An Isotopic Diagnosis of Seizure

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Abstract

A 22-year-old healthy woman visited our clinic for seizure and consciousness loss. A thorough history taking and physical examination was negative except for persistent high blood pressure. Serial workup for suspicious secondary hypertension revealed secondary hyperaldosteronism. Further image study showed diminished unilateral kidney size, but the computed tomographic angiogram was unremarkable. Radionuclide renography disclosed a specific pattern of compromised unilateral renal function after captopril challenge, suggesting a high probability of renal artery stenosis. Renal artery angiography finally confirmed the diagnosis, and angioplasty with stenting successfully reversed the refractory hypertension despite the shrinking kidney size. Although isotopic study is gradually fading away among our diagnostic tools, the value it demonstrates in this case warrants attention.

Key words: renal artery stenosis, radionuclide, renography, hypertension


Introduction

Hypertension is an ever-increasing chronic illness in the general population, especially among those of advanced age. The Framingham study clearly showed that lifetime risk of hypertension will be up to 90% if a person without hypertension survives from his fifties to eighties (1). Secondary hypertension, occupying only <10% of all hypertensive cases, is potentially curable and warrants intensive investigation (2-4). This report describes a peculiar case of secondary hypertension presenting with seizure initially, and confirmed subsequently with radionuclide study and angiography. The role of isotopic examination is also discussed in depth in such a setting.

Case Report

A 22-year-old Asian woman presented to our clinic for involuntary movement with consciousness disturbance. She had no underlying disease previously, and there was also no relevant family history of inherited diseases. Her birth was uneventful, and she denied febrile convulsion experience previously. She presented initially with deviated eye gaze and involuntary movement after binge drinking the night before. On examination, her vital signs were within normal limit without fever, except for a blood pressure (BP) of 180/120 mmHg. Repeated measurement from both forearms yielded equivalent results. Brudzinski sign was negative. Emergent brain computed tomography (CT) showed no intracranial hemorrhage, and magnetic resonance imaging and angiography (MRI/MRA) was negative for stroke or vascular abnormality. A lumbar puncture was also normal without a sign of central nervous system infection. Repeated BP measurement was similar to her first recording (systolic 170-180 mmHg), requiring 3 classes of antihypertensive agents for control even after seizure ceased and she regained consciousness. She was temporarily discharged as she had no further seizure attacks. Her hypertension was attributed to binge drinking and lifestyle factors at that time.

At a subsequent follow-up in the outpatient clinic, secondary hypertension was suspected on clinical grounds due to its refractory nature. Comprehensive workup including adrenal and renal function, thyroid function profile, and urine catecholamine level were checked. All laboratory examinations were normal except for plasma renin activity (PRA) and aldosterone concentration (PAC) of 35.5 ng/mL/hr (ref. 1-5 ng/mL/hr) and 244.1 ng/dL (ref. 5-30 ng/dL), respec-
Figure 1. (Left) Baseline renography shows normal uptake and excretory capacity of the left kidney, and abnormally low uptake and impaired excretion of radioisotope tracers for the right kidney. (Right) Captopril augmented renography shows further compromise of right kidney uptake and excretory function, with a lower peak and significantly more curve prolongation.

Figure 2. Angiography of the right renal artery discloses segmental stenosis over the mid-portion.

tatively. Abdominal CT with contrast enhancement disclosed no adrenal mass nor vascular abnormality, but a shrinking right kidney was discovered (right 8.6 cm and left 11.9 cm). Though the reconstructed CT angiography did not reveal obvious narrowing of the right renal artery, renal artery stenosis (RAS) was still a major concern. We subsequently arranged radionuclide renography, with intravenous 8 mCi 99mTc-DTPA, to confirm the diagnosis of RAS and also assess the viability of right kidney (Fig. 1). Baseline study showed decreased right kidney uptake and prolonged excretory curve, while 1 hour after oral 50 mg captopril, radionuclide renography demonstrated more than a 50% reduction of peak right kidney uptake and further flattening of excretory curve. Left kidney perfusion and uptake activity was preserved while excretion was mildly blunted. Subsequent selective right renal artery angiography indicated a short mid-arterial stenosis up to 75%. The stenosis was thought to be fibromuscular dysplasia in origin but angiography presentation was atypical (Fig. 2). We performed successful balloon angioplasty with stenting over the lesion site. Immediately was atypical (Fig. 2). We performed successful balloon angioplasty with stenting over the lesion site. Immediate post-procedure BP was 150/75 mmHg, and her hypertension dramatically improved from the day after the procedure. We discontinued all of her medication for hypertension, and her systolic BP remained at 120-130 mmHg. Follow-up PRA and PAC level were 6.43 ng/mL/hr and 24.1 ng/dL, respectively, 1 month later. She is still free of medication 6 months later after the procedure.

Discussion

RAS accounts for approximately 8-10% of secondary hypertension in children, but only 1% in adults, while the elderly population has an even higher prevalence (7%) (5, 6). Presentation involves hypertension with various features (onset before 30 years old, abrupt and severe in grading, resistant in nature), and related symptoms such as headache or vision blurring from hypertensive retinopathy, but a first seizure is more common in children while it is rare in adults. The exact prevalence of hypertension in RAS population remained undetermined, and the severity of stenosis correlates poorly with hypertension severity, the degree of renal impairment or chance of recovery (7).

