PERCUTANEOUS RADIOFREQUENCY ABLATION OF RENAL TUMORS IN SOLITARY KIDNEY PATIENTS


Summary.- OBJECTIVES: In solitary kidney patients with renal cell carcinoma (RCC), radiofrequency ablation (RFA) could be effective in achieving complete tumor necrosis without increasing the risk of complications or renal failure.

To analyze the outcomes of a group of solitary kidney patients treated for RCC by RFA considering tumor size and location, renal function involvement and complications.

METHODS: A transversal retrospective study was performed, in which we selected 11 solitary kidney patients with 19 tumors in total treated by RFA for one or more renal tumors. A CT protocol was used for follow up. It included unenhanced series and contrast enhanced series at 1 month, 3-6 months, 12 months and yearly after RFA. Serum creatinine levels of each patient, pre RFA and within the first 48 hours after RFA, were collected.

RESULTS: Complete ablation was achieved in 17 tumors (89.4%) after one or two RFA sessions. 100% of exophytic and parenchymal tumors, and 3 cm size or smaller, were completely ablated. Renal failure, immediate complications or more than 24 hours hospitalization were not observed in 10 (90.1%) of our patients.

CONCLUSIONS: RFA treatment for RCC in solitary kidney patients has a high success rate; it does not affect renal function and achieves complete initial tumor necrosis, especially in exophytic, parenchymal and 3 cm or smaller lesions.

Keywords: Catheter Ablation. Renal Cancer. Solitary kidney. Radiofrequency.

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Resumen.- OBJETIVO: En los pacientes monorrenos (PMR) con carcinoma de células renales (CCR), en los que existe la necesidad de conservar la función renal, la ablación por radiofrecuencia (ARF) podría ser efectiva para conseguir la necrosis total del tumor, sin incrementar el riesgo de complicaciones y fallo renal. Objetivo: analizar la evolución de un grupo de PMR a quienes se les realizó ARF considerando la localización y tamaño de las lesiones, la posible afectación de la función renal y la ocurrencia de complicaciones.

MÉTODOS: En el presente estudio transversal y retrospectivo, 11 PMR, con un total de 19 tumores, sometidos...
Renal cell carcinoma (RCC) represents the 2-3% of all malignant neoplasms in adults. In the last decades there’re evidences that indicate these rates are still arising (1). This could be attributed to a greater use of image tests that increases the number of incidental RCC findings that are still small and non-symptomatic (2).

This facts and others as high surgical risk of some patient suffering from RCC, surgery refusing or a good renal function requirement in solitary kidney (SKP) patients and in familiar multiple RCC, have driven to develop minimally invasive techniques such as radiofrequency ablation (RFA).

RFA is effective in ablating small tumors, preserving renal parenchyma and maintaining a good renal function. As it’s less invasive, it has a lower complications rate than surgery and also a shorter convalescence time (3). However this technique could not achieve tumor complete necrosis. In this case, a new RFA session could be performed. Also in patients with familial multiple RCC, RFA can be performed repeatedly throughout patients life (3). In case of SKP, partial and radical nephrectomy have demonstrated similar oncological long-term results (4,5), so that’s why nephron sparing surgery is the election treatment in these patients (6,7) even when there’s a renal failure risk that could leads patients to hemodialysis. That’s the reason why, although there’re just a few studies that analyzes RFA in SKP, RFA could be an alternative treatment for patients with a renal mass(es) in solitary kidneys.

Based in these evidences, the main objective of our study is to analyze the evolution of a SKP group treated by RFA for one or more renal tumors diagnosed during the oncological follow-up because of a first contralateral renal tumor that led to radical nephrectomy.

Our study emphasizes on the technique characteristics, on results depending on tumor size and location, on renal function affection and on acute complications.

MATERIAL AND METHODS

POPULATION

The population of this study (descriptive, transversal and retrospective) was composed by 11 SKP secondarily to radical contralateral nephrectomy because of renal cancer. There were 3 women and 8 men between 39 and 81 years old (mean age 66.2 years). 19 tumors were diagnosed: 2 patients had 4 tumors, 2 patients had 2 tumors, and 7 patients had 1 tumor. 4 patients had metastases (Mx) before RFA (2 patients had an adrenal Mx, one patient had a cerebral Mx and another one had a vertebral Mx). There was one patient that had undergone surgery for a colon cancer and an hepatic metastasectomy but he had no evidence of colon cancer or metastases at the RFA moment. There was another patient that suffered from Von Hippel Lindau disease (VHL). In 4 cases RCC coexisted with large simple renal cysts (Figure 1).

The main selection criteria for our patients were being SKP and treated by RFA, because of renal cancer, between February 2004 and January 2010. RFA has been done as treatment for one or more renal tumors diagnosed during the oncological following up for the first tumor. Patients had a basal renal function between 0.79-2.5 mg/dl and they were asymptomatic. Main pathologic characteristics of patients and RFA treated tumors are summarized in Table I.

