Brain Death Determination
& Donation After Cardiac Death

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Types of Death

• Brain Death
  – Irreversible loss of function of the brain and brain stem.

• Cardiac Death
  – Irreversible cardiopulmonary arrest.
Brain Death Determination
1. Are there brain dead patients who recover function?
2. What is optimal observation period?
3. Are there complex motor movements that falsely suggest brain function?
4. How safe is apnea test?
5. Any new ancillary tests?

Neurology 2010; 74: 1911-1918
AAN 2010: Do brain dead patients recover?

- 9 studies
- Brain death mimics
  - Guillain-Barre syndrome
  - Toxicity: organophosphates, lidocaine, baclofen, delayed vecuronium clearance
- Complete brain death exam not performed
- No report of recovery after complete brain death exam using 1995 AAN guidelines.
Accuracy of Single Brain Death Examination

- Retrospective study
- N = 1229 adults; N=82 pediatrics (age>1)
- Brain dead patients referred to NYODN
  - 88 New York hospitals
  - June 2007- Dec 2009
- Outcome
  - No patient regained brain function on repeat exam
  - Mean brain death interval 19 hours
Single Brain Death Examination Hospitals

- North Shore LIJ Health System
- Mayo Clinic
- MGH
- Cleveland Clinic
- Barnes St. Louis
- Methodist Houston
- U Wisconsin
- U Minnesota
- Ohio State
- Baylor
- U Colorado
- Rush
- UPMC
Benefits/Burdens of Second Clinical Brain Death Examination
Burden of a Second Brain Death Examination

- Extra day of ICU costs and resources
- Prolonged anguish for bereaved family
- Slow death diagnosis may negatively impact survivors: PTSD, anxiety, depression
- Increased burden for minorities
- Cardiac arrest rate 12%
- Reduced organ donation rate
Benefits of a Second Brain Death Examination
AAN 2010: What should observation interval be?

- There is insufficient evidence to determine minimally acceptable observation period to ensure neurologic recovery has ceased irreversibly.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Year</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard</td>
<td>1968</td>
<td>24 hrs</td>
</tr>
<tr>
<td>Minn Criteria</td>
<td>1971</td>
<td>12 hrs</td>
</tr>
<tr>
<td>NIH Collab</td>
<td>1977</td>
<td>6 hrs before, 30 mins</td>
</tr>
<tr>
<td>PresCommission</td>
<td>1981</td>
<td>12 hrs</td>
</tr>
<tr>
<td>AAN</td>
<td>1995</td>
<td>6 hrs optional</td>
</tr>
<tr>
<td>AAN</td>
<td>2010</td>
<td>None</td>
</tr>
<tr>
<td>The rest of the world</td>
<td>2002*</td>
<td>2 – 48 hours</td>
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</tbody>
</table>
Mean Brain Death Interval 19 Hours

(Lustbader et al. Neurology 2011)
Mean Brain Death Interval by Day of Week

<table>
<thead>
<tr>
<th>Day of Brain Death Initiation (First Brain Death Note)</th>
<th>The Mean Brain Death Interval (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>21.9</td>
</tr>
<tr>
<td>Monday</td>
<td>19.5</td>
</tr>
<tr>
<td>Tuesday</td>
<td>18.1</td>
</tr>
<tr>
<td>Wednesday</td>
<td>19.4</td>
</tr>
<tr>
<td>Thursday</td>
<td>18.1</td>
</tr>
<tr>
<td>Friday</td>
<td>18.3</td>
</tr>
<tr>
<td>Saturday</td>
<td>19.9</td>
</tr>
</tbody>
</table>
AAN 2010: Can complex motor movements falsely suggest brain function?

- 6 studies
- N=144, plantar reflexes or undulating toe flexion in 55%
- Plantar flexion persistence 32 hours
- Ventilator autocycling may falsely suggest patient initiated breathing
  - Chest tubes
  - Disconnect ventilator for apnea assessment
AAN 2010: Apnea test safe?

- 4 studies
- N=212, preoxygenation 100% x 10 mins and apneic oxygenation diffusion 6 L/min – 7% not attempted, 3% aborted
- N=20, T piece 12L/min CPAP 10 cmH₂O – All completed
- Abort if SBP < 90 mmHg or SaO₂ < 85% for > 30 seconds. Retry with T piece CPAP 10 cmH₂O and 100% 12L/min.
AAN 2010: Prerequisites

- Coma, irreversible and cause known
- Exclude CNS depressants
  - Wait 5 half lives, do not need levels
  - Barbiturates < 10 mcg/mL
- $T > 36^\circ C$
- SBP > 100 mmHg
- No severe metabolic abnormalities
- Time has passed, usually several hours
AAN 2010: