BRAIN DEATH POLICY

Background:

Death by Neurologic Criteria, or brain death, is a medical and legal definition of death. Per the State if California Health and Safety Code, Chapter 3.7, Article 1 (Uniform Determination of Death Act) Section 7180 (a) "An individual who has sustained either (1) irreversible cessation of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brain stem, is dead. A determination of death must be made in accordance with accepted medical standards." Section 7181 states "When an individual is pronounced dead by determining that the individual has sustained an irreversible cessation of all functions of the entire brain, including the brain stem, there shall be independent confirmation by another licensed physician".

Purpose:

The purpose of this document is to define standards for the determination of death by neurologic criteria in adult patients (those 18 years of age and older) in accordance with state and federal requirements.

Policy :

1. It is the policy of Alameda Health System (AHS) and the State of California that brain death is equivalent to legal death; a patient who is brain dead is legally dead. Brain death will be determined by the following protocol, which is based upon accepted medical standards.

2. Death by brain criteria, "brain-death," is a medical and legal definition. It does not require consent or participation by family or surrogate decision-makers. Appropriate efforts will be made to discuss the patient's medical condition and the process of determining death by brain criteria with family or surrogate decision-makers prior to evaluating the patient for brain death.

Protocol:

When: Determination of brain death should be accomplished as early as practical in the patient's clinical course for the benefit of patient, family/surrogate decision-makers and staff.

Assessment for brain death should be initiated when clinical exam suggests irreversible loss of cerebral and brain stem function. In the early period following acute brain injury, it is often difficult to discern the clinical course the patient will take. Time must be allowed for any possible recovery to occur. During this time, other causes of depressed cerebral function must be ruled out. Once the brain death protocol is initiated, the organ procurement agency should be notified.

Resident physicians may perform the brain death exam as long as an Attending physician is present and directly supervising the exam and attests to the findings in all documentation related to the process.

If a patient meets criteria for brain death and other mimics of brain death have been ruled out, meet with the family and inform them the findings on the initial assessment are consistent with brain death. Delineate for the family what to expect next, specifically that an apnea test and second clinical exam will be done. It is at this point the reasonable period for accommodation begins and the family has 24 hours to say goodbye. During this period NO sedating drugs can be given and the patient's physiology should be maximally supported. For families with special religious or cultural practices, attempts will be made to honor such practices if at all possible.

Steps of Brain Death Assessment:

Step 1. Labs are corrected, all sedating gtts stopped / held, toxins screen.

Step 2. If labs abnormal or on gtts / sedating meds – correct labs / stop meds

Step 3. Clinical Exam and Apnea Test

Step 4. Discussion with family and begin period of reasonable accommodation *if needed (period can be up to 24 hours for family to gather and say goodbye)*

Step 5. Second brain death exam and declaration of death.

I. Prerequisites prior to clinical brain death assessment

1) Establish irreversible and proximate cause of loss of brain steam reflexes.
The cause of complete lack of neurologic responsiveness is usually established by history, examination, neuroimaging, and laboratory studies. It must be determined that the etiology of brain injury is capable of causing neuronal death to the degree that is compatible with brain death.

1) Reversible causes of CNS depression must also be excluded. This is done by:
   a. Drug screen demonstrating drug plasma levels below the therapeutic range and/or calculating drug clearance using at least five times the drug's half-life (assuming

normal renal and hepatic function). If hypothermia was used, bear in mind that this may affect drug metabolism.

b. Blood alcohol levels must be below the legal limit for driving.

c. No recent or continued administration of neuromuscular blocking agents. If neuromuscular blocking agents were recently administered, train of four stimulation should be performed with four twitches present to confirm absence of neuromuscular blockade.

d. No severe electrolyte, acid-base, endocrine, or metabolic disturbances that could contribute to lack of brain stem reflexes on exam. Conditions which should be ruled out include hepatic or renal encephalopathy, hypo or hyperthyroidism, hyper-ammonia, hypo or hyperglycemia, hyponatremia, and severe hyperosmolar states.

Lab Panel

Study
ABG
CBC
Basic Metabolic Panel (BMP)
Osmolality
TSH/T4

e. *Achieve normal core temperature.* A core temperature of at least 36^{o} Celsius must be achieved. Hypothermia can cause diminished brain stem reflexes, as well as affect the metabolism of medications that are given. Therefore, sufficient time must pass after normothermia is achieved to allow for the clearance of sedating medications. A warming blanket is may be needed order to slowly reward the patient to normothermia. Although there is insufficient evidence regarding a maximum accepted core body temperature, hyperthermia should also be avoided.

f. Achieve normal systolic blood pressure.
Systolic blood pressure should be greater than or equal to 100 mm Hg. Hypotension due to hypovolemia from diabetes insipidus or blood loss, of from loss of peripheral vascular tone is common. Blood pressure should be maintained with use of vasopressors and volume repletion as necessary in order to maintain adequate systemic perfusion.

II. Clinical Neurologic Exam

A. Absence of neurologic function on exam

Patient must lack all evidence of responsiveness. The patient should be observed for spontaneous movement and responses to noxious stimuli centrally and peripherally. There must be no brain mediated responses that occur spontaneously or in response to noxious stimuli. This includes decorticate or decerebrate posturing, dyskinesias, myoclonus, or seizures.

Spinal reflexes are excluded as the spinal cord may be unaffected. Spinal reflexes include deep tendon reflexes, plantar reflexes, triple flexion of the legs, toe flexion or extension on plantar stimulation, superficial abdominal reflexes, and blood pressure changes in response to noxious stimulation. Complex motor movements ("Lazarus sign") may be observed, and clinical expertise or ancillary testing must be used to exclude cerebral origin of the movement.

B. Absence of brain stem reflexes

a. Absence of pupillary response to a bright light in both eyes.
Pupils must be mid-size or larger (4-9 mm) and non-reactive to bright light. Ensure that no medications have been administered that could affect pupil size (e.g. atropine). Pupillometry should be used to confirm size and lack of responsiveness.

b. Absence of ocular movements using oculocephalic testing and/or oculovestibular reflex testing. The head should be briskly rotated horizontally, then vertically to assess for eye movement. There should be no movement of the eyes relative to head movement. If the integrity of the cervical spine is in question, oculocephalic testing cannot be performed.

c. Cold caloric testing of the oculovestibular reflex should be performed by elevating the head of the bed to 30 degrees. The external auditory canal must be visually inspected to ensure patency and visualization of the tympanic membrane. Using a large syringe with flexible tubing, the first external auditory canal is then irrigated continuously for 1 minute with ice water (approximately 50 mls). There should be no movement of the eyes during this period. Following a recovery interval of 5 minutes, the second side is testing in the same fashion.

d. Absence of corneal reflex.
Absence of corneal reflex is demonstrated by touching the cornea with a cotton swab. No eyelid movement should be noted following the stimulus.

e. Absence of facial muscle movement to a noxious stimulus.
Deep pressure to the supraorbital ridge, temporomandibular joint, or mastoid should produce no grimace or facial muscle movement.

f. Absence of the pharyngeal and tracheal reflexes.
The pharyngeal (gag) reflex is tested by stimulating the posterior pharynx with a tongue blade or suction device. The tracheal (cough) reflex is tested by

assessing for a cough upon endotracheal suctioning. The suction catheter should be advanced to the level of the carina followed by one or two suctioning passes.

III. Apnea Test

A test performed to determine absence of breathing drive. This is tested with a CO2 challenge, and documentation to an increase in PaCO2 sufficient to trigger the respiratory drive, without resulting respirations. This test requires preparation prior to performing and should only be performed on patient with blood pressure within normal limits. Special consideration should be taken when the patient ahs a history of CO2 retention (chronic obstructive pulmonary disease, severe obesity).

