Diagnostic Use of Angiotensin Converting Enzyme (ACE)-Inhibited Renal Scintigraphy in the Identification of Selective Renal Artery Stenosis in the Presence of Multiple Renal Arteries: A Case Report

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In patients with renovascular hypertension, it is unknown whether the angiotensin converting enzyme- (ACE) inhibited renal scan will identify stenosis of a segmental branch of a single renal artery or of an accessory artery where multiple renal arteries are present. Since multiple renal arteries may be present in approximately 25% of all individuals, it will be important to establish whether the ACE-inhibited renal scan is useful in this population. We report a case of stenosis involving a renal artery in a patient with multiple renal arteries, successfully identified by ACE-inhibited renal scintigraphy.


Renovascular hypertension (RVH), which accounts for only 5% or less of all cases of hypertension, is nonetheless the most common form of secondary hypertension (1). The disease is most often caused by activation of the renin-angiotensin system due to renal artery stenosis (RAS). The identification of those patients with RVH is important since the disease can often be cured or significantly improved by surgery or angioplasty (2,3).

Previously, the diagnosis of RVH depended on the selective sampling of renal vein levels of renin and on the visualization of renal artery lesions by angiography (4). In recent years, radionuclide renal scintigraphy has been shown to be a useful screening test for RVH (5–10). Renal scans are performed both before and after the administration of an angiotensin converting enzyme (ACE) inhibitor, such as Captopril. The ACE inhibitor blocks formation of angiotensin II, resulting in a decrease in perfusion pressure and glomerular filtration in kidneys supplied by stenotic arteries. These changes in renal function have been observed following ACE inhibition in renal scans performed with technetium-99m- (99mTc) diethylene triaminepentaacetic acid (DTPA), 99mTc-dimercaptosuccinic acid (DMSA), and iodine-131 (131I) or iodine-123-hippurate (HIP).

In patients with RVH, it is unknown whether the ACE-inhibited renal scan will identify stenosis of a branch of a single renal artery or of an accessory artery in a kidney supplied by multiple renal arteries. Since multiple renal arteries may be present in approximately 25% of subjects, it will be important to establish whether the ACE-inhibited renal scan is useful in this population. We present a case of stenosis involving a renal artery in a patient with multiple renal arteries, successfully identified by ACE-inhibited renal scintigraphy.

CASE REPORT

A 50-yr-old white female was admitted to the hospital with multiple medical problems, including poorly controlled hypertension, advanced atherosclerotic vascular disease, and an abdominal aortic aneurysm. The physical exam was remarkable for diminished pulses in the lower extremities and the presence of bruits over both posterior flanks. Her blood pressure on admission was 164/92 mm Hg, despite treatment with Minoxidil and Nifedipine. Pertinent laboratory data included: serum sodium 136 mEq/l (normal), serum glucose 87 mg/dl (normal), blood urea nitrogen 31 mg/dl (normal), serum creatinine 1.1 mg/dl (normal). The urinalysis was normal.

Radionuclide renal scintigraphy was performed both with and without ACE-inhibition. For both studies, the patient received 10 mCi of 99mTc-DTPA and 300 Ci 131I-HIP. Using

Received Jan. 17, 1990; revision accepted April 25, 1990.
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RESULTS

Dynamic (angiographic) images, static images, and time-activity curves of the standard (pre-captopril) DTPA scan demonstrated delayed and diminished blood flow and diminished delayed uptake of DTPA in a small left kidney, with normal flow and uptake in the right kidney. Tortuosity and pooling of DTPA in the abdominal aorta and poor bilateral visualization of the iliac arteries were consistent with the presence of an abdominal aortic aneurysm. On the pre-captopril HIP scan, uptake and excretion from the left kidney were diminished when compared to the right. These findings suggested the possibility of renal artery stenosis involving the left kidney.

