Phantom Kidney in Technetium-99m DTPA Studies of Renal Blood Flow: Case Report

Edwin R. Holmes III, William C. Klingensmith III, Peter T. Kirchner, and Henry N. Wagner, Jr.

The Johns Hopkins Medical Institutions and National Naval Medical Center, Bethesda, Maryland

Renal perfusion, filtration rate, and excretion can be evaluated with technetium-99m diethylenetriamine pentaacetate (Tc-DTPA) using immediate and delayed imaging. Two cases are presented in which the immediate images reveal a bilateral distribution of radiotracer characteristic of bilateral renal perfusion, but the delayed images showed no evidence of filtration or excretion on one side. There was congenital absence of the kidney on that side in one case and surgical absence in the other. The apparent renal perfusion on the side of the absent kidney was probably attributable to perfusion of small bowel occupying the renal fossa.

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Renal imaging with technetium-99m diethylenetriamine pentaacetate (Tc-DTPA) is commonly used to assess renal perfusion, filtration, and excretion (*1*). Each of these functions predominates at a different time following injection of the radiotracer and, therefore, can be evaluated independently within certain limits. While most diseases of the kidney impair perfusion and glomerular filtration to a similar degree, some (such as acute tubular necrosis) affect filtration to a greater extent than perfusion (*2*). We report two cases in which a similar dissociation between perfusion and filtration was seen in the absence of a kidney.

A 14-year-old boy was admitted for evaluation of right-sided abdominal pain, fever, and hematuria which developed three days following a minor injury. A Tc-DTPA study (8.5 mCi) revealed a bilateral accumulation of radiotracer in the region of the kidneys on the early rapid-sequence images (Fig. 1). The concentration of radiotracer was greater on the left, suggesting greater perfusion to that side. Subsequent images showed lack of radiotracer accumulation, filtration, or excretion on the left. On the right there was a gradual increase in radiotracer concentration, revealing a large kidney with dilated calyces and delayed excretion. An intravenous pyelogram showed nonvisualization of the left kidney and a large right kidney with pyelocaliectasis. A retrograde pyelogram showed a short, blind-ending ureter on the left. A right pyeloplasty was performed, and exploration of the left peritoneal cavity and renal fossa failed to locate renal tissue. The liver and spleen were normal.

A 38-year-old man was admitted for evaluation of hypertension. A Tc-DTPA study of the kidneys showed apparent bilateral renal perfusion, but accumulation and excretion of the radiotracer were seen only on the right (Fig. 2A). The reniform activity on the left decreased as the concentration of radiotracer in the blood decreased. One month later, a followup Tc-DTPA study showed absence of perfusion as well as filtration on the left side (Fig. 2B). The right kidney was normal on both the first and second studies. The patient had had a left nephrectomy several years previously for inflammatory and cystic disease of the kidney. He had no detectable abnormality of the spleen, and it can be seen to be in the normal position on the early Tc-DTPA images (Fig. 2).

DISCUSSION

The two patients presented here exhibited, during the first transit of a bolus of Tc-DTPA, an accumu-

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For reprints contact: Edwin R. Holmes III, Div. of Nuclear Medicine, 615 North Wolfe St., Baltimore, MD 21205.

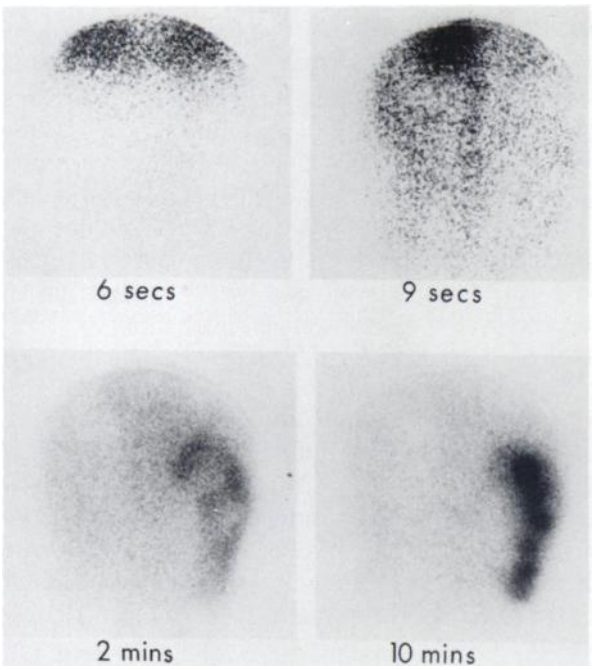

FIG. 1. Tc-DTPA imaging study of kidneys in posterior projection shows, at 6 sec, a good bolus of radiotracer entering abdominal aorta and, at 9 sec, bilateral accumulation of radiotracer that has shape, location, and timing of renal perfusion. Size of radiotracer accumulation on both sides is larger than normal, but symmetrical. Later images show no accumulation of radiotracer on left side although it showed greater amount of perfusion. Right kidney shows moderately good tracer accumulation, delayed excretion, enlargement, and dilated calyces.

