

**Template for Trust Clinical Guidelines**  
**Derby Hospitals NHS Foundation Trust**

**BRAIN DEATH - DIAGNOSIS AND MANAGEMENT**

**Reference No:**

**Introduction**

Full and detailed guidance can be found at this link:

<http://www.odt.nhs.uk/donation/deceased-donation/donation-after-brain-stem-death/resources/>

Traditional Criteria of "Death" -	No breath sounds	)	Features of
	No heart sounds	)	cardiorespiratory
	Unrousable	)	cessation

- After the polio epidemic of the 1950's the first element became reversible.
- With modern intensive care medicine (inotropes, intra-arterial balloon pumps, pacemakers) the second element may also be reversible.
- But there is no replacement for brain function.
- Also the brain is the most susceptible organ to insult.

Brain death equates to the death of the patient as a whole. The brain has many different components.

We recognise the concept of brain stem death.

There is also cortical death. This is described as a persistent vegetative state (PVS).

Brainstem death has two components:

- 1 Irreversible loss of consciousness
- 2 Irreversible loss of the ability to breathe and therefore to maintain a heartbeat.

It was realised in the 1970's that ventilating brain stem death patients always lead to asystole. The time to asystole is variable ranging from hours to days.

Therefore ventilation is futile and not in the patient's best interest. Secondly it was realised that these patients are potential organ donors. Therefore we need to identify brain stem death patients early and appropriately.

#### Causes of Brain Stem Death

CVA	64%	
Trauma	13%	
Miscellaneous	23%	(encephalitis, meningitis, brain tumour, abscess, overdose e.g. carbon monoxide poisoning)

### **Aim and Purpose**

To identify all patients with suspected brain-stem death through the use of Internationally accepted and defined criteria.

### **Scope**

Adult Intensive Care Unit and Emergency Medicine Department

### **Guideline**

#### **BRAIN STEM DEATH TESTING**

It remains the duty of the two doctors carrying out the testing to be satisfied with the aetiology, the exclusion of all potentially reversible causes, the clinical tests of brain-stem function and of any ancillary investigations so that each doctor may independently confirm death following irreversible cessation of brain-stem function. It is recommended to wait at least 6 hours from the time of the acute event prior to contemplating BSDT

#### **Evidence for Irreversible Brain Damage of Known Aetiology**

- There should be no doubt that the patient's condition is due to irreversible brain damage of known aetiology.
- Occasionally it may take a period of continued clinical observation and investigation to be confident of the irreversible nature of the prognosis. The timing of the first test and the timing between the two tests should be adequate for the reassurance of all those directly concerned.

#### **Children**

- **Older than 2 months:** This guideline can be used in children older than 2 months of age.
- **Between thirty seven weeks gestation to 2 months of age:** given the current state of knowledge, it is rarely possible to confidently diagnose brain-stem death in this age group.
- **Infants below 37 weeks gestation:** the concept of brain-stem death is inappropriate for infants in this age group.

## Drugs

- As a general rule the patient should not have received any drugs that affect consciousness (narcotics, hypnotics, sedatives or tranquillisers) nor should they have received any neuromuscular blocking agents (atracurium, vecuronium or suxamethonium) during the preceding 12 (twelve) hours.
- Renal or hepatic failure may prolong metabolism / excretion of these drugs.
- Where there is any doubt specific drug levels should be carried out (midazolam should be less than  $< 10\text{mcg/L}$ , thiopentone  $< 5\text{mg/L}$ ), residual neuromuscular blockade should be tested for by peripheral nerve stimulation. Alternatively ancillary investigations may be used to confirm the clinical diagnosis.

## Temperature, Circulatory or Metabolic or Endocrine Disorders

- If the core temperature is  $\leq 34^\circ\text{C}$  brain stem testing cannot be carried out.
- Prior to testing the mean arterial pressure should be consistently  $> 60\text{mmHg}$  (or age appropriate parameters for children) with maintenance of normocarbida and avoidance of hypoxia, acidaemia or alkalaemia ( $\text{PaCO}_2 < 6.0\text{KPa}$ ,  $\text{PaO}_2 > 10\text{KPa}$  and  $\text{pH } 7.35 - 7.45$ ).
- Serum  $\text{Na}^+$  should be between  $115-160\text{mmol/L}$ . Serum  $\text{K}^+$  should be  $> 2\text{mmol/L}$ .
- Serum  $\text{PO}_4^{3-}$  and  $\text{Mg}^{2+}$  should not be profoundly elevated ( $> 3.0\text{mmol/L}$ ) or lowered ( $< 0.5\text{mmol/L}$ ) from normal.
- Blood glucose should be between  $3.0-20\text{mmol/L}$  and should be tested prior to each brain stem test.
- If there is any clinical reason to expect endocrine disturbances then it is obligatory to ensure appropriate hormonal assays are undertaken.

