Clinical Outcomes following Percutaneous Radiofrequency Ablation of Unilateral Aldosterone-Producing Adenoma: Comparison with Adrenalectomy

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ABSTRACT

Purpose: To compare adrenal radiofrequency (RF) ablation with adrenalectomy in treating unilateral aldosterone-producing adenoma (APA).

Materials and Methods: Between April 2008 and September 2013, 44 patients with adrenal venous sampling–confirmed (lateralization index $\geq$ 4) unilateral APA underwent adrenal RF ablation (12/44 [27%]) or adrenalectomy (32/44 [73%]). Outcomes of adrenal RF ablation (patient age, 51 y $\pm$ 11; 4/12 men) were compared with adrenalectomy (patient age, 50 y $\pm$ 11; 19/32 men). Blood pressure (145/94 mm Hg $\pm$ 19/13 vs 144/89 mm Hg $\pm$ 10/8, $P = .92$), number of antihypertensives (3.0 $\pm$ 1.3 vs 2.7 $\pm$ 0.89, $P = .38$), and serum potassium (3.2 mEq/L $\pm$ 0.6 vs 3.5 mEq/L $\pm$ 0.6, $P = .65$) of patients were similar before treatment.

Results: RF ablation and adrenalectomy resulted in normokalemia (RF ablation, 4.2 mEq/L $\pm$ 0.1, $P = .0004$; adrenalectomy, 4.3 mEq/L $\pm$ 0.6, $P < .0001$) and normotension (RF ablation, 129/81 mm Hg $\pm$ 11/11, $P = .02/P = .001$; adrenalectomy, 128/85 mm Hg $\pm$ 13/12, $P < .0001/P = .07$) in all patients. Proportions of RF ablation and adrenalectomy patients cured of hypertension (2/12 [17%] vs 12/32 [38%], $P = .28$) or requiring fewer antihypertensives (7/12 [58%] vs 13/32 [40%], $P = .29$) were similar. RF ablation patients had a shorter length of stay (0.6 d $\pm$ 0.8 [range, 0–2 d] vs 1.7 d $\pm$ 1.4 [range, 0–7 d]; $P = .01$) and less intraoperative blood loss (1.2 mL $\pm$ 3 vs 40 mL $\pm$85; $P = .01$). Procedural complications occurred in 5/32 (15%) adrenalectomy patients (2 major, 3 minor) and in 0/12 RF ablation patients.

Conclusions: RF ablation to treat APA can achieve similar clinical outcomes as adrenalectomy and results in shorter hospital stays. Larger, prospective trials are needed to validate these results.

ABBREVIATIONS

APA = aldosterone-producing adenoma, AVS = adrenal venous sampling, PA = primary aldosteronism, RF = radiofrequency

Primary aldosteronism (PA) is the most common cause of secondary hypertension, with a reported prevalence of 4.3% in the general population with hypertension and > 11% in patients referred to specialized centers (1–3). The Endocrine Society recommends adrenal venous sampling (AVS) as the gold standard study for lateralization of excess hormone production (4). Unilateral production of excess aldosterone is most commonly due to an aldosterone-producing adenoma (APA) or unilateral adrenal hyperplasia (5). Clinical practice guidelines from the Endocrine Society recommend unilateral laparoscopic adrenalectomy for patients with documented unilateral PA (1).

Adrenalectomy results in a cure of hypertension (defined as normotension without the use of antihypertensive medications) in 21%–72% (mean 42%) of patients and improvement (normotension on same or reduced number of antihypertensive medications) in 18%–68%

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None of the authors have identified a conflict of interest.

J Vasc Interv Radiol 2016; 27:961–967

http://dx.doi.org/10.1016/j.jvir.2016.03.042

(mean 43%) of patients (6,7). Prior studies have shown the following to be associated with surgical cure: young age, fewer antihypertensive medications before the procedure, higher preoperative blood pressure, body mass index < 25 kg/m^2, and female sex (6,8,9). Outcomes after adrenalectomy also depend on whether AVS was used to determine laterality as well as the thresholds used to interpret results of the AVS (10,11). However, a report from the German Conn registry reported that $<50\%$ of patients with unilateral PA underwent adrenalectomy (15%–46%) (12).

