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Critical Synopsis in Brain Death Determination: A Case Report of Brain Death

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ABSTRACT

Brain death is a novel construct of death for the procurement of transplantable organs. Brain death is a novel Western construct of human death. Beecher and the Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death (1968) introduced this particular concept of death in the USA. Brain death is a neurologic state that belongs to the spectrum of disorders of consciousness and is associated with severe disabilities (1,2). The presence of severe neurologic disabilities should not be confused with death (2,3).

KEYWORDS: Brain death, Moral code, Neuroscience, Criteria, Guidelines, Tests, Organ harvesting.

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INTRODUCTION

Death is a process with a time line and cannot be envisaged as a one-time event with 2 dichotomous states, dead and not dead. There is a need to determine a point on the timeline of the death process that defines a point of no return after which the patient enters a rapid irreversible course to ultimate death (4–6).

Brain death, also commonly referred to as death by neurologic criteria, has been considered a legal definition of death for decades. Its determination involves many considerations and subtleties (4,7–9).

Death in essence is failure of the cardio-respiratory system that transports chemical nutrients and oxygen needed for the continued life and metabolism of cells. The sensitivity of cells to oxygen deprivation varies; brain tissue is the most sensitive and its cells will die earlier that those of other tissues (4,6–8).

Preceding the 1950s, the concept of death revolved around cessation of cardiorespiratory function. It naturally followed that cessation of brain function occurred after the loss of respiration and circulation, and indeed loss of brain activity was considered a critical component of death.

When the cardio-respiratory system fails to deliver enough oxygen and nutrients to the brain, brain cells will die earlier that those of the heart and blood vessels making brain death an earlier indicator of death than death of the cardiovascular and respiratory systems (4,8). Proponents of the idea of neurologic criteria to diagnose brain death argue that the body is more than the sum of its parts, and that death is equated to loss of the whole person (4,9).

CASE PRESENTATION

A woman 47-year-old was admitted to the emergency room in a deep coma state and acute renal failure following a urinary infection. Reported within the last 4 days. She had extensive past medical history of stage four squamous cell lung cancer with bone metastasis for which she completed radiotherapy treatment. She also experienced chronic intermittent fever, chills, and productive cough with green-yellow sputum since her cancer diagnosis two years ago. She had an 80-pack year smoking history. Diagnosed with chronic obstructive pulmonary disease. Street dweller with high cigarette and drug consumption not described in the medical history.

On exam, she was found to be cachexic. Sixty-four minutes after admission, her condition rapidly deteriorated, and she suddenly entered cardiopulmonary arrest. An electrocardiogram showed pulseless electrical activity. Cardiopulmonary resuscitation was promptly started and 1 mg adrenaline was administrated. She was intubated and moved to the intensive care unit.

Cardiopulmonary resuscitation continued for about one hour. After resuscitation, she remained comatose with bilateral mydriasis and a Glasgow Coma Scale score of 3. Brain computed tomography showed brainstem and intraventricular haemorrhage with hydrocephalus in the brainstem, brain swelling (Management of Intraventricular Hemorrhage).

The clinical history states: Care continues in the intensive care unit setting. Patients should have the benefit of conventional neurologic intensive care unit care including resuscitation with intravenous fluids, placement of the head of bed at 30°, correction of fever with antipyretics, and deep venous thrombosis prophylaxis with sequential compression devices and/or compression stockings. Low-dose prophylactic anticoagulation should be initiated 48 h after injury. Brain hemorrhage is the most fatal form of stroke and has the highest morbidity of any stroke subtype.

On the following day, 72 h after resuscitation, her neurological status had not changed. Her brainstem function was tested. Neurological examination showed the absence of the photomotor, oculovestibular, corneal, gag, and cough cranial reflexes. Moreover, the patient, after being hypoventilated (4 acts per minute with a tidal volume of 250 cc) until reaching a blood gas CO2 value >60 mmHg, was disconnected for one minute from the ventilator, showing the absence of respiratory drive. It is described in the clinical history Clinical Criteria for brain death assurance.

The three essential findings in brain death are coma, absence of brainstem reflexes, and apnoea (Apnoea means your throat muscles relax and close up and you stop breathing). An evaluation for brain death should be considered in patients who have suffered a massive, irreversible brain injury of identifiable cause. A patient determined to be brain dead is legally and clinically dead.

Epidemiology: Brain death accounts for around 2% of deaths in the United States and is often caused by traumatic brain injury (3,10).

Treatment: The determination of brain death is typically made on the basis of clinical assessment and requires demonstration of the permanent loss of all brain function, including brainstem function, in the absence of factors that may confound the assessment. If these factors cannot be eliminated, or if the examination cannot be safely or fully performed, ancillary testing is conducted (1–3).

