

# DIAGNOSIS AND MANAGEMENT OF BRAIN DEATH

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## INTRODUCTION

Death is a common human event that a layman knows what it involves. Death is a term so simple and basic that definition is considered unnecessary by many people. There would have been little disagreement till recently, if death was defined as complete cessation of vital functions of respiration and circulation. However, recently, diagnosis of death has been an issue of much debate and discussion in several countries. This can be attributed to the advancement of medical sciences especially in the field of resuscitation and intensive care. With the development of new techniques and forms of management in the intensive care units, it is now possible to have deeply comatose and unresponsive patients with severe brain damage maintained on artificial respiration by means of mechanical ventilators.

Currently, death is not considered as an event but as a process though instant death does occur occasionally. Death is a process leading to the failure of the various organs and systems supporting the continuation of life and eventually complete cessation. Death can occur in 2 ways:— In majority of the cases, the organ failure occurs and eventually reaches a point when brain death occurs and this is the point of no return. In some cases, however, death does not occur as a result of the failure of other organs or systems but as a direct result of severe damage to the brain itself. In this situation the process of dying is reversed. Brain death normally results in the arrest of spontaneous respiration and this is normally followed within a few minutes by cardiac arrest due to hypoxia. If however, artificial respiration is instituted early, the cardiac arrest can be delayed for several days or weeks and haemo-perfusion of other organs like liver and kidneys can be maintained.

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With the advent of transplant surgery it became essential to establish the exact criteria for diagnosis of death. Several countries have drawn up their own criteria and tests for confirming brain death. In 1969 Harvard criteria was the first to be devised to guide doctors in U.S.A. to diagnose brain death. The National Board of Health of Finland published their diagnostic criteria in 1971 and Finland was the first country to legally accept brain death. In 1976 the Conference of Medical Royal Colleges and Faculties in the U.K. issued a statement setting out the diagnostic criteria of brain death and these were as follows:—

## CONDITIONS FOR CONSIDERING DIAGNOSIS OF BRAIN DEATH

All the following should co-exist.

1. The patient is deeply comatose. There should be no suspicion that this state is due to depressant drugs like narcotics, hypnotics and tranquilisers. The drug history should be carefully reviewed and adequate time be allowed to exclude the persistence of drug effects. Primary hypothermia as a cause of coma should have been excluded. Metabolic and endocrine causes of coma should have been excluded.
2. The patient is being maintained on a ventilator because spontaneous respiration had previously become inadequate or had ceased altogether. Neuro-muscular blocking agents and other drugs like narcotics can cause respiratory failure and persistence of these drug effects must be excluded.
3. There should be no doubt that the patient's condition is due to irremediable structural brain damage and the diagnosis of a disorder which can lead to brain death should have been fully established.

## TESTS FOR CONFIRMING BRAIN DEATH

All brain stem reflexes should be absent. The pupils are fixed in diameter and do not respond to sharp changes in the intensity of incident light. There is no corneal reflex. The vestibulo-ocular reflexes are absent. No motor responses within the

cranial nerve distribution can be elicited by adequate stimulation of any somatic area. There is no gag reflex or reflex response to bronchial stimulation by a suction catheter passed down the trachea. There is no respiratory movements when a patient is disconnected from a mechanical ventilator for long enough period to ensure that arterial carbon dioxide tension rises above the threshold for stimulating respiration — that is the PaCO<sub>2</sub> must normally reach 50 mm Hg. Hypoxia during disconnection must be prevented by oxygen insufflation through catheter into the trachea.

### OTHER CONSIDERATIONS

To prevent observer error it is recommended that the tests should be repeated after 24 hours especially when there are doubts as to the condition which can lead to brain death. In certain situations when there is no doubt it is unnecessary to repeat the tests.

It has been well documented that spinal cord function can persist or return after initial absence when the brain stem has been destroyed, and therefore, spinal reflexes should be ignored in the diagnosis of brain death (Ivan, 1973).

Confirmatory investigations are now widely accepted as unnecessary. If EEG is used, the strict criteria recommended by the The International Federation of EEG Societies must be followed (Report, 1974). Body temperature should not be less than 35°C when the tests are done.

Specialist advice by a neurologist or a neurosurgeon are only required when the primary diagnosis is in doubt. Any two consultants can certify brain death.

These criteria have been used in the diagnosis of brain death in the Intensive Care Unit of the University Hospital, Kuala Lumpur.

