Clinician’s Guide to Establishing the Diagnosis of Brain Death in Adults

Andrew Slivka, MD    Diana Greene-Chandos, MD
June Hinkle, RN    Amy Pope-Harman, MD
Robert Taylor, MD


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• Apnea testing: conditions required for testing, procedure, and interpretation
• Includes the “Criteria for Brain Death Documentation Tool”

Quality Measures
• Appropriate use of confirmatory testing (e.g., when apnea test cannot be completed)
• Brain death determination in a timely manner (e.g., within 6 hours of preliminary evidence of brain death)
• Patients suspected of brain death are appropriately assessed prior to withdrawal of life sustaining treatment
• Completion of the “Brain Death Checklist”
• Appropriate Requestor for organ donation

Disclaimer: Clinical practice guidelines and algorithms at The Ohio State University Medical Center (OSUMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUMC’s guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.

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Establishing the Diagnosis of Brain Death in Adults

The determination of brain death may ONLY be made by an attending physician who is a Neurologist, Neurosurgeon, or Critical Care specialist.

Preliminary Criteria

- Patients who meet the following preliminary criteria must be evaluated:
  - Apparent coma
  - Lack of brain stem reflexes
  - Not over-breathing the ventilator

Evaluation of Coma

- Establish irreversible and proximate cause of coma:
  - The cause of coma can usually be established by history, examination, neuroimaging, and laboratory tests.
  - Test for CNS-depressant drug effect by history, drug screen, or calculation of clearance using 5 half-life’s of the drug (assuming normal hepatic and renal function); or, if available, drug plasma levels below the therapeutic range. (If barbiturate given, serum level < 10 mcg/ml.)
  - Rule out sedating drugs, neuromuscular blocking agents, intoxication (blood alcohol level < 0.08%) or poisoning as cause of coma.
  - Rule out severe acid-base, electrolyte, or endocrine abnormalities.
- Achieve core temperature \( \geq 36^\circ C \) or 96.8° F
- Achieve normal systolic blood pressure \( \geq 100 \text{ mm Hg} \) (may use pharmacologic support).
- Exclusion or correction of complicating medical conditions that may confound clinical assessment.

Perform Neurologic Assessment

- Coma – Patient lacks all evidence of responsiveness.
- Brain stem reflexes—absence of the following:
  - Pupillary response to bright light, documented in both eyes. Pupils must be midrange to dilated (4 mm to 9 mm).
  - Ocular movements using oculocephalic testing and oculovestibular reflex testing -- deviation of the eyes to irrigation of ear with 50 mL of cold water (allow up to 1 minute for response; allow 5 minutes between testing of ears).
  - Corneal reflex.
  - Facial muscle movement to a noxious stimulus
  - Pharyngeal and tracheal reflexes
- Apnea testing - see page 3 for conditions required, procedure, and interpretation of apnea testing.

Confirmatory Testing

- The following confirmatory tests can be used when uncertainty exists about the reliability of parts of the neurologic examination or when the apnea test cannot be performed:
  - Cerebral angiography
  - Electroencephalography (EEG)
  - Scintigraphy (nuclear scan)
- The following conditions may interfere with the clinical diagnosis of brain death, therefore, in such instances confirmatory testing is recommended:
  - Severe facial trauma
  - Pre-existing papillary abnormalities
  - Presence of sedative drugs or neuromuscular blocking agents, or toxic levels of aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs, or chemotherapeutic agents.
  - Sleep apnea or severe pulmonary disease resulting in a chronic retention of CO2
- If confirmatory testing is negative (not consistent with brain death), and if a complete and reliable repeat clinical exam can be done after the initial confirmatory test, further testing is not necessary.
- If a repeat clinical exam cannot be done, confirmatory testing should be repeated in 24 hours.
- To determine the appropriate confirmatory test, consider:
  - Specialist availability.
  - Need to transport a critically ill patient to a diagnostic suite.
  - Clinical factors that may interfere with test interpretation.

Repeat Clinical Assessment

- When the full clinical examination, including both assessments of brain stem reflexes and the apnea test is conclusively performed, no additional testing is required to determine brain death.
- If testing is not consistent with brain death, repeat the assessment at a clinically appropriate interval.

See page 2 for Brain Death Determination Process Flowchart.
Brain Death Determination Process Flowchart

Neurological Examination and Apnea Testing

- Inconsistent with Brain Death
- Cannot be Completed or Unreliable
- Consistent with Brain Death

Order Confirmatory Testing

- **Negative**
  - Not Consistent with Brain Death
  - Unable to Do Repeat Clinical Exam
  - Repeat Confirmatory Testing in 24 hours

- **Positive**
  - Consistent with Brain Death
  - Able to Do Reliable and Complete Repeat Clinical Exam (Can be done any time after initial confirmatory testing)
  - No Further Testing Necessary

Complete Checklist and Initiate Organ Procurement Process
Apnea Testing

Obtain apnea testing only if these conditions are present:
- Core temperature > 36°C or 96.8°F.
- Systolic blood pressure ≥ 100 mm Hg (may use pharmacologic support).
- Euvolemia.
- Normal PaCO2 (35-45 mm Hg).
- Normal PaO2 (or preoxygenation to obtain > 200 mm Hg).

If these conditions are not present, defer apnea testing until these conditions are met, or use confirmatory test.