*** The pre-requisites for the clinical exam should continue to be met for the apnea test. If laboratory studies were done > 4hrs before start of apnea test, repeat ABG, CBC and Chem 10 to reconfirm levels within accepted ranges**

a. Adjust vasopressors to maintain a systolic blood pressure ≥ 100 mm Hg.
b. Preoxygenate for at least 10 minutes with 100% oxygen with a goal PaO2 > 200 mm Hg.
c. Adjust ventilation to achieve target of 35 – 45 mm Hg, if patient is a CO2 retainer at baseline, adjust ventilator to range within 5 mm Hg of most recent baseline CO2 value.
d. Reduce positive end-expiratory pressure (PEEP) to 5 cm H20. Be aware that oxygen desaturations with decreasing PEEP may suggest apnea test will be difficult to perform
e. If pulse oximetry shows oxygen saturation > 95%, obtain a baseline arterial blood gas (PaO2, PaCO2, pH, bicarbonate, base excess)
f. Fully disconnect the patient from the ventilator and start timer
g. Preserve oxygenation by placing a flexible suction catheter attached to an oxygen delivery device with 100% O2 at 6 L/minute through the endotracheal tube to the level of the carina.
h. Monitor closely for respiratory movements for 8-10 minutes. Respirations are defined as abdominal or chest wall excursion, and may include a brief gasp.
i. If no respiratory drive is noted after 10 minutes, repeat an arterial blood gas
j. The test is positive and supports a clinical diagnosis of brain death if no respiratory movement is noted and the repeat arterial PCO2 is ≥ 60 mm Hg, or the repeat arterial PCO2 is 20 mm Hg higher than the baseline PCO2.
k. If the test is inconclusive after 10 minutes and the patient remains hemodynamically stable, the test may be repeated for a longer period, up to 15 minutes, after the patient is again adequately preoxygenated and normocarbia reestablished.
l. Abort the test if systolic blood pressure is not able to be maintained above 90 mm Hg, or if oxygen saturation by pulse oximetry drops below 85% for more than 30 seconds. If the oxygen saturation is not able to be maintained on supplemental

oxygen, retry the procedure with a T-piece or provide continuous positive airway pressure (CPAP) at 10 cm H2O with 100% O2 at 12 L/minute.

IV. Second Clinical Examination

Once the period of reasonable accommodation has completed ***or*** if no period is requested the second exam may be performed. The pre-requisites and clinical assessment protocols listed in sections I & II above should be used to perform the second clinical exam. The two exams should be performed by separate teams with one team preferably neurosurgery or neurology.

If the patient meets all criteria for brain death and two Attending physicians have documented this in the patient's chart, the patient is legally dead and declared dead at the time of the completion of the second brain death examination.

V. Ancillary Test (if applicable)

Ancillary tests can be used when uncertainty exists about the reliability of part of the neurologic examination or when the apnea test cannot be performed. Ancillary tests can also be used when there are electrolyte, acid-base, endocrine, or metabolic disturbances present that could contribute to coma but that are not able to be fully corrected. An ancillary test should not be used as a substitution for a clinical determination of brain death. Those ordering ancillary tests must appreciate the disparities between the tests and the potential for false positives. Care must also be taken to interpret the test results within the clinical context.

Nuclear medicine cerebral blood flow study (SPECT) and cerebral angiography are acceptable ancillary tests to confirm the absence of blood flow to the brain.

VI. Documentation

Each examination and apnea test must be documented in the patient's medical record and attested by an attending physician. Prerequisites for determination of brain death must be included in the documentation. Time of death is determined by the end of the second brain death declaration exam and should be documented in the death note.

The procurement agency is notified of the time of death. ***No member from the patient care team should ever discuss organ donation with the family*****.** If asked about organ donation, members of the care team should indicate that another team handles donation and that team will contact the family at the appropriate time.

References

- California health and safety Code, section 7181
- American Academy of Neurology Clinician Guideline Supplement. Update: Determining Brain Death in Adults. *Neurology* 2010;74:1911–1918.
- Sample Brain Death Policy for adaption at an Individual Hospital. Neurocritical Care Society

The Quality Standards Subcommittee of the American Academy of Neurology. Practice parameters for determining brain death in adults (summary statement). Neurology 1995;45:1012–1014.