Unilateral APA can also be treated with percutaneous radiofrequency (RF) ablation of the adrenal gland under computed tomography (CT) guidance (Fig 1) (13). Multiple reports document the technical and clinical success of RF ablation in the treatment of functional adrenal tumors (13–16). This study compares outcomes of RF ablation versus adrenalectomy in treating AVS-confirmed unilateral APA.

MATERIALS AND METHODS

Institutional review board approval was obtained, and the need for informed consent was waived. The study was conducted at two tertiary care institutions located in the same city in the northeastern United States, with one serving as a regional clinical and surgical referral center for adrenal disorders and the second serving as a regional referral center for AVS and RF ablation of adrenal adenomas. All patients were referred for AVS by endocrinologists after confirmation of aldosterone excess (serum aldosterone-to-renin ratio ≥ 25 and a positive oral salt or saline loading test) (1). There was no significant difference between the preoperative characteristics of patients undergoing adrenalectomy versus RF ablation (Table 1).

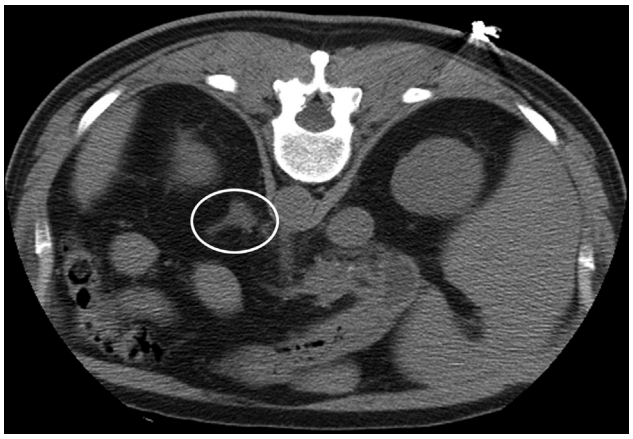

Figure 1. CT axial image of a prone patient with PA showing a 17-mm right adrenal nodule (white circle).

Inclusion and Exclusion Criteria

All patients referred for AVS at the AVS referral center were reviewed for study eligibility. AVS was performed using a standard technique, as previously described (17). In patients with a selectivity index (selectivity index = plasma cortisol in adrenal vein/plasma cortisol in inferior vena cava) > 2 in nonstimulated samples of each adrenal vein, a lateralization index (lateralization index = [plasma aldosterone of dominant adrenal vein/plasma cortisol of dominant adrenal vein]/[plasma aldosterone of nondominant adrenal vein/plasma cortisol of nondominant adrenal vein]) was calculated in samples after adrenocorticotropic hormone administration (1). Unilateral PA was defined as a lateralization index $\geq$ 4.0, per published guidelines (1). Patients were excluded if adrenal veins were not successfully catheterized (selectivity index < 2), the patient did not have an identifiable nodule on cross-sectional imaging, the lateralization index was < 4, or the patient was lost to follow-up (Fig 2). Between April 2008 and September 2013, 44 patients fit study criteria and underwent RF ablation or adrenalectomy for unilateral APA.

Treatment for PA

An adrenal nodule that satisfied size (< 4 cm) and enhancement criteria for adrenal adenoma was present on cross-sectional imaging in 44 patients. All patients with AVS were offered RF ablation treatment. The decision for RF ablation versus adrenalectomy was made by the patient and referring endocrinologist; 32 of 44 (72%) patients underwent adrenalectomy, and 12

Table 1. Characteristics of Patients with Unilateral APA before Undergoing Surgical Adrenalectomy or RF Ablation

Characteristic	RF Ablation (n = 12)	Adrenalectomy (n = 32)	*P* Value
Age (y)	51 ± 11	50 ± 11	.68
Male sex	4/12 (33%)	19/32 (59%)	.18
Preoperative BP (mm Hg)	145/94 ± 19/13	144/89 ± 10/8	.92
No. medications	3.0 ± 1.3	2.7 ± 0.89	.38
Renal artery stenosis	None	None	—
Obesity (BMI ≥ 25)	3/12	14/32	.31
Serum potassium (mEq/L)	3.2 ± 0.6	3.5 ± 0.6	.65
Follow-up (d)	463 ± 470	299 ± 339	.59

Note–Values are presented as mean ± SD or number.
APA = aldosterone-producing adenoma; BMI = body mass index; BP = blood pressure; RF = radiofrequency.