CASE REPORT

Kalevi J. A. Kairemo,[1] *M.D., Ph.D., M.Sc. (Eng.)*

Unexpected Death During a Brain Scintigraphy

REFERENCE: Kairemo KJA. Unexpected death during a brain scintigraphy. J Forensic Sci 1998;43(4):903–904.

ABSTRACT: Brain scintigraphy was performed for differential diagnosis of suspected subdural hemorrhage in a 79-year-old woman.

Planar pertechnetate ($^{99m}TcO_4^-$) brain scan with AP, PA, lateral and vertex projections was planned. The procedure was started with AP-projection, continuing with lateral projections. After these images the patient was determined dead and the planned scannings were aborted. There was a clear difference in the intracranial uptake (choroid plexuses) in the lateral views as well as in the uptake in the venous sinuses. The findings in the AP view were normal and no signs of subdural hemorrhage were observed. The patient died during a routine nuclear medicine procedure, and cessation of intracranial circulation was observable on $^{99m}TcO_4^-$ scans; the lack of uptake in cerebral sinuses confirmed the lack of intracerebral flow. In this rare case, brain death could be timed accurately using a static nuclear medicine procedure. Autopsy confirmed sudden brain circulatory disorders and general arteriosclerosis.

KEYWORDS: forensic science, forensic pathology, pertechnetate, Tc-99m, radionuclide imaging, brain death, death

Nuclear medicine procedures have been used occasionally for determination of brain death. Intravenous isotope angiography performed at the bedside with a mobile gamma camera is a safe, convenient, rapid, reliable, and easily understood method of proving the absence of cerebral blood flow that occurs in brain death (1). The method involves an intravenous injection of 2 mCi of pertechnetate ($^{99m}TcO_4^-$), and recording of time/activity curves over the cranial cavity and a femoral artery simultaneously, using twin probe radioisotope detector equipment (2). Roine et al. (3) used static images and ^{99m}Tc-HMPAO to confirm brain death. Bedside acquisition of immediate static images in combination with a dynamic radionuclide cerebral angiogram can be quickly and safely performed as a confirmatory test in the diagnosis of brain death. Confusion in the differentiation of extracerebral from intracerebral flow on the dynamic radionuclide angiogram can be avoided by identifying the presence or absence of uptake in the cerebral sinuses (4). Absence of intracerebral circulation on the dynamic radionuclide cerebral angiogram combined with the lack of uptake in cerebral sinuses confirms the lack of intracerebral flow and can be used as confirmatory evidence of a diagnosis of brain death (4). The aim of this study is to present a case where brain death was confirmed using static images during a routine nuclear medicine study.

[1] Senior lecturer, Department of Oncology, Helsinki University Central Hospital, Helsinki, Finland.

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Case Report

A 79-year-old woman was hospitalized because of dyspnea and general weakness. In her medical history at the age of 20 she had had pulmonary tuberculosis. Three years before this hospitalization she had a myocardial infarction, and recovery was normal. Since that her medication consisted of hydrochlorothiazide, digoxin and metoprolol. She was living in a home for senior citizens. Karnofsky performance status was 90.

On the first day at the hospital she developed mild dysphasia and hemiparesis on the right side. Blood pressure was 135/75 and pulse 64/min, PQ-time varied from 0.22 to 0.32 s in a normal electrocardiogram. Clinically the patient was mildly dehydrated, which was corrected by intravenous fluids.

Because of progressing symptoms a brain scan was performed on the third day to exclude subdural hemorrhage. A Siemens Scintiview gamma camera was used equipped with a low energy collimator. The matrix size was 256 × 256, and 600 kilocounts were collected for each image. The gamma energy peak of 140 keV (20%) was recorded after an intravenous bolus of 555 MBq pertechnetate. The static scanning procedure, 30 min later started with an AP-projection, continuing with lateral projections. After these images the patient was determined dead. The determination of death was confirmed both by the nuclear medicine physician and referring internist according to guidelines presented in Ref 5. Also the planned scannings were aborted. In the gamma images there was a clear difference in the intracranial uptake (choroid plexuses) between brain hemispheres in the lateral views as well as the uptake in the venous sinuses (Fig. 1). The scanning time for the left lateral projection (most right, Fig. 1) was 11% longer than for the right lateral projection (in the middle, Fig. 1). The left lateral projection is darker to demonstrate clearly decreased uptake. The findings in the AP view were normal and no signs of subdural hemorrhage were observed (Fig. 1).

