
Opportunistic Intracranial Infection in AIDS Detection by Technetium-99m DTPA Brain Scintigraphy

Wei-Jen Shih, Peggy A. Domstad, and Frank H. DeLand

Nuclear Medicine Service, Veterans Administration Medical Center; and University of Kentucky Medical Center, Lexington, Kentucky

Radionuclide brain scintigraphy and computed tomography (CT) demonstrated cerebral lesions in two patients with acquired immunodeficiency disease syndrome (AIDS) complicated by opportunistic infection of the brain. In the detection of these cerebral lesions, [^{99m}Tc]DTPA radionuclide scintigraphy was as reliable as CT. Since malignant lymphoma involving the brain has been seen with increasing frequency in patients with AIDS, the positive brain scan alone is nonspecific and should be correlated appropriately with the clinical setting.

J Nucl Med 27:498-501, 1986

Acquired immunodeficiency disease syndrome (AIDS) is manifested primarily by profound disturbances of T-cell mediated immunity and unusual susceptibility to both neoplasms and opportunistic infections (1). To date, there has been no evidence of sustained immunologic recovery once AIDS is established. Although 43% of the early reported AIDS patients are known to have died (2), the ultimate mortality may approach 100% (3,4).

A common clinical presentation of full-blown AIDS is opportunistic infection of the lungs, the gastrointestinal tract, and the central nervous system (CNS). Pathogens involving the CNS in AIDS include: *cytomegalovirus* (5), *Candida albicans* (6), *Aspergillus fumigatus* (7), *Toxoplasma gondii* (8), *Cryptococcus neoformans* (8), *papovavirus* (9), and *Mycobacterium tuberculosis* (10). Recently, 14/100 AIDS patients were found to have focal CNS lesions by computed tomographic (CT) studies (11). We present two AIDS cases complicated by opportunistic infection of the CNS demonstrated by radionuclide brain scintigraphy as well as by CT head studies.

CASE REPORTS

Case 1

Two weeks after discharge from his first admission, a 23-yr-old man was re-admitted because of generalized seizures and a peripharyngeal mass. Five months earlier, he had a sore

throat and lymphadenopathy in association with granulocytopenia that was treated as tonsillitis with little improvement. A mononucleosis spot test was positive. Two months later he was admitted to the hospital because of continued lymphadenopathy and weight loss. During that admission, he had a toxoplasma antibody titer of 1:4,096 and a reversed T₄/T₈ ratio. A bone marrow biopsy was negative. The only significant medical history was that he admitted to infrequent homosexual contact.

Physical examination on the second admission revealed a well-developed, but cachectic young man in mild to moderate distress. The deep tendon reflexes were slightly hyperactive in the lower extremities. On the tenth day of the second admission, he developed hemispheric spasticity. Radionuclide brain scintigraphy using technetium-99m diethylenetriaminepentaacetic acid ([^{99m}Tc]DTPA) (Fig. 1) revealed four lesions in the left hemisphere and a prominent parieto-occipital lesion on the right, also seen in the CT scan (Fig. 2). Subsequent brain scintigrams (Fig. 3) showed progression of the disease, also seen in the follow-up CTs of the head (Fig. 4). Spiking fevers and seizures continued and his condition progressively deteriorated. He died on the 52nd day.

At autopsy, the surface of the brain was covered by purulent exudate and there was multifocal cerebritis throughout the brain substance. The largest semiconfluent lesion, 3.5 cm in size, was in the posterior aspect of the left parietal area. There was focal hemorrhage in the parietal white matter. Microscopically, the leptomeninges were expanded by an infiltration of mononuclear cells, histocytes, and lymphocytes with a small component of polymorphonuclear cells. Perivascular infiltrates were noted with suppurative necrosis of small vessels.

Case 2

A 60-yr-old man was admitted through the emergency room because of diarrhea and weight loss. He had watery

Received May 28, 1985; revision accepted Nov. 26, 1985.

