

BRAIN DEATH PROTOCOL

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PURPOSE: To establish guidelines for the determination of brain death in adult patients at UAB Medical Center.

PHILOSOPHY: It is our belief that there should be a standard for determination of brain death that is consistent with Alabama state law and medical ethics.

ASSOCIATED INFORMATION:

Definitions

1. Brain Death is a clinical diagnosis comprised of the complete and irreversible cessation of all functions of the entire brain, including the brain stem.
2. Electrocerebral silence (ECS) is the lack of detectable electrical cerebral activity using standard electroencephalographic parameters used for brain death evaluation.
3. Pupillary reflexes: Pupils constrict to direct light.
4. Corneal reflexes: There is a blink response (which may be partial) to corneal stimulation.
5. Oculocephalic reflex (Doll's Eyes): Eyes rotate to the opposite side of the direction of head rotation.
6. Oculovestibular reflex: There is deviation of the eyes during or following the slow injection of at least 20 mL of iced water into the external acoustic meatus, with the head of bed at 30 degrees.
7. Oropharyngeal or tracheal reflexes: Pharyngeal or tracheal stimulation elicits cough or gag.
8. Spontaneous respiration: Abdominal or chest excursions that produce any

measurable tidal volume.

POLICY:

Established standards and recommendations shall be utilized as guidelines to assist the medical and nursing staff in determining brain death.

A patient determined to be brain dead is legally and clinically dead.

- The diagnosis of brain death is a clinical one and may be made by any licensed physician. However, complex, spontaneous motor movements and false-positive triggering of the ventilator may occur in patients who are brain dead. Therefore, the complexities of an individual case often require nuanced decision making and clinical experience. For this reason, **at least one member of the UAB Hospital active medical staff must be involved in making a clinical diagnosis of brain death.**
- The proximate cause of brain death must be sought and must be known to be irreversible (e.g. Massive intracerebral hemorrhage, gunshot wound to the head, tumor with herniation).
 - There must be clinical and/or neuroimaging evidence of a central nervous system catastrophe that is compatible with the clinical diagnosis of death by brain criteria.
- Two physicians must complete and document a brain death exam.
 - Only one exam needs to include an assessment of spontaneous respiration.
 - If the diagnosis is certain, the exams do not need to be separated by a period of observation.
 - Neither the physician making the determination of death nor the physician making the independent confirmation shall participate in the procedures for removing or transplanting an organ or body part.

- If the cause of the patient's unresponsive state is unclear, or if prognosis for recovery remains uncertain (for example, possible ingestion of CNS-depressing substances, recent cardiac arrest with ROSC, recent therapeutic hypothermia, or if other confounding factors are present), a delay in brain death diagnosis is recommended, typically 6-12 hours, until uncertainty is eliminated or minimized to the extent possible. In situations where the etiology of the coma cannot be determined definitively despite reasonable efforts, corroboratory testing should be considered.
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- Before the clinical brain death evaluation begins, the patient should be evaluated for factors that may simulate brain death and the absence of these factors should be established and documented.
 - Especially important are detection of toxic and metabolic disorders, sedative-hypnotic drugs, alcohol, paralytic agents, hypothermia (core temperature less than or equal to 36 degrees Celsius or 96.8 degrees Fahrenheit), shock (systolic BP less than 90 mmHg), and surgically remediable conditions.
 - Prior to performing a brain death evaluation, the presence of CNS-depressant drug effect should be excluded by history or drug screen. If significant doses of CNS-depressing medications have been administered recently, a reversal agent may be considered. If reversal is not feasible and if serum levels are available, a serum level below the therapeutic range should be targeted. Alternatively, calculation of a drug's clearance using 5 times the drug's half-life (in patients with normal renal and hepatic function) may provide a useful guideline if there is ongoing concern about clinically significant medication effects. If the clinical situation precludes this waiting period, or if there is

high suspicion for unknown, non-measurable, or irreversible CNS-depressants, corroboratory testing should be utilized.

Three primary criteria shall be met, in ordinary circumstances, to establish brain death:

- The absence of cerebral function.
 - The absence of brain stem function, including spontaneous respirations.
 - The irreversibility of the condition.
1. The absence of cerebral function shall be established as follows:
 - Cerebral function is absent when no movement is observed and no response is detected to centrally applied deep pain stimulation.
 - Spinal mediated responses (such as superficial and tendon reflexes) may be induced by noxious stimuli applied to the extremities or periphery. **Spontaneous spinal reflexes, or spinal-spinal reflexes may be compatible with brain death**. Complex integrated motor movements should call the diagnosis of brain death into question.
 2. The absence of brain stem function shall be established as follows:
 - Brain stem function is absent when none of the following cephalic reflexes occur and cannot be elicited by stimulation of any part of the body, and no respiratory movements occur either spontaneously or during the apnea test. Loss of cephalic reflexes produces the following findings:
 - Absent Pupillary Reflexes. Pupils under 5mm in diameter increase the suspicion of drug intoxication.
 - Absent Corneal Reflexes.
 - Absent Oculocephalic reflex (doll's eyes).

