BRAIN DEATH EVALUATION	PENNSTATE The Milton S. Hershey Medical Center
Hershey Medical Center – Hospital Administrative Manual	**Policy Number: L-06 HAM**
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Authorized: _____ Executive Director	
Approved: _____ Michael J. Green, MD, MS Chairman, Ethics Committee	

POLICY STATEMENT

1. Brain death is defined as the irreversible loss of function of the brain, including the brainstem (1). The cardinal findings in brain death are: a) persistent coma or unresponsiveness; b) absence of brain stem reflexes; and c) apnea, in a patient whose pathogenesis of neurological dysfunction is known to be irreversible.

2. The determination of brain death requires a two-step process of: 1) review and evaluation of the patient by an attending physician in Neurology or Neurosurgery to be sure that the pathogenesis of neurological dysfunction is irreversible and 2) a standardized examination to document the absence of brain function.

3. The standardized examination may be performed by an attending physician in Neurology, Neurosurgery, or Critical Care; a fellow in Critical Care; or a resident (PGY-3 or higher) in Neurology or Neurosurgery at the discretion of the Neurology or Neurosurgery attending physician. Examinations will follow parameters established by the American Academy of Neurology as general guidelines (2) (see attached Brain Death Evaluation Guidelines). Two different physicians will perform the examinations, with the time between examinations to follow the guidelines below. In adults, an attending physician in Neurology, Neurosurgery, or Critical Care must be responsible for at least one examination. For neonatal and pediatric patients, an attending physician in Neurology, Neurosurgery, Neonatology, or Pediatric Intensive Care Medicine must be responsible for the examinations. Individuals involved in the transplant coordination or organ procurement process will not be eligible to perform the examinations.

4. If brain death criteria are fulfilled on one examination, a repeat examination and the confirmation of those criteria are necessary prior to a declaration of brain death. The second examination in adults should be conducted approximately six hours after the first examination. The duration of the observation interval between the first and second examination in children is age-dependent, and will be guided by clinical circumstances. The recommended intervals between examinations are: premature infants and any infant under 7 days of age - 48 hours to 72 hours; infants between 7 days and 2 months - 48 hours; children between 2 months and one year - 24 hours; children over 1 year of age -

12 hours but the interval may be as short as 6 hours in older children and adolescents, depending upon the clinical circumstances as determined by the attending intensive care physician (neonatologist or pediatric intensivist) and the neurologist or neurosurgeon (3).

5. Clinical examinations to determine the absence of brain function will meet accepted professional standards. The examination for brain death will be invalid in the presence of any of the following:

a) Core temperature less than 32° C or 90° F
b) Severe electrolyte, endocrine, or acid base disturbances that may confound clinical assessment of coma
c) Shock
d) Intoxication from drugs or poisons
e) Conditions resulting in chronic severe hypercapnia
f) Neuromuscular blockade

6. Confirmatory tests for brain death (electroencephalography, angiography, radio nuclide brain scan) are not necessary in adults or children. They may be performed to confirm the diagnosis of brain death if clinically indicated (4).

References

1. Pennsylvania Uniform Determination of Death Act, 1982, amended 1994

2. American Academy of Neurology. Practice parameters for determining brain death in adults. Neurology 1995, 45:1012-1014

3. American Academy of Pediatrics. Report of special task force guidelines for the determination of brain death in children. Pediatrics 1987, 80:296-300

4. Wijdicks EFM. Current concepts: The diagnosis of brain death. New Eng J Med 2001, 344:1215-1221

PERSON RESPONSIBLE FOR REVIEW OF POLICY

Chairman, Ethics Committee

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Brain Death Evaluation	Effective: October 2007

Brain Death Evaluation Guidelines

Definition: Brain death is the irreversible loss of function of the brain, including the brainstem. BRAIN DEATH IS DEATH. (Source: Pennsylvania Uniform Determination of Death Act, 1982, American Academy of Neurology, 1995)

Some causes: Severe head injury, subarachnoid hemorrhage, anoxia, stroke, and brain tumors. Death occurs when the brain no longer has a blood supply.

Why making the diagnosis of brain death matters: For family acceptance of death, organ donation and/or discontinuing use of resources after death has occurred.

