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# Failure to Visualize Acutely Injured Kidneys with Technetium-99m DMSA Does Not Preclude Recoverable Function

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A 35-yr-old patient developed severe acute tubular necrosis requiring hemodialysis. A [<sup>99m</sup>Tc]dimercaptosuccinic acid scan of the kidneys showed no renal uptake at 4 or 24 hr, but the patient subsequently recovered normal renal function as judged by a normal serum creatinine. Based on this case report and a review of the literature, one cannot assume irreversible loss of function in patients with acute renal failure, based on the absence of radiopharmaceutical uptake by the kidneys.

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The relative renal uptake of technetium-99m dimercaptosuccinic acid ([<sup>99m</sup>Tc]DMSA), a renal cortical imaging agent, parallels the relative renal function as determined by the glomerular filtration rate (GFR) or the effective renal plasma flow (ERPF) (1-6). Kawamura has suggested that the renal uptake of DMSA can actually be taken as a measure of absolute renal function (7). DMSA uptake is significantly decreased in the obstructed kidney and uptake may improve following relief of obstruction (8,9); however, animal studies suggest that little functional recovery can be expected if the renal uptake is <4% (10). The failure to visualize a kidney using a radiopharmaceutical is generally accepted as a poor prognostic sign (10-13). In this report, we describe a patient with acute tubular necrosis secondary to ischemia. Although a [<sup>99m</sup>Tc]DMSA scan failed to visualize the kidneys, the patient received hemodialysis and she subsequently recovered normal renal function.

## CASE REPORT

A 35-yr-old primigravida was admitted to an outside hospital for labor induction following spontaneous rupture of membranes. She received 2 days of i.v. oxytocin and was given intravaginal prostaglandin. On the morning of the third day,

she bled profusely from her vagina; her blood pressure and pulse were undetectable for 30-40 min. She was rapidly infused with whole blood and underwent an emergency supracervical hysterectomy which was complicated by massive bleeding and oozing. She continued to bleed postoperatively during which time her systolic blood pressure ranged from 40-60 mmHg. She returned to the operating room for a bilateral hypogastric artery ligation and later for oversewing of bleeding sites. During the 3 days following onset of hemorrhage, her urine output fell to 8-10 cc/hr and she was transferred to our medical center, having received a total of 46 units of blood.

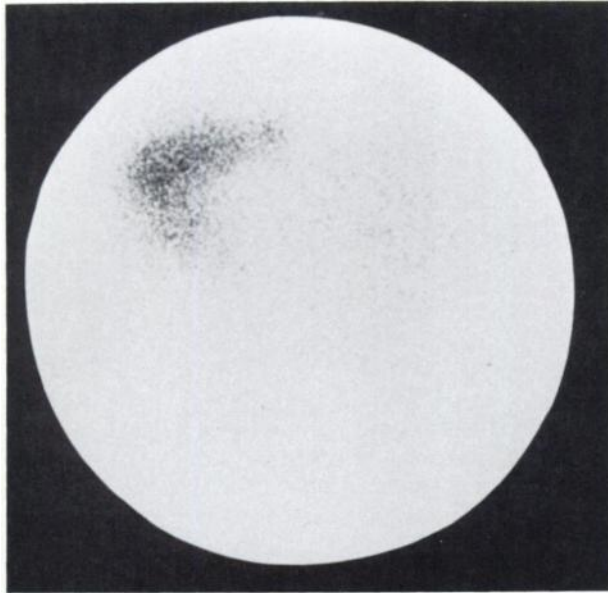
On admission, the patient was comatose, anuric, and suffered from diffuse intravascular coagulopathy and acute respiratory distress syndrome. Her blood pressure was 80/50 mmHg. She was placed on a ventilator, hemodialysis was initiated, and she was treated with i.v. amikacin and chloramphenicol for methicillin-resistant *S. aureus* sepsis. Multiple intra-abdominal hematomas were found by computed tomography and ultrasound; two were drained surgically. No hematomas were observed in the retroperitoneal region, nor was there any evidence of obstructive uropathy.

A [<sup>99m</sup>Tc]DMSA scan was performed on the 18th medical center hospital day to evaluate possible causes for her persisting renal failure. At the time, the patient was still on dialysis and her BUN and creatinine were 132 and 5.4 mg/dl, respectively. The 4-hr scan showed no DMSA uptake in the region of the renal fossae, but a posterior 24-hr scan demonstrated curvilinear activity in the left upper quadrant which initially suggested unilateral renal uptake (Fig. 1). An anterior view indicated that the activity might be in the stomach and this hypothesis was confirmed by imaging the stomach after instilling 0.5 mCi of [<sup>99m</sup>Tc]pertechnetate in 100 ml of water

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**FIGURE 1**  
Posterior 24-hr [<sup>99m</sup>Tc]DMSA scan shows left upper quadrant activity which initially suggested unilateral renal visualization

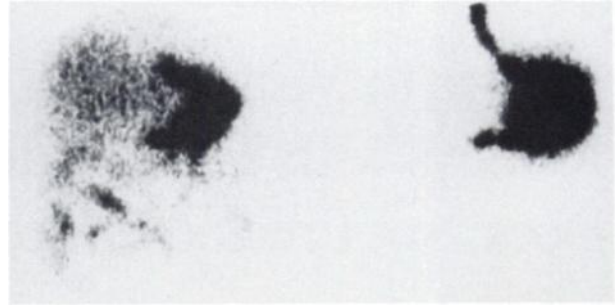
(Fig. 2) into the stomach by way of the patient's nasogastric tube.

