Body-Background Defects with ^{99m}Tc-DTPA after Renal Transplantation: Case Reports

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Photon-deficient areas adjacent to transplanted kidneys were seen in the early phases of several dynamic studies obtained with ^{99m}Tc-diethylenetriaminepentaacetic acid (^{99m}Tc-DTPA). The causes included hematoma, urinoma, and lymphocele. These fluid collections do not readily exchange as part of the extracellular space and, if sufficiently large, may be visualized as photon-deficient areas in the normally homogeneous background of ^{99m}Tc-DTPA studies.

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During evaluation of transplanted kidneys with ^{99m}Tc-DTPA scanning, we have noted a localization effect similar to the total-body opacification effect seen in pediatric urography. This sign has been found to be diagnostically useful (*1,2*).

METHODS

One hundred twenty-five patients received renal transplants at Walter Reed Army Medical Center and George Washington University Hospital between 1970 and 1974. After transplantation, 42 of these patients had dynamic flow studies with delayed views for evaluation of low-output renal failure. After injection of 15 mCi of ^{99m}Tc-DTPA, sequential 5-sec scintigrams were taken for 40 sec. Static images were then obtained at 1, 3, 5, 10, 20, and 30 min using a scintillation camera and either a high-resolution parallel-hole or a low-energy converging collimator. The normal post-transplant study shows homogeneous background activity in the perirenal soft tissues, due to the distribution of tracer in the extracellular space before renal excretion. This is best seen in the late vascular or early static images. An abnormality in this background phase was considered present whenever a persistent deficiency appeared in the perirenal background activity.

CASE REPORTS

Case 1. A 21-year-old man who had received a cadaveric homograft was studied in the immediate postoperative period. Although the lower pole of the kidney appeared slightly dusky at surgery, the scintigram showed a normally functioning kidney with homogeneous perirenal background activity (Fig. 1A). However, on the fifth postoperative day, the patient became anuric. Although a subsequent ^{99m}Tc-DTPA study showed that the kidney was normally perfused, the lower pole was seen to be deformed and displaced, with a persistent photon-deficient area adjacent to it (Fig. 1B). A hematoma was found at surgery.

Case 2. Early in the postoperative period, a 20-year-old man who had received a cadaveric homograft, was evaluated for low-output renal failure. Although the kidney was normally perfused, static images revealed a persistent background defect adjacent to the lower pole (Fig. 1C). At surgery an infected hematoma was found.

Case 3. Twenty-four hours after transplantation, a 48-year-old man was found to have a perirenal mass on physical examination. Repeated needle aspirations confirmed the presence of a lymphocele, but the condition persisted. The patient became anuric and a subsequent ^{99m}Tc-DTPA study showed two photon-

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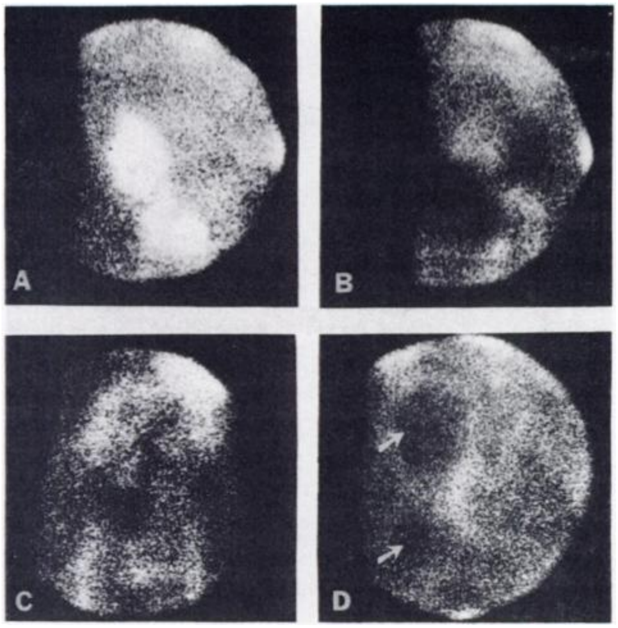

FIG. 1. (A) Case 1: Scintigram with ^{99m}Tc-DTPA of transplanted kidney. Delayed image (10 min) shows normal renal function and homogeneous perirenal background activity. (B) Repeat study shows superolateral displacement of kidney and photon-deficient area around lower pole, both due to hematoma. (C) Case 2: Decreased activity at lower renal pole secondary to perirenal hematoma. (D) Case 3: Two photon-deficient areas corresponding to rejected kidney (upper arrow) and lymphocele (lower arrow).

deficient areas corresponding to the rejected kidney and the lymphocele (Fig. 1D, arrows).