Prerequisites to the clinical exam: Proximate cause is known and irreversible, no sedative or drug intoxication or poisoning present, no neuromuscular blocking agents present (check a "train of four" if any question), core temperature > 32° C, no shock (SBP>90 mmHg), absence of severe electrolyte, fluid, acid-base, or endocrine disorder that may confound clinical assessment. (Source: American Academy of Neurology, Neurology 1995, 45:1012-1014)

Findings of brain death on clinical exam: 1) no central (brain or brainstem) response either spontaneously or in response to a centrally applied painful stimulus, although spinal reflexes may persist; 2) absence of brainstem reflexes (no pupillary response to light, no corneal reflexes, no oculocephalic reflex, no eye movements to cold calorics, no cough or gag); and 3) apnea (no respiratory effort in the face of an elevated pCO2). In adults, the exam needs to be repeated in approximately 6 hours by a different physician and the time and results of both exams should be documented in the medical record. In children, the timing of the second exam is determined by the child's age and clinical circumstances, as outlined in the Policy Statement. The time of death is the time of the completion of the second evaluation.

Who is qualified to conduct the clinical exam: To be qualified to conduct this exam in adults, one must be an attending physician in Neurology, Neurosurgery, or Critical Care, a fellow in Critical Care, or a resident (PGY-3 or higher) in Neurology or Neurosurgery. Although the standardized examination may be performed by an appropriately trained resident, review of the patient and determination of brain death remain the responsibility of attending physicians. To be qualified to conduct this exam in children, one must be an attending Neurologist, Neurosurgeon, Neonatologist, or Pediatric Intensivist.

For adults and children, the examinations should not be performed by anyone involved in the transplant coordination or organ procurement process.

What are the confirmatory tests: Isoelectric EEG, radionuclide scans with absence of isotope uptake in the brain (preferred test), or angiography without evidence of cerebral perfusion.

When confirmatory tests may be indicated: While confirmatory studies are not mandatory for the determination of brain death in adults or children, some reasons for conducting confirmatory studies may include: severe facial trauma, preexisting pupil abnormalities, toxic drug levels, hypothermia, chronic severe hypercapnia, inability to tolerate the apnea test, conditions that result in a de-efferented state, such as acute cervical spinal cord or brain stem injury, severe Guillain-Barre syndrome, severe myasthenia gravis, or pontine injury resulting in a locked-in state.

Organ donation: Notify the Gift of Life of a potential organ donor. Keep the family up to date on the patient's condition discussing the possibility of brain death and providing information to help them understand what brain death is. The family must understand brain death and acknowledge the patient's death before organ donation is mentioned. The discussions about organ donation should be done with the Gift of Life Coordinator present. In the meantime, maintain hemodynamic stability.

How to perform a clinical evaluation for brain death in an adult:

- Be sure the patient meets the prerequisites for a clinical examination as above.
- Observe the patient for spontaneous movement or movement or grimacing in response to pain created in all four extremities by nail-bed pressure, by supraorbital ridge pressure, and by temporomandibular joint pressure. If there is any movement or response the patient is not brain dead and the test should be terminated. Note however that there may be spinal reflexes (Babinski, deep tendon reflexes) in the presence of brain death.
- Check pupil size (expect midposition to dilated, 4-9 mm) and look for absence of response to bright light.
- Check for absence of corneal response by lightly touching the cornea of both eyes with a swab or gauze. There should be no blinking of the eyelids.
- Check for absence of a jaw reflex.
- Turn the head from side to side (if no cervical spine fracture or instability) and look for an oculocephalic response (doll's eyes). In brain death the eyes should stay with the head as it is moved ("no doll's eyes").
- Prior to cold caloric testing, be sure the ear canal is patent. Then using a syringe and butterfly tubing without the needle instill about 50 ml of ice water into each ear canal and observe the eyes. Watch for one minute after instillation, and allow at least five minutes between ears. If brain death is present, there should be no eye movements.
- Suction the endotracheal tube to observe for an absence of cough. Use the Yankaur suction or tongue blade to check for a gag in the posterior pharynx.
- Perform the apnea test as below.
- Document the brain death evaluation in the medical record.
- Inform the family of the results of the examination.
- Repeat the entire evaluation, including the apnea test in approximately 6 hours with a different examiner.