Procedure for Apnea Testing

- After pre-oxygenation for at least 10 minutes with 100% oxygen, draw a blood gas and maintain normal PCO2 level.
- If SpO2 remains > 95%, disconnect the ventilator, maintain pulse oximetry.
- Deliver 100% O2 via tracheal cannula at least 6 L/min.
- Watch for respiratory movements that produce abdominal or chest excursion and this may include a brief gasp.
- This does not include reflexive shoulder movement, back arching, or intercostal movement without significant tidal flow.
- After approximately 8 minutes (or as soon as adequate respirations observed), obtain arterial blood gas and resume ventilation.
- Obtain arterial blood gas and reconnect ventilator if:
  - SBP drops below 90 mm Hg or
  - MAP drops below 60 or
  - O2 saturation drops < 85% for 30 seconds or
  - Cardiac dysrhythmias develop

Interpretation of Apnea Testing

- Respiration observed the patient is not brain dead.
- Repeat as clinically indicated.
- No respiration observed, and PCO2 ≥ 60 mm Hg or increases by 20 mm Hg or more over baseline — testing supports the diagnosis of brain death.
- Clinical deterioration and PCO2 does not increase over 60 mm Hg or by 20 mm Hg over baseline—testing is inconclusive, proceed with additional confirmatory testing.
- If inconclusive, you may repeat the apnea test with a longer period of preoxygenation or proceed to confirmatory testing.
- In the majority of patients, brain death can be diagnosed clinically with a thorough neurologic examination and apnea testing. The neurologic examination should be conducted by an attending physician who is a Neurologist, Neurosurgeon, or Critical Care specialist.

Organ Transplantation and Brain Death

- Family members who inquire about organ donation should be referred to the Lifeline of Ohio Organ Procurement (LOOP) representative or the OSUMC Family Care Coordinator at beeper 2828.
- Brain dead patients who have provided first-person authorization through the Ohio Donor Registry are eligible for organ donation, provided that medical screening by LOOP shows no contraindications. First-person authorization outweighs objections by the family, both legally and ethically.
- To avoid a conflict of interest, the physician who determines and/or certifies the death of a potential organ or tissue donor should not be involved in the organ or tissue removal, nor in subsequent transplantation procedures, nor be responsible for the care of potential recipients.

Physiologic Support and Brain Death

- If a brain dead patient is a candidate for organ procurement, maintain physiologic support as needed until the organ procurement screening process is complete.
- If the patient is not a candidate for organ procurement, removal of physiologic support should occur expeditiously, with time allowed for family bereavement.
- If the patient is not a candidate for organ procurement, explain to the family, with compassion, that the decision to withdraw physiologic support is a requirement, not an option. Some flexibility can be used in timing of the withdrawal.

Documentation Requirements

All phases of the determination of brain death should be documented in the Medical Record using the “Brain Death Testing Documentation Form” (see page 4).

Reference

### Brain Death Testing Documentation Form

#### Clinical Evaluation (prerequisites):

- ☐ Establish irreversible and proximate cause of coma. Etiology: ________________________________
- ☐ Neuroimaging consistent with etiology of coma
- ☐ CNS-depressant drug effect absent (if indicated, toxicology screen; if barbiturates given; serum level < 10 mcg/ml)
- ☐ No evidence of residual paralytics (electrical stimulation if paralytics used)
- ☐ Absence of severe acid-base, electrolyte, or endocrine abnormality
- ☐ Normothermia or mild hypothermia (core temperature ≥ 36°C or 98.6°F)
- ☐ Systolic blood pressure > 100 mm Hg; note: vasopressors or vasopressin are often required
- ☐ No spontaneous respirations

If ALL of the above items are checked, perform neurological examination to continue with brain death determination.

#### Neurological Examination

- ☐ Pupil non-reactive to bright light
- ☐ Corneal reflex absent
- ☐ Oculocephalic reflex absent (Doll’s eyes); note: tested only if C-spine integrity ensured
- ☐ Oculovestibular reflex absent
- ☐ No facial movement to noxious stimuli at supraorbital nerve, temporomandibular joint
- ☐ Gag reflex absent
- ☐ Cough reflex absent to tracheal suctioning
- ☐ Absence of motor response to noxious stimuli in all 4 limbs (spinally mediated reflexes are permissible)

If ALL of the above are checked and consistent with brain death, perform apnea test to continue with brain death determination.

- ☐ If any of the above cannot be completed or are inconclusive, order confirmatory test.

#### Apnea Test

- ☐ No spontaneous respirations observed
- ☐ PaCO₂ ≥ 60 mm Hg or 20 mm Hg increase over baseline

If both of the items above are checked, the apnea result is positive (i.e., supports the clinical diagnosis of brain death)

- ☐ If Apnea test is inconclusive or cannot be completed, order confirmatory test.

Reason Apnea test cannot be completed: __________________________________________________

#### Confirmatory Testing (if clinical exam cannot be fully performed due to patient factors or if apnea testing inconclusive or aborted):

- ☐ Results consistent with brain death

- ☐ Patient DOES MEET criteria for brain death
- ☐ Patient DOES NOT MEET criteria for brain death

Exam completed by:
Patient Name: ________________________________

Medical Record Number: ________________________________

Date of Birth: ________________________________
Attending Physician Signature: ________________________________

Date: ____________________ Time: ____________________