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Brain SPECT Images in a Patient with Brain Death

Teruhiko Takayama*, Kenichi Nakajima**, Junichi Nozaki***,
Keiko Kawabata****, Shigeru Sekimoto****, Kinichi Hisada**

KEY WORDS

Brain death, SPECT, Cerebral blood flow, Subarachnoid hemorrhage.

INTRODUCTION

The problems on brain death have been argued in various departments. One of the most important problems is whether brain death can be diagnosed exactly in the clinical state. The use of several clinical signs and examinations have been recommended to diagnose brain death by the Japanese standard guide for the judgment of brain death[1),2)]. However, the scintigraphic estimation of cerebral blood flow (CBF) has not been included in this guide. On the other hand, CBF can be easily evaluated by scintigraphy.

In this paper we describe a patient with brain death, whose scintigraphy demonstrated no perfusion in the brain.

CASE REPORT

A 60-year-old man was admitted to a community hospital by ambulance car. Twenty min. before arrival, he fell about 2m from a ladder and hit the left half of his body. After the loss of consciousness for 10 min., he gradually restored his consciousness. In spite of his complaint of pain, however, his reply to doctor's questions couldn't be obtained. The loss of his consciousness was graded as II-2 on the Japan coma scale, and 12 scores on the Glasgow coma scale with 3 of eye-opening, 4 of best verbal response and 5 of best motor response. Physical examination revealed lacerated wound on his left face, soft tissue swelling near his left ear and shoulder, and slight bleeding from his left ear. His right pupil was 4mm in diameter and his left eye was artificial. The motions of his left upper and lower extremities were so feeble that he was diagnosed to have fallen into incomplete hemiplegia. His blood pressure was within normal limits. Plain craniography showed linear skull fracture, extending from the left basilar bones to the right parietal bone via the left temporal and parietal bones. Prominent fractures of the left clavicle and fourth rib were shown. In addition, the compression fracture of the fourth cervical vertebra was suspected by cervical radiography. Computed tomography (CT) showed bilateral cerebral contusion and subarachnoid hemorrhage (SAH) ranging from the right sylvian fissure to cortical sulcus. Cerebral angiography showed aneurysm in the bifurcation of the right internal carotid artery and the posterior communicating artery. The circulating time of contrast media was so delayed

* Department of Radiological technology, School of Medicine, Kanazawa University.
** Department of Nuclear Medicine, Kanazawa University Hospital.
*** Deapartments of Neurosurgery, Kaga Central Hospital.
**** Radiological technology, Kaga Central Hospital.

that it couldn't be approved in the superior sagittal sinus within 1 min. after the injection. The pooling of contrast media made us suspect the obstruction of the superior sagittal sinus due to thrombus. During cerebral angiography, the level of consciousness decreased gradually. He began to make an effort to breathe so that oral intubation was performed. X-ray CT after angiography showed the left epidural hematoma. Neither quadrigeminal nor ambient cistern were visualized clearly. His coma attained to III-2 grade and mydriasis in his right pupil was also recognized. The operation was performed to exclude epidural hematoma and to reduce intracranial cerebrospinal fluid pressure within normal limits. Unfortunately, his coma degraded to be III-3. Ultimately, the use of respirator was started. After this, his heart continued to function for 17 days. The patient sometimes revealed the reaction against pain. However, his condition deteriorated day by day with the appearance of transient hypotension, oliguria, and cyanosis on the lower extremities. At the 18th day from the accident, his blood pressure dropped and cardiac arrest occurred following ventricular fibrillation. Thus, the cardiac death was certified.

Brain scintigraphy was performed to estimate CBF using Tc-99m HMPAO on the 16th day. Radionuclide (RN) angiography with 1 second/frame was imaged immediately after the intravenous injection of 740 MBq of this tracer. The acquisition of projection data for single photon emission computed tomography (SPECT) was started from 5min. after the injection. Data were accumulated for 90 angles with 30 second/angle using a rotating single head gamma camera system (GCA401-5, Toshiba Corp.). RN angiography showed no perfusion in the bilateral hemisphere, while it showed slight perfusion in the region of the external carotid artery (Fig. 1). Tomographic images showed no perfusion of CBF (Fig. 2). For the comparison, normal transverse tomographic image was represented in Fig. 3.

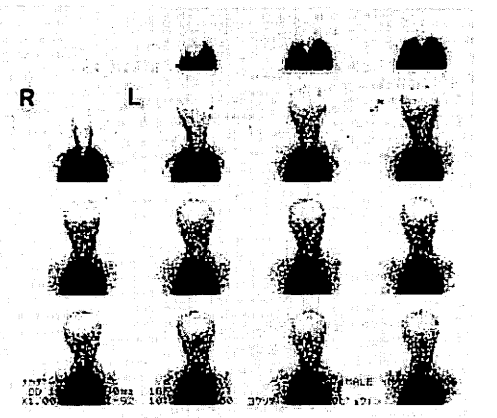

Fig. 1 Radionuclide angiography using Tc-99m HMPAO shows no perfusion in the brain.