The ACE-inhibited renal scan produced striking changes in both kidneys, when compared to the pre-captopril scan. Blood flow and uptake of DTPA in the small left kidney was markedly diminished. In the right kidney, the ACE-inhibited $^{99m}$Tc-DTPA renal scan demonstrated markedly diminished blood flow and uptake of the pharmaceutical only in the upper pole, with preservation of flow and uptake of DTPA in the lower pole. The ACE-inhibited HIP scan demonstrated a global decrease in excretion, as shown by progressive accumulation of activity in both kidneys. No definite intrarenal differences were appreciated in the right kidney on the HIP scan following ACE inhibition, either by visual analysis or time-activity curves. Overall, the scans suggested renin-mediated hypertension, with severe stenosis of the left renal artery and stenosis of either an upper pole renal artery (in the presence of multiple arteries) or of a subsegmental branch in the right kidney. Lack of right intrarenal variation in uptake or excretion on the HIP scan following captopril may have been due to the limited resolution with $^{131}$I, when compared to $^{99m}$Tc.

The contrast aortogram demonstrated severe atherosclerotic changes of the abdominal aorta and iliac arteries. The small left kidney was supplied by a single renal artery which had a high-grade proximal stenosis (>95% of the diameter). The right kidney was normal in size and was supplied by two renal arteries; the more cephalad of these supplied the upper pole of the kidney and had a high grade proximal stenosis (greater than 90% of the diameter). The lower pole renal artery was angiographically normal. The patient refused surgery or further intervention with respect to her renal artery stenoses.

DISCUSSION

Multiple renal arteries are among the most common variants of renal anatomy. Although more often present in malrotated or ectopic kidneys, the incidence of mult-
multiple renal arteries in orthotopic (normally-placed) kidneys has been estimated at 20%–27% in the angiographic literature (11). Of kidneys with multiple renal arteries, only 5% have more than two arteries (12). One dominant artery usually arises from the aorta at the normal level and supplies the anterior and dorsal intermediate portions of the kidney. Supplemental renal arteries can arise from the abdominal aorta, from iliac arteries, or, in rare cases, from mesenteric, celiac, lumbar or sacral arteries (13). Seventy-five percent of all supplemental renal arteries arise from the aorta just below the main renal artery and supply the lower pole of the kidney. This supplemental artery usually passes anterior to the ureteropelvic junction, where it may cause obstruction and hydronephrosis (13).

The noninvasive detection of individual stenotic renal arteries in the presence of multiple arteries is likely to contribute greatly to the diagnostic evaluation of patients with suspected RVH. The angiographic identification of multiple renal arteries can be difficult. The supplementary vessels may be confused with overlying mesenteric or lumbar arteries. Therefore, a high index of suspicion for stenosis of supplemental vessels provided by the ACE-inhibited renal scan justifies a comprehensive search for these vessels at the time of angiography to include additional angiographic projections. These same principles would apply to the detection of stenoses in segmental branches of single renal arteries.

Based on the findings in this single patient with multiple renal arteries, the ACE-inhibited renal scan may be used successfully to identify a single stenotic vessel in patients with RVH and multiple renal arteries. Additional investigation is warranted to establish the efficacy of the ACE-inhibited renal scan in this population and for those in whom stenoses of segmental branches of single renal arteries exist.

REFERENCES


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**ACQUISITION INFORMATION:**
A 37-yr-old obese female with fever and leukocytosis was referred for $^{67}$Ga imaging to rule out abdominal abcess. The patient was 17 days status post-emergency laparotomy for acute abdomen, which had disclosed a very large pelvic abcess adherent to the uterus and ovaries. Deep fascial closure with drains and retention sutures had been placed. Gallium-$^{67}$ imaging showed patchy diffuse activity in the abdomen with focal areas of activity at the suture sites. Probing and drainage of the abdomen demonstrated an abdominal wall abcess. The patient did well following drainage and antibiotic therapy.

**TRACER:**
10.59 mCi $^{67}$Ga-citrate

**ROUTE OF ADMINISTRATION:**
Intravenous injection.

**TIME AFTER INJECTION:**
48 and 72 hours.

**INSTRUMENTATION:**
Gallium-$^{67}$ spot and whole-body imaging.

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