Autopsy revealed an old myocardial infarction, scars in the lungs related to old pulmonary tuberculosis. Macroscopically there was no bleeding nor infarction in the brain. Microscopic investigation demonstrated changes in the brain matter, indicative of circulatory disorders, and general arteriosclerosis. The morphopathological causes of death were *arteriosclerosis universalis* (generalized arteriosclerosis) and *insultus cerebri acutus cum hemiparesis l.dx* (an acute cerebral event with right hemiparesis).

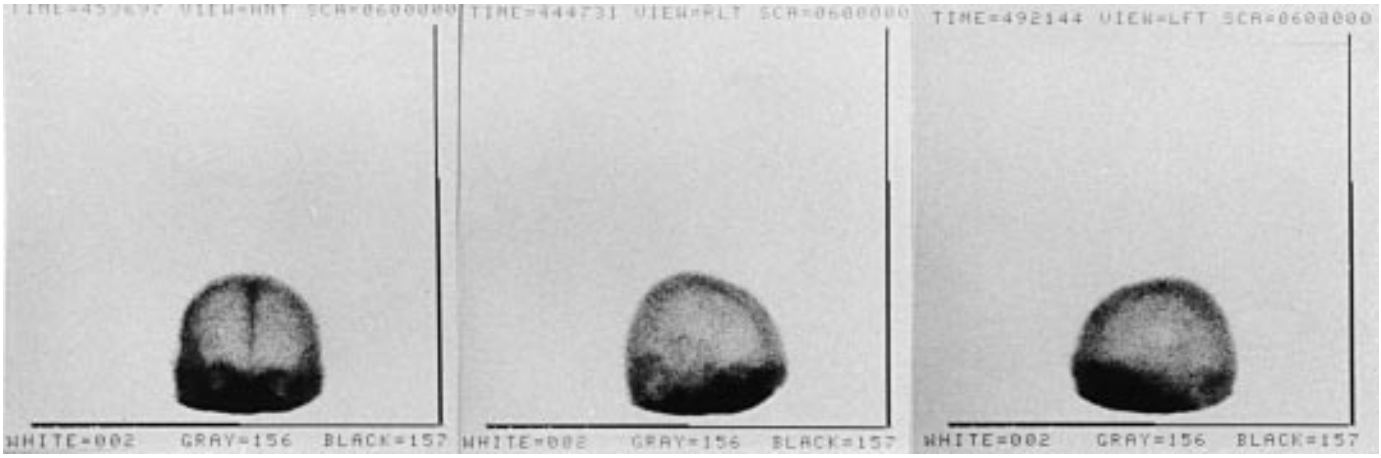

FIG. 1—*Static brain scans in the scanning order after injecting 555 MBq pertechnetate. AP-view: normal findings; right lateral view: normal uptake in the brain, choroid plexus and venous sinus; left lateral view: decreased uptake in the brain, choroid plexus and venous sinus. The patient died during the procedure. The autopsy confirmed the cause of death to be sudden cerebral circulatory disorder and generalized arteriosclerosis.*

Discussion

This is, to my knowledge, the first report of a patient dying during a routine nuclear medicine procedure for diagnostic purposes. Fortunately, the nature of the scanning revealed the cessation of intracranial circulation as seen on pertechnetate scans (Fig. 1). The lack of uptake in cerebral sinuses confirmed the lack of intracerebral flow, which has been shown in brain death studies (4). In this rare case, brain death could be timed accurately using a static nuclear medicine procedure. The autopsy confirmed the sudden cerebral circulatory disorder related to general arteriosclerosis. Nuclear medicine methods are not used routinely for determination of brain death, even though good procedures exist (2,3).

The method of choice is carotid angiography; it has been applied to demonstrate no filling of the intracranial arteries for determination of brain death. Also, selective cerebral angiographic techniques in order to determine onset of death have been developed (6). Nowadays, transcranial Doppler sonography can be used to evaluate a spectrum of intracranial and extracranial vascular abnormalities and can play an important role in the determination of brain death (7). The transcranial Doppler appearance of brain death can be understood to result from an increase in intracranial pressure. When intracranial pressure is at the level at which blood flow to the peripheral circulation is prevented, a characteristic to-and-from blood flow pattern in the middle cerebral artery can be observed (7). This oscillatory pattern is caused by systolic forward flow in the large basal arteries and diastolic reversal of flow produced by the microcirculatory obstruction and reflex contraction of the basal arteries (7). This transcranial Doppler demonstration is suggestive for cerebral circulatory arrest, and can be used for determination of brain death. Doppler sonography measurements of carotid arteries have been applied for determination of brain death in children (8).

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Additional information and reprint requests:
Dr. Kalevi Kairemo
Department of Oncology
Helsinki University Central Hospital
Haartmaninkatu 4
00290 Helsinki, Finland