

Determining Brain Death: A Summary

B Phillips

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Abstract

We describe a standard approach regarding declaration of death by brain criteria.

DECLARATION OF DEATH BY BRAIN CRITERIA STATEMENT

Death by brain criteria is a clinical diagnosis that can be made when there is complete and irreversible cessation of all brain function. Since it is now technically possible to sustain cardiac, circulatory, respiratory and other organ function after the brain has ceased to be alive; a diagnosis of death by brain criteria can be made before the heart beat stops. The diagnosis of death by brain criteria is based primarily on clinical criteria. A confirmatory laboratory test may be done to supplement the clinical diagnosis. An individual with irreversible cessation of all brain function, including the brain stem, is dead. By Federal Law, you must notify the Organ Bank as soon as you believe death by brain criteria may occur (do not wait until after you have made the declaration).

APPLICATION

Adults and children 5 years and older.

EXCEPTIONS

For children younger than 5 years of age, consultation with a pediatric neurologist or neurosurgeon should be obtained.

PROCEDURE

PREREQUISITES

The presence of sedative drugs, hypothermia, shock, or other potentially reversible conditions that may depress brain function must be excluded for these clinical criteria to be valid:

1. Body temperature must be 32.2 degree C (90 degree F) or higher,
2. If barbiturates are present in the blood, or were

used therapeutically for control of intracranial pressure or seizures, serum levels should not exceed 1 mg. % at the time of the clinical examination.

3. Screen to exclude other sedative drugs – where clinically indicated.
4. Absence of severe hypotension (shock).

CLINICAL CRITERIA

The clinical examination should be done by a neurologist, neurosurgeon, or critical care attending familiar with the neurological examination and with these criteria:

1. Coma with cerebral unresponsivity
2. Apnea
3. Absent brain stem reflexes
4. Persistence of condition for at least 6 to 24 hours

A. UNRESPONSIVE COMA

The patient should be deeply comatose with no movements, no withdrawal, seizures, or posturing (decerebrate or decorticate), spontaneously or to noxious stimulation. There may be spinal cord reflexes.

B. APNEA

Apnea may be demonstrated by the absence of spontaneous respiration in the presence of an adequate carbon dioxide (CO₂) drive. The apnea test is a clinical bedside test to determine the response of the medullary brainstem respiratory center to a CO₂ stimulus. In the absence of significant pulmonary disease or neuromuscular paralysis, a

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lack of respiratory effort to hypercarbia implies destruction of the most caudal part of the brain stem.

The test is begun by pre-oxygenation with 100% oxygen via the ventilator for about 5 minutes. The ventilator is withdrawn and the trachea is cannulated with an oxygen catheter. A passive flow of 100% oxygen at 4 l/minute allows the PCO₂ to rise without hypoxia. A baseline arterial blood gas (ABG) is drawn to ensure that the PCO₂ is normalized. Observe the patient's undraped chest and abdomen for respiratory effort. After 5 and 10 minutes an ABG is drawn and the patient returned to the ventilator. A pulse oximeter should be used.

If in the presence of a negative drug screen and in the absence of metabolic intoxication, evidence of a paralyzing disease (e.g. Guillain-Barre, Myasthenia Gravis), or of neuromuscular blockade, there is no respiratory effort after an arterial PCO₂ of more than 60mm Hg has been achieved, the patient is apneic. Usually an ABG is drawn at baseline, 5 and 10 minutes.

The apnea test is done near the end of the period of observation. Patients whose PO₂ cannot be maintained at normal levels may be excluded from a formal apnea test.

RECOMMENDED PROCEDURE

A. Prerequisites:

1. Core temperature should be at least 90°F (32.2°C)
2. The patient should be hemodynamically stable.
3. A baseline ABG has been obtained and the results show that the PaO₂ is greater than 80, or O₂ saturation is at least 95% and the PCO₂ in 35-45 mm Hg.
4. If the patient has a history of COPD or other chronic pulmonary disease, a pulmonary consult may be obtained.
5. If the patient has received medications which may interfere with apnea testing, consultation with a neurologist, a neurosurgeon, an anesthesiologist or a toxicologist may be sought. If there is any question concerning narcotic toxicity, a narcotic antagonist should be given.

