Intermediate Oncological Outcomes of Percutaneous Radiofrequency Ablation for Small Renal Tumors: Initial Experience

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Abstract. Background: For T1 stage incidental renal cell carcinoma (RCC), partial nephrectomy with or without laparoscopy is widely used on the basis of its nephron-sparing and minimally invasive nature. However, high-risk patients of advanced age, or with cardiovascular events are not often suitable candidates for surgery under general anesthesia. Percutaneous radiofrequency ablation (RFA) for mainly the treatment of these patients reportedly achieves satisfactory outcomes. We evaluated the clinical usefulness of this procedure in our initial cases. Patients and Methods: In total, 24 renal tumors in 22 patients who had been diagnosed with T1 stage RCC were treated by percutaneous RFA. A LeVeen Needle (Radiotherapeutics) was used with an RF3000 generator. The overlapping ablation method was applied to these tumors, which were larger than 3 cm or located close to the renal hilus. Dynamic contrast-enhanced computed tomography or magnetic resonance imaging was routinely carried out to evaluate the post-treatment state. Results: Maximum tumor diameters ranged from 1.0 to 4.5 cm (mean=2.4 cm). The follow-up period was 1-61 months (mean=18 months) after RFA treatment. Contrast enhancement completely disappeared immediately after this procedure in 23 tumors, the one exception being a 4.5-cm tumor. The tumor recurrence-free and overall survival rates were 85% and 79%, respectively, at two years after RFA. Conclusion: Percutaneous RFA is a feasible option for the treatment of RCCs, particularly for those less than 3 cm in diameter.

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had elapsed since the beginning of the ablation, then the ablation was electively terminated. Regarding renal tumors which were larger than 3 cm or located close to the renal hilus, overlapping ablation with therapeutic effects were evaluated employing contrast-enhanced CT or MRI within one month after the procedure. Basically, complete disappearance of enhanced tissue was defined as a complete response (CR). Patients were followed up with contrast-enhanced CT or MRI at three-month intervals. Ekusotreutokei® 2010 (Social Survey Research Information Co., Ltd., Tokyo, Japan) was used for statistical analyses. The Kaplan-Meier method was used to estimate actuarial recurrence-free and overall survival rates.

**Results**

Patient ages ranged from 59 to 84 years (mean=73.3 years). The mean tumor size was 2.4 cm, based on the largest diameter (range=1.0-4.5 cm). Tumor locations were classified according to the definition of Gervais *et al.* (1). There were 16 exophytic, 4 intraparenchymal, and 4 mixed

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**Table I. Selection criteria for RFA.**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cases</th>
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<tr>
<td>Single kidney</td>
<td>5</td>
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<tr>
<td>Prior treatments for other types of cancer</td>
<td>8</td>
</tr>
<tr>
<td>Severe cardiovascular events</td>
<td>2</td>
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<tr>
<td>Bilateral RCCs</td>
<td>3</td>
</tr>
<tr>
<td>Unilateral multiple RCCs with poor renal function</td>
<td>1</td>
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<td>Advanced age</td>
<td>3</td>
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Figure 1. Kaplan-Meier survival curves for patients who underwent RFA. A: Overall survival (total, 22 patients). B: Local recurrence-free survival (total, 24 tumors). C: Local recurrence-free survival according to central and non-central tumor locations.
tumors. RFA was successfully carried out and elimination of tumor enhancement was confirmed after 1-10 sessions for all but one lesion, the largest diameter of which was 4.5 cm. For two cases with tumors located beside the ascending and descending colon, respectively, a 5% glucose solution was injected around the colon to achieve separation from the tumor. The mean follow-up period was 18 months (range=1-61 months) after RFA. As shown in Figures 1A and B, the tumor recurrence-free and overall survival rates were 85% and 79%, respectively, at two years postoperation. Furthermore, two cases with mixed-type tumors, including a central component at the tumor site, developed local recurrences within two years (Figure 2). These cases did not undergo additional sessions because of refusal for secondary RFA. The two-year recurrence-free survival rate was 100% for patients with non-centrally located renal tumors (Figure 1C). As intraoperative complications, nausea and vomiting were observed in two patients. All patients tolerated discomfort during the treatment. Postoperative complications were subcapsular hematoma in one patient and retroperitoneal hemorrhage in another patient. There was one late complication, stricture of the pyeloureteral junction (PUJ), which occurred two months after RFA for the treatment of a mixed-type tumor. A temporary indwelling ureteral stent had been placed for the purpose of rescuing renal function. No significant differences in renal function were observed before versus after this procedure, as confirmed by mean serum creatinine levels (0.7 versus 0.67 mg/dl, respectively) and mean estimated glomerular filtration rates (eGFR) values (61.1 versus 64.1 ml/min versus 1.73 m², respectively).

**Discussion**

RFA has been widely used for the treatment of liver tumors. The application of RFA for RCC was initially introduced by Zlotta et al. in 1997 (6). Gervais et al. reported that it was possible to completely ablate all of 29 exophlic tumors (mean size=3.2 cm; size range=1.1-5.0 cm) and that there were no recurrences during a mean 13.2-month follow-up period (1). They also demonstrated that tumors larger than 3 cm with a central component near the renal hilum were difficult to ablate because of the cooling effect of constant blood flow. Most previous reports concluded that patients with RCCs ≤3 cm and far from large vessels are good candidates for RFA (4-5, 7-9). In this series, we observed tumor control failure after RFA in two cases with tumors containing a central component, the sizes of which were 3.0 and 4.5 cm, respectively. RFA had no major influence on renal function, i.e. there were no significant changes between preoperative and postoperative data, including serum creatinine and eGFR levels. Although one renal subcapsular hematoma and two retroperitoneal hemorrhages occurred soon after RFA, all three cases recovered without invasive therapy. One case with an iatrogenic stricture of the PUJ is scheduled to undergo balloon dilation as a curative procedure. Some groups have described a technique using retrograde pyelo-perfusion with cold 5% dextrose or saline to be capable of protecting the collecting system from thermal injury induced by RFA. Moreover, laparoscopic RFA was reported to potentially prevent thermal damage of adjacent organs (e.g., ureter, PUJ, colon) via sufficient tumor mobilization and correct placement of the RFA probe under direct vision. However, this approach is more invasive than percutaneous RFA in terms of anesthesia and surgical methods.
Tracy et al. recently reported long-term oncological outcomes of RFA for small renal masses (10). They managed 208 RFA-treated patients with 243 tumors over a period of 7.5 years, concomitantly with 66 patients bearing 84 tumors who received radiographic follow-up for at least 3 years. The average tumor size was 2.4 cm. A pre-RFA biopsy was performed for 227 tumors (93%) and 79% were thereby diagnosed as RCC. The overall five-year recurrence-free survival rate was 93% for all 208 patients, and 90% for 160 who had biopsy-proven RCC. The recurrence-free and metastasis-free survival rates after RFA appear to be equivalent to those of partial nephrectomy at five years’ follow-up in patients with renal masses ≤3 cm (7, 10-12).

Conclusion

Our initial percutaneous RFA results for small renal tumors were reasonable and consistent, while being comparable to those of several previous reports. This procedure should definitely be available for patients with RCCs ≤3 cm who have surgical contraindication. The upcoming results of a longer term follow-up study of RFA are anticipated to yield reliable guidelines for treating small RCCs.

Conflict of Interest

The Authors have no conflicts of interest to declare.

References


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