BRAIN IMAGING WITH ^{99m}Tc-DTPA: A CLINICAL COMPARISON OF EARLY AND DELAYED STUDIES

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One hundred and twenty-six patients had a total of 129 studies performed 30–60 min and repeated 3–5 hr following intravenous injection of ^{99m}Tc-DTPA. Fifty-one abnormal studies showed 55 lesions. Twenty-seven percent of lesions could not be identified in early imaging but were clearly seen in delayed studies. An additional 35% of lesions had significantly improved visualization with delayed imaging.

Technetium-99m-diethylenetriamine penta-acetic acid (DTPA) has been suggested as a better brain-scanning agent than ^{99m}Tc as the pertechnetate because (A) its renal clearance from the blood stream is more rapid, presumably resulting in better lesion-to-background ratio at earlier times after injection and (B) there is no interference from choroid plexus and salivary gland concentration (*1*). Clinically, marked reduction in the time delay between injection and imaging to 1 hr or less has been advocated because such early studies with DTPA were felt to be at least as reliable as pertechnetate images 2 or more hr after injection (*2*).

MATERIALS AND METHODS

Between January 15 and March 15, 1974, all patients referred for brain scanning at Cedars of Lebanon Hospital Department of Nuclear Medicine were studied using ^{99m}Tc-DTPA; 95 studies were performed on 92 patients. Similarly studied were 34 unselected cases at Rancho Los Amigos Hospital between February 19 and April 1, 1974. The tracer was prepared using kits manufactured by CIS Radiopharmaceuticals and Diagnostic Isotopes, Inc. Fifteen to 20 mCi or appropriately smaller doses for children, were given each patient as a bolus intravenous injection for evaluation of perfusion in either anterior or posterior views, followed by static imag-

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TABLE 1. RESULTS OF 51 ABNORMAL STUDIES

Lesion	E Normal D Abnormal	D > E	D = E	E > D	Total
Primary neoplasm	1	2	2	—	5
Metastatic neoplasm	—	1	1	—	2
Cerebral infarction	12	10	8	—	30
Skull and scalp lesions	—	1	4	2	7
Subdural hematoma	—	2	1	—	3
Encephalitis	1	1	—	—	2
AVM	—	—	—	1	1
Etiology undetermined	1	2	2	—	5
Total	15	19	18	3	55
%	27	35	33	5	100

Code: E = early; D = delayed.

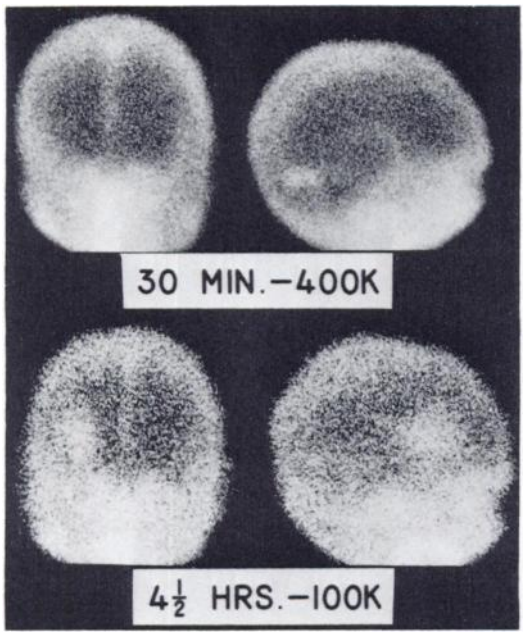

FIG. 1. MC, 60-year-old white man. Sudden onset of left hemiparesis immediately following accident with no head injury 2 days prior to scan. Clinical course: resolving stroke. Date: Feb. 26, 1974. Normal perfusion study. Normal gallium brain scan. (Top row) early DTPA views; (bottom row) delayed DTPA views.

ing 30–60 min and repeated 3–5 hr following injection, using a Searle Radiographics Pho/Gamma HP camera with HR collimator. The procedure was the same in both departments.

RESULTS

Of the total 129 studies on 126 patients, 78 were normal and 51 abnormal showing 55 lesions. This report analyzes findings in the 51 abnormal studies. Confirmation was obtained in all but five cases either by surgery, autopsy, angiography, or characteristic clinical course following infarction. Fifteen abnormalities could be identified only in delayed imaging, early imaging being entirely normal (Table 1 and Figs. 1 and 2).

An additional 19 abnormal areas were detected in at least one view of the early study but were identified with far better clarity in at least two views of the delayed study (Fig. 3). Three abnormalities [arterial venous malformation (AVM) confirmed by angiography, burr hole, and focal skull osteosclerosis] were minimally present in the delayed study, better seen in the early study, but best visualized in the perfusion study and immediate postflow static image.

DISCUSSION

Experimental studies performed on mouse brain tumor showed significantly higher tumor content at 30 min and significantly higher tumor-to-brain ratio beginning at 1 hr following injection of ^{99m}Tc-DTPA in comparison with other tracers, including ^{99m}Tc-pertechnetate (*3*). In studying 14 patients, however, Brookeman and Williams reported no significant difference in lesion-to-brain or lesion-to-blood ratios using ^{99m}Tc-DTPA in comparison with ^{99m}Tc-pertechnetate nor did they find any significant increase in lesion-to-brain and lesion-to-blood ratio with either tracer after 1 hr. They did find increase in tumor-background ratio between 30 min and 1 hr for both tracers but no similar increase for infarct-background ratio with either agent. They therefore concluded that 1 hr following injection was the optimal scanning time and that "there is no advantage in waiting until three hours after injection before scanning" (*4*).

Our data demonstrated that no single time for scanning is optimum for all lesions but that if imaging were to be done only ½–1 hr following injection of DTPA, a highly significant number of lesions would be completely missed (27% in this series). The majority of lesions (62% in this series) were either more clearly delineated or seen only with imaging at the 3–5 hr interval. Although most of the lesions missed by early imaging were infarcts, three other cases were in this category: encephalitis (Fig.

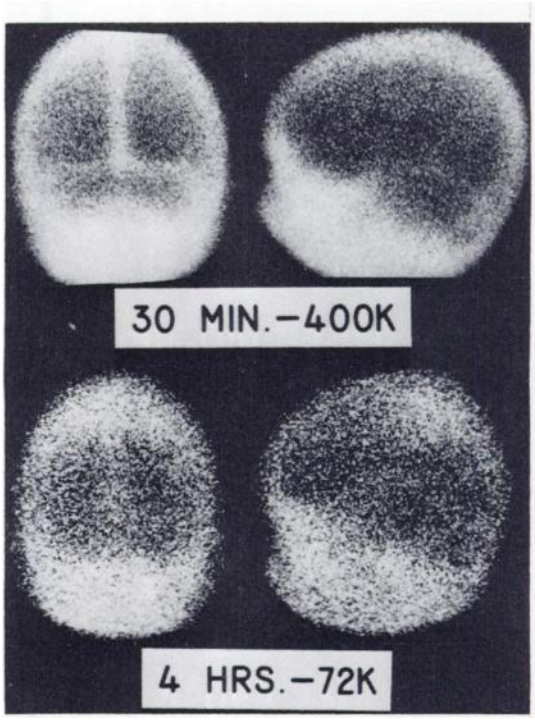

FIG. 2. EK, 12-year-old white boy with known agamma-globulinemia, headaches, fever, left hemiparesis, and impaired coordination. Date: March 11, 1974. Normal perfusion study. Bilateral scan abnormality. Angiogram March 13, 1974: surface vessels displaced from inner table of skull along high convexities, unchanged in past year. Biopsy: chronic encephalitis. (Top row) early DTPA views; (bottom row) delayed DTPA views.

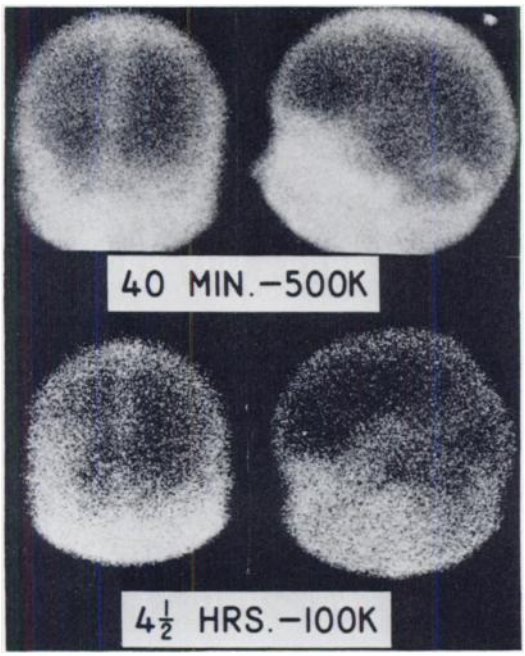

FIG. 3. RK, 76-year-old white woman. Initial episode of slurred speech and diplopia 4 days and complete aphasia 2 days before scan. Date: Feb. 26, 1974. Abnormal perfusion study. Clinical course: resolving stroke. (Top row) early DTPA views; (bottom row) delayed DTPA views.

2), primary neoplasm, and one probable primary neoplasm. A single significant intracranial lesion, an AVM, was best visualized very early, minimally apparent in delayed imaging.

These conclusions apply only to the commercial DTPA preparations employed, as differences in the biologic behavior of various types of Tc-DTPA have been well documented in the literature (*5*). However, with the preparations used in this study, we feel that judicious choice of the time interval between injection and imaging is just as important as it is with pertechnetate and other radiopharmaceuticals (*6,7*).

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