TRANSIENT BRAIN SCAN ABNORMALITIES IN RENAL DIALYSIS PATIENTS

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Two patients on chronic renal hemodialysis developed acute neurologic symptoms and unusual brain scan findings, including very prominent cranial sinuses. Symptoms and scan abnormalities reverted to normal within a few days. The possible mechanisms are discussed.

This report presents observations on two patients on chronic renal dialysis who developed neurologic symptoms and unusual brain scan abnormalities which disappeared again very rapidly, in 3 and 4 days, respectively.

CASE REPORTS

Case 1. An 18-year-old white girl had pancreatitis and developed acute tubular necrosis in December 1973. She subsequently was maintained on hemodialysis about twice weekly. On February 14, 1974, 1 week after her most recent hemodialysis, she had a grand mal seizure. Subsequently she was lethargic but neurologic examination was otherwise normal. Blood urea nitrogen (62 mg/100 ml) was essentially unchanged. Skull x-rays, lumbar puncture, and all other laboratory examinations were normal. An electroencephalogram on February 15, 1974, showed diffuse intermittent abnormalities, none focal. On the same day radionuclide studies were done with 15 mCi of ^{99m}Tc-DTPA, using an Anger scintillation camera. A perfusion distribution study was done in anterior projection, with subsequent early and delayed (3 hr) static studies, but the posterior view on the delayed study was omitted. The perfusion distribution study was normal; static imaging (Fig. 1A) showed greatly increased concentration in the region of the transverse sinus and the posterior part of the superior sagittal sinus, making these structures appear very prominent and dilated. In addition, there was bilateral focal concentration in the frontoparietal regions. Three days later, a repeat camera study was done, delayed 3 hr and with all four views. It showed marked improvement (Fig. 1B).

Dilantin treatment, 100 mg four times a day, was started on February 14. The patient received no other medication and no hemodialysis between the two studies. She had three generalized convulsions on February 15, several the next day, and none thereafter. Lumbar puncture on February 18 was again normal. Gallium-67-citrate brain scans, made 3 and 6 days after injection on February 18, were normal. The patient has had no further neurologic symptoms.

Case 2. A 35-year-old black man was admitted on June 1, 1973, with a 2-week history of frontal headaches, nausea, and vomiting. Renal failure had been well-controlled on hemodialysis about twice weekly since 1966, most recently 2 days prior to admission. The patient had no history of convulsions. On admission physical examination—and, specifically, neurologic examination—were normal. X-ray examination of chest, skull, and sinuses was normal, as were electroencephalogram, spinal fluid examination, and routine laboratory procedures. Blood urea nitrogen was unchanged at 60 mg/100 ml. Radionuclide brain studies were done on admission, including perfusion distribution and early and delayed (4 hr) brain scanning with four views. Twenty millicuries of ^{99m}Tc-pertechnetate were used with an Ohio-Nuclear dual-head scanner. Figure 2A shows the abnormally increased concentration in the anterior and posterior portions of the superior sagittal sinus, with an interruption in the middle and an extension to the right. There was also focal accumulation in both temporal areas. On delayed (4 hr) brain scan, 4 days after admission (Fig. 2B), abnormalities had markedly cleared. The patient improved with symptomatic treatment and received no dialysis between the two studies. He has had no further symptoms.

