Radiofrequency Ablation of Functioning Adrenal Adenomas: Preliminary Clinical and Laboratory Findings

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ABSTRACT

Purpose: To evaluate clinical and laboratory findings in patients undergoing radiofrequency (RF) ablation for functioning adrenal adenomas.

Materials and Methods: Eleven adult patients, nine with Conn syndrome and two with Cushing syndrome, underwent percutaneous computed tomography–guided RF ablation for benign adrenal neoplasms. Systolic, diastolic, and mean blood pressure and the number of classes of antihypertensive drugs used by each patient were analyzed before and 1, 4, and 12 weeks after the procedure. Serum hormone levels were analyzed within 30 days before and 12 weeks after the procedure.

Results: Of the nine patients with Conn syndrome, eight showed normal serum aldosterone levels after the procedure and one patient had a nodule located very close to the inferior vena cava, resulting in incomplete ablation. The two patients with Cushing syndrome had normal serum and salivary cortisol levels after the procedure. Mean aldosterone concentration at baseline was 63.3 ng/dL ± 28.0 and decreased to 13.3 ng/dL ± 13.5 at 12 weeks postoperatively ($P = .008$). Systolic, diastolic, and mean blood pressures decreased significantly in the first week after the procedure ($P < .001$) and remained stable during further follow-up.

Conclusions: In patients with Conn syndrome or Cushing syndrome, percutaneous RF ablation of functioning adrenal adenomas may result in normalization of hormone secretion, improvement in blood pressure, and reduced need for antihypertensive drugs.

ABBREVIATIONS

ARR = aldosterone-to-renin ratio, RF = radiofrequency

The use of laparoscopic adrenalectomy was first described in 1992 (1). Since then, many studies have attested to the value of this method for the treatment of functioning adrenal adenomas because of its association with reduced postoperative pain, shorter hospital stay, and decreased short- and long-term morbidity compared with open surgical procedures (2–4). Laparoscopic adrenalectomy has also resulted in favorable clinical outcomes, such as normalization of hormone levels and attenuation of related symptoms, with most studies demonstrating a consistent decrease in blood pressure and in the number of antihypertensive drugs required by patients (5,6). Therefore, this technique is currently considered the standard treatment for small, benign, and functioning adrenal lesions (7).

Percutaneous radiofrequency (RF) ablation is a minimally invasive technique that uses localized heat to ablate small tumors and has been widely used to treat small hepatocarcinomas and renal cell carcinomas, leading to results comparable to those achieved by surgical resection (8,9). RF ablation has been demonstrated to be a safe and effective method for the treatment of benign functioning adrenal tumors with only a few minor complications (10).

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Our group recently published a preliminary study on a series of 11 cases assessing the safety of RF ablation in the treatment of functioning benign nodules (11). Although the previous study was based on the same patient cohort used for the present study, we focused on the reproducibility of RF ablation in adenomas and demonstrated the safety of this technique in the earlier study (11). In the present study, we assessed the efficacy of RF ablation based on appropriate clinical and laboratory data from an endocrine point of view and medium-term results. Treatment of aldosterone-producing adenomas with RF ablation will become a valid treatment option only when clinical and laboratory results prove consistent. The present study deals precisely with this issue. Therefore, the aim of the present study was to evaluate clinical and laboratory findings of patients undergoing RF ablation for the treatment of functioning adrenal adenomas.

MATERIALS AND METHODS

This prospective study was approved by the local research ethics committee and conducted in accordance with the Declaration of Helsinki. All patients gave written informed consent at the time of the procedure for future use of their data.

From October 2011 to August 2012, 11 patients (seven women and four men, age 33–60 y) with functioning adrenal adenomas (nine with primary aldosteronism and two with Cushing syndrome) were treated at a single institution with computed tomography (CT)–guided percutaneous RF ablation. All patients were referred from the endocrinology outpatient clinic of our institution with a previous diagnosis of benign unilateral adrenal tumors. The laboratory diagnosis of primary aldosteronism was based on simultaneous increased serum aldosterone and suppressed plasma renin concentrations (ie, increased aldosterone-to-renin ratio [ARR]). In patients aged < 45 years with solitary adenomas and ARR > 50, these findings were sufficient to confirm the diagnosis. In all other cases, diagnosis was confirmed by one of the following tests: postural stimulation test to ascertain the anomalous postural response of aldosterone concentration; saline suppression test in patients with ARR < 50 to determine absence of aldosterone suppression and autonomous aldosterone production; and bilateral adrenal sampling, when the results of hormone testing and/or adrenal imaging were not definitive, to determine lateralization of aldosterone secretion (12–14).

The diagnosis of Cushing syndrome was based on increased 11 P.M. salivary cortisol levels and absence of plasma and salivary cortisol suppression after a repeated overnight 1-mg dexamethasone suppression test. The overnight test was also used to measure serum dexamethasone concentrations. The presence of benign adrenal nodules was detected by computed tomography (CT) and/or magnetic resonance (MR) imaging. CT criteria for benign masses included a density of < 10 HU on unenhanced CT and/or absolute washout greater than 60% on enhanced CT. On MR imaging, a signal intensity ratio higher than 16% on the in/out phase of a T1-weighted gradient-recalled echo sequence was used to establish the diagnosis (15–17).

Exclusion criteria were the presence of cardiac pacemakers, pregnancy, coagulopathies, familial syndromes, nephropathy with a creatinine clearance $< 50\%$, allergy to iodinated contrast agents, largest tumor diameter > 3.5 cm, bilateral adrenal disease (as bilateral nodules are indicative of nodular adrenal hyperplasia rather than bilateral adenomas in most cases), presence of potentially inaccessible nodules, and refusal to undergo surgery. At the time of enrollment in the present study, all patients were on a waiting list for surgical resection and were informed that they would still be able to receive surgical treatment if the ablation technique failed.

Plasma active renin was determined by chemiluminescent immunoassay (LIAISON; Diasorin, Saluggia, Italy) and plasma aldosterone concentrations were measured by radioimmunoassay (Siemens Medical Solutions Diagnostics, Erlangen, Germany) according to the manufacturers' instructions. Plasma renin and aldosterone concentrations were measured in patients with hyperaldosteronism, and serum and salivary cortisol (plus dexamethasone) concentrations were measured in patients with Cushing syndrome. Histologic confirmation was not compulsory because, in addition to the CT and MR imaging findings, all patients had previously undergone all clinical and laboratory examinations required to confirm their diagnosis. None of the patients had a primary neoplasm.

RF Ablation Procedures

Before RF ablation, all patients were evaluated by endocrinologists to optimize blood pressure control and correct hypokalemia. RF ablation procedures were performed in an inpatient setting. Immediately before RF ablation, a prophylactic dose of parenteral antibiotic agent (intravenous cefuroxime 1.5 g) was administered. A single interventional radiologist with more than 10 years of experience (D.S.) performed all RF ablation procedures.

Under multidetector CT fluoroscopic and/or ultrasound guidance, patients were placed in the prone or lateral decubitus position to select the optimal access route for insertion of the RF ablation needle. After local anesthetic infiltration with 1–5 mL of 1% lidocaine, a single RF ablation needle with a 2-cm active tip (StarBurst electrodes; RITA, Mountain View, California) was inserted and gradually advanced into the center of the target lesion under real-time CT guidance. An electrical circuit was thereby established connecting the needle tip, the two plates of insulating material attached