Exclusion criteria were tumor size larger than 4 cm (although there was one patient with a 5.5 cm tumor that was compasive treated) and technique impossibility (central located tumors).
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RFA PROCEDURE

RFA was performed using the RITA system (Rita Medical System Mountain View, CA) using a 14 G electrode, expanding the electrode to 0.5-1 cm outside the tumor diameter. We overlapped ablations in tumors larger than 3.5 cm. During RFA, patients were under general anaesthesia with hemodynamic monitoring and endotracheal intubation. In all cases (except in one) patients were lying prone and all procedures were CT guided. In one case the patient was supine because of an anteromedial location mass. To avoid tumor seeding, tact ablation was performed in all cases.

Hidrodissection was performed in one case because of colon proximity, to avoid colon damage during de RFA (8). We injected 100 cm3 of saline between the colon and the tumor, and later the procedure was performed as it was mentioned above (Figure 2).

Although anteromedial and colon proximal located tumors could have been treated through laparoscopic RFA, percutaneous RFA was performed because of tumor multiplicity in solitary kidneys (two tumors in the first case and four in the second one).

FOLLOW-UP

Follow-up was set up with unenhanced and enhanced CT at 1, 6, and 12 months after RFA. As other authors (9) have demonstrated that a CT performed immediately after RFA could overdimension the lesion and it can look larger than in pre-ablation

FIGURE 1. A). Enhanced abdominal CT, pre RFA, where there’s an exophytic 3.2 cm size mass located in medial face of left kidney (*). There’s also some large simple cysts. B). Enhanced CT one month after RFA where there’s a hypodense mass that has decreased in size [arrow] which means complete ablation.

FIGURE 2. Hidrodissection technique.
A). enhanced abdomen CT in a patient with VHL and an exophytic right renal tumor appeared new on an oncological follow up (white arrow). Observe colon proximity [star]. B). To separate tumor from colon, a needle is placed in perirenal space and 100 cm3 of saline are injected. C). RFA procedure. The electrode is placed into the lesion. D). Abdomen enhanced CT 15 months after RFA. There’s a complete tumor necrosis [arrowhead].
study, in our research CT wasn’t performed immediately after RFA to avoid confusions between incomplete ablation and post ablation edema.

On the other hand, previous biopsy wasn’t carried out. During the follow up we considered complete necrosis when the enhancement (comparing enhanced and unenhanced studies) was higher than 10 HU (10) (Figures 3 and 4). Others complete necrosis features were the decreasing in size, presence of

FIGURE 3. A]. abdomen enhanced CT where there’s a right renal mass (white arrow) that later was treated by RFA. B]. Follow up enhanced CT of the same lesion 5 years after RFA (black arrow). In the tumor location now there’s a smaller hypodense area with calcium, which means complete necrosis.

FIGURE 4. A]. Enhanced CT where there’s a right posterior renal mass (white arrow), pre RFA: B]. Enhanced abdomen CT of the same patient 2 months after RFA treatment. There’s an incomplete ablation as there’s still tumor (arrowhead) that needed a new RFA. C]. Abdomen enhanced CT 18 months after the second RFA. There’a hypodense area at the tumor location and the halo sign which means complete necrosis (star).
calcium, presence of fat between the treatment area and the kidney (11) or the presence of the halo sign (12).

Serum creatinine levels before and after RFA were measured and considered retrospectively as patients renal function indicator.

RESULTS

During our study we performed 21 RFA sessions. The average follow up was 14 months (follow up time range: 1-66 months) and the median was 7 months.

According to cases progression, we achieved complete ablation in 17 tumors (89.4%). 14 masses were completely ablated in one session, while 3 masses required two sessions to achieve complete necrosis (mean size: 4 cm). Results are summarized in table I. We did not achieve complete necrosis in 2 tumors (10.6%): one was a 3.2 cm tumor because the patient refused to undergo a second session and the other one was a 5.5 cm tumor size because of technical impossibility after 3 sessions.

According to tumor location, complete necrosis was achieved in 100% of parenchymal and exophytic location tumors and in 60% of mixed location ones (n=3). Average tumor size was 2.9 cm (range: 1.2-6 cm). Tumors 3 cm size or smaller were completely ablated in 100% of cases (n=10), while a 75% of larger than 3 cm tumors were completely ablated (n=6).

Serum creatinine levels didn’t rise significantly after RFA in 54% of all patients (n=6), while in a 45% (n=5) these levels rose in a mildly and self-limiting way and they recovered their initial values in a few days. Figure 5 shows serum creatinine levels progression.

Only in one case there was a significant creatinine levels rise. This was the only patient that needed an income larger than 24 hours, because of an iatrogenic urinary tract stricture, hydronephrosis and

<table>
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anuria that led to death one month later, as patient refused to undergo more therapeutics procedures. In the same patient we observed an hepatic subcapsular hematoma while an anterior renal face tumor was treated by transhepatic RFA. It only required conservative treatment (Figure 6).

