

Hyperperfusion and Early Technetium-99m-HMPAO SPECT Appearance of Central Nervous System Toxoplasmosis

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Three correlative ^{99m}Tc -HMPAO brain SPECT studies were performed on an AIDS patient from the early stage of a CNS toxoplasma lesion to its resolution after specific therapy. A hyperactive area in the right parieto-occipital lobe appeared in the first SPECT study, matching the heterogeneous T2-weighted image with Gd-DTPA enhancement reported on MRI. Both studies were performed 3 days after the onset of neurological symptoms when no abnormalities were found on a CT scan. This fact can be explained by the hyperemia that occurs in the acute stage of inflammation. Three months later, along with clinical improvement under specific treatment, both MRI and brain SPECT were normal. No hypoperfusion was seen in SPECT images, probably because the necrotic phase of the toxoplasma lesion was not reached in this case.

Key Words: toxoplasmosis; SPECT; technetium-99m-HMPAO; cerebral perfusion

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Cerebral toxoplasmosis is a common opportunistic central nervous system (CNS) infection in AIDS patients (1,2). Neuropathological findings include inflammatory infiltrates with polymorphonuclear leukocytes, in addition to lymphocytes, plasma cells and histiocytes. In later stages, cysts are present adjacent to areas of necrosis. Initially, no abnormalities may be observed on a CT brain scan of symptomatic individuals, although MRI may show T2-weighted enhancement images in early stages. Both techniques may also show focal enhancing mass lesions several days later.

Recently, CNS toxoplasmosis has been described in perfusion SPECT studies as a focal area of impaired regional cerebral blood flow (rCBF) matching with the lesion and surrounding edema showed by CT or MRI (3-7). We describe the early appearance of a CNS toxoplasma lesion on

^{99m}Tc -HMPAO-SPECT as a hyperperfused area and discuss its evolution toward its resolution after therapy.

CASE REPORT

The patient was a 31-yr-old female who had been diagnosed with AIDS (CDC stage IVc) 1 yr before. When admitted to the emergency department she was moderately confused and disoriented regarding time and place, and reported prior seizure activity. Laboratory test findings included leukopenia (WBC = 3,120/mm³) and a negative test for cryptococcal antigens. A chest x-ray was normal and a cranial CT scan showed mild frontal atrophy (Fig. 1). However, she was hospitalized because of a strong suspicion of a focal CNS process. During her hospitalization, treatment with diphenylhydantoin was started due to a new epileptic episode and fever. Three days after her admission, a ^{99m}Tc -HMPAO SPECT study was performed using a rotating gamma camera equipped with a low-energy all-purpose parallel-hole collimator. Data acquisition started 15 min after an intravenous injection of 740 MBq of ^{99m}Tc -HMPAO in a silent and dimly lit room. Sixty 30-sec frames were collected during a 360° rotation in a 64 × 64 matrix with a zoom of 1.5, obtaining a 4.5-mm pixel size. Image data were processed on an Elscint SP1 computer (Apex SP-x Functions, software version 3.12). Reconstruction was performed by filtered backprojection using a Butterworth filter (cutoff frequency 0.35, power factor 5.8) without attenuation correction. Spatial resolution was 16 mm (FWHM) in the transaxial plane. Two-pixel thick slices were obtained in coronal, sagittal and oblique (parallel to the orbito-meatal line) planes. SPECT images were finally presented on a polychromatic scale (20 colors), and standardized by adjusting the upper discriminator

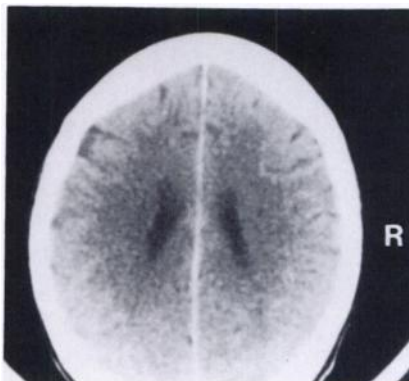


FIGURE 1. Cranial CT scan performed in the emergency department showing mild frontal atrophy.

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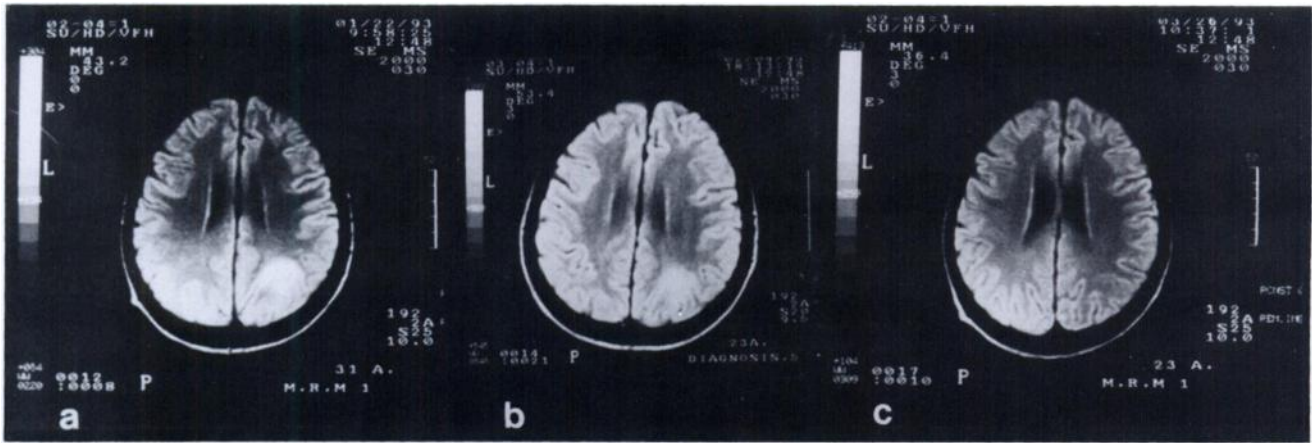


FIGURE 2. T2-weighted MRI images (with Gd-DTPA) show: (a) right parieto-occipital lobe lesion (3 days after the onset of symptoms), (b) a residual lesion (1 mo later) and (c) no abnormalities (3 mo later).

threshold so as to render maximum pixel values within oblique slices, within the most intense color range of the color table.

This ^{99m}Tc -HMPAO SPECT image showed a hyperperfused area in the right parieto-occipital lobe matching the heterogeneous T2-weighted images with Gd-DTPA enhancement, reported on the MRI performed the same day (Figs. 2a, 3a and 4 (top)). As the clinical suspicion was CNS toxoplasmosis, the patient was treated with the conventional therapy of pyrimethamine and sulfadiazine. The optimal response to therapy after 2 wk of treatment led to the diagnosis of toxoplasmosis.

One month later, MRI and brain SPECT were repeated. The MRI showed a residual lesion image (Fig. 2B). The hyperperfused area seen in the first SPECT study was less evident, although perfusion asymmetry between both parieto-occipital cortex still remained (Figs. 3b and 4 (middle)).

Both studies showed complete imaging normalization when repeated 3 mo later (Figs. 2c, 3c and 4 (bottom)).

DISCUSSION

With brain SPECT, CNS toxoplasmosis has been described as focal hyperperfused areas that may or may not

match CT and/or MRI abnormalities (3–8). In this case report, we observed a hyperactive appearance of a CNS toxoplasma lesion on ^{99m}Tc -HMPAO SPECT images in the early stages of the disease. This fact can be explained by the hyperemia that occurs in the acute phase of inflammation, as it has been shown in other CNS infections such as herpes simplex, in which there is an acute phase of encephalitis (9). On the other hand, a hypermetabolic pattern on [^{18}F]FDG PET has been described in other cerebral infections in patients with AIDS (10). Due to metabolic-perfusion coupling, this could be another hypothesis that explains the increase of ^{99m}Tc -HMPAO activity in the infected area. However, in an experiment with mouse tumors, Kubota et al. (11) demonstrated high ^{18}F -FDG accumulation in granulation tissue and phagocytes (i.e., macrophages and neutrophils) on microautoradiographs. It is not known if this fact has any relationship to the increase of ^{99m}Tc -HMPAO uptake.