- Oculovestibular Reflex. Visual inspection of the external auditory canal should be carried out to rule out obstruction.
- Absent Oropharyngeal or Tracheal Reflexes.
- Absence of Spontaneous Respiration.
- Apnea Test
 - The apnea test should be reserved as a final diagnostic verification and only used when the diagnosis of brain death is reasonably certain or after all other cerebral and brain stem responses have irreversibly disappeared.
 - PROCEDURE:
 1. The apnea test should be preceded by ventilating the patient for 10-15 minutes with 100% oxygen to minimize hypoxemia during the test period.
 2. A baseline arterial blood gas is obtained following this 10-15 minute period of hyper-oxygenation.
 3. In order to perform a successful apnea test, adequate oxygenation ($SaO_2 > 90\%$), intravascular volume, and blood pressure ($SBP > 90$ mmHg) should be present. The body temperature should be raised to near-normal levels of 36.1 degrees C (96.9 degrees F) or greater using a warming blanket if needed.
 4. Prior to the test, the ventilator should be adjusted to bring the $PaCO_2$ 35-45 mmHg (eucapnia). In patients with significant baseline hypercapnia (due to COPD or chronic hypoventilation), an ancillary test should be considered.
 5. The patient is then removed from the ventilator. Supplementary oxygen at a rate of 6 to 8 L/min is given through a narrow bore cannula inserted into the endotracheal tube to the level of the carina. The

patient is observed closely for any respiratory movements.

6. The apnea test is aborted prematurely if:
 - the patient makes respiratory attempts;
 - significant hypotension (SBP < 90) occurs;
 - O₂ saturation drops below 80% on pulse oximetry;
 - significant cardiac dysrhythmias occur.
 7. After an interval of 6 minutes passes, with the patient's vital signs remaining stable and no respiratory efforts being noted, a post apnea test arterial blood gas is obtained.
 - A pCO₂ of >60 mmHg or increase in pCO₂ of >20 mmHg in the absence of respiratory effort indicates a loss of brainstem respiratory drive. Either of these results supports the diagnosis of brain death and is considered a positive apnea test.
 - If the apnea test must be aborted prematurely, a blood gas should be obtained at the time of resumed mechanical ventilation. If the pCO₂ meets requirements set forth above, the test may be considered positive and supportive of a brain death diagnosis. Otherwise, the test is indeterminate and may suggest the need for ancillary testing or a repeat apnea test with improved hemodynamic support.
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Corroborating Laboratory Tests in the diagnosis of brain death

Includes electroencephalography, conventional angiography and transcranial Doppler ultrasonography. **Brain death remains a clinical diagnosis and confirmatory tests are not mandatory in most cases.** A confirmatory test may be used in cases where specific components of clinical testing cannot be reliably evaluated.

- Electroencephalogram (EEG) Note - The EEG does not detect brain stem activity, and electrocortical silence (ECS) does not exclude the possibility of reversible coma. A minimum of thirty minutes of recording time performed according to American Clinical Neurophysiology Society standards is necessary. Lack of electro-cortical activity signifies ECS.
 - A repeat EEG should be performed if there is doubt about ECS.
 - The above-mentioned procedure for establishing cerebral death does not include young children (under the age of 3) or infants.
- Transcranial Doppler Ultrasonography
 - Demonstration of a blood flow velocity waveform consisting of a sharp systolic peak followed by cessation of flow during diastole or an oscillatory waveform showing reversal of flow during diastole indicates cessation of cerebral blood flow and, along with significant clinical findings as outlined above, is compatible with brain death.
- Catheter angiography
 - Absence of intracerebral arterial filling with contrast injections in the bilateral anterior and posterior circulations is consistent with brain death.
- Nuclear Cerebral Vascular Blood Flow Study

- The cerebral blood flow (CBF) study involves the injection of a radioactive isotope into the blood stream. Images are obtained. Absence of detectable brain perfusion is consistent with brain death.
 - There is insufficient evidence –based or consensus data to recommend the use of CT angiography, MRI, MR angiography, or somatosensory evoked potentials for brain death determination; thus, these are not currently considered acceptable ancillary tests.
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Medical Record Documentation

- The declaration of death by brain criteria must be documented in the medical record as a death note in a manner similar to any other declaration of death and should include the following:
 - Etiology and irreversibility of coma.
 - Potential confounding conditions that may simulate brain death have been sought out and excluded.
 - Absence of motor response to pain.
 - Absence of brain stem reflexes.
 - Details of the apnea test, including pre- and post-test arterial blood gas values.
 - Justification for ancillary testing, if performed, along with results and name of attending physician responsible for their interpretation.
 - The date and time of declaration and the name of the physician declaring death by brain criteria.
 - Certification of brain death by the confirming physician is the formal pronouncement of death.

- All deaths and imminent deaths shall be reported to Alabama Organ Center (AOC) in a timely manner. (See Policy I 168r8).
- If determined by AOC that organ donation is not an option, all artificial means of support shall stop immediately. At the request of the family of the deceased, and with the physician agreement, support may be continued for a short period of time (up to two hours, or longer at the discretion of the attending MD) with compelling social reasons (i.e., there is a family en route to the hospital and will arrive shortly, clergy is enroute to conduct post mortem rituals). (See Death Care policy).

- The time documented for this certification is the time of patient death to be used for all legal matters, including the death certificate issued by the hospital.

- The pronouncement of death is by law a medical act, and therefore, consent is not required nor is it to be requested from the next-of-kin. However, the attending physician and/or designees must give the patient's family full information concerning the certification process.
 - If the family has voiced disbelief in the diagnosis, the involved clinicians shall further explain the rationale for the determination of death using neurologic criteria.
 - If conflict continues, consultations with Risk Management and the UAB Ethics Committee are necessary to assist with resolution.

REFERENCE:

UAB Medicine, Interdisciplinary Policy: Guidelines for the Determination of Brain Death in Adult Patients.

