT image showing hyperattenuating iodine-containing fluid (asterisk) instilled for hydrodissection through a 22-guage needle (white arrowhead), leading to the displacement of the colon (C) and duodenum (D) neighboring the renal cell carcinoma. One (black arrowhead) of the three RF electrodes is placed within the tumor (arrow), and RFA is performed using a switching controller. RFA = radiofrequency ablation



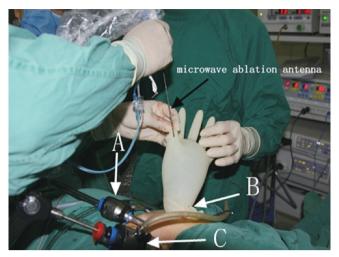
**Fig. 2. Percutaneous cryoablation in a 63-year-old male.**Non-contrast axial CT image showing one (arrowhead) of two cryoapplicators placed in the right renal cell carcinoma. An ice ball (arrows) was created to ablate the tumor.

procedures (Figs. 1, 2) [15,16]. Furthermore, this imaging modality clearly shows the ablation margin during cryoablation procedures. In contrast, the ablation margins during RFA or MWA are relatively unclear. A high radiation dose is a challenge when CT is used for guidance [19]. The low-dose CT protocol is useful for Asian patients with relatively lower body mass indices [18]. US is a useful

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**Fig. 3. BLaparoscopic microwave ablation in a 73-year-old male.** A, B, and C (white arrows) are the trocars in three different positions. Microwave antenna (black arrow) enters the tumor through the glove and trocar B. Gloves are mainly used to prevent leakage of carbon dioxide qas.

imaging modality for treating exophytic RCC in slim Asian patients [35,36]. However, local tumor progression tends to be more frequent because posterior US shadowing resulting from echogenic ablation area makes it difficult to determine if the tumor margin and RCC are completely ablated [21].

#### **Cystic Renal Mass**

Park et al. [37,38] showed that RFA achieves a higher recurrence-free survival rate in patients with Bosniak III or IV cysts, most of which were not proven to be RCC. Cryoablation and MWA have the potential to provide excellent treatment outcomes in treating these cysts [39,40]. The investigations dealing with long-term outcomes of treating cystic renal masses are scarce that the evidence level of recommendation is not high. Therefore, thermal ablation should be performed selectively in patients who cannot undergo surgery.

#### **Influence on Renal Function**

Increasing tumor size, endophytic tumor location, increasing number of tumors, and increasing number of sessions are more likely to result in loss of renal function [41]. These conditions increase the volume of the tumor margin to be ablated [41].

#### **Thermal Ablation Modalities**

#### RFA

RFA is the most widely used thermal ablation therapy for

the treatment of solid cancers. RFA utilizes an oscillating electrical current of 375–500 kHz to induce tissue hyperthermia, and a tissue temperature exceeding 60°C can lead to immediate cell death (Fig. 1) [42-45]. Five-year overall survival and cancer-specific survival rates among patients with T1 RCC after RFA were reported to range from 72% to 97% and 96% to 97%, respectively [46-49]. Comparable 5-year overall survival and cancer-specific survival rates have been reported in Asia, ranging from 78% to 90% and 96% to 100%, respectively [50-52]. Hemorrhage is the most frequent complication; however, more than 80% of cases are self-limiting [47,53-55]. Urothelial injury after RFA develops more frequently than cryoablation, and the reported incidence rate ranges from 2% to 10% [47,49,55,56].

#### Cryoablation

Cryoablation is a minimally invasive technique that causes cell death by freezing (Fig. 2). Cryoablation causes direct cell injury based on two biophysical changes [57]: osmotic dehydration of cells [58] and formation of intracellular ice. A complete cryoablation session consists of a double freeze-thaw cycle with 10-15 minutes of freezing and 8-10 minutes of thawing. For RCCs < 4 cm (T1a), cryoablation offers excellent local control results with a 5-year recurrence-free survival rate of > 90% [17,59,60]. For renal tumors  $\geq 4$  cm (T1b), cryoablation is also a valid treatment alternative to surgery, although the local recurrence rate is higher than that with surgery [61-64]. The most common complication of cryoablation is bleeding, followed by frozen injury to adjacent vulnerable organs, including ureter stricture, colon perforation or fistula, and nerve injury [17,59,65-67].

# MWA

MW energy causes cell death due to the agitation of water molecules (Fig. 3). MWA offers several advantages, including higher intratumoral temperatures, less ablation time, and less dependence on the electrical conductivity of tissue [68-70]. In particular, MWA is useful for treating renal tumors because it has fewer heat sink effects [68-70]. A single antenna was used for tumors  $\leq$  3.0 cm in diameter, and  $\geq$  2 antennas were used simultaneously for tumors > 3.0 cm in diameter. In a recent meta-analysis, no significant difference was observed in local recurrence and cancer-specific mortality between MWA and nephronsparing surgery [71]. MWA has a relatively low complication



rate [71], which is similar to that of other techniques.

# **Post Ablation Imaging Follow Up**

Pre- and post-contrast CT and MRI are the best imaging modalities to assess renal tumor ablation if normal renal function is preserved [17,46-52,59,60,72]. If renal function is subnormal or impaired, unenhanced MRI, including diffusion-weighted imaging, may be used [73]. Generally, a 6-month interval until 2 years post-ablation is considered acceptable [17,46-52,59,60,72]. Thereafter, a one-year follow-up is recommended until 5 years post-ablation [17,46-52,59,60,72].

#### CONCLUSION

Thermal ablation for RCC is expected to become more popular in Asian countries, as the necessity for minimally invasive treatments increases. Therefore, interventional oncologists should be familiar with the ACTA expert consensus to perform safe and precise renal tumor ablation in Asian patients.

#### Key words

Thermal ablation; Renal cell carcinoma; Radiofrequency ablation; Cryoablation; Microwave ablation

#### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

#### **Author Contributions**

Conceptualization: all authors. Data curation: all authors. Formal analysis: all authors. Investigation: all authors. Methodology: all authors. Resources: all authors. Supervision: Byung Kwan Park. Validation: all authors. Visualization: Byung Kwan Park.

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