How to perform an apnea test (adult):

- Goals are to maintain oxygenation, allow pCO2 to rise, and document the absence of respiratory effort.
- The physician should stay at the bedside during the apnea test.
- The patient must be attached to a pulse oximeter.
- Pre-oxygenate with 100% oxygen for 5-10 minutes.
- Send an arterial blood gas prior to the start of the apnea test. It is advisable to start with a pCO2 of 35-40 mmHg and a pO2 of > 200 mmHg.
- Disconnect the ventilator and administer 6-12 liters of oxygen via a tracheal catheter inserted down the endotracheal tube (insufflation). You may use a suction catheter with the thumb suction port covered by tape. Estimate the distance into the trachea and try not to insert the catheter into the main stem bronchus as it may lead to desaturation.
- Observe continuously for spontaneous respiratory effort (abdominal or chest excursions), desaturation, or hemodynamic instability. Any of these mean that the test must end. The patient may be monitored using an end-tidal CO2 monitor or respiratory monitor to assist in observing for respirations.
- Observe with only insufflation of oxygen until the pCO2 is > 60 mmHg or increased 20 mmHg over baseline normal pCO2. CO2 raises about 3 mmHg per minute, so you can estimate how long that will take.
- Send an arterial blood gas and reconnect the ventilator. If the pCO2 is not > 60 mmHg, the apnea test should be repeated.
- If hypotension, desaturation, or arrhythmias occur before the test can be completed, return the patient to the ventilator and consider confirmatory testing.
- If respiratory movements are observed, the apnea test results are negative, and the patient has not suffered brain death.
- If respiratory movements are absent and arterial pCO2 is > 60 mmHg, the apnea test result is positive and supports the diagnosis of brain death.

Confirmatory Studies for the Determination of Electrocerebral Inactivity:

Electroencephalogram (EEG)

All personnel involved should be aware of methods of enhancing the value of the EEG in the determination of electrocerebral inactivity. The laboratory personnel performing an EEG should be careful to note any possible technical artifacts which may contaminate the record. Artifacts may be produced from a variety of sources including: intravenous drip and infusion devices, EKG, ventilators, and movement of people about the room during the recording. Intensive Care Unit personnel should be aware that they may be able to enhance the diagnostic accuracy of the test by restricting their movements near the patient during the test. Temporary neuromuscular blockade with agents such as succinylcholine or pancuronium are often invaluable to the EEG recording, because these drugs can temporarily attenuate muscle activity which obscures the electroencephalographic record. In the presence of low-amplitude muscle artifact, an EEG diagnosis of electrocerebral silence may be difficult to determine; temporary

neuromuscular blockade may improve the ability to diagnose electrocerebral inactivity through elimination of muscle artifact. It should be noted that the findings on clinical examination cannot be accurately assessed in the presence of neuromuscular blockade.

Laboratory technologists performing EEGs should be aware of the standards for such recordings, particularly the need for 1) recording at high sensitivity (at least two microvolts per millimeter); 2) using interelectrode distances of at least 10 cm in adults; 3) using appropriate filter settings and appropriate activation procedures during the recording; and 4) recording for at least 30 minutes. Intensive Care Unit and EEG laboratory personnel must be aware of the technical limitations of the test and of the possibility that a specific test may be non-diagnostic. A non-diagnostic EEG is not the same as an EEG demonstrating electrocerebral activity. In the event of a non-diagnostic EEG, the test may be repeated or a decision regarding the diagnosis of brain death may be made on other clinical grounds.

Imaging and other vascular flow studies

The criteria for such studies are less clearly defined than for EEG, but the absence of intracranial blood flow is an accepted indicator of brain death. These studies are of particular importance in certain instances, most notably when barbiturates, hypothermia or other treatments that suppress cerebral function are being used. In such instances, the clinical examination of EEG may not be sufficient for brain death determination. The demonstration of absent cerebral blood flow by imaging or flow studies can be used to confirm the diagnosis of brain death.