**DISCUSSION**

The main finding of our study has been that RFA for RCC treatment in SKP in our institution has demonstrated to be a technique with a high initial complete necrosis rate. In 17 of the observed tumors, complete necrosis was achieved after one or two RFA sessions with no significantly renal function affection and with a low complications rate. There’re previous studies that have demonstrated a good effectiveness for RFA as minimally invasive technique for small renal masses treatment (7). Particularly, our results are similar to the ones reported by others authors (13, 14, 15) who presented a total necrosis rate of 89%. In our study, we couldn’t achieve complete necrosis in only two patients. And we believe it’s important to emphasize that one patient refused to undergo a second session and the other one had vertebral metastases and after three sessions we gave up another try.

Some studies have research that the RFA for RCC treatment achieve a complete necrosis up to 100% of RCC cases (1, 12, 15-18). In all studies mentioned the success rate depends directly on tumor size and location. In our investigation, this relation was confirmed as we achieved 100% of complete necrosis in tumors smaller than 3 cm even after one or two RFA sessions, while in tumors larger than 3 cm the success rate decreased down to a 75% of cases. Also a 100% of exophytic and parenchymal tumors were completely ablated after one or two RFA sessions while mixed location decreased effectiveness down to a 60% of cases. Both characteristics (size and location) have been proposed for different authors, as independent RFA success factors (15, 18, 19). In case of tumor size, the influence over success probability

**FIGURE 5.** Serum creatinine levels progression before and after RFA.

**FIGURE 6A.** Iatrogenic urinary tract rupture during RFA of a parenchymal posterior face renal tumor (star). Observe contrast extravasation (thin arrow). **B.** Subcapsular hepatic hematoma (wide arrow) after RFA of a parenchymal anterior renal face tumor, by transhepatic approach in the same patient. Observe the inferior cave vein proximity (black cross).
is due to that the ablation diameter is limited so big masses have a lower complete necrosis rate.

According to location, it is believed that exophytic location has a higher success rate because perirrenal fat acts as an insulator so higher temperatures can be achieved and maintained. On the other hand, a central location tumor is technically more difficult to treat and also blood flow causes a cooler effect that limits the temperatures that can be reached and maintained (20).

In our study we didn’t performed percutaneous biopsy before RFA because all tumors were new findings during the follow up in nephrectomized patients because of contralateral RCC and all masses had radiological malignant features (21). Also there’re studies that shows that percutaneous biopsy has some risks, and have a false negative rate up to a 22% and this proportion increase as the mass size decrease (3, 22). As well, up to a 70% of non diagnostic biopsies can be a RCC (22). Despite that, it could be useful to perform biopsies before RFA as tumor pathologic classification could be interesting posteriorly (especially for follow up in cases of malignancy).

Although percutaneous ARF is a procedure that could be performed under deep sedation, we prefer general anesthesia because it allows a better ventilation control with the patient lying prone and a higher technical precision.

Procedure monitoring can be performed using ultrasound, instead of using CT, but it has the disadvantage that is technically more difficult because gas bubbles that are generated can obscure the tumor and lead to an incomplete treatment. We prefer CT monitoring because it doesn’t have this disadvantage, permits bubbles location control and other organs relation.

Neither post RFA biopsy was performed to assess tumor necrosis, even though when there’re some specific techniques (as NADH technique) for necrosis diagnostic. We only used the radiological sings described in material and methods for the necrosis diagnostic.

Finally, maintaining renal function in SKP is a fact that justifies RFA as a high benefit technique for RCC treatment (23). We have found that in 10 of our 11 patients, basal creatinine serum levels (between 0.79 and 2.5 mg/dl) didn’t change significantly after RFA (between 0.7 and 2.9 mg/dl). In cases in which creatinine serum level increased, they return to their baseline levels in a few days or weeks. These results improve even the ones observed by Adkins et al. (24) after partial nephrectomy, and also Chockeo et al. ones (2) that used RFA in no SKP. A significant increase in creatinine serum levels was observed just in one case, and it was because of an iatrogenic urinary tract rupture that caused a urinary extravasation that wasn’t treated immediately with a urinary stent. The patient died one month later because of an obstructive anury as the patient refused to undergo more thera-peutics procedures. Also in this patient a subcapsular hematoma was observed. It only required conservative treatment. Because of both complications this patient was the only one that needed an income larger than 24 hours. These were the only complications we found out in our study.

Although follow up is usually made through CT (unenhanced and enhanced), ultrasound and MR could be an effective alternative for solitary kidney patients and/or patients with renal function affectation.

CONCLUSION

Despite our study is limited by the low number of patients, because of being retrospective, and because of the short follow up time (that make unknown the long term recurrences rate), we can conclude that RFA treatment for RCC in SKP has a high success rate because it achieves initial lesion complete necrosis in small masses and in those with exophytic or parenchymal location and preserves renal function.

For this reason, RFA is a safe and effective alternative for patients with a renal mass(es) in solitary kidneys as their renal function can be preserved. It’s also a minimally invasive technique and has a low acute complications rate.

REFERENCES AND RECOMMENDED READINGS
(*of special interest, **of outstanding interest)


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