Brain Death: It’s Not as Easy as You Think
There are no Conflicts of Interests
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At the End of this Session the Participant will be able to:

- Describe the history of brain death definitions
- Discuss the current definition
- Define the issues associated with actual “death” and organ donation
- Assimilate the issues associated with caring for the patient and family
Historical Perspective

- 1959 *Coma de’passe’* Mollaret and Goulon
- 1968 *Irreversible Coma/Brain Death* Harvard Medical School Ad Hoc Committee
- 1981 Uniform Determination of Death Act - President’s Commission for the Study of Ethical Problems in Medicine
- 1994 American Academy of Neurology Guidelines for the determination of Brain Death
- 2005 NYS Guidelines for Determining Brain Death
Brain stem death criteria requires the absence of:

* pupillary light reflex
* vestibulo-ocular reflex
* cough and gag reflex
* corneal and jaw reflex
* motor responses within the cranial nerve distribution

- In addition a positive apnea test
President’s Commission Report

- Someone had to step in...
- 1981-First formalized criteria for determination of brain death
- Recommendation for the state legislature and courts
- Adult only
National Task Force

- 1987 – assembled to provide guidelines for children and brain death
Historical Perspective

Prior to the advent of mechanical respiration, death was defined as the cessation of circulation and breathing.
Brain Death...

- “...irreversible loss of the capacity for consciousness combined with irreversible loss of the capacity to breathe.”

Center for Bioethics 1998
Why Do We Worry So?

- To ensure common practice in the diagnosis of brain death
- Avoid useless treatment and futile care
- Reduce the stress on family and caregivers
- Reduce controversy in the transplant venue
- Reduce risk for civil and criminal charges
- Ensure appropriate use of limited resources
- Improve nursing morale
Three Themes that Challenge Brain Death Criteria

- Cardiac cessation is enough
  1. The heart is the “center” of the being
  2. The heart perfuses the brain
  3. Transplantation after death
  4. Hair and nails after death
Personhood

1. Difficulty from separation of who we are from our brain function
2. The integration of the body and the brain

Organ donation and brain death

Potential conflicts
What Patients Experience Brain Death

- Successfully resuscitated traumatic arrest
  - Severe TBI
  - Anoxic brain injury

- TBI with refractory intracranial hypertension

- Non-survivable brain injury (GCS=3)
  - Trans-cerebral GSW
  - Devastating blunt head trauma
- Cerebral anoxia
- Cerebral hemorrhage
- Meningitis
Brain Death Current Consensus

- Absent Cerebral Function
- Absent Brainstem Function
- Apnea
Brain Stem

Cranial Nerves IV, V, VI
- conjugate eye movement
- corneal reflex
Brain Stem

Medulla

Cranial Nerves IX, X
- Pharyngeal (Gag) Reflex
- Tracheal (Cough) Reflex

Respiration
Reticular Activating System

- Receives multiple sensory inputs
- Mediates wakefulness
Mechanism of Cerebral Death

- Neuronal Injury
- Neuronal Swelling
- Decreased Intracranial Blood Flow
- Increased Intracranial Pressure

ICP > MAP is incompatible with life
Conditions Distinct From Brain Death

- Persistent Vegetative State
- Locked-in Syndrome
- Minimally Responsive State
Persistent Vegetative State

- Normal Sleep-Wake Cycles
- No Response to Environmental Stimuli
- Diffuse Brain Injury with Preservation of Brain Stem Function
Locked-in Syndrome

Ventral Pontine Infarct

- Complete Paralysis
- Preserved Consciousness
- Preserved Eye Movement
Minimally Responsive State

Static Encephalopathy

- Diffuse or Multi-Focal Brain Injury
- Preserved Brain Stem Function
- Variable Interaction with Environmental Stimuli
When to Evaluate for Brain Death

- Acute loss of brain stem reflexes on neurologic examination.
- Acute loss of spontaneous respirations.
- Acute deterioration in hemodynamic status.
  - Bradycardia
  - Hypertension
  - Hypotension
- Acute increase in ICP.
CUSHING’S TRIAD

A sign of increased intracranial pressure. It is the triad of:

1. Hypertension (progressively increasing systolic blood pressure)
2. Bradycardia
3. Widening pulse pressure (an increase in the difference between systolic and diastolic pressure over time)
What To Do if Brain Death is Suspected

- Inform family ("The Big Talk").
- Inform consulting neurologist / neurosurgeon.
- Inform organ donation organization.
- Proceed with formal brain death determination.
- Continue all other medical therapies unless contraindicated.
Clinical Prerequisites

- Known irreversible cause
- Exclusion of potentially reversible causes
  - **Drug intoxication or poisoning**
  - **Electrolyte or acid/base imbalance**
  - **Endocrine disturbances**
  - **Shock states**
  - **Sedation/NMB**
- Core temp > 32°C (>35°C)
Brain Death Examination