## Brain Stem Reflexes

- Pupils should be fixed in diameter and unresponsive to light.
- Nystagmus or any eye movement should not occur when each ear is instilled with 50mls of ice cold water. Each ear drum should be clearly visualised before the test.
- There should be no corneal reflex.
- There should be no spontaneous or reflex movement within the cranial nerve distribution. Reflex limb and trunk movements represent spinal reflexes and may still be present. The potential for these reflexes should be explained to relatives, partners, carers and other staff, so that they understand these reflexes do not represent residual brain-stem function.
- There should be no gag reflex following stimulation to the posterior pharynx or cough reflex following suction catheter passed into the trachea.

## Apnoea Test

- More detailed description of the apnoea test can be found in the reference below.
- End tidal carbon dioxide can be used to guide the starting of each apnoea test but should not replace the pre and post arterial  $\text{paCO}_2$ .
- Oxygenation and cardiovascular stability should be maintained through each apnoea test. To ensure oxygenation throughout the apnoea test  $\text{FiO}_2$  should be 1.0 and the patient should be pre-oxygenated for a minimum of 5 (five) minutes.
- **Ensure the  $\text{paCO}_2 > 6.0\text{ KPa}$  and the  $\text{pH} < 7.4$ .** In patients with chronic  $\text{CO}_2$  retention, or those who have receives intravenous bicarbonate, ensure the  $\text{paCO}_2 > 6.5\text{ KPa}$  and the  $\text{pH} < 7.4$ .
- Disconnect the patient from the ventilator and administer oxygen via a catheter in the trachea at a rate of  $> 6\text{L/minute}$ . If oxygenation is a problem consider the use of a CPAP circuit.
- There should be no spontaneous respiration within 5 (five) minutes of disconnecting the ventilator. Intensive Care Society guidance is for 10 (ten) minutes and some clinicians may

prefer to follow this guidance.

- **Confirm that the PaCO<sub>2</sub> has increased from the starting level by more than 0.5KPa**
- At the conclusion of the 1st apnoea test a period of ventilation will be required to normalise parameters

### **Ancillary Investigations**

- Ancillary investigations are not required for the diagnosis of death following irreversible cessation of brain-stem function. They may be useful however where neurological examination is not possible (eg. extensive facio-maxillary injuries, residual sedation and some cases of paediatric hypoxic brain injury), where a primary metabolic or pharmacological derangement cannot be ruled out or in cases of high cervical cord injury. In such cases a confirmatory test may reduce any element of uncertainty and possibly foreshorten any period of observation prior to formal testing of brain-stem reflexes.
- The utility of each ancillary investigation is for the two testing doctors to decide. Some possible ancillary investigations are:
  1. Rotation of the head to either side should not produce any eye movement (absent doll's eyes response). This should NOT be performed if there is suspected or possible cervical spine injury.
  2. Administration of 2mg atropine should not lead to an increased heart rate (>3%).
  3. Neurophysiological demonstration of loss of bioelectrical activity in the brain (EEG, evoked potentials).
  4. Radiological demonstration of absent cerebral blood flow or brain tissue perfusion (CT angiography, 4 vessel angiography, transcranial doppler). A guideline for 'Neuroimaging for ancillary testing' in establishing the diagnosis of brain death' is available.

### **Organ Donation**

- National professional Guidance advocates the confirmation of death by neurological criteria wherever this seems a likely diagnosis and regardless of the likelihood of organ donation.

- NICE Guidance recommends that the specialist nurse for organ donation (SN-OD) Should be

notified at the point when the clinical team declare

### **References**

- Academy of Medical Royal Colleges (2008) "A Code of Practice for the Diagnosis and Confirmation of Death"

<http://www.aomrc.org.uk/aomrc/admin/reports/docs/DofD-final.pdf>

- Intensive Care Society (2005) "Guidelines for Adult Organ and Tissue Donation"

[http://www.ics.ac.uk/intensive\\_care\\_professional/organ\\_and\\_tissue\\_donation\\_2005](http://www.ics.ac.uk/intensive_care_professional/organ_and_tissue_donation_2005)