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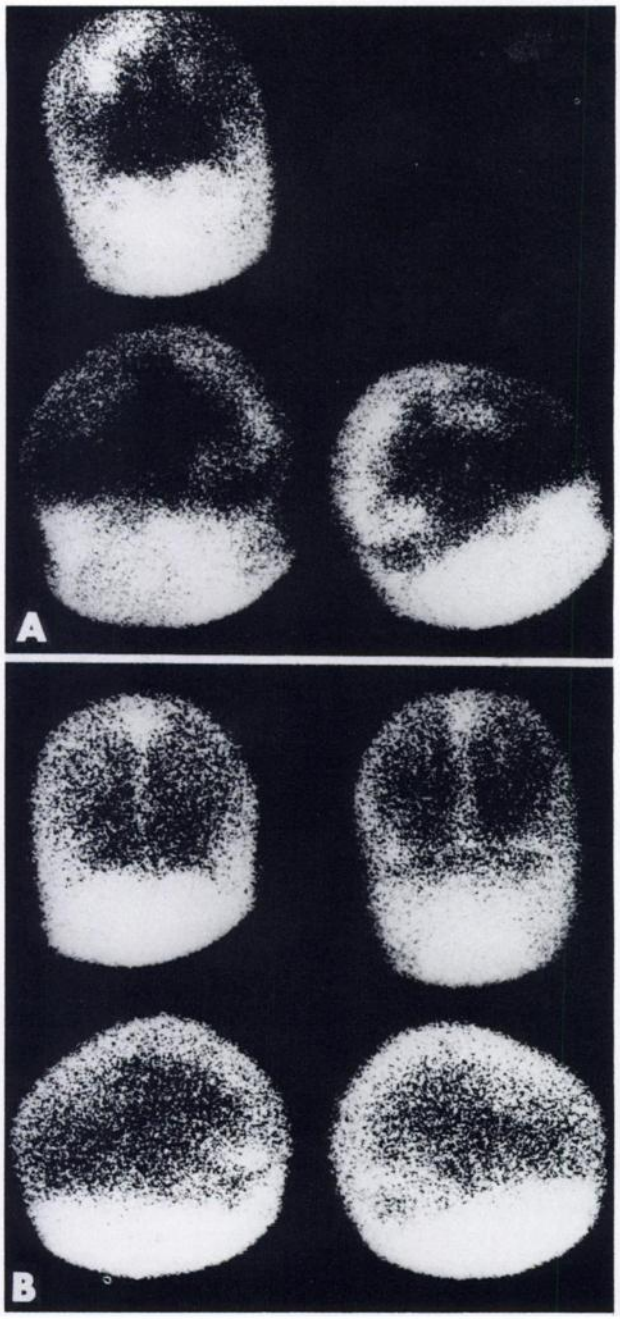
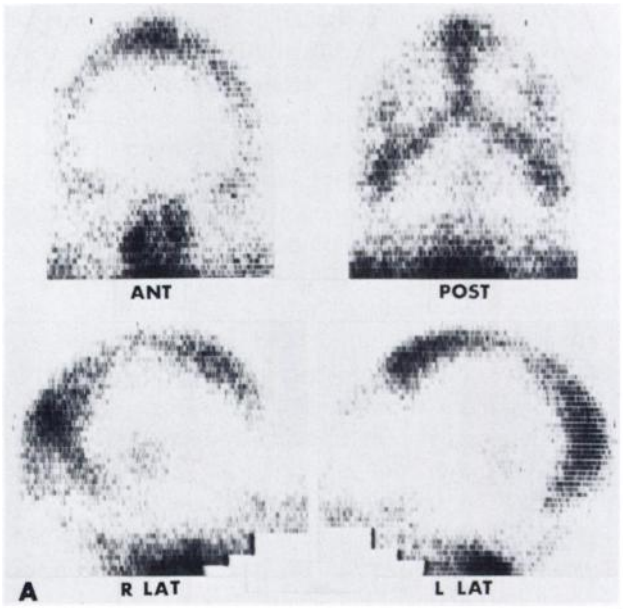


FIG. 1. Case 1: (A) ^{99m}Tc-DTPA delayed brain scan (February 15, 1974) showing increased uptake at frontoparietal regions bilaterally and posteriorly along superior sagittal and transverse sinuses. (B) ^{99m}Tc-DTPA delayed brain scan (February 18, 1974) showing regression of abnormalities.

DISCUSSION

Neurologic complications and symptoms are common during renal hemodialysis (*1*) and may be produced by the dialysis treatment itself as well as by the underlying renal disease and uremia. Some of these complications are focal and detectable by brain scan: infarcts due to emboli or hypertension, subdural hematomas, abscesses, or cerebral edema due to uremia (*2*). All of these more "conventional" causes of brain scan abnormalities, however, are excluded from diagnostic consideration in our cases by the clinical picture, the scan pattern, and chiefly by the rapid reversibility. On the other hand, the similarity of these two cases is striking and suggests a common mechanism.