For reprints contact: Wei-Jen Shih, MD, Nuclear Medicine Service, University of Kentucky Medical Center, Lexington, KY 40536.

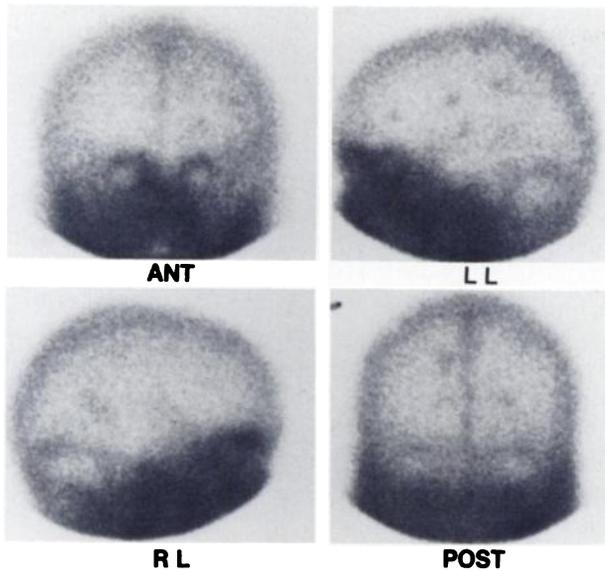


FIGURE 1
 $[^{99m}\text{Tc}]$ DTPA brain scintigram, Case 1: Note multiple well-defined areas of increased radioactivity seen in both hemispheres

diarrhea consisting of 7–10 stools per day for 7 mo and had lost 36 lb. He admitted oral-genital homosexual contact about twice a year for many years. Physical examination on admission revealed a thin male with whitish plaques on the mucosa of the posterior pharynx. Hemogram revealed Hct 35.4%, WBC 7,100 with 56% segmental, 14% bands, 20% lymphocytes, 2% eosinophils, 1% basophils. Stool cultures yielded

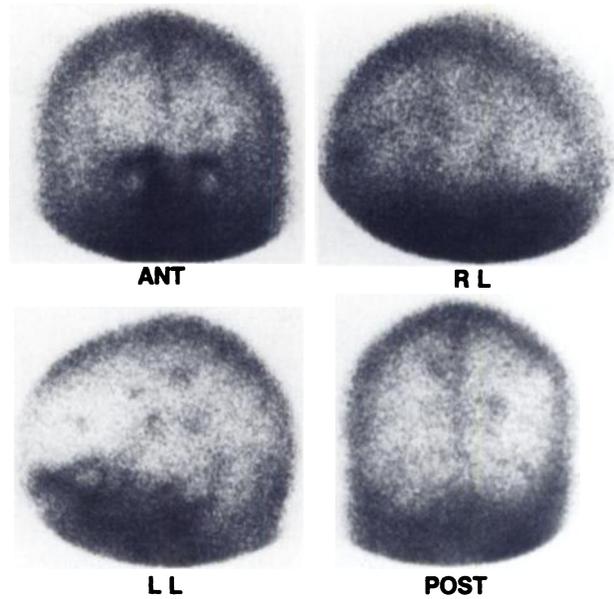


FIGURE 3
 Follow-up brain scintigram of Case 1 (left side) done 10 days after that shown in Fig. 1. There is enlargement of lesions in cerebral hemispheres

Shigella sp. and culture of the oral lesions yielded *Candida albicans*. The oral *Candidiasis* and diarrhea were treated successfully with nystatin, and trimethoprim and sulfamethoxazol, respectively.