Biochemical tests like PRA and PAC are useful for screening purposes, since RAS is associated with secondary hyperreninemia and hyperaldosteronism. The choice of confirmatory test is under intense scrutiny, including doppler ultrasound, MRA, CT angiography and digital angiography. Doppler study is operator and technique-dependent though non-invasive, while MRA and CT angiography are notorious for their adverse renal effect. CTA carries the risk of contrast-induced nephropathy and MRA is associated with nephrogenic systemic sclerosis in patients with advanced chronic kidney disease. Results of comparison between different modalities are conflicting. Vasbinder et al, in an early metaanalysis, showed that contrast-enhanced MRA and CTA are superior to other modalities with respect to sensitivity and specificity (8). However, these image modalities all lack physiologic measures, since not all RAS patients develop...
hypothesis or renal dysfunction, and small kidney size is not always synonymous with absence of function.

The false negative finding of CTA in the present patient is surprising. As mentioned above, CTA is associated with a high sensitivity and specificity for renal artery stenosis (90-95%) in an early metaanalysis (8). However, another large multicenter prospective study, enrolling more than 400 patients with suspicious renal artery stenosis, subsequently suggested the contrary: CTA demonstrated a suboptimal sensitivity (64%), compared with historical data (9). The possible reasons for the poor diagnostic performance include poor techniques of acquiring images, selection bias from patient recruitment, selective exclusion of renal artery stenosis of fibromuscular dysplasia origin, and inclusion of smaller renal artery within analysis. CTA does serve as a poorer diagnostic tool for lesions involving smaller, accessory and polar renal arteries, as well as peripheral segments of main renal artery (10). In our patients, we believe that the location of lesion over mid-renal artery, the short segment of lesion, and the possible fibromuscular origin may contribute to the unexpected negative CTA interpretation.

The main indication of radionuclide renography is not for screening, but rather, for providing useful information on diagnosis confirmation and gauging renal reserve. It has the potential of assessing affected kidney reserve and predicts the chance of hypertension amelioration and even renal recovery. Although it is often criticized for low sensitivity (52-93%), its specificity is similar (71-92%) to other image modalities, and it further offers the physiologic parameters that we are interested in. Radionuclide renography utilizes radioactive pharmaceuticals such as diethylenetriaminepentaacetic acid (DTPA) or mercaptoacetyltriglycine (MAG3) bound to Tc for renal extraction and excretion, and MAG3 has the advantage of better imaging quality when used in renal insufficiency patients. By determining tracer retention amount and excretory rate between different time frame of imaging, RAS patients will display a lower uptake and prolonged intraparenchymal transit time. Captopril augmentation improves the study sensitivity by demonstrating the consequence of blocking renin and angiotensin II effect. A high probability of RAS (>90%) is suggested when a marked change in renogram [reduction of relative uptake greater than 10% or 10% decrease in calculated glomerular filtration rate (GFR) of the ipsilateral kidney] occurs after captopril sequence of blocking renin and angiotensin II effect. A high probability of RAS (>90%) is suggested when a marked change in renogram [reduction of relative uptake greater than 10% or 10% decrease in calculated glomerular filtration rate (GFR) of the ipsilateral kidney] occurs after captopril administration. The present patient’s renography showed a 14% reduction of right renal estimated GFR and 34% reduction in isotope uptake, suggesting a high probability of RAS. The renographic curve (Fig. 1) also depicts a typical switch of pattern, from one that signifies “renal failure with measurable kidney uptake” to “renal failure with minimal or no measurable kidney uptake” (11). Although there is no formal consensus utilizing radionuclide renography to guide treatment strategy for renovascular hypertension, this diagnostic modality is shown to correlate fairly closely with intervention outcome (12). Fernandez et al in a small yet elegant study concerning the role of captopril augmented renal scintigraphy, further indicated that such examination might predict the beneficial effect of revascularization for hemodynamically significant stenosis (13). Thus a functionally-oriented management strategy, as suggested by renal scintigraphy, is likely to outperform the traditional anatomy/morphologic associated strategy, which downplays the role of mechanical intervention if affected kidneys shrink significantly. We believe that the present patient’s renographic finding indicates the benefit of intervention for right renal artery, and then proceeding with percutaneous balloon angioplasty.

Treatment of RAS traditionally is divided into medical treatment, endovascular therapy and surgery. Surgery is associated with a reported 10% in-hospital mortality, thus it is generally reserved for the refractory patients (7). Balloon angioplasty is more effective than medical treatment for RAS from fibromuscular dysplasia, and previous reports also conclude that those aged younger than 40 years old, with hypertension duration of less than 5 years, and a systolic BP less than 160 mmHg, are associated with better angioplasty outcome (14). The present patient’s angiogram of the right renal artery favors fibromuscular dysplasia in origin, and the procedure does cure the hypertension completely, despite her shrinking right kidney presence. This further strengthens our point that radionuclide renography still possesses a valuable role in assessing RAS patients.

In conclusion, the current patient presented with seizure, a rare initial manifestation of RAS in adults. First-line imaging test with CTA did not reveal the diagnosis, while radionuclide renography did, and subsequently it was proven by renal artery angiography. By virtue of the physiologic measures obtained by isotope study, we have successfully predicted the favorable outcome of intervention. We believe that isotope study should be enlisted in the diagnostic armamentarium for RAS, rather than being discarded.

The authors state that they have no Conflict of Interest (COI).

References

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