

## BRAIN DEATH

### Introduction

Legally and medically, death has occurred when there is either:

1. Irreversible cessation of all function of the brain of the person.

*OR*

2. Irreversible cessation of circulation of blood in the body of the person

### Pathophysiology

Scenarios include:

1. Traumatic brain Injury
2. Intracranial Hemorrhage (including Subarachnoid Hemorrhage)
3. Hypoxia (eg. Post cardiac arrest, stroke or drowning)
4. Infection (eg. Encephalitis), (less commonly)

Following a catastrophic intracranial event there is significant cerebral oedema.

As the cerebral oedema increases, intracranial pressure rises above that of the arteries supplying the brain and brain stem and subsequently blood flow into the brain ceases.

### Definition

**The Australian and New Zealand Intensive Care Society Statement on Death and Organ Donation (2008) states that:**

**Determination of brain death requires that there is:**

- **Unresponsive coma**
- **Absence of brain-stem reflexes**
- **Absence of respiratory centre function**
- **A clinical setting in which these findings are irreversible.**

In particular there must be definite clinical or neuro-imaging evidence of acute brain pathology (eg. traumatic brain injury, intracranial hemorrhage, hypoxic encephalopathy) consistent with the irreversible loss of neurological function.

Note that a brain stem stroke may provide the same signs as brain death but the determination of brain death cannot occur because this on its own is not associated with the clinical scenario in which brain death occurs unless there is a complication (eg. severe hydrocephalus).

### **Determination of Brain Death**

**Brain Death is determined by either:**

1. **Clinical Testing if preconditions are met**

*OR*

2. **Imaging that demonstrates the absence of intracranial blood flow.**

### **Determination of Brain Death by Clinical Examination**

1. **Preconditions:**

- Sufficient intracranial pathology
- Normothermia (T > 35)
- Normotension (Systolic > 90mmHg and MAP > 60mmHg)
- Exclusion of effects of sedative drugs (may need specific antagonists to be given).
- Absence of severe electrolyte, metabolic or endocrine disturbance (eg. Glucose, sodium level, liver and renal function)
- Intact neuromuscular function (this may need the use of a peripheral nerve stimulator)
- Ability to examine the brain stem reflexes
- Ability to perform apnoea testing

2. **Observation:**

- Minimum of 4 hours of observation and mechanical ventilation with:
- GCS 3

- Pupils non-reactive to light
- Absent cough/tracheal reflex to suctioning
- No spontaneous breathing efforts

**NB It is recommended that testing be delayed for 24 hours in patients with presumed hypoxic-ischaemic encephalopathy post CPR because return of some brain function can be delayed.**

3. **Designated formal examiners:**

Examination must be carried out by **2 medical practitioners** with *specific experience and qualifications*:

The exact criteria varies from state to state, but in the state of Victoria the examiners must:

- Have been medical practitioners for not less than 5 years
- Not be the designated officer
- Not be the remover of tissues.

**The following needs to be established:**

1. Absence of responsiveness:

- GCS 3
- Painful stimulus in cranial nerve distribution and peripheral distribution

2. Absence of brain stem reflexes:

- *All* cranial nerves are tested apart from I, XI, and XII
- Pupillary light reflex (II and III)
- Corneal reflex (V and VII)
- Response to pain in trigeminal distribution (V and VII)
- Vestibular-ocular reflex (III, IV, VI, VIII)
- Gag reflex (IX and X)

*Only when cranial nerve testing has been completed does the performance of the apnoea test occur.*

3. Presence of apnoea:

The patient is removed from the ventilator and observed for any respiratory effort until the respiratory centre is maximally stimulated:

- PaCO<sub>2</sub> > 60mmHg

*OR*

- pH < 7.30

**Observations that are compatible with brain death:**

- Spinal Reflexes
- Sweating/blushing/tachycardia
- Absence of Diabetes Insipidus

**Observations that are *not* compatible with brain death:**

- Decerebrate or decorticate posturing
- Extensor or flexor motor response to painful stimuli
- Seizures

*Determination of Brain Death by Imaging Techniques*

If the pre-conditions can't be met or if clinical testing can't be performed (eg. patient too unstable to perform apnoea test), then **imaging is mandatory to confirm absence of intracranial blood flow.**

**It is also useful as a confirmatory test in addition to clinical tests but is not sufficient on its own.**

The preferred techniques are:

- Radionuclide Imaging.

This assesses blood flow and cerebral uptake of radio-labelled marker.

- Four Vessel Angiogram.

## **Certification of the Death**

Death is certified when the two medical practitioners defined by local legislation have both completed the process required for determination of brain death.

**The time of Death should be recorded as the time when the second clinical examination has been completed.**

No patient fulfilling the strict criteria for brain death as described have ever subsequently developed detectable brain function.

**See Separate guidelines for Management of the Organ Donor Patient and “GIVE” clinical triggers in the ED.**

### *References:*

1. The ANZICS Statement on Death and Organ Donation, Third Edition, 2008

Dr Andrew Casamento/ Dr Graeme Duke  
Dr James Hayes  
April 2010