### PATIENTS, METHODS, AND RESULTS

During the period January to June 1979 10 patients admitted into Multidisciplinary Intensive Care Unit of University Hospital, Kuala Lumpur, were diagnosed to have brain death. The diagnostic criteria used were those recommended by the Conference of the Medical Royal Colleges and their Faculties in the United Kingdom (1976). The clinical details of the patients are given in Table I. Of the 10 patients, 7 were children below the age of 10 years (age range: 6 months to 10 years). The other

3 were adults between the ages of 15 years and 49 years. Of the children there were 4 female and 3 male patients and of the adults, there were 2 women and 1 man.

2 children presented with Reye-Johnson Syndrome. 1 child had cerebral malaria, another child had viral encephalopathy and another had idiopathic thrombocytopenic purpura with intracranial haemorrhage. There was 1 case of brain stem and cerebral contusion following a motor vehicle accident (MVA). One child had aspirated a "chiku seed" into the trachea and suffered a cardiac arrest while removal of the foreign body was attempted under anaesthesia. Of the adults, 2 patients were involved in MVA and suffered brain stem contusions. The oldest patient (Case No. 7) with pituitary tumour, which was confirmed as pituitary chromophobe adenoma during surgery, probably developed a brain stem infarction in the post-operative period.

The clinical diagnosis was confirmed in 4 cases during autopsy. Consent for autopsy in other 6 patients was refused by the relatives.

Brain death in all the 10 patients was based on simple clinical examination carried out by a neurosurgeon and an anaesthesiologist. Only 2 patients (Cases No. 7 and 10) had confirmatory investigation in the form of electroencephalography (EEG) though there were no doubts during the clinical examination. In both these patients the EEG showed electrical silence.

When brain death was diagnosed, the relatives were informed of the grim prognosis. Nine patients were put on the brain death regime which consisted of withdrawal of all forms of active treatment like drug therapy, parenteral alimentation, tracheo-bronchial suction and physiotherapy with the exception of artificial ventilation which was carried on till there was a cardiac arrest when no resuscitation was attempted. In one patient (Case No. 10), the parents did not accept brain death as death and the management remained unchanged till the circulation ceased 9 days later. The detailed case history of this patient is given below.

### CASE REPORT (Case No. 10)

This patient was a 3 year old girl who developed bruises all over the body spontaneously. The condition was diagnosed as idiopathic thrombocytopenic

purpura when the platelet count was found to be very low. The diagnosis was confirmed by a bone marrow biopsy 3 days later. On the fifth day, she knocked her head against the sink in the bath-room and within 3 hours she became drowsy and vomited several times. She was admitted to the University Hospital with a dilated and non-reacting left pupil and right hemiparesis.

Intra-cranial haemorrhage was suspected and a carotid angiogram revealed a left temporal lobe haematoma. A sub-temporal craniectomy and decompression were performed. During the operation a very large amount of infarcted and haemorrhagic brain drained out when the dura was opened. Post-operatively, she was unresponsive and both her pupils were widely dilated and did not react to light. She was managed in the Intensive Care Unit with artificial ventilation, intravenous dexamethasone, dilantin and a continuous infusion of the anaesthetic agent Althesin to keep the intra-cranial pressure low.

Two days after the operation there was no change in the condition, except for the return of the spinal reflexes in the lower limbs. Brain death was diagnosed and confirmed by an isoelectric EEG. The grim prognosis was explained to the parents who not only did not accept our prognosis but were optimistic because of the return of the spinal reflexes. They requested us not to discontinue any form of treatment and to attempt resuscitation if cardiac arrest should occur. They sought our permission to bring in faith healers and other traditional medical practitioners. Permission was granted on condition that they did not interfere with our management.

Five days after diagnosis of brain death there was still no change in the condition of the patient. Futility of continuing active treatment was again explained to the father who, however, still had exaggerated expectations.

On the ninth day after brain death was diagnosed she had three cardiac arrests. She was successfully resuscitated on two occasions, but the third attempt failed.

The time interval between the diagnosis of brain death and the legal pronouncement of death ranged from 6 hours (Case No. 2) to 9 days (Case No. 10). Two patients (Cases No. 2 and 6) died within the first 24 hours of diagnosis of brain death. Both were

involved in MVA and in addition to brain stem contusion both had other injuries including several fractures. The longest time interval in a patient who was on brain death regime was 6 days (Case No. 6). The only patient in whom the management was unchanged after diagnosis of brain death survived for 9 days.

