

The determination of brain death requires performance of all of the following:

1. Identification of the reason for severe brain injury;
2. Fulfillment of preconditions and exclusion of confounding factors;
3. Clinical examination including state of consciousness, tests of brain stem function and an apnea test.
4. The performance of an accessory test in all cases.

1. Identification of the reason for severe brain injury

In order to commence the process of brain death determination, one or more of the following diagnoses must be present:

1. Head trauma;
2. Intracerebral bleeding;
3. Anoxic brain damage;
4. Intracerebral neoplasm;
5. Intracerebral infection;
6. Intracerebral infarction;
7. Cerebral edema.

1.1 Timing of brain death determination.

1. When the cause for suspected brain death is due to head injury, intracerebral bleeding or intracerebral neoplasm, the determination may be commenced after at least 6 hours have elapsed since the clinical suspicion of brain death arose according to clinical examination;
2. When the cause for suspected brain death is due to anoxic damage, intracerebral infection, intracerebral infarction or cerebral edema, the determination may be commenced after at least 24 hours have elapsed since the clinical suspicion of brain death arose according to clinical examination;
3. Irrespective of the above, when suspected brain death occurs in a child of ≤ 13 years of age, the determination may be commenced after at least 24 hours have elapsed since the clinical suspicion of brain death arose according to clinical examination.

2. Fulfillment of preconditions and exclusion of confounding factors

2.1 Essential preconditions include the following:

2.1.1 Core body temperature > 34⁰C

2.1.2 Adequate blood pressure

- patient < 1 year of age – systolic BP at least 70 mm Hg
- patient between 1 and 3 years of age – systolic BP at least 80 mm Hg
- patient > 3 years of age – systolic BP at least 90mm Hg

2.2 Exclusion of confounding factors:

These include:

2.2.1. Substances which might depress the central nervous system, including the effects of sedative drugs;

2.2.2 Severe electrolyte or metabolic disturbances (these include marked derangements in plasma concentrations of glucose, sodium, phosphate or magnesium; liver and renal dysfunction);

2.2.3 Severe endocrine disturbances (including severe hypothyroidism).

2.2.4 Intact neuromuscular function (exclude use of neuromuscular blocking agents and high cervical spinal cord injury).

In the presence of 1 or more of these factors, brain death may only be determined when ONE of the following conditions has been met:

- a) the substance affecting the CNS is less than the therapeutic level. If there is any doubt about the persisting effects of opioids or benzodiazepines, an appropriate drug antagonist (narcane or flumazenil) should be administered; OR
- b) the metabolic or endocrine disturbance has been corrected; OR
- c) an accessory test demonstrates absent intracranial blood flow.

3. Clinical examination

3.1 Composition of the brain death determination team

Clinical testing is carried out by two physicians, with specific experience and qualifications, from different specialties. These include:

- a. Neurosurgery
- b. Intensive care
- c. Neurology
- d. Cardiology
- e. Internal medicine
- f. Pediatrics
- g. Anesthesia
- h. Emergency medicine
- i. Pediatric cardiology
- j. Pediatric neurology

3.1.1 Where the patient is < 13 years of age, one member of the team must be a pediatrician, pediatric neurologist, pediatric cardiologist or pediatric intensivist;

3.1.2 One determination will be performed with both physicians present at all times;

3.1.3 The team will not include a physician who is actively involved in either the present treatment of the patient or directly involved in organ transplantation;

3.1.4 The diagnosis of brain death will be made by both physicians unanimously;

3.1.5 Where the diagnosis is not unanimous, the team should reconvene after at least 6 hours.

3.2. Demonstration of absence of consciousness, i.e. Glasgow Coma Score (GCS = 3)

There should be no response to noxious stimuli (pressure over the supra-orbital nerve, sternal rub, and deep nail bed pressure) within the cranial nerve distribution, or any response in the limbs in response to cranial nerve stimulation.

4.2.1. Spinal reflexes may be present in patients with brain death and do not exclude the diagnosis.

3.3. Demonstration of absent brain stem reflexes including

3.3.1 Pupillary light reflex

3.3.2 Corneal reflex

3.3.3 Response to pain (trigeminal nerve testing)

3.3.4 Oculo-vestibular reflex

3.3.5 Gag reflex

3.3.6 Cough reflex

Note: 3.3.6.1 All tests must be performed and all must be absent to determine brain death.

3.3.6.2. At least 1 eye and 1 ear must be available for examination.

3.3.6.3 When 1 or more of the tests cannot be performed (e.g. severe facial trauma) imaging demonstrating the absence of intracranial blood flow should be performed.

3.4 Apnea test – demonstration of absence of spontaneous breathing despite maximal stimulus, i.e. hypercarbia with $p\text{CO}_2 \geq 60$ mm Hg

3.4.1. The apnea test should be performed only if all the above reflexes are absent

3.4.2 Monitor SpO₂, pulse and blood pressure throughout the procedure

3.4.3. Pre-oxygenate the patient with 100% oxygen for at least 5 minutes.

3.4.4. Mechanically ventilate to mild hypercarbia (PaCO₂ ~ 45 mmHg)

3.4.5. Disconnect the patient from the ventilator.

3.4.6. Connect the patient to a T-piece or a continuous positive air pressure (CPAP) circuit to supply oxygen to the tracheal tube.

3.4.7. Observe continuously for any spontaneous breathing.

3.4.8. Take an arterial blood gas to confirm the pCO₂ has risen to ≥ 60 mm Hg.

(Note: Usually PaCO₂ rises by ~ 3 mmHg for every minute of apnoea.)

3.4.9 The absence of attempts at breathing in the presence of a pCO₂ ≥ 60 mmHg confirms the absence spontaneous breathing. In patients with pre-existing hypercapnia, the PaCO₂ should increase by > 20 mmHg above the base line level.

Note:3.4.9.1 If during the apnea test the patient develops significant hemodynamic instability (systolic BP < 90mm Hg), arrhythmia with hypotension or significant hypoxemia (SaO₂ < 86%), the test should be stopped, the patient reconnected to the ventilator and the test repeated once stability has been achieved after at least 30 minutes.