On the 20th hospital day, *Cryptococcus neoformans* (by India ink smear) was found in CSF obtained by lumbar puncture, with a cryptococcal antigen titer of 1:512. Blood

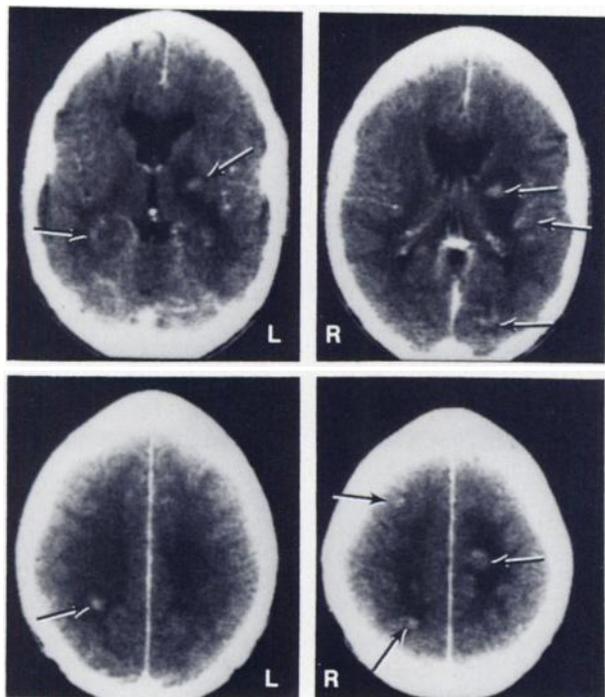


FIGURE 2
 Concurrent computed tomograph of brain in Case 1 demonstrated multiple lesions in both hemispheres (arrows)

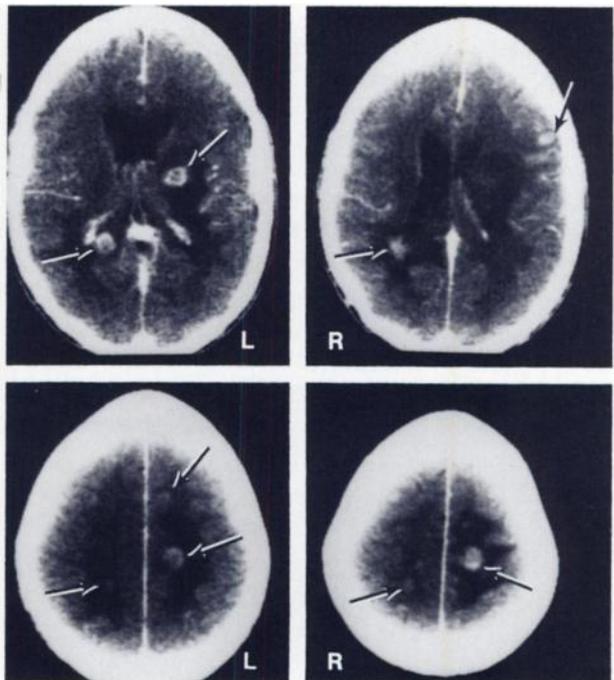


FIGURE 4
 Follow-up CT done 4 days after repeat brain scintigram (Fig. 3), cerebral lesions are more apparent (arrows)

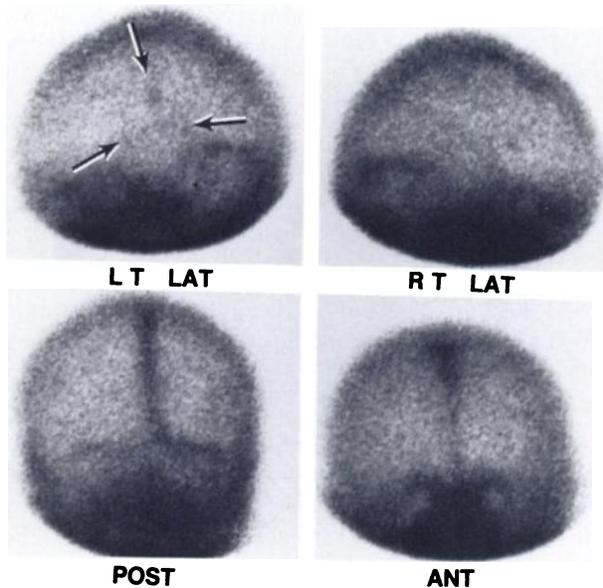


FIGURE 5
Brain scintigram of Case 2. Note ill-defined lesion in each cerebral hemisphere with diffusely increased uptake in right hemisphere seen on right lateral view. There are prominent irregular areas of abnormal radioactivity in left midparietal region (arrows)

culture later yielded *Cryptococcus neoformans*, and the patient was treated with amphotericin and flucytosin for 6 wk.