## DISCUSSION

Death is not a medical question alone but involves legal, socio-economic, religious and sometimes political issues as well. It is, therefore, not surprising that criteria for establishing death has produced much debate and discussions.

The Harvard Committee on Irreversible Coma (1968) established the criteria for diagnosis of brain death and this is perhaps most widely known. The criteria include an unresponsive, apnoeic patient with electrical silence on the EEG. One year later requirement of an isoelectric EEG was withdrawn (Beecher, 1969). However, this criteria was once again recommended in 1977 more as a legal protection against litigation than anything else (Collaborative study, 1977).

The code recommended by the Swedish Medical Society is claimed to be the most complete (Kaste, Hillbom and Palo, 1979). This code recommends EEG and cerebral angiogram to confirm brain death. The availability of these special facilities may be limited and therefore it is doubtful that this code will be followed widely.

The Finnish code has been in existence for 8 years and is similar to the British recommendations. However, the Finnish code does not give the procedure to verify the arrest of spontaneous respiration.

The British code recommends simple clinical tests to diagnose brain death. Each test is dealt with in detail and is easy to perform. Expensive and trained personnel-requiring confirmatory investigations like EEG and cerebral angiogram are not required. These were the factors which made us choose the British code in this small series. It is felt that this code is suitable to be applied in our local situation especially when facilities for doing confirmatory investigations are lacking in many of our hospitals.

Brain death has been legally accepted in many countries. The Conference of Medical Royal Colle-

**Table I.**  
**CLINICAL DETAILS OF PATIENTS WITH BRAIN DEATH**

Case No	Sex	Age (yr)	Clinical Diagnosis	Autopsy Diagnosis	Confirmatory Investigation	Time Interval Between Diagnosis of Brain Death and Final Cardiac Arrest	Management After Diagnosis of Brain Death
1	F	2½	Cerebral malaria	Autopsy not done	Not done	4 days	Brain death regime
2	M	33	Multiple injuries Brain stem contusion	Brain stem haemorrhage	Not done	6 hours	- do -
3	F	½	Reye-Johnson syndrome	Autopsy not done	Not done	2 days	- do -
4	M	5	Reye-Johnson syndrome	Autopsy not done	Not done	2 days	- do -
5	M	10	Brain stem contusion. Cerebral contusion	Brain stem haemorrhage Subarachnoid haemorrhage	Not done	36 hours	- do -
6	F	15	Multiple injuries Brain stem contusion	Brain stem haemorrhage	Not done	15 hours	- do -
7	F	49	Pituitary tumor ? Brain stem infarction	Autopsy not done	E.E.G.	2 days	- do -
8	F	6	Viral encephalopathy	Autopsy not done	Not done	6 days	- do -
9	M	1	Aspiration of foreign body into trachea and cardiac arrest	Autopsy not done	Not done	3 days	- do -
10	F	3	Idiopathic thrombocytopaenic purpura with intra cranial haemorrhage	Cerebral haemorrhage and necrosis	E.E.G.	9 days	Unchanged

ges and their Faculties in the United Kingdom (1979) in another memorandum stated that 'identification of brain death means that the patient is dead, whether or not the function of some organs, such as a heart beat, is still maintained by artificial means'.

In Malaysia, there are no guidelines to help the doctors in management of patients with brain death. In the absence of any policy the ventilator was not switched off till the cardiac arrest occurred. However, it was felt that all other forms of treatment should be withdrawn. In one patient the management was unchanged and she had the final cardiac arrest nine days after the diagnosis of brain death.

It is felt that continuing any form of supportive management in patients with no hope of recovery unnecessarily prolongs the emotional distress of relatives. Moreover, the morale of the staff of the Intensive Care Unit is at the lowest when they have to maintain expensive supportive systems and provide constant highly specialised nursing and medical care. Most important of all, the capacity to give life-saving intensive care to patients with a better prognosis is reduced especially when our facilities are limited. Another factor which may be of importance in the near future is the availability of organs for transplantation from patients with brain death.

It is for these reasons that it is felt that there is an urgent need to recognise brain death as legal death and to draw up guidelines on management of patients with brain death. The local cultural and traditional beliefs, economic, and legal implications and finally theological aspects of a multiracial society must be thoroughly explored when such a policy is being considered.

#### SUMMARY

The diagnosis and management of brain death is discussed in this paper. Criteria recommended by the Conference of Medical Royal Colleges and their Faculties in U.K. were used in the diagnosis of brain death. It is felt that brain death should be considered as death of the individual and a plea is made to draw up guidelines on management of patients with brain death.

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