Aldosteronoma resolution score predicts long-term resolution of hypertension

Anna Aronova, MD, Benjamin L. Gordon, BA, Brendan M. Finnerty, MD, Rasa Zarnegar, MD, *and* **Thomas J. Fahey III, MD,** *New York, NY*

Background. *The Aldosteronoma Resolution Score (ARS) takes into consideration four, readily available, preoperative clinical parameters in predicting the likelihood of resolution of hypertension in patients 6 months after undergoing unilateral adrenalectomy for aldosterone-producing adenoma (APA). We sought to determine the durability of this predictive model after 1 year.*

Methods. *Sixty patients who underwent unilateral adrenalectomy for APA at a single institution between 2004 and 2013 were reviewed retrospectively. Patients who were normotensive without any antihypertensive medication requirement at greater than 1-year follow-up were considered to have complete resolution of hypertension.*

Results. *Forty-seven patients had data available for analysis. Median follow-up was 1,135 days (371–3,202). Forty-five percent of patients had complete resolution, 45% had improvement, and 10% had no improvement in hypertension. Applying the ARS, we found there was complete resolution of hypertension in 73% of patients with ARS 4–5, 53% of patients with ARS 2–3, and 24% of patients with ARS 0–1 compared with 75% (*P *= .9), 46% (*P *= .66), and 28% (*P *= .76), respectively, in the original cohort used to create the ARS.*

Conclusion. *Most patients (90%) have long-term improvement or complete resolution of hypertension after unilateral adrenalectomy for APA. The ARS predicts accurately a patient's likelihood of complete resolution of hypertension beyond 1 year. (Surgery 2014;156:1387-93.)*

From the Department of Surgery, Weill Cornell Medical College/New York Presbyterian Hospital, New York, NY

Primary aldosteronism (PA) is often cited as the most common cause of secondary hypertension, with a prevalence estimated at 5–18% among hypertensive patients.[1,2] The most common etiologies include bilateral idiopathic hyperplasia, alternatively known as idiopathic hyperaldosteronism, which accounts for 60–65% of cases, and unilateral aldosterone-producing adenoma, making up approximately 30–35% of cases.[2-4] Other rare causes of PA include unilateral adrenal hyperplasia (1–2%), aldosterone-secreting adrenocortical carcinoma (1%), familial hyperaldosteronism (1%), and ectopic aldosterone-producing adenoma or carcinoma (1%).[2-4] An excess of aldosterone has been shown to cause substantial, although potentially reversible, adverse effects on the cardiovascular, renal, and central nervous systems, independent of the hypertensive effects.[5] Accordingly, it is critical to recognize and manage PA appropriately. Specifically, the treatment of APA is unilateral adrenalectomy, whereas idiopathic hyperaldosteronism is most amenable to aldosterone blockade by mineralocorticoid antagonists. Differentiation of these major types of PA is accomplished by cross-sectional imaging supplemented by adrenal vein sampling in equivocal cases.[6]

Reported outcomes after unilateral adrenalectomy consistently have shown biochemical resolution of serum aldosterone levels and hypokalemia in nearly all patients[7]; however, although up to 90% experience improved control of hypertension, complete cure has been a less consistent finding; 30–60% of adrenalectomized patients no longer require antihypertensive medications postoperatively. Multiple studies have described factors that correlate with favorable surgical outcomes, including younger age, female sex, lesser body mass index (BMI), fewer preoperative antihypertensive medications, lesser

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Reprint requests: Thomas J. Fahey III, MD, 525 East 68th Street, Room F-2024, New York, NY 10065. E-mail: tjfahey@med.cornell.edu.