Differential diagnosis of focal hyperactivity in ^{99m}Tc -

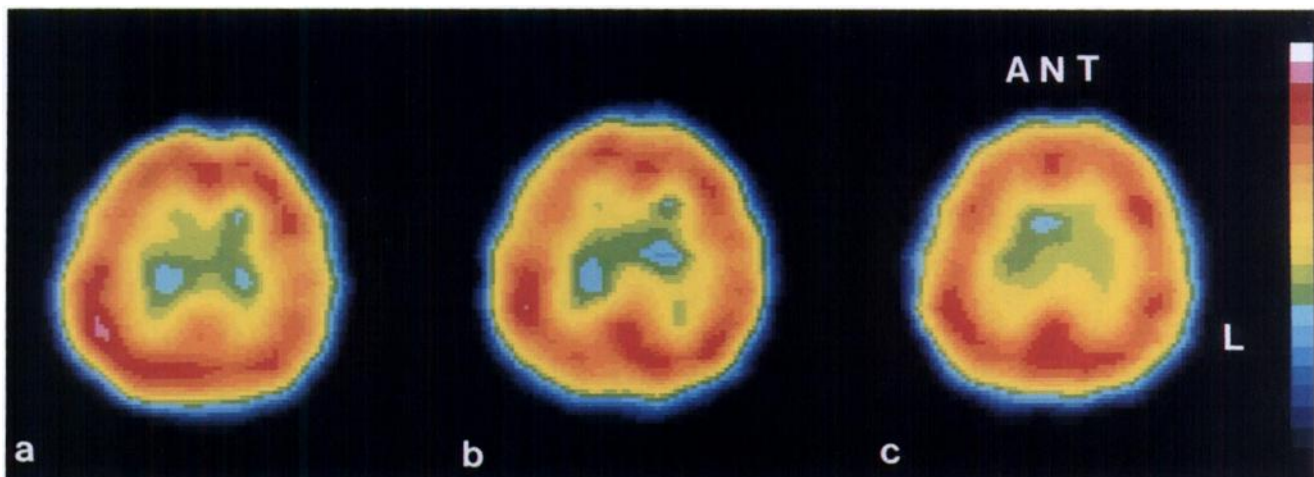


FIGURE 3. Technetium-99m-HMPAO SPECT images at the level of the MRI lesion show: (a) hyperperfusion in the right parieto-occipital area (3 days after the onset of symptoms), (b) remaining right parieto-occipital hyperactivity (1 mo later) and (c) a normal rCBF image (3 mo later).

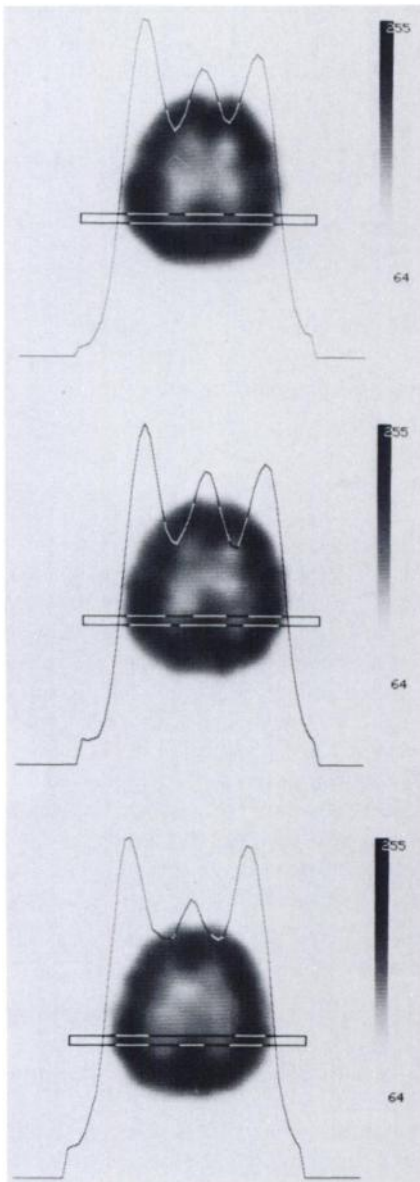


FIGURE 4. Horizontal ROI profiles through the area of abnormality in the three slices from Figure 3. Top and middle: right parieto-occipital hyperperfusion, corresponding to the first and second HMPAO-SPECT studies. Bottom: symmetric perfusion in both parieto-occipital regions, corresponding to the third study (see text).

HMPAO brain SPECT images also include ictal phase of epilepsy, luxury perfusion in cerebrovascular disease, response to specific activation of cerebral areas and some brain tumors. The resolution after specific anti-toxoplasma therapy to normal rCBF in the affected parieto-occipital area excludes these causes. In addition, the image proba-

bly did not reflect an epileptogenic focus because ^{99m}Tc -HMPAO was never injected during seizure activity.

The rCBF changes described here ranged from hyperperfusion to normalization, along with MRI findings and clinical improvement. The typical pattern described in the literature of focal hypoperfusion has not been found in this case, probably due to the success of therapy applied in early stages which would have prevented tissue from necrosis.

The early representation of CNS toxoplasmosis as an increased perfusion on ^{99m}Tc -HMPAO SPECT is an additional new finding in this field. This case also indicates the usefulness of ^{99m}Tc -HMPAO brain SPECT in the evaluation of response to therapy.

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