As activity in the stomach was not present on the 4-hr image and there was no evidence of bleeding in the stomach at the time of the scan, we assume the stomach activity was due to in vivo breakdown of [<sup>99m</sup>Tc]DMSA with free [<sup>99m</sup>Tc]pertechnetate accumulating in the stomach.

Shortly after the initial [<sup>99m</sup>Tc]DMSA scan was performed, the patient regained consciousness, and was eventually weaned from her respirator. A second [<sup>99m</sup>Tc]DMSA scan was performed on the 24th medical center hospital day while the patient was still on dialysis. At this time, the patient's BUN was 86, her creatinine was 5.8, and her urine output had increased to 460 ml/24 hr. The 24-hr [<sup>99m</sup>Tc]DMSA scan clearly demonstrated bilateral renal activity (Fig. 3). Dialysis was terminated on the 38th hospital day and the patient was discharged on the 68th hospital day with a BUN of 29 and a creatinine of 1.2 mg/dl. Two years later the plasma creatinine remains within the normal range.

## DISCUSSION

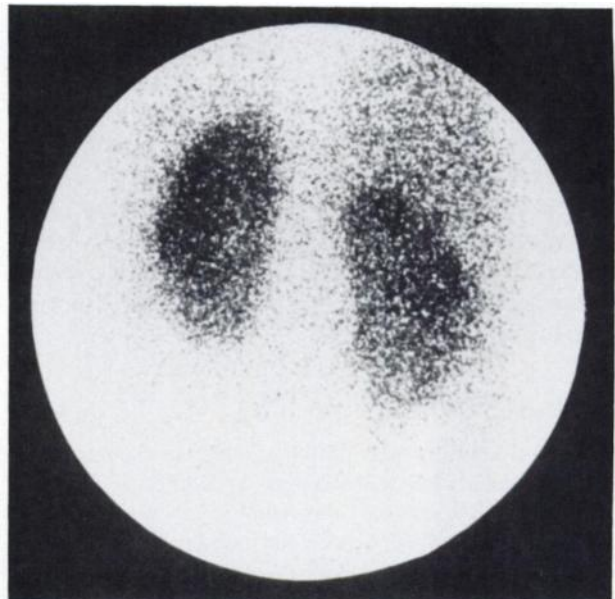
Kidneys which fail to accumulate a radiopharmaceutical rarely recover useful function (10–13), although partial recovery may occur after relief of urinary obstruction even if uptake of tracer was very poor or even absent during the period of obstruction (9, 10, 13, 16). Chishoim (9) described a patient with unilateral obstruction and no uptake of [<sup>99m</sup>Tc]DTPA (diethylenetriaminepentaacetic acid) in the obstructed kidney; a DMSA scan immediately following surgical relief of obstruction showed some uptake in the previously obstructed kidney and a repeat DMSA scan 20 mo later



**FIGURE 2**  
Anterior 24-hr DMSA image enhanced by computer (left) shows unilateral activity to be in area of stomach. Liver and small bowel activity are also visualized. Patient stayed in same position and swallowed 100 ml of water containing 0.5 mCi of [<sup>99m</sup>Tc]pertechnetate. Resulting image (right) shows esophagus and stomach. Stomach activity exactly corresponded to <sup>99m</sup>Tc activity noted on 24-hr anterior [<sup>99m</sup>Tc]DMSA image

showed that this kidney contributed 20% of the total renal uptake.

Technetium-99m penicillamine (TPEN) is a renal cortical imaging agent similar to DMSA and we have shown that minimal TPEN uptake in an acutely obstructed canine kidney does not preclude substantial recovery (14–16). Sherman and Blafox described four patients with obstructive renal failure whose kidneys failed to accumulate iodine-131 (<sup>131</sup>I) hippurate, yet the kidneys recovered some function after relief of obstruction (13). In contrast to these results, little renal function can be regained in rats with unilateral ureteral



**FIGURE 3**  
Second 24-hr posterior [<sup>99m</sup>Tc]DMSA scan clearly demonstrates bilateral renal activity

obstruction once the uptake of [ $^{99m}\text{Tc}$ ]DMSA falls below 4% (10).

If renal failure is caused by acute tubular necrosis (ATN) even less information is available. There were seven patients with ATN in Sherman and Blaufox's series: none accumulated [ $^{131}\text{I}$ ]hippurate and all died (13). In a recent study (11) ten of 150 renal allografts showed no uptake of [ $^{131}\text{I}$ ]hippurate in the immediate postoperative period. Of these, seven grafts failed to accumulate [ $^{99m}\text{Tc}$ ]DTPA and proved to have renal infarction. The three patients with ATN did accumulate DTPA and subsequently recovered. In our patient with ATN normal renal function was restored, despite failure, at one point, to visualize the kidneys with DMSA.

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