End of Life in the ED – Brain Death and Organ Transplantation

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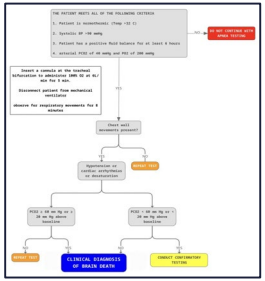
INTRODUCTION

Prior to the development of life-sustaining technology, determination of death was relatively facile, the patient suffered a circulatory arrest and/or they stopped breathing. However, the development of advanced life preserving technology has allowed for circulation and respiration to be maintained mechanically, thus eliminating cardiopulmonary death in the presence of brain death and requiring the creation of a new definition of death [1]. The American Academy of Neurology (AAN) guidelines state that brain death can be declared when brainstem reflexes, motor responses, and respiratory drive are absent in a normothermic, nondrugged comatose patient with a known irreversible massive brain lesion and no contributing metabolic derangements [2]. Although brain function has ceased, mechanical ventilation/perfusion maintains the functionality of many other organs, making brain dead patients excellent candidates for organ donation. Despite being ideal candidates, less than half of patients declared brain dead end up serving as organ donors. In 2020 there were 21,424 brain deaths but only 9,364 brain dead individuals were organ donors [3,4]. With the Organ Procurement and Transplantation Network data as of March 31st 2022 listing 133,319 patients on the transplant list it is more vital than ever that physicians be able to confidently and efficiently diagnose and explain brain death. Our aim is to improve education about brain death and organ transplantation so physicians are more confident in diagnosing brain death and and explaining its consequences to their patients.

METHODS

A comprehensive review of current standards and necessary tests was completed. Using this information, bioethical theory, and the latest data on organ donations, a recommendation to improve organ donation outcomes in brain dead patients was made.



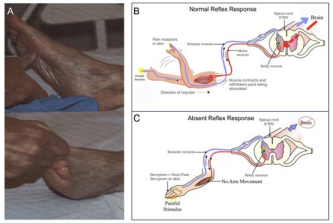
CLINICAL TESTING FOR BRAIN DEATH

Rule out Mimics

The clinical diagnosis of brain death first requires ruling out potential mimics. The patient must not have electrolyte imbalance, acid-base imbalance, drug intoxication/poisoning, endocrine or metabolic imbalance, or hypothermia.

Coma or Unresponsiveness

Coma or unresponsiveness can be determined by an absence of cerebral motor response to pain in all extremities. The physician can test for a loss of cerebral motor response by applying nail-bed pressure, temporomandibular joint pressure, and/or supraorbital ridge pressure [1, 5] (Figure 1A). Testing for the anatomic response to pain assesses the integrity of the cortex, as well as two major long spinal tract pathways, the corticospinal and spinothalamic tracts [6] (Figure 1 B-C). It is important to communicate with family that some motor responses are spinal reflexes and still consistent with brain death (e.g. “Lazarus Sign” and triple flexion). Additionally, decorticate and decerebrate posturing are not seen in brain death

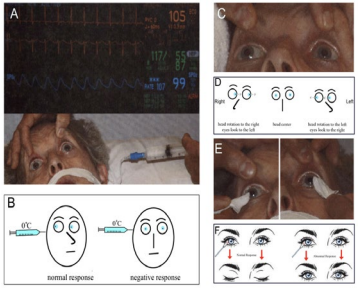


Loss of Cranial Nerve Reflexes

The absence of brainstem reflexes can be elicited by testing the patient's pupillary reflexes, ocular movements, facial sensation, facial motor response, and pharyngeal and tracheal reflexes. Loss of cranial nerve (CN) reflexes indicates damage to the brainstem that is incompatible with life. .

Pupillary Light Reflex

A test of the Pupillary Light Reflex is performed by shining a bright light in the pupil and observing both the ipsilateral (direct light reflex) and contralateral (consensual light reflex) pupils for normal anatomic constriction in response to the light [6]. Testing the Pupillary Light Reflex allows for observance of the integrity of the Optic Nerve (Cn II), Oculomotor Nerve (Cn III), Edinger Westphal Nucleus in the rostral midbrain (parasympathetic component of CN III), and the pretectal area [6].

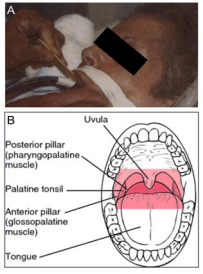


Ocular movements

Ocular movements can be tested by assessing the presence of the oculovestibular reflex and the corneal reflex. A test of the Oculovestibular Reflex is performed by tilting the head to thirty degrees and irrigating the tympanum with ice water (Figure 2A) [4]. When uncompromised, the eyes gaze to the side of cold-water irrigation in the external auditory meatus via stimulation of the Abducens N. (Cn VI) on the ipsilateral side and the Oculomotor N. (Cn III) on the contralateral side [6] (Figure 2B). One minute should be allowed for reaction time to the cold-water stimulus, and five minutes should be taken between irrigation of each tympanum [5]. A test of the Oculocephalic Reflex is performed by slightly tilting the head forward, and rapidly rotating the head from a middle position to ninety degrees on each side [1]. If the reflex is intact, the eyes gaze to the side opposite the direction of rotation of the head under stimulation via Oculomotor N. (Cn III) on the ipsilateral side, and the Abducens N. (Cn IV) on the contralateral side of the head [6] (Figure 2 C-D). Testing the Oculocephalic Reflex allows for observation of the integrity of the Oculomotor (Cn III) Motor Nucleus in the rostral midbrain, and the motor nuclei of the Abducens N. (CN VI), the Vestibular N. (Cn VIII), and the medial longitudinal fasciculus (MLF), which are all located in the caudal pons [6]. A test of the Corneal Reflex is performed by opening the patient’s eye and lightly stroking the sclera with a cotton swab [1, 5] (Figure 2 E). The normal anatomic response is for the eyelid to blink when the eye is touched with the cotton (Figure 2 F). For this reflex, the Trigeminal Nerve (Cn V) serves as the afferent nerve and the Facial Nerve (Cn VII) serves as the efferent nerve [6].