Case 4. Twelve hours after transplantation in a 32-year-old man, urinary output ceased. A ^{99m}Tc-DTPA flow study and a renal arteriogram showed vascular patency, and acute tubular necrosis was suspected. Anuria persisted and a repeat renal scan showed a photon-deficient area medial to the lower pole of the kidney (Fig. 2). Ultrasonography indicated a cyst, but despite needle aspiration under ultrasonic control the fluid remained. At surgery a large urinoma was found.

DISCUSSION

After intravenous injection and initial circulation, ^{99m}Tc-DTPA is primarily distributed in the extracellular space (*3*). The essence of the background effect is that collections of fluid or solids that do not exchange as part of the extracellular space may be defined as photon-deficient areas within this background. These fluid collections may be considered separate compartments in the distribution and clearance model for ^{99m}Tc-DTPA. Their concentrations of radioactivity are determined by the rates of exchange between compartments and their respective dilution volumes. The ability to visualize them scintigraphically against body-background activity is determined by the relative concentrations at any given time.

The causes of photon-deficient areas seen during the background phase of ^{99m}Tc-DTPA studies are varied. Examples of lymphocele, urinoma, hematoma, and a nonperfused kidney have been presented. Other possible causes that should be considered include abscess and hydronephrosis and hydroureter prior to excretion of tracer into the collecting system.

Pitfalls may be encountered in interpreting such background defects. Early scintigrams in one normal patient showed a negative defect inferomedial to the lower pole of the transplanted kidney (Fig. 3A): later images showed this to be a full urinary bladder which did not yet contain radionuclide (Fig. 3B). Moreover, mock lesions, formed between major blood vessels and vascular organs early in a study, may be incorrectly interpreted as pathologic (Fig. 3A). Finally, air-, fluid-, or barium-filled loops of bowel overlying the transplanted kidney may mimic a lesion.

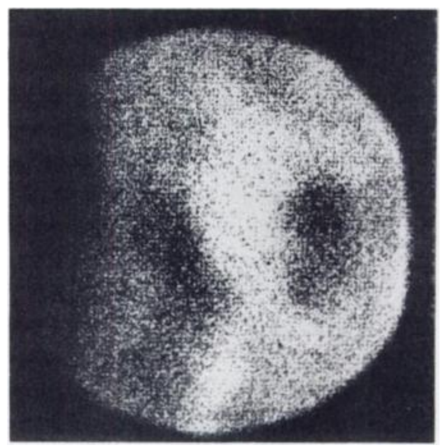

FIG. 2. Case 4: Urinoma causes photon-deficient area adjacent to lower pole of kidney.

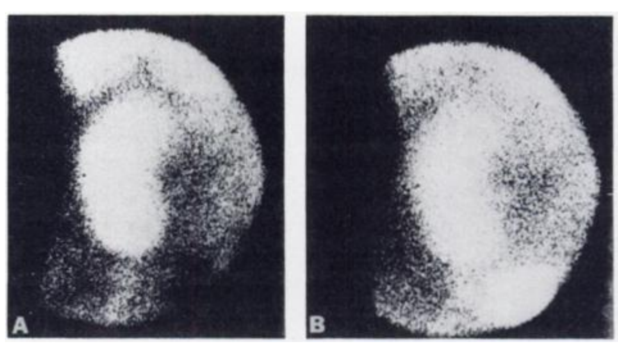

FIG. 3. Example of pitfalls. (A) Early scintigram shows apparent defects superior and inferomedial to transplanted kidney. (B) Later image shows that first defect was mock lesion between kidney and liver and that second was due to full urinary bladder devoid of tracer.

A ^{99m}Tc-DTPA study is not recommended as the first procedure when a perirenal fluid collection is suspected clinically. Ultrasonography is better in this situation since it is equally noninvasive and probably more sensitive in detecting small fluid collections. Also, needle aspiration under ultrasonic control may be used both to confirm the diagnosis and to drain the fluid. In the cases presented, the indication for the nuclear medicine procedure was low-output renal failure, and the detection of the extrarenal abnormalities was incidental. Only with systematic analysis of the static images were the extrarenal complications noted.

REFERENCES

1. KOENIGSBERG M, FREEMAN LM: The total body scintillation effect. *J Nucl Med* 15: 507–508, 1974

2. PUYAU FA, MECKSTROTH GR, HO RD: Total body radionuclide localization in infants. *Radiology* 110: 395–398, 1974

3. HAUSER W, ATKINS HL, NELSON KG, et al.: Technetium-99m DTPA: A new radiopharmaceutical for brain and kidney scanning. *Radiology* 94: 679–684, 1970