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duration of hypertension preoperatively, fewer first-degree family members with hypertension, better renal function as evidenced by greater glomerular filtration rate, less serum creatinine and aldosterone, less proteinuria, the TT genotype of CYP11B2 gene encoding aldosterone synthase, pathologic features, and smaller tumor size.[8-14]

To synthesize these data, in 2008, Zarnegar et al[15] created a predictive model based on four easily accessible preoperative factors that could predict accurately which patients had a high likelihood of complete resolution of hypertension after adrenalectomy for APA. This externally validated model, termed the Aldosteronoma Resolution Score (ARS), scores BMI ≤25 kg/m^2, female sex, and duration of hypertension ≤6 years as 1 point each and the number of preoperative antihypertensive medications ≤2 as 2 points. A composite ARS score of ≥4 predicted a high likelihood of resolution of hypertension.[15] Notably, the ARS outcomes data were based on 6-month follow-up to assess for resolution. Additional studies have shown that although blood pressure typically normalizes or shows maximal improvement 1–6 months after adrenalectomy, it can continue to decrease for up to 1 year after surgery.[12,16] Thus, we sought to determine the durability of this predictive model for patients with greater than 1 year follow-up.

METHODS

Patient cohort. We reviewed retrospectively charts of 60 consecutive patients with primary aldosteronism who underwent adrenalectomy at Weill Cornell Medical College–New York Presbyterian Hospital from 2004 to 2013. Patients were excluded if they had inadequate data or duration of follow-up (ie, missing documentation of blood pressure and prescribed medications at least 1 year after adrenalectomy). In total, 47 patients had complete data for analysis. The Institutional Review Board of Weill Cornell Medical College approved this study.

Definitions. The criteria used to determine the presence of primary aldosteronism were a history of persistent hypertension (with or without the presence of hypokalemia) with increased serum aldosterone concentration of ≥15 g/dL, suppressed plasma renin activity level of ≤1 ng·mL^{-1}· hr^{-1}, and aldosterone renin activity ratio ≥20. APA was discerned from idiopathic hyperaldosteronism by evidence of a unilateral adrenal tumor on cross-sectional imaging. Equivocal cases were localized further by adrenal vein sampling. Hypertension was defined as systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg. Complete resolution of hypertension after adrenalectomy was assessed at the most recent documented blood pressure measurement, at least 1 year after operation, and defined as normotension (systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg) without the need for any antihypertensive medications. Patients who continued to be hypertensive or who required antihypertensive medications for adequate blood pressure control at 1 year were classified as not resolved.

The ARS was computed as described previously: each patient was assigned 1 point for female sex, BMI ≤25 kg/m^2, or duration of hypertension ≤6 years and 2 points for patients on ≤2 antihypertensive medications preoperatively. The scores (0–5) were tabulated and compared with the data published by Zarnegar et al[15] for the derivation cohort used to generate the predictive model (University of California, San Francisco [UCSF]) and the validation cohort (Mayo Clinic).

Table I. WCMC patient characteristics

Variable	N = *47 (SD)**
Age	49 (10)
Male	62%
Female	38%
Race	
White	59%
Hispanic	9%
Asian	6%
Black	4%
Unknown	22%
Smoking (never-smoking)	57.8%
Family history of hypertension	50%
Body mass index, kg/m^2	29 (6)
Duration hypertension, y†	5 (0–42)
No. antihypertensive medications preoperatively†	3 (0–7)
Tumor size, mm	18 (7.6)
Potassium preoperatively	4 (0.59)
Aldosterone preoperatively†	31 (8–216)
Renin preoperatively†	0.23 (0.04–9.4)
Aldosterone/renin ratio†	137 (18–1,270)
Unilateral adenoma on computed tomography	88%
Adrenal vein sampling	34%
Number antihypertensive medications postoperatively†	1 (0–5)
Potassium postoperatively‡	4.3 (0.6)
Aldosterone postoperatively†,§	3.0 (1.6–22)

*Values expressed as means (±SD).
†Values not normally distributed are given as medians (range).
‡*N* = 43.
§*N* = 29.
WCMC, Weill Cornell Medical College–New York Presbyterian Hospital.