Reversible radionuclide brain study abnormalities associated with seizures have recently been thought to represent regional hyperemia (3–5), and we have observed abnormally prominent sinuses. Nevertheless, one of the cases herein reported has never had a convulsion.



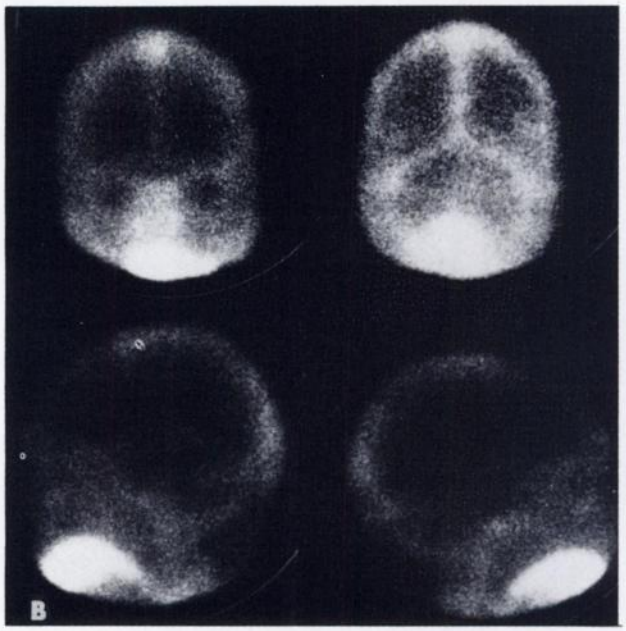


FIG. 2. Case 2: (A) Pertechnetate delayed brain scan (June 1, 1973) showing increased concentration in area of superior sagittal sinus and bilateral temporal areas. (B) Pertechnetate brain scan (June 5, 1973) showing regression of abnormalities.

Renal hemodialysis patients have frequent thromboembolic complications. Three recently reported cases (*6,7*) illustrate the brain scan findings of cranial venous sinus thrombosis. One of the main features is absence of visualization of the involved sinus, quite unlike the finding of a prominent sinus in our cases. Therefore, and because of the rapid reversibility of the abnormalities, thrombosis can be excluded.

The prominence and "dilated" appearance of the cranial sinuses in Figs. 1A and 2A could be attributed to an unusually slow blood clearance of the radionuclide, giving, in fact, a kind of "blood pool scan" even several hours after injection. The same observation of prominent cranial sinuses has been made on pertechnetate scans in patients recently given technetium-labeled radiopharmaceuticals prepared with stannous chloride. The minute amount of tin still present in circulation at the time of the pertechnetate scan is thought to result in the binding of pertechnetate to red blood cells, thereby prolonging intravascular retention (*8*). This hypothesis is supported by the fact that tin does, indeed, alter pertechnetate distribution and kinetics in the rat, even in very small concentrations (*9*).

Tin, a trace metal normally present only in minute amounts, is found in greatly increased concentration in brain and other tissues of renal dialysis patients with and without neurologic complications (*10*). The degree of accumulation seems to correspond to the duration of treatment. Nothing is known about tin blood levels.

Conceivably, increased tin concentration in dialysis patients may be connected with abnormal scan findings, part of which may be explained by increased binding of pertechnetate to red blood cells mediated by tin. All of the steps in this hypothesis require proof, and the rapid reversibility of the scan findings would still be unexplained. Furthermore, one of our two patients was studied with ^{99m}Tc-DTPA, which already contains stannous chloride and is therefore, presumably, unaffected by any additional tin in the body.

Also speculative is the possibility that an increased binding effect between pertechnetate and its derivatives and the red blood cells could be caused by renal failure or the dialysis treatment. This could occur through chemical alteration of metabolites or pharmaceuticals or through mechanical damage to the red blood cells themselves.

In short, the origin of transient brain scan abnormalities in these two patients is unknown, as is that of most neurologic complications in renal hemodialysis.

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