- Response to pain (central and peripheral)
- Pupillary reflexes
- Corneal reflexes
- Pharyngeal (gag) reflex
- Tracheal (cough) reflex
- Occulocephalic (Doll’s eyes) reflex
- Occulovestibular (Caloric) reflex
Brain Death Neurological Examination

- Coma
- Absent Brain Stem Reflexes
- Apnea
Basic Exam: Pain

- Cerebral motor response to pain
  **Supraorbital ridge, nail bed, trapezius**
  **NO NIPPLE PINCHING**
  **Motor response may occur spontaneously during apnea test (spinal reflex)**
  **Occur more often in the young**
  **If NMB utilize the train - of - four**
Pain response:

Grimace in response to pain by deep pressure to the nail beds, supraorbital ridge, TMJ or swab in nose
Absence of Brain Stem Reflexes

- Pupillary Reflex
- Eye Movements
- Facial Sensation and Motor Response
- Pharyngeal (Gag) Reflex
- Tracheal (Cough) Reflex
Pupillary Reflex

Pupils dilated with no constriction to bright light
Basic Exam - Pupils

- Round, oval or irregular shape
- Midsize (4-6 mm), may be blown
- Absent pupillary light reflex
  **Drugs can impact BUT there is NO reaction in presence of BD**
  **Eye trauma/CN VII injury**
Basic Exam- Eye Movement

- Normal eye movement is dependent on large functioning brain segment
- Look at eyes at rest
  **Horizontal/vertical/disconjugate gaze**
  **Nystagmus (supratentorial)**
Reflexive Movement:

Oculocephalic reflex (Doll’s eyes)

**Normal:** Eyes move contralateral to the direction of the head turn of 90°

C-spine issue!

**Brain death:** No eye movement in response to the turn

NOT BARBIE!
Eye Movements

Occulo-Cephalic Response

“Doll’s Eyes Maneuver”
Oculovestibular Response (Cold Water Calorics)

- Elevate HOB 30°
- Irrigate one intact tympanic membrane with iced water
- Observe for 1 full minute after instillation and wait 5 minutes before testing contralateral TM
Oculovestibular Interpretation

- **Nystagmus** - both eyes slow toward to cold stimuli: NOT COMATOSE

- Both eyes tonically deviate toward cold stimuli: Coma with intact brainstem

- No eye movement: BRAIN DEATH
Facial Sensation and Motor Response

- Corneal Reflex
- Jaw Reflex
- Grimace to Supraorbital or Temporo-Mandibular Pressure
Pharyngeal and Tracheal Reflex

- Both cough and gag reflex are absent in brain death
Apnea Testing

Prerequisites

- Core Body Temperature > 32° C
- Systolic Blood Pressure ≥ 90 mm Hg
- Normal Electrolytes
- Normal PCO2
Apnea Testing

1. Pre-Oxygenation
   - 100% Oxygen via Tracheal Cannula
   - PO2 = 200 mm Hg
2. Monitor PCO2 and PO2 with pulse oximetry
3. Disconnect Ventilator
4. Observe for Respiratory Movement until PCO2 = 60 mm Hg
5. Discontinue Testing if BP < 90, PO2 saturation decreases, or cardiac dysrhythmia observed
Caveats to Apnea Test

■ Prepare beforehand
  – Turn down ventilator rate to 10-12 BPM.
  – Turn up FiO2 to 100%.
  – Obtain initial ABG be certain CO2 is in normal range.

■ When ventilator rate is withdrawn for test make sure that machine does not have an apnea backup (T-piece or BiPAP).
- Maintain euvolemia, normotension, and normothermia beforehand.

- Negative apnea tests can be repeated as soon as 10 minutes apart.
Contraindications to Apnea Test

- Significant hypoxemia (P/F ratio ≥ 200, PEEP ≥ 10).
- Significant metabolic acidosis (BD>5).
- Hemodynamic instability (More than one pressor required to keep SBP > 90).

- Inappropriate apnea test can result in cardiac death.
Confounding Clinical Conditions

- Facial Trauma
- Pupillary Abnormalities
- CNS Sedatives or Neuromuscular Blockers
- Hepatic Failure
- Pulmonary Disease
Observations Compatible with Brain Death

- Sweating, Blushing
- Deep Tendon Reflexes
- Spontaneous Spinal Reflexes
Family Presence During Brain Stem Testing

- Pugh, 2004 good data
- Explanation
- Helps to clarify the disease state
- Closure
Confirmatory Testing

Recommended when the proximate cause of coma is not known or when confounding clinical conditions limit the clinical examination.
Caveats to Other Confirmatory Tests

- Road trips to nuclear medicine or interventional radiology departments are potentially dangerous.
- If positive for flow, a cerebral blood flow scan cannot be repeated for 36 to 48 hours.
- Most of these tests have very little blinded research to support their validity in brain death determination.
Confirmatory Testing

MR-Angiography
Confirmatory Testing

Transcranial Ultrasonography
Concern for man and his fate must always form the chief interest of all technical endeavors. Never forget this in the midst of your diagrams and equations.

