

Differentiation of Reversible Ischemia from End-Stage Renal Failure in Nephrotic Children with ¹³¹I-Hippurate Dynamic Scintigraphy

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In renal failure associated with the nephrotic syndrome, therapeutic strategy is highly dependent upon the cause of the renal failure. Dynamic hippurate scintigraphy was studied in five pediatric patients. Four had nephrotic syndrome, and of these, three had acute renal failure. The fifth patient had end-stage renal failure. Specific alteration in renal hippurate kinetics offers a noninvasive assessment of renal failure in this clinical setting.

J Nucl Med 18: 438-440, 1977

Nephrotic syndrome (NS) in childhood usually carries a favorable prognosis for preservation of renal function and for potential remission (1). This is because the most common cause of NS in childhood is so-called minimal-change glomerular disease (2,3).

Despite this optimistic outlook, NS is attended by significant morbidity. A well-documented but unusual complication of NS is acute renal failure, frequently occurring in the wake of exacerbation of NS often associated with a febrile illness after initial glucocorticoid-induced remission (4,5).

The clinician is then confronted with an ill, azotemic child whose hydration is difficult to assess in the presence of edema. The clinical strategy is to stabilize the patient and to administer any specifically indicated therapy. In order of decreasing probability, acute renal failure in NS can be due to: (A) reversible ischemic renal failure (RIRF) due to dehydration from fever, vomiting, and diarrhea associated with the febrile illness, and the extravascular fluid shift due to hypoalbuminemia, (B) chronic glomerulonephritis, and (C) other rarer entities (6-8). To differentiate between the possible causes a renal biopsy is taken, and if glomerulonephritis is discovered, end-stage renal failure is diagnosed and hemodialysis instituted. If RIRF is diagnosed, the patient is managed conservatively, and if necessary, dialysis is performed intraperitoneally. It is

clear that a sensitive and specific noninvasive diagnostic test capable of differentiating end-stage renal failure from RIRF would circumvent renal biopsy and permit appropriate therapeutic choices. The following patient series and supporting data from the literature suggest that ¹³¹I-hippurate scintigraphy provides such a test.

MATERIALS AND METHODS

Hippurate scintigraphy. Within two days of admission the patients were injected with 3 μ Ci/kg of ¹³¹I-hippurate in the supine position with scintillation camera viewing the flank region from below. The medium-energy collimator had 1000 parallel holes. A series of 4-min images were then taken during the next 32 min.

Patients. Patient 1 was an 8-year-old girl who first developed NS at age 5, and had four relapses over the next three years. She was admitted with a 3-day history of staphylococcal cellulitis with fever, anorexia, and vomiting. Proteinuria, oliguria, and increasing azotemia were present (peak values: cre-

Received Oct. 13, 1976; revision accepted Dec. 8, 1976.

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atinine 12.8 mg/dl and BUN 181 mg/dl). She was dialyzed peritoneally and treated with prednisone and antibiotics. Seventeen days after admission normal renal function had been recovered.

Patient 2 was a 12-year-old boy who first developed NS at age 3, and had three subsequent relapses. He was admitted with a 7-day history of pharyngitis, otitis media, fever, and vomiting. Proteinuria and

azotemia (peak values: creatinine 4.8 mg/dl and BUN 96 mg/dl) were observed. The patient was treated with prednisone and antibiotics. Seventeen days after admission normal renal function had been recovered.

Patient 3 was an 8-year-old boy who first manifested NS at age 2, and had not subsequently relapsed. He was admitted with a five-day history of

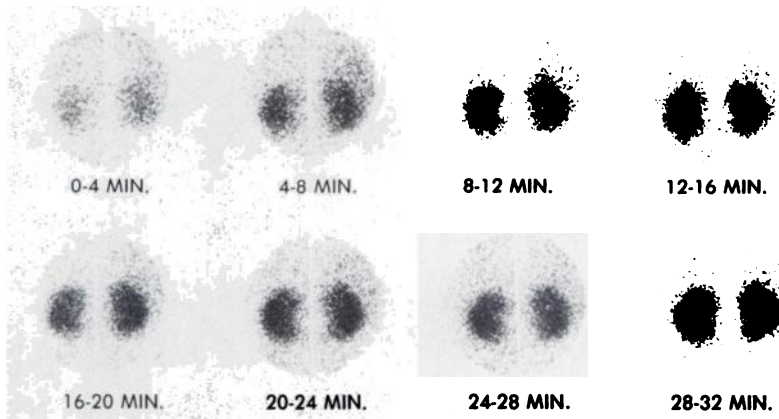


FIG. 1. Patient 1. Prompt hippurate uptake with markedly delayed cortical clearing.