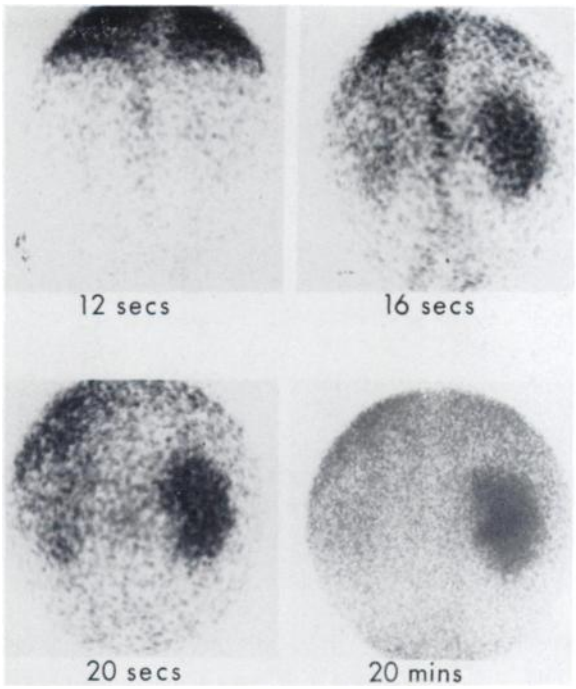

FIG. 2A. Tc-DTPA imaging study in posterior projection shows a good bolus at 12 sec and, at 16 and 20 sec, a bilateral accumulation of radiotracer that is less intense on left, but on both sides has the size, shape, position, and timing of renal perfusion. Perfusion to a normally positioned spleen can be identified above the apparent left-renal perfusion. A delayed image at 20 min shows no parenchymal activity on left and good parenchymal accumulation on the right.

lation of radiotracer that simulated renal perfusion in location, shape, and timing despite the fact that no kidney was present. This finding raises two questions:

1. Is it possible to distinguish this pattern from those renal conditions that result in a relative preservation of perfusion compared to filtration?
2. What factors account for the phantom kidney during the first transit of the radiotracer?

Although most diseases of the kidney affect both perfusion and the filtration rate or clearance to a similar extent (Fig. 3), some conditions—such as acute tubular necrosis—tend to spare perfusion (Fig. 4). In some cases the characteristic findings in the Tc-DTPA renal imaging study are a transient appearance of radiotracer in the kidney on the early rapid-sequence images and relatively poor accumulation of the radiotracer on delayed images, indicating a disproportionately impaired filtration (*2*). While the findings in acute tubular necrosis are qualitatively the same as those in the patients reported here, acute tubular necrosis is always associated with some evidence of radiotracer accumulation in our experience, and is infrequently unilateral in the presence of two kidneys.

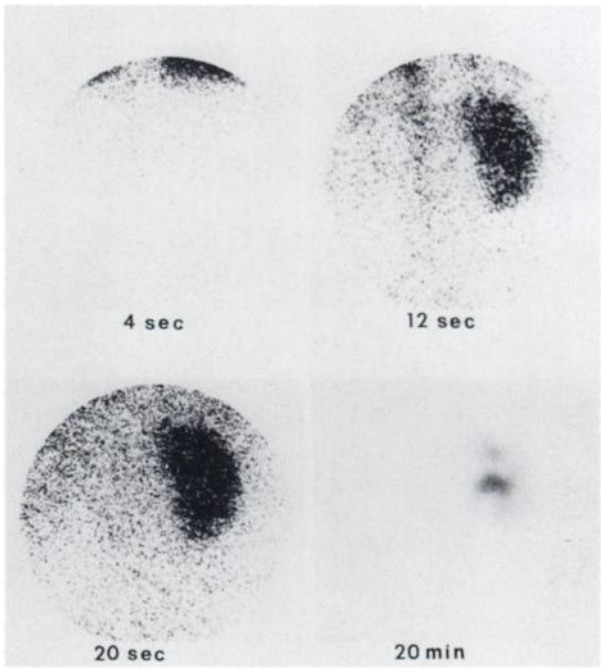

FIG. 2B. One month later, followup Tc-DTPA imaging study of the kidneys in the posterior projection shows, at 12 sec, a good bolus of radiotracer in the abdominal aorta and right kidney. An image at 20 min shows accumulation and excretion of radiotracer only on right, as expected after left nephrectomy.

