

Form for the Diagnosis of Death using Neurological Criteria in Infants less than 2 months old {short version}

This form is consistent with and should be used in conjunction with, the AoMRC¹ (2008) *A Code of Practice for the Diagnosis and Confirmation of Death* and RCPCH (2015) *The diagnosis of death by neurological criteria in infants less than two months old*² and has been endorsed for use by the following institutions: Paediatric Intensive Care Society, Royal College of Paediatrics and Child Health and National Organ Donation Committee: Paediatric Subgroup. Date for review: 1/5/2023

HOSPITAL ADDRESSOGRAPH or

Surname
First Name
Date of Birth
NHS / CHI number

Examining Doctors

The diagnosis of death by neurological criteria should be made by at least two medical practitioners. Both medical practitioners should have been registered with the General Medical Council (or equivalent Professional Body) for more than five years and be competent in the assessment of a patient who may be deceased following the irreversible cessation of brain-stem function and competent in the conduct and interpretation of the brain-stem examination. Both doctors should be competent in the diagnosis of death by neurological criteria, both should be paediatricians or paediatric intensivists and one should be a consultant.

Clinicians unfamiliar with the test should seek advice from Neonatal or Paediatric Intensivists in Regional Units.

Testing should be undertaken by the nominated doctors acting together and must always be performed on two occasions. A complete set of tests should be performed on each occasion, i.e., a total of two sets of tests will be performed. Doctor One may perform the tests while Doctor Two observes; this would constitute the first set. Roles may be reversed for the second set. The tests, in particular the apnoea test, are therefore performed only twice in total.

Preconditions

The following preconditions should be met prior to testing:

- The infant is comatose and mechanically ventilated for apnoea.¹
- The diagnosis of structural brain damage has been established or the immediate cause of coma is known and in particular:
 - Drugs are not the cause of coma
 - Neuromuscular blockade has been demonstrably reversed
 - Core temperature >34°C
 - There is no endocrine or metabolic disturbance that could be the primary cause of the state of unresponsiveness.¹

An additional precondition to be taken in this patient population:

In post-asphyxiated infants, or those receiving intensive care after resuscitation, whether or not they have undergone hypothermia, there should be a period of at least 24 hours of observation during which the preconditions necessary for the assessment of diagnosis of neurological criteria should be present before clinical testing. If there are concerns about residual drug-induced sedation, then this period may need to be extended.²

Diagnostic caution is advised in the following 'Red Flag' patient groups. (Based on the literature and unpublished case reports.) For advice in difficult circumstances contact the local or regional Clinical Lead for Organ Donation, or regional paediatric / neonatal intensive care

1. Testing < 6 hours of the loss of the last brain-stem reflex	4. Patients with any neuro-muscular disorders	6. Prolonged fentanyl infusions
2. Testing < 24 hours from the loss of last brain stem reflex where aetiology primarily anoxic damage	5. Steroids given in space occupying lesions such as abscesses	7. Aetiology primarily located to the brain-stem or posterior fossa
3. Hypothermia 24-hour observation period following re-warming to normothermia		

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Evidence for Irreversible Brain Damage of Known Aetiology

- There should be no doubt that the infant'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. **If in doubt wait and seek advice.**

Drugs

- The infant should not have received any drugs that might still be contributing to the unconsciousness, apnoea and loss of brainstem reflexes (narcotics, hypnotics, sedatives or tranquillisers). Where there is any doubt specific drug levels should be carried out. Testing for DNC should not be carried out if midazolam level is > 10mcg/L, or thiopentone level is > 5mg/L.
- There should be no residual effect from any neuromuscular blocking agents (atracurium, vecuronium or suxamethonium), consider the use of peripheral nerve stimulation.
- Renal or hepatic impairment and immaturity may prolong metabolism / excretion of these drugs.

Temperature, Circulatory, Metabolic or Endocrine Disorders

- Prior to testing aim for: core temperature > 34°C, mean arterial pressure should be consistently > 37mmHg, maintenance of normal respiratory parameters *if possible* (PaCO₂ < 6.0 kPa, PaO₂ >10 kPa and pH 7.35 - 7.45). If prior to testing any cardiovascular or respiratory instability is present, exclude possibility that this is the cause of observed coma and apnoea. For infants with congenital cyanotic heart disease oxygen levels should be kept in their normal range.
- Serum Na⁺ levels below 115 or above 160 mmol/l are associated with unresponsiveness. This should be borne in mind if the primary cause of unresponsiveness is uncertain. Testing for DNC should not be carried out if serum K⁺ <2 mmol/L, or serum PO₄³⁻ and/or Mg²⁺ < 0.5 mmol/L or > 3.0 mmol/L as there may be associated severe neuromuscular weakness.
- Blood glucose should be between 3.0 - 20mmol/L before 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.
- There should be no corneal (blink) reflex (care should be taken to avoid damage to cornea).
- Eye movement should not occur when each ear is instilled, over one minute, with 20 - 50mls of ice cold water, head flexed 30°. Each ear drum should be clearly visualised before the test.
- There should be no motor response within the cranial nerve or somatic distribution in response to supraorbital pressure. Reflex limb and trunk movements (spinal reflexes) may still be present.
- There should be no gag reflex following stimulation to the posterior pharynx or cough reflex following suction catheter placed down the trachea to the carina.