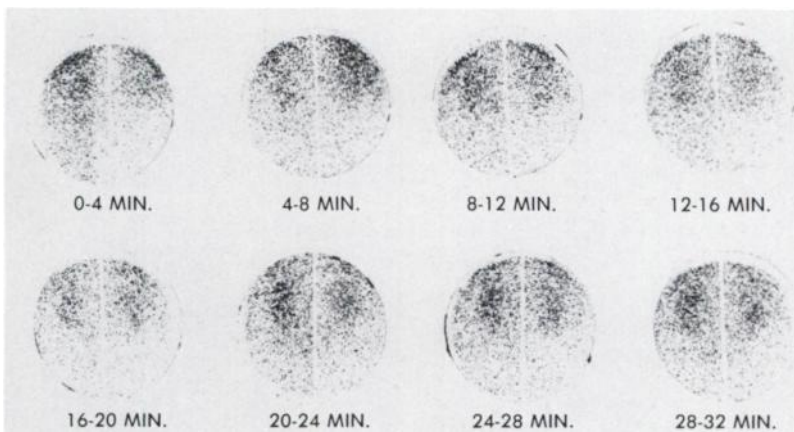


FIG. 2. Patient 4. Marked impairment of rate of hippurate uptake, with poor hippurate concentration.

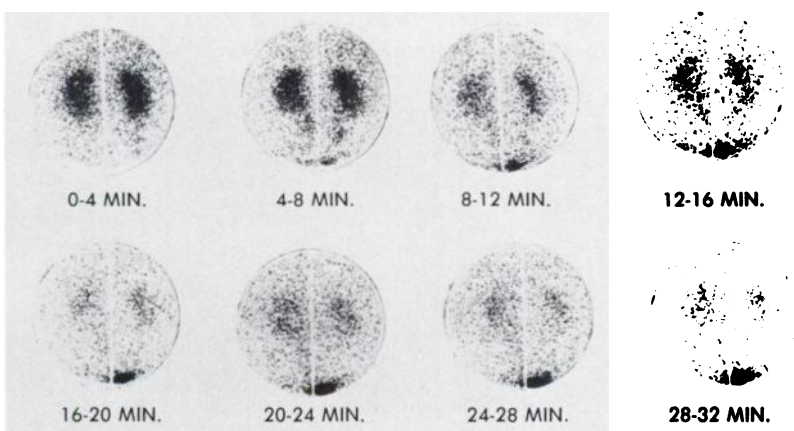


FIG. 3. Patient 5. Prompt hippurate uptake and washout.

pharyngitis, anorexia, fever, and diarrhea. Progressive oliguria had been noted, and the patient had been anuric for the two days before admission. Hypoalbuminemia and azotemia (BUN 120 mg/dl) were found. Prednisone, antibiotics, and supportive measures were instituted, and normal renal function was recovered by day eight.

Patient 4 was a 12-year-old girl who was admitted with congestive heart failure and a 2-month history of weakness. Anemia and azotemia (creatinine-12 mg/dl) were found. Supportive measures were begun, but renal function did not recover and hemodialysis was instituted after a renal biopsy showed end-stage kidney.

Patient 5 was a 6-year-old boy who was admitted with a seven-day history of fever, pharyngitis and progressive edema. Proteinuria and hypoalbuminemia were found, but renal function was normal (creatinine-0.5 mg/dl). A subsequent renal biopsy showed minimal-change glomerulopathy, and prednisone therapy induced a remission of the NS.

RESULTS

Dynamic hippurate renal scans are illustrated in Figs. 1-3. Patient 1, with renal failure and recurrent nephrosis, shows prompt and abundant hippurate uptake with markedly prolonged renal transit time (Fig. 1). Patients 2 and 3 demonstrated similar scan findings. Patient 4 (Fig. 2), who subsequently was found to have end-stage renal failure (with a serum creatinine identical to that of patient one) exhibits poor and delayed hippurate accumulation with prolonged transit time. Patient 5 (Fig. 3), with nephrosis and normal renal function, shows prompt and abundant hippurate uptake with rapid parenchymal clearance and normal transit time.

DISCUSSION

Although acutely nephrotic patients usually present with normal renal function, as did Patient 5, renal failure is a well-documented complication of NS. This most commonly results from reversible ischemic renal failure, the ensuing fluid deficit, and extravascular shift in a clinical situation where NS

follows a febrile illness (4,5). However, renal failure in NS may be due to underlying glomerulonephritis in a significant number of such patients, and to rare causes in others (6-8). For the patients with RIRF, the therapeutic strategy is considerably different from that of others. Dynamic hippurate scintigraphy appears to identify these patients. RIRF is characterized by prompt and abundant renal hippurate concentration with markedly prolonged renal transit time, in end-stage renal failure (9,10).

ACKNOWLEDGMENTS

This study was presented at the 21st Annual Meeting of the Society of Nuclear Medicine, held at San Diego, California, June, 1974. R. S. Hattner is a Picker Scholar of the James Picker Foundation.

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