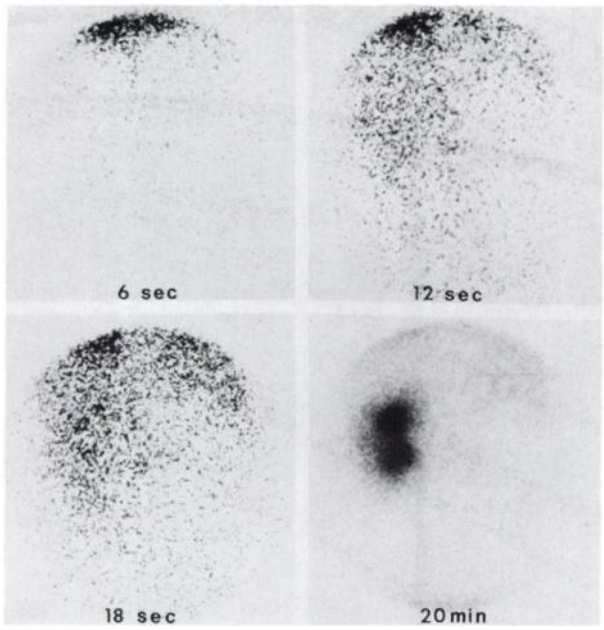

FIG. 3. Tc-DTPA imaging study of the kidneys in the posterior projection shows activity entering abdominal aorta at 6 sec and left kidney at 12 sec. Twenty-minute image shows accumulation and excretion of radiotracer only on left. There is markedly decreased perfusion and parenchymal function of right kidney, which at surgery revealed only a thin rim of cortical renal tissue around a large pyonephosis. This thin rim may be faintly seen on 20-min image.

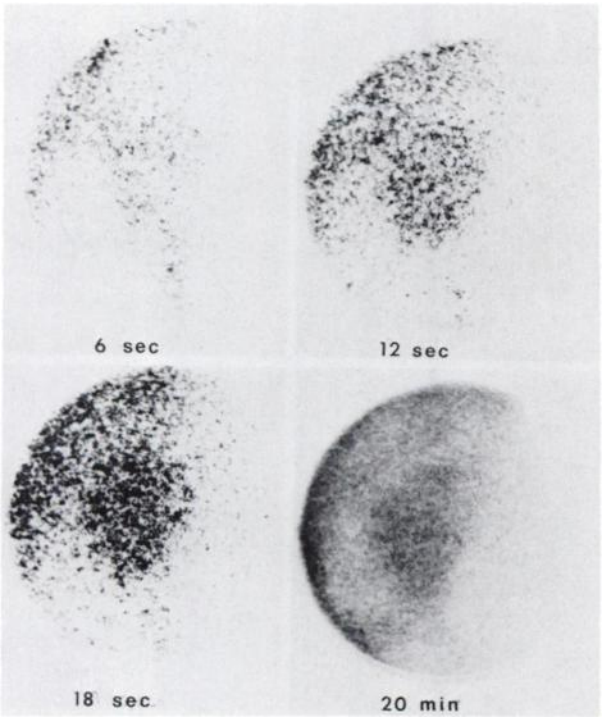

FIG. 4. Tc-DTPA anterior imaging study of a renal transplant to left iliac fossa shows radiotracer in left iliac artery at 6 sec. There is good entry of activity into kidney at 12 sec. Twenty-minute image, however, shows poor parenchymal accumulation and excretion. Kidney followed clinical course of acute tubular necrosis in early postoperative period.

Splenic and hepatic blood flow have previously been suggested as potential sources of confusion with renal perfusion in Tc-DTPA studies (*3*). In both of the present patients the phantom kidney was on the left, but splenic perfusion is an unlikely explanation because the spleen was of normal size and position in both patients and was identifiable as a separate structure in the Tc-DTPA study in the second patient (Fig. 2). The most likely explanation of the phantom kidney is suggested by the observation of Meyers et al. (*4*) that patients with congenital absence of a kidney may show an arteriocapillary blush of contrast material in the renal fossa on an arteriogram secondary to malposition of the jejunum or portions of the colon in the space normally occupied by the kidney. Detection of first-transit tracer passage through the malpositioned intestine would be facilitated by the lack of attenuation by renal tissue on the side of the absent kidney and the proximity of the intestine to the posteriorly positioned gamma camera. The fact that apparent renal perfusion was not seen on the second Tc-DTPA study in our second patient may be attributed to normal variations in intestinal position and perfusion.

Whenever there is unilateral absence of tracer accumulation and excretion on delayed images of a Tc-DTPA study, the differential diagnosis is between a present, but nonfunctioning, kidney and a surgically or congenitally absent kidney. In the former case the kidney will be relatively avascular and the radiotracer during the first transit should either approximate background or be less than background. It is possible, but unproven, that the pattern of unilateral apparent renal perfusion, without evidence of parenchymal accumulation or excretion, should increase the suspicion of an absent kidney.

ADDENDUM

During revision of this report Rambler has reported in the August 1976 issue of *Radiology* a case in which mesenteric vasculature simulated a perfused left kidney, this during dynamic renal imaging with Tc-DTPA in a patient with a prior left nephrectomy. Angiography the day before the Tc-DTPA study showed superior mesenteric vasculature on the left exhibiting a conspicuous reniform configuration.

ACKNOWLEDGMENT

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