Pharyngeal Reflexes

The pharyngeal reflex can be tested by opening the mouth and slightly stroking the posterior pharynx with a tongue blade. Tracheal reflexes can be tested by inserting a bronchial suction catheter deep into the trachea [1]. If functioning properly, a gag reflex will result from stimulating the posterior pharynx with a tongue blade (Figure 3) and a cough reflex with the introduction of a bronchial suction catheter deep into the trachea. Testing for the presence of pharyngeal reflexes assesses the integrity of the glossopharyngeal (CN IX) and Vagus (CNX) nerves.



Apnea Testing

If coma or unresponsiveness has been established and the absence of brainstem reflexes has been demonstrated, then clinical apnea testing should be implemented. Because the brainstem reflexes are typically lost in a rostral to caudal fashion, apnea will be amongst the last findings in a brainstem lesion due to the location of the respiratory centers in the medulla [7]. As a result, the apnea test is a vital component of the brain death diagnosis and must be considered greatly significant. The procedure for apnea testing is detailed in Figure 4. In circumstances where apnea testing is inconclusive, confirmatory testing has shown relevance. However, in the absence of confounding factors and when a clear cause is evident, brain death is generally declared without a second set of neurologic examinations.

ORGAN DONATION

Brain dead patients are currently 74% of decreased organ donors, however only 43% of eligible brain dead individuals were donors in 2020 [8, 9, 10]. The main reason for not donating is lack of consent [11]. The primary reasons for lack of consent appear to be loss of organ viability, lack of supportive and empathetic relationship with the physician and family, and lack of effective communication between the organ procurement organization (OPO) and family [12, 13, 10].

Efforts to promote organ donation should be focused on creating a supportive and empathetic relationship between the healthcare team and family. Steps that should be taken are the following, decoupling the organ donation request from the brain death diagnosis to reduce the assumption of bias or malicious intent, making the request in a private setting, allowing families time to make a decision, utilizing professionally trained personnel to make the request, separating the patient care team and organ procurement team if possible, emphasizing the benefits of organ donation, and offering the option of organ donation to all brain death patients.

Once consent to donate is given, special care should be given to maintain hemodynamic stability to maximize the number of possible organs donated. Stability is ensured by preserving normovolemia, blood pressure, and cardiac output. Vasoactive drug support should be minimalized as much as possible with anti-infective therapy and maintenance of pulmonary hygiene associated with better organ outcomes [14]

REFERENCES

1. Practice parameters for determining brain death in adults. Neurology. 1995;45(5):1012. doi:10.1212/WNL.45.5.1012
2. Wijdicks EF. Determining brain death in adults. Neurology. 1995;45(5):1003-1011. doi:10.1212/wnl.45.5.1003
3. Ahmad FB, Cisewski JA, Anderson RN. Provisional Mortality Data — United States, 2021. MMWR Morbity and Mortal Weekly. 2022. doi:http://dx.doi.org/10.15585/mmwr.mm7117e1external icon
4. Aboubakr M, Yousaf MIK, Alameda G. Brain Death Criteria. In: Brain Death Criteria. In: StatPearlsStatPearls Publishing; 2022. http://www.ncbi.nlm.nih.gov/books/NBK545144/. Accessed Sep 21, 2022
5. Wijdicks E, Varelas P, Gronseth G, Greer D. Evidence-based guideline update: Determining brain death in adults. 2010;74:1911-1918
6. Siegel A, Sapru HN. Essential Neuroscience, 4e. 2019. https://mederd.lwwhealthlibrary.com/book.aspx?bookid=2482. Accessed Sep 21,2022
7. Van Norman G. A Matter of Life and Death : What Every Anesthesiologist Should Know about the Medical, Legal, and Ethical Aspects of Declaring Brain Death. Anesthesiology. 1999;91(1):275-287. doi:10.1097/00000542-199907000-00036
8. 2020 Annual Report of the U.S. Organ Procurement and Transplantation Network and the Scientific Registry of Transplant Recipients: Transplant Data 2009-2020. 2020
9. Bhattacharyya KB, Rai S. Joseph Godwin Greenfield: The father of neuropathology (1884-1958). Ann Indian Acad Neurol. 2015;18(3):290-291. doi:10.4103/0972-2327.152087
10. Valdes M, Johnson G, Cutler JA. Organ donation after neurologically unsurviable injury: a case study with ethical implications for physicians. Proc (Bayl Univ Med Cent). 2002;15(2):129-132. doi:10.1080/08998280.2002.11927827
11. Sheehy E, Conrad SL, Brigham LE, et al. Estimating the Number of Potential Organ Donors in the United States. New England Journal of Medicine. 2003;349(7):667-674. doi:10.1056/NEJMsa021271
12. DeJong W, Franz HG, Wolfe SM, et al. Requesting organ donation: an interview study of donor and nondonor families. Am J Crit Care. 1998;7(1):13-23
13. Siminoff LA, Gordon N, Hewlett J, Arnold RM. Factors influencing families' consent for donation of solid organs for transplantation. JAMA. 2001;286(1):71-77. doi:10.1001/jama.286.1.71
14. Wood KE, Becker BN, McCartney JG, D'Alessandro AM, Coursin DB. Care of the potential organ donor. N Engl J Med. 2004;351(26):2730-2739. doi:10.1056/NEJMra013103

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