Controversies in brain death: The concept of death by neurological criteria is supported by a consensus of critical care professionals and clinicians involved in death determination around the world, yet some people perceive it to be tantamount to a legal fiction and believe that only cardiopulmonary death is true death (11,12).

DISCUSSION: BRAIN DEATH

This report provides recommendations for the minimum clinical standards for determination of brain death/death by neurologic criteria in adults with clear guidance for various clinical circumstances (13–16).

Brain death is death, and organ and tissue donation must be a priority. For all involved in declaring brain death, there is acceptance, resignation, compassion, support, and a deep humanistic appreciation that lives can be saved (13,16,17). A determination of death must be made in accordance with the accepted medical standards and must additionally include one of the following: “Irreversible cessation of circulatory and pulmonary functions” and “Irreversible cessation of all functions of the entire brain, including the brainstem, is dead” (10,18).

The largest known study to date regarding brain death determination protocols worldwide was released in 2020 by Lewis A. et al. 136 corresponding countries' contacts (42% world) revealed high variability in the brain death criteria protocols internationally. There is considerable variability in brain death/death by neurologic criteria determination protocols around the world. Medical standards for death should be the same everywhere (18).

Clinical and instrumental criteria for brain death ascertainment:

Absence of following brain stem reflexes: Oculovestibular reflex, Corneal reflex, Gag reflex, Cough reflex, Pupillary inactivity to bright light in both eyes, Motor response after painful stimulation applied to the trigeminal and facial territories and Unconsciousness. Absence of spontaneous breath for 60 sec without ventilator if pCO2 > 60 mmHg and pH < 7.40 (9,19).

Instrumental criteria: Electroencephalogram for 30 minutes Mandatory to revealing absence of spontaneous or triggered brain electric activity greater than 2 microvolts in all cerebral regions (9,19).

Cerebral CT (computed tomography) angiography or transcranial Doppler: only if: (Instrumental criteria). Using of drugs depressant on cerebral functions; Impossibility of evaluating brain stem reflexes or electroencephalogram. Age < 12 months. Post-anoxic coma from cardiac arrest that occurred within 24 h (9,19).

CONCLUSIONS

Transparency and truthfulness about brain death is essential to avoid negative sociocultural consequences and to maintain trust in medicine (4,6).

Ethical Statements: According to Colombiana law, case reports do not need to be approved by the Ethics Committee; however, the work complies with the ethical guidelines of the Helsinki declaration and the Oviedo convention, as well as the ethical standards of the University (Pontificia Universidad Javeriana de Cali- Colombia).

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Consent: The authors confirm that written consent for submission and publication of this case report associated text has been obtained from the patient in line with COPE guidance.

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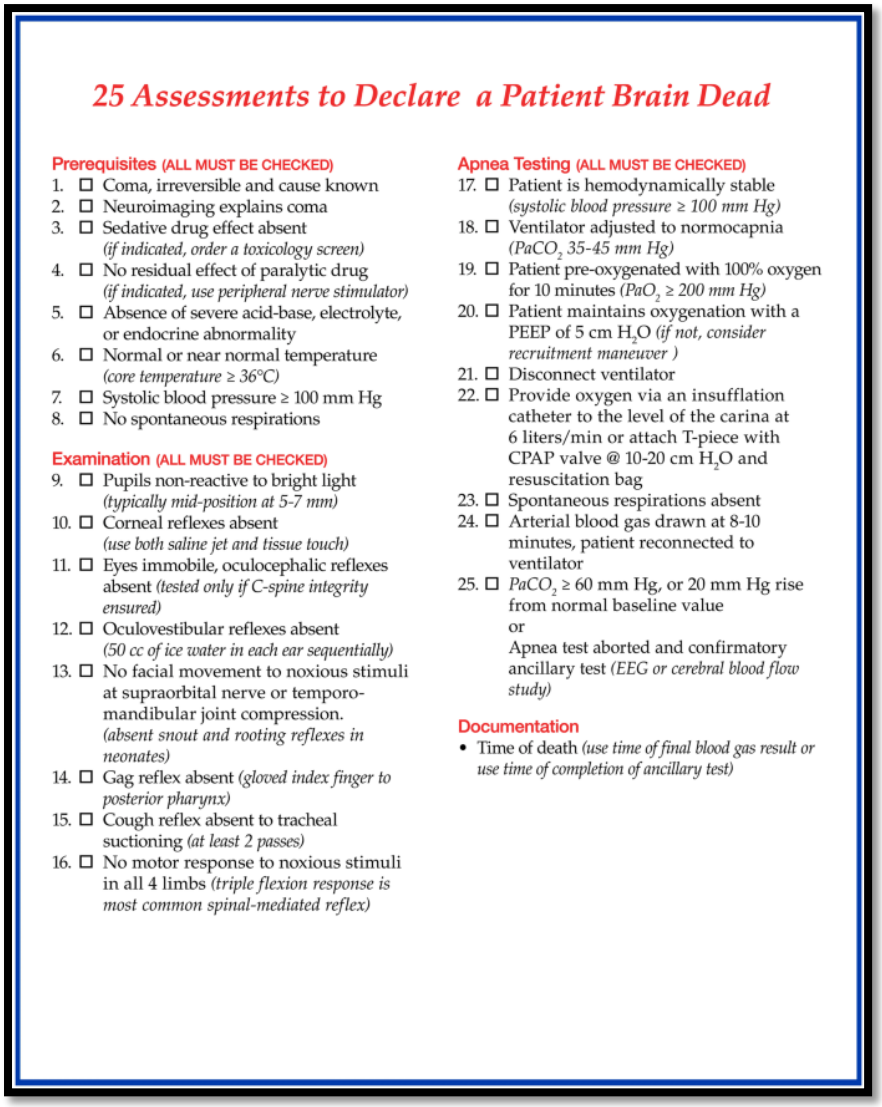
Conflict of interest: none declared.