B. Equipment and Personnel

1. Suction catheter of appropriate size with

connecting tubing

2. Sterile gloves
3. Oxygen or suction connecting tubing
4. Oxygen flow meter with nipple
5. ABG kits, pulse oximeter, cardiac monitor
6. Nursing and respiratory therapy personnel may be of assistance in performing the procedure.

C. Suction the patient according to the standard procedure

D. Pre-oxygenate the patient with 100% oxygen on present means of respiratory support for 5 minutes

E. Remove patient from the ventilator (if possible); observe the time the test is started.

F. Insert catheter into the endotracheal or tracheostomy tube. Care must be taken not to intubate a mainstem bronchus; the tip of the catheter should be at, or a few millimeters below, the tip of the endotracheal or tracheostomy tube.

G. Attach the aspirator manifold of the catheter to the oxygen flow meter via the oxygen connecting tubing. Tape over the aspirator manifold port or occlude it with your thumb throughout the remainder of the procedure.

H. Set the flow meter for 4 lpm. Monitor SaO₂ by pulse oximeter.

I. It is suggested that starting PaCO₂ be 35-45 Torr. The PaCO₂ will be allowed to rise while the undraped thorax and abdomen are observed and palpated carefully for signs of spontaneous respirations.

J. An ABG should be drawn at approximately 5 minutes and 10 minutes of elapsed time to establish that the paCO₂ has reached 60mm Hg.

K. If there are any respirations or if there is a loss of vital signs or oxygen desaturation below 90%, draw ABG and discontinue the test immediately. Reconnect the patient to ventilatory support after 10 hyperinflating breaths with the resuscitation bag using 100% oxygen.

L. The test is over after approximately 10 minutes. If there is no respiratory effort after an arterial PCO₂ of more than 60 mm Hg has been achieved, the patient is apneic. Repeat testing for a period of time longer than 10 minutes may be

required if PaCO₂ is below 60 at the end of this test.

M. Discontinue the test by hyperinflating with a resuscitation bag on 100% oxygen for a brief period until the patient's vital signs are stable and his/her color is normal. Resume pre-test ventilation.

N. Document test results in progress notes and on the Patient Flow Sheet. Include vital signs, ABG, SaO₂, clinical observations and personnel performing the test. It is recognized that on some occasions departure from the above procedures may be necessary. The reasons for such departure, if taken, should be documented in the patient's record.

ABSENT BRAIN STEM REFLEXES

1. The pupils should be mid position in size (4mm) or dilated in the absence of mydriatics and unreactive to bright light or noxious stimulation.
2. Eye movements- There should be no spontaneous eye movements, and the eyes should remain in the neutral position on testing the oculocephalic and oculovestibular reflexes. The oculocephalic response is tested by rapid rotation of the head to either side. In eliciting the oculovestibular reflex, 20-30 ml of ice water are instilled into each ear external auditory canal with an intact tympanic membrane with the head elevated 30 degrees.
3. Corneal Reflex – No blinking or eye movement when the cornea is touched lightly with cotton.
4. Gag Reflex- No gagging or coughing when the oropharynx or trachea is stimulated. The presence

of deep tendon or other spinal reflexes does not preclude the diagnosis of death by brain criteria.

DURATION OF OBSERVATION

The clinical examination may be repeated after 12 – 24 hours. When there is a structural brain damage and the diagnosis is known with certainty, a shorter period of observation is adequate if central nervous system depressant drugs, metabolic and anoxic causes have been excluded.

CONFIRMATORY TESTS

A confirmatory test supplements but is not a requirement for the clinical diagnosis of death by brain criteria. Absence of cerebral blood flow demonstrated by radionuclide flow study or angiogram or electrocerebral silence on electroencephalography is considered confirmatory.

EEG recording is done for at least 30 minutes, with electrode distances of at least 10 cm and impedances between 100 and 10,000 ohms. It is considered isoelectric if there is no cerebral activity greater than 2 microvolts in amplitude.

Either confirmatory test should be repeated if the result is equivocal.

In situations where there is an inability to do an adequate clinical examination, such as high levels of barbiturates, or in cases of massive facial trauma, absence of brain circulation (to cerebral hemispheres and brain stem) on four vessel cerebral angiography is considered definitive of death by brain criteria. A radionuclear flow study is not sensitive for brain stem circulation and, therefore, a single scan is not adequate.

References

Author Information

Bradley J. Phillips, M.D.

Critical Care Medicine