Brain death confirmed by Tc^{99m} DTPA scan in a case of subarachnoid haemorrhage following a krait bite

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Introduction

Brain death is defined as the cessation of cerebral and brainstem function. It is a clinical diagnosis made on the results of a series of brainstem reflex testing, in the absence of endogenous or exogenous poisons, toxins and hypothermia confounding the clinical picture. It is known that certain chemical agents in snake toxin can alter the neuronal function mimicking brainstem death. In such situations, an objective method of demonstrating brainstem death becomes essential. The demonstration of lack of cerebral perfusion is the diagnostic criterion for brain death. Here we discuss a case of brain death confirmed by a reliable and quick method using Tc ^{99m} DTPA cerebral perfusion scan following a krait bite.

Case report

A 14-year old boy was transferred for ventilatory support in the intensive care unit (ICU) from a local hospital following a krait bite. On admission to the local hospital he had bilateral ptosis and diplopia. While being treated with antivenom serum he developed a respiratory arrest and was intubated and manually ventilated until his admission to our hospital.

On examination at the ICU, he was deeply unconscious with a Glasgow coma scale value of 3. He was afebrile, not icteric or pale, and without neck stiffness. His pulse rate was 118/ min and the blood pressure was 150/80 mmHg. The respiratory system examination showed bilateral basal crepitations. The abdomen was clinically normal. He had bilateral partly dilated pupils with absent pupillary light reflexes. There was no papilloedema. The plantar reflex was flexor.

His whole blood clotting time was 9 minutes, bleeding time 5 minutes, and prothrombin time 22 seconds. The INR was 1.7. Haemoglobin content was 11g/dL, white cell count 18.3 x 10^9/L, with neutrophils 90%, lymphocytes 10%, and the platelet count 276 x 10^9/L. Blood urea 2.8 mmol/L, creatinine 70 µmol/L, sodium 137 mmol/L, potassium 4.6 mmol/L, bilirubin 18.6µmol/L , and SGPT 15 IU/L. ECG showed sinus tachycardia and the chest radiograph was normal.

His urine output was 1 mL/kg/min and there was no haematuria. Within the next 36 hours he developed a convulsion followed by hypotension and hypothermia. At this stage the clinical examination revealed absent oculo-cephalic, oculo-vestibular , and oculo-pharyngeal responses. A cerebral CT scan done on the fourth day after the krait bite showed significant cerebral oedema and a subarachnoid haemorrhage with no evidence of midline shift. As the clinical testing of brainstem reflexes could be affected by the direct toxicity of krait venom due to its depressent effect, technetium 99^m DTPA (Diethylenetriamine penta-acetic acid) scan was performed. It showed no evidence of cerebral perfusion. Tracer flow up to the brainstem area was seen demonstrating the "hot nose sign" (Figure 1) . This was in keeping with brainstem death.

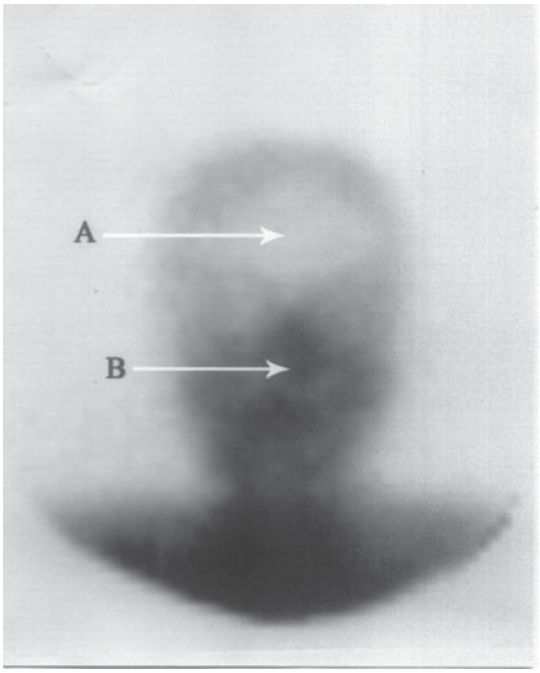

Figure 1. **Tc^{99m} DTPA cerebral perfusion scan showing: A, lack of cerebral perfusion, and B, "hot nose" sign of perfusion up to the brainstem.**

Discussion

Neurotoxicity following krait bite is common, manifesting frequently as respiratory muscle paralysis.

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The krait venom competes with acetylcholine at the neuromuscular junction post-synaptic receptors leading to neuromuscular paralysis. The venom by its direct neurotoxic effect on the brain could produce alteration of level of consciousness ranging from drowsiness to deep coma [1]. Although our patient did not show significant coagulopathy initially, within the next 4 days he developed a subarachnoid haemorrhage. Bleeding delayed up to 1 week has been reported following krait bite [2]. The possible explanation for this manifestation is that local blebs constitute a venom depot which is suddenly released into the blood stream [3]. As the brainstem reflexes are absent in deeply commatose patients, the challenge was to confirm brain death with a reliable method.

Brain death implies irreversible cessation of circulatory and respiratory function, or the irreversible cessation of cerebral and brainstem function. Confirmatory tests include the apnoea test, atropine test, electroencephalography (EEG), auditory brainstem response, and radionuclide cerebral blood flow angiography [4]. Clinically, the absence of pupillary light, corneal, oculo-cephalic, oculo-pharyngeal, oculo-vestibular and respiratory reflexes reflect brainstem death. Absent cerebral function is manifested by deep coma, and unreceptivity, as seen in this case. Cerebral oedema, tissue necrosis and autolysis leads to raised intracranial pressure, and impedes the cerebral blood flow. Demonstration of lack of cerebral blood flow is diagnostic of brain death [4]. The brain perfusion scan can be used to confirm the absence of blood flow. The study can be performed with intravenous injection of Tc^{99m} DTPA or Tc^{99m} Hexamethyl propyleneamine oxime (HMPAO). Flow images are obtained in the anterior projection.The diagnosis can be confirmed only if lack of cerebral perfusion is demonstrated. The use of Tc^{99m} DTPA is comparable to Tc HMPAO scanning but is relatively much cheaper than the latter [5]. The absence of EEG activity is an important factor in the determination of brain death, but it cannot be applied always, as there are instances when the EEG may show absent activity, due to the effect of drugs or certain anaesthetic agents. Scintigraphic brain imaging is the modality least affected by the patient's condition or medications. As this procedure does not require withdrawal of medications or give confusing results due to pharmaceutical agents, this is considered to be superior to neurophysiological studies [6] This method also has the added advantage of being simple and quick [4]. Numerous pharmaceutical agents have been employed for scintigraphy like Tc 99 m pertechnate, Tc 99m glucoheptonate, Tc^{99m} DTPA, Tc^{99m} HMPAO and more recently Tc^{99m} Bicisate (ECD). The latter two agents have the ability to cross the blood brain barrier so that it can be used to image the cerebral metabolism. But in the diagnosis of brain death we are mainly concerned about the cerebral perfusion. A complicating factor for the Tc^{99m} DTPA scan is the false negativity due to the presence of activity within the sagittal sinus and misleading soft tissue hyperaemia, a factor which can delay the diagnosis of brain death [7, 8]. When the accurate diagnosis of brain death becomes a legal concern, and a medical emergency in the transplant medicine, we feel that DTPA scan is a reliable, accurate, relatively simple and low cost method which can be used in our country.

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