Apnoea Testing

- End tidal carbon dioxide can be used to guide the start of each apnoea test but should not replace the pre and post arterial paCO₂.
- Oxygenation and cardiovascular stability should be maintained through each apnoea test.
- **Confirm PaCO₂ ≥ 5.3 kPa**
- Either use a CPAP circuit (e.g. Neopuff or Ayres T piece) or disconnect the patient from the ventilator and administer oxygen via a catheter in the ETT at a rate of 2 - 6 L/minute.
- There should be no spontaneous respiration over the time period required for the child's pCO₂ to rise. It is recommended that the period of observation should be at least 5 minutes providing haemodynamic stability can be maintained.

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- **Confirm that the PaCO₂ has increased from the starting level by more than 2.7 kPa to greater than 8.0 kPa.** The lack of spontaneous respiratory effort in response to this hypercarbic stimulus is the most important clinical observation during the apnoea test in this population of patients.
- At the conclusion of the apnoea test, manual recruitment manoeuvres should be carried out before resuming mechanical ventilation and ventilation parameters normalised.

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.^{3,4,6}
- NICE guidance and UKPICS Standards recommends that the specialist nurse for organ donation (SN-OD) should be notified at the point when the clinical team declare the intention to perform brain-stem death tests and this is supported by GMC guidance.^{3,4,5}

References

1. Academy of Medical Royal Colleges (2008) "A Code of Practice for the Diagnosis and Confirmation of Death" www.aomrc.org.uk
2. Royal College of Paediatrics and Child Health (2015) "The diagnosis of death by neurological criteria in infants less than two months old" www.rcpch.ac.uk
3. GMC (2010) "Treatment and care towards the end of life." www.gmc-uk.org
4. NICE (2011) "Organ Donation for Transplantation" www.nice.org.uk
5. Report from the Organ Donation Taskforce (2008) "Organs for Transplant" www.webarchive.nationalarchives.gov.uk
6. Paediatric Intensive Care Society (2014) "PICS Organ Donation Standards" <http://picsociety.uk/resources/>
7. A series of helpful education videos are available: <https://www.odt.nhs.uk/deceased-donation/best-practice-guidance/donation-after-brainstem-death/diagnosing-death-using-neurological-criteria/>

Form authorship and feedback

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Patient Name..... DOB..... NHS / CHI number.....

Primary Diagnosis:
Evidence for Irreversible Brain Damage of Known Aetiology:
Diagnostic caution is advised in certain 'Red Flag' patient groups. See Page 1 for details.

Exclusion of Reversible Causes of Coma and Apnoea				
	1 st Test Dr One	1 st Test Dr Two	2 nd Test Dr One	2 nd Test Dr Two
Is the coma due to depressant drugs? Drug Levels (if taken):	Yes / No	Yes / No	Yes / No	Yes / No
Is the infant's core body temperature $\leq 34^{\circ}\text{C}$?	Yes / No	Yes / No	Yes / No	Yes / No
Is the coma due to a circulatory, metabolic or endocrine disorder?	Yes / No	Yes / No	Yes / No	Yes / No
Is the apnoea due to neuromuscular blocking agents, other drugs or a non brain-stem cause (e.g. cervical injury, any neuromuscular weakness)?	Yes / No	Yes / No	Yes / No	Yes / No
Tests for Absence of Brain-Stem Reflexes				
	1 st Test Dr One	1 st Test Dr Two	2 nd Test Dr One	2 nd Test Dr Two
Do the pupils react to light?	Yes / No	Yes / No	Yes / No	Yes / No
Is there any eyelid movement when each cornea is touched in turn?	Yes / No	Yes / No	Yes / No	Yes / No
Is there any motor response when supraorbital pressure is applied?	Yes / No	Yes / No	Yes / No	Yes / No
Is the gag reflex present?	Yes / No	Yes / No	Yes / No	Yes / No
Is the cough reflex present?	Yes / No	Yes / No	Yes / No	Yes / No
Is there any eye movement during or following caloric testing in each ear?	Yes / No	Yes / No	Yes / No	Yes / No

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Apnoea Test				
	1 st Test Dr One	1 st Test Dr Two	2 nd Test Dr One	2 nd Test Dr Two
Arterial Blood Gas pre apnoea test check: (Starting PaCO ₂ ≥ 5.3 kPa)	1 st Test Starting PaCO ₂ :		2 nd Test Starting PaCO ₂ :	
Arterial Blood Gas Result post apnoea test: PaCO ₂ shows a clear rise of > 2.7 kPa (> 20 mmHg) above the baseline to > 8.0 kPa (60 mmHg).	1 st Test Final PaCO ₂ : <i>Perform lung recruitment</i>		2 nd Test Final PaCO ₂ : <i>Perform lung recruitment</i>	
Was there spontaneous respiration during the apnoea test? (To diagnose death using neurological criteria, ALL answers should be NO)	Yes / No	Yes / No	Yes / No	Yes / No
Completion of Diagnosis				
Are you satisfied that death has been confirmed following the irreversible cessation of brain-stem function?	YES / NO		YES / NO	
Legal time of death is when the 1 st Test indicates death due to the absence of brain-stem reflexes. Death is confirmed following the 2 nd Test.	Date: Time: Dr One Name Grade GMC Number Signature		Date: Time: Dr One Name Grade GMC Number Signature	
	Dr Two Name Grade GMC Number Signature		Dr Two Name Grade GMC Number Signature	

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 and the clinical tests of brain-stem function so that each doctor may independently confirm death following irreversible cessation of brain-stem function.