RECOMMENDATION

Summary of steps in neurologic evaluation of a comatose patient with a destructive acute brain injury in order to determine brain death- (**Figure No.1**). Eelco F.M. Wijdicks is Professor of Neurology, Mayo Clinic College of Medicine, Chair of the Division of Critical Care Neurology, and Consultant, Neurological Neurosurgical Intensive Care Unit, Saint Marys Hospital, Mayo Clinic.



25 Assessments to Declare a Patient Brain Dead

Prerequisites (ALL MUST BE CHECKED)

1. ☐ Coma, irreversible and cause known
2. ☐ Neuroimaging explains coma
3. ☐ Sedative drug effect absent *(if indicated, order a toxicology screen)*
4. ☐ No residual effect of paralytic drug *(if indicated, use peripheral nerve stimulator)*
5. ☐ Absence of severe acid-base, electrolyte, or endocrine abnormality
6. ☐ Normal or near normal temperature *(core temperature ≥ 36°C)*
7. ☐ Systolic blood pressure ≥ 100 mm Hg
8. ☐ No spontaneous respirations

Examination (ALL MUST BE CHECKED)

9. ☐ Pupils non-reactive to bright light *(typically mid-position at 5-7 mm)*
10. ☐ Corneal reflexes absent *(use both saline jet and tissue touch)*
11. ☐ Eyes immobile, oculocephalic reflexes absent *(tested only if C-spine integrity ensured)*
12. ☐ Oculovestibular reflexes absent *(50 cc of ice water in each ear sequentially)*
13. ☐ No facial movement to noxious stimuli at supraorbital nerve or temporo-mandibular joint compression. *(absent snout and rooting reflexes in neonates)*
14. ☐ Gag reflex absent *(gloved index finger to posterior pharynx)*
15. ☐ Cough reflex absent to tracheal suctioning *(at least 2 passes)*
16. ☐ No motor response to noxious stimuli in all 4 limbs *(triple flexion response is most common spinal-mediated reflex)*

Apnea Testing (ALL MUST BE CHECKED)

17. ☐ Patient is hemodynamically stable *(systolic blood pressure ≥ 100 mm Hg)*
18. ☐ Ventilator adjusted to normocapnia *($PaCO_2$ 35-45 mm Hg)*
19. ☐ Patient pre-oxygenated with 100% oxygen for 10 minutes *(PaO_2 ≥ 200 mm Hg)*
20. ☐ Patient maintains oxygenation with a PEEP of 5 cm H_2O *(if not, consider recruitment maneuver)*
21. ☐ Disconnect ventilator
22. ☐ Provide oxygen via an insufflation catheter to the level of the carina at 6 liters/min or attach T-piece with CPAP valve @ 10-20 cm H_2O and resuscitation bag
23. ☐ Spontaneous respirations absent
24. ☐ Arterial blood gas drawn at 8-10 minutes, patient reconnected to ventilator
25. ☐ $PaCO_2$ ≥ 60 mm Hg, or 20 mm Hg rise from normal baseline value
    or
    Apnea test aborted and confirmatory ancillary test *(EEG or cerebral blood flow study)*

Documentation

- Time of death *(use time of final blood gas result or use time of completion of ancillary test)*

Figure No.1: Brain Death. (Adapted from Wijdicks EFM Brain Death 3ed Oxford University Press, 2017).

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