Map of Medicine <http://organdonation.mapofmedicine.com/>

Wijdicks E (2001) "The diagnosis of Brain Death" NEJM 344:1215-21

**Appendix 1: Diagnosis of Death Using Neurological Criteria  
(BSD testing form)**

<b>The Diagnosis of Death Following Irreversible Cessation of Brain-Stem Function</b>				
<p>The diagnosis of death by brain-stem testing should be made by at least two medical practitioners who have been registered for more than five years and are competent in the conduct and interpretation of brain-stem testing. At least one of the doctors must be a consultant. Testing should be performed completely and successfully on two occasions with both doctors present.</p>				
<b>Doctor One, Name and Designation</b>		<b>Doctor Two, Name and Designation</b>		
Name.....		Name.....		
Signature.....		Signature.....		
Grade.....		Grade.....		
<b>Date and time.....</b>		<p align="center"><b>HOSPITAL ADDRESSOGRAPH or</b></p> <p>Surname First Name Date of Birth Hospital Number</p>		
<b>Primary Diagnosis.....</b>				
<b>Evidence for Irreversible Brain Damage of known Aetiology</b>				
.....				
<b>Exclusion of Potentially Reversible Causes</b>				
	1 <sup>st</sup> Test	1 <sup>st</sup> Test	2 <sup>nd</sup> Test	2 <sup>nd</sup> Test
	Dr One	Dr Two	Dr One	Dr Two
1. Is the coma due to depressant drugs? Drug Levels (if taken):	Y/N	Y/N	Y/N	Y/N
2. Is the patient's body temperature $\leq 34^{\circ}\text{C}$ ?	Y/N	Y/N	Y/N	Y/N
3. Is the coma due to a circulatory, metabolic or endocrine disorder?	Y/N	Y/N	Y/N	Y/N
4. Is the respiratory failure due to neuromuscular blocking agents, other drugs or potentially reversible causes of apnoea (eg. cervical injury, profound neuromuscular weakness)?	Y/N	Y/N	Y/N	Y/N

<b>Tests for Absence of Brain-Stem Function</b>				
	<b>1<sup>st</sup> Test Dr One Examining</b>	<b>1<sup>st</sup> Test Dr Two Observing</b>	<b>2<sup>nd</sup> Test Dr One Observing</b>	<b>2<sup>nd</sup> Test Dr Two Examining</b>
<b>Brain-Stem Reflexes</b>				
1. Do the pupils react to light?	Y/N	Y/N	Y/N	Y/N
2. Is there any eye movement when each cornea is touched in turn?	Y/N	Y/N	Y/N	Y/N
3. Is there nystagmus or any eye movement present when each ear is instilled with 50mls ice cold water?	Y/N	Y/N	Y/N	Y/N
4. Is the gag reflex present?	Y/N	Y/N	Y/N	Y/N
Is the cough reflex response present when a suction catheter is passed down the trachea?	Y/N	Y/N	Y/N	Y/N
5. Is there any motor response when supraorbital pressure is applied?	Y/N	Y/N	Y/N	Y/N
<b>Apnoea Test</b>				
Arterial Blood Gas Result pre apnoea test: Starting paCO <sub>2</sub> KPa (paCO <sub>2</sub> should be > 6.0 KPa) Starting pH (pH should be <7.4)	1 <sup>st</sup> Test Starting paCO <sub>2</sub> :  Starting pH:		2 <sup>nd</sup> Test Starting paCO <sub>2</sub> :  Starting pH:	
Is there any spontaneous respiration within 5 (five) minutes of disconnecting the ventilator?	Y/N	Y/N	Y/N	Y/N
Arterial Blood Gas Result post apnoea test: Final paCO <sub>2</sub> KPa (paCO <sub>2</sub> should have risen by > 0.5 KPa)	1 <sup>st</sup> Test Final paCO <sub>2</sub> :		2 <sup>nd</sup> Test Final paCO <sub>2</sub> :	
<b>Ancillary Investigations Used To Confirm the Diagnosis</b>				
Is there a need for ancillary investigations to confirm the diagnosis? If yes please outline the results of these investigations:	Y/N		Y/N	
<b>Completion of Diagnosis</b>				
<b>Are you satisfied that death has been confirmed following the irreversible cessation of brain-stem-function?</b>	<b>Yes / No</b>		<b>Yes / No</b>	
Legal time of death is when the 1 <sup>st</sup> Test indicates death due to the absence of brain-stem reflexes. Death is confirmed following the 2 <sup>nd</sup> Test.	Date: Time:		Date: Time:	
	Dr One signature  Dr Two signature		Dr One signature  Dr Two signature	

## Documentation Controls

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