Albert Einstein
Second Examination

- AAN guidelines state that the 2 exams should be 6 hours apart

“Irreversibility”
Loyola Guideline

- All the criteria of the AAN
- Both physicians examining the patient should be at the attending level
- One physician should be a neurologist or neurosurgeon
- Time frame from exam 1 to 2 is 6 hours
It is Not as Easy as One Might Think!

- They are sick!
- Hemodynamic support
- Full ventilator support
- Deep sedation/paralytics
- Hypothermia therapy
When to be Suspect!

- Increasing lability
- Change in pupillary examination
- Loss of thermoregulation
Keep on Guard!

- Sedation/paralytic vacations
- Regular pupillary assessments
- Close assessment of temp curve
- Bedside assessments:
  **2 channel EEG
  **Cerebral perfusion baseline
What To Do with Medical Therapies Before Determination

- ICP/CPP and cerebral oxygenation monitoring are no longer relevant.

- All sedation should be withdrawn in anticipation of apnea testing.

- Seizure prophylaxis can be withheld.
Ventilator settings should be adjusted in anticipation of apnea testing.

Pressors can be adjusted to traditional hemodynamic endpoints (SBP > 90 or MAP > 60).
Remember!

- Until the patient is determined brain dead the focus is patient care not organ care
The Potential Donor

**Know our place**

**Care in management and demeanor**

**Care of patient not the organs**
Medical Management of the Potential Organ Donor

- UNOS Guidelines / Critical Pathways.

Medical Management of the Potential Organ Donor

- **Endpoints of Resuscitation:**
  - CVP = 6-8
  - PCWP = 8-12
  - CI $\geq$ 2.4
  - LVSWI $> 15$
  - SVR = 800-1200
  - MAP $\geq$ 60
  - Hct $> 30$
  - U/O $\geq$ 1.0 mL/kg/hr
Potential Donor Families

- Cultural and religious sensitivity
- Education about the end results
- Involvement in decision making
Donation After Cardiac Death (DCD)

- This is not a brain dead patient
- Withdrawal of ventilator in the OR
- An attending determines death
- After 5 minutes organs can be harvested
- If no cardiac death in 90 minutes organ donation is no longer viable and comfort measures are entertained
A Case...

- Late 2008 a 25 year old with a lifelong neurologic disorder, moribund and is designated for DCD
- A San Francisco based, Stanford trained transplant surgeon is discharged to a small hospital in the Sierra Madres.
The patient is brought to the OR and mechanical support suspended

The hospital attending is called to determine death BEFORE organ donation

The transplant surgeon enters the room, notes the patient continues to breath and instructs the nurses to administer large doses of Ativan and Morphine
He then injects the patient’s feeding tube with Betadine

He instructs the nurses to “give more candy.”

Nurses contact administration

Patient is taken to a room for palliative care and dies 8 hours later, no organs obtained

After 2 years physician is found not guilty
Care of the Family

- Get chaplain/SW involved early
- ID spokes persons
- Get a feel for the family dynamic
- Misconceptions as brain death is approaching
  - “You need my permission to remove him/her from machines.”
  - “Brain dead patients have woken up in the past.”
  - “There’s no harm in leaving him/her hooked up to the machines for a day or two and see what happens.”
  - “If he/she had been offered surgery, this wouldn’t have happened.”
The “Talk”

- Meeting early on and honest information is often helpful
- Most people make good decisions when given accurate information
- Those families that are comfortable with the concept of brain death are more likely to be open to donation
Terminology is Important

- Say “dead” not “brain dead”
- Say “artificial or mechanical ventilation” not “life support”
- Do not say “kept alive”
- Time of death is when brain death determined
- Do not speak to the patient
Terminal Wean

- Indications
- Prep work
- Policy and Ethics
- Procedure
Molter’s 10 Important Family Needs

1. To feel there is hope
2. To feel that the personnel care
3. To have a waiting room nearby
4. To know when something goes wrong you will be called
5. To know the prognosis
6. To have questions answered honestly
7. To know specifics regarding care
8. To get an update daily
9. To have questions answered understandably
10. To see the patient frequently
Doing One’s Utmost

- Ensure dignity and comfort
- When there is no family present:
  **Be a substitute**
  **Assure they are not alone**
  **Contact relatives**
Approach When Relative Are Present:

**Assure the family they are not suffering**

**Communicate**

**Promote presence**

**Be present**

**Adjust the high tech environment**

**Lower side rails**

**Let them touch the patient**

**Arrange a dignified goodbye**