DISCUSSION

One of the most important problems on brain death is whether we can diagnose brain death exactly in the clinical state. In 1985, the Japanese Ministry of Public Welfare indicated the standard guide for the judgment of brain death[1]. The following examinations and symptoms have been included in this guide; (1) deep coma, (2) disappearance of spontaneous respiration, (3) pupil, (4) disappearance of brain stem reflex, (5) isoelectric electroencephalography, and (6) time transit. However, brain scintigraphy has not been included in this guide. One of the reason seems to be that brain scintigraphy can't be examined at any limited institution. However, the institutions where scintillation camera is available are recently more increasing with increasing usefulness of scintigraphic examination. It is no more specific examination. In addition, the examination is performed easily and repeatedly because it requires only intravenous injection. The most valuable benefit of scintigraphic examination in diagnosing brain death is to evaluate CBF itself on tomographic images. Furthermore, quantitative analysis on CBF is possible using some methods. Consequently, brain death is judged more objectively. Clinical signs such as pupil and disappearance of brain stem reflex can't be recorded objectively. On the other hand, scintigraphy can be easily achieved and reviewed retrospectively if necessary. Therefore, scintigraphic examination seems to play a complementary role in diagnosing brain death by

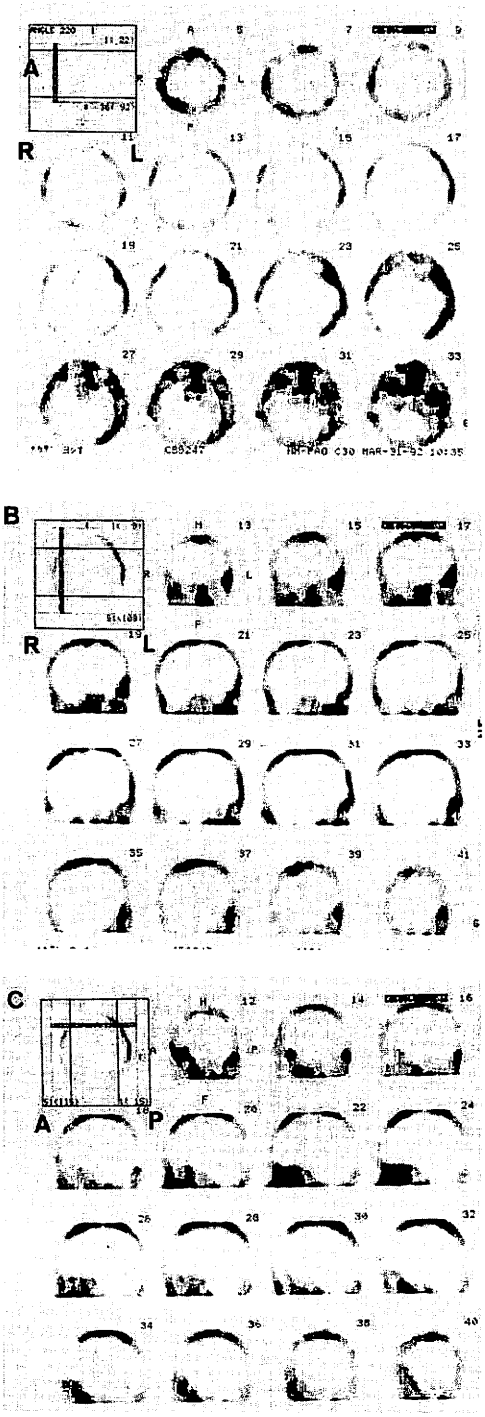

Fig.2 Tc-99m HMPAO SPECT images in a patient with brain death show no perfusion in the brain: Transverse (A), Coronal (B), and Sagittal (C).

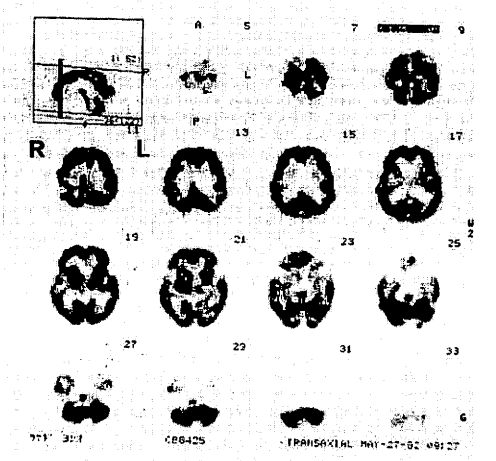

Fig.3 Normal transverse tomographic Tc-99m HMPAO images show normal perfusion in the brain.

confirming no perfusion of CBF after the clinical death of brain.

In conclusion, the evaluation of CBF using scintigraphy should be added to the examination list for the diagnosis of brain death.

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脳死症例のSPECT像

高山　輝彦，中嶋　憲一，能崎　純一，
河端　佳子，関本　　繁，久田　欣一

要　旨

臨床的に脳死の状態になった症例で，脳シンチグラフィにより脳血流の欠如が証明された。脳シンチグラフィは簡便で客観的な脳血流の評価に適した検査であり，脳死の判定に有効なことから判定の検査項目の中に加えられるべきものと思われる。