He developed intermittent fever of 102°F and an enlarged lymph node was found in the right axilla. The total lymphocyte count was 350 (normal, 80–3,200), total T-cells were 135 (normal, 687–2,318), Helper inducing T-cells 19 (normal, 328–1,466) OKT4/OKT8 ratio 0.226 (normal, 0.84–3.40), suppressor cytotoxic T-cells 85 (normal, 231–868). Because of altered mental status, a CT of the head and a brain scintigram using [^{99m}Tc]DTPA were done on the same day. Brain scintigraphy using [^{99m}Tc]DTPA showed lesions involving both the right and left parietal regions (Fig. 5) and CT demonstrated an area of hypodensity in the left parietal region (Fig. 6). These abnormal findings were unchanged in repeat CT and scintigraphy 4 days later. Lung infiltrates, bilateral pleural effusions, and left lower lobe atelectasis were also observed. In the late hospital course, cellulitis due to *Aeromonas hydrophilia* developed in the left ankle and was treated with cefox-

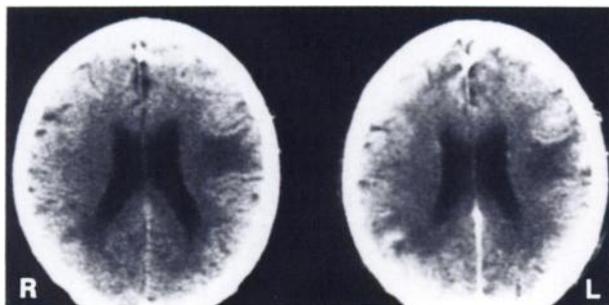


FIGURE 6
Concurrent CT showing low density lesion in left midparietal region

itin. He had a massive lower gastrointestinal hemorrhage and required blood transfusion with four units. Progression of the pulmonary infection and sepsis developed and he expired.

DISCUSSION

These two patients had well-established AIDS clinically, complicated by multiple opportunistic infections including cerebral lesions. One patient had proven *Cryptococcus neoformans meningitis* and the other patient at autopsy had purulent meningeal exudates and multiple focal lesions in the brain implying bacterial infection; perivascular infiltrates were consistent with a viral encephalitis and the marked increase in IgM antibody suggested toxoplasmosis.

Brain abscesses developed from extracranial hematogenous spread or contiguous from extracortical foci are frequently multiple; >90% of all cortical abscesses are demonstrated by conventional brain scintigraphy (12,13). Both early cerebritis and late abscess may produce a similar appearance as in our Case 1, which at autopsy had multifocal cerebritis and abscesses. Certainly, the multiplicity of the lesions of abscess or cerebritis could not be differentiated from multiple cerebral metastases.

The validity and reliability of radionuclide studies using gallium-67 (⁶⁷Ga) citrate in AIDS complicated by pneumocystis carinii pneumonia has been documented (14). In addition, a ⁶⁷Ga study has helped in the diagnostic workup of a case of AIDS with lymphadenopathy and disseminated mycobacterial infection (15).

Intracranial lesions in AIDS have been well demonstrated by CT (10). Pathogens that have been implicated include *Cryptococcus neoformans*, *Toxoplasma Gondii*, *Papovavirus*, *Candida albicans*, *Cytomegalovirus*, *Mycobacterium tuberculosis*, *Aspergillus fumigatus*, and *Mycobacterium avium-intracellulare*.

Tumors associated with AIDS include Kaposi's sarcoma, Burkitt's lymphoma, T-cell lymphoma, Hodgkin's disease, and non-Hodgkin's lymphoma (1,16–18). Although Kaposi's sarcoma has remained a rare disease in North America (19), lymphomatous involvement of the central nervous system was seen with increased frequency in patients with AIDS (19,20). The multiplicity of lesions in the radionuclide brain images make it difficult to distinguish between cerebral abscesses and multifocal tumors associated with AIDS involving the central nervous system. The finding of a positive brain scintigram alone is nonspecific and should be correlated appropriately with the clinical setting.

ACKNOWLEDGMENT

The authors thank Mrs. Angela Sandifer for typing this manuscript.

REFERENCES

1. Centers for Disease Control: Update on acquired immunodeficiency syndrome United States. *MMWR* 31:507-514, 1982
2. Centers for Disease Control: Update: AIDS-United States, *MMWR* 32:686-680, 1984
3. Hansen RS, Ahloy RD, Meyer RD: The acquired immunodeficiency syndrome in emergency medicine. *Clin North Am* 3:3-23, 1985
4. Reichert CM, O'Leary TJ, Levens DL, et al: Autopsy pathology in the acquired immune deficiency syndrome. *Am J Pathol* 112:357-382, 1983
5. Levy RM, et al: CNS mass lesion in acquired IDS. *J Neurosurg* 61:6-9
6. Snider WD, Simpson DM, Nielsen S, et al: Neurological complications of acquired immune deficiency syndrome: Analysis of 50 patients. *Am Neurol* 14:403-418, 1983
7. Gapen P: Neurological complications now characterizing many AIDS victims. *JAMA* 248:2941-2942, 1982
8. Whelan MA, Kricheff II, Handler M, et al: Acquired immunodeficiency syndrome: Cerebral computed tomographic manifestations. *Radiology* 149:477-484, 1983
9. Bedri J, Weinstein W, De Gregorio P: Progressive multifocal leukoencephalopathy in acquired immunodeficiency syndrome. *N Engl J Med* 309:492-493, 1983
10. Pitchenik AE, Fischl MA, Walls KW: Evaluation of cerebral mass lesions in acquired immunodeficiency syndrome. *N Engl J Med* 308:1099, 1983
11. Elkin CM, Leon E, Grenell SL, et al: Intracranial lesions in the acquired immunodeficiency syndrome. Radiological (CT) features. *JAMA* 253:393-396, 1985
12. Jordan CE, James HE, Jr., Hodges FJ: Comparison of the cerebral angiogram and the brain radionuclide image in brain abscess. *Radiology* 104:327, 1972
13. Cowan RJ, Kelly DL Jr., Maynard CD: The neurologic patient. In *Continuing Education Lectures: Clinical Decision Making in Nuclear Medicine*, Patton DD, ed. Southeastern Chapter, The Society Nuclear Medicine, Atlanta, 1974, p 31
14. Barron TF, Birnbaum NS, Shane LB, Goldsmith SJ, Rosen MJ: Pneumocystis carinii pneumonia studied by Ga-67 scanning. *Radiology* 154:791-793, 1985
15. Malhatra CM, Erickson AD, Feinsilver SH, et al: Ga-67 studies in a patient with acquired immunodeficiency syndrome and disseminated mycobacterial infection. *Clin Nucl Med* 10:96-98, 1985
16. Centers for Disease Control: Diffuse undifferentiated non-Hodgkins lymphoma. *MMWR* 31:227-229, 1982
17. Levine AM, Meyer PR, Begandy MK, et al: Development of b-cell lymphoma in homosexual men. Clinical and immunologic findings. *Ann Intern Med* 100: 7-13, 1984
18. Fauci AS, Macher AM, Longo DL, et al: Acquired immunodeficiency syndrome: Epidemiologic, clinical, immunologic, and therapeutic considerations. *Ann Intern Med* 100:92-106, 1984
19. Case records of a Massachusetts General Hospital. Case 32. *N Eng J Med* 309:359-369, 1983
20. Snider WD, Simpson DM, Aronyk KE, et al: Primary lymphoma of the nervous system associated with acquired immunodeficiency syndrome (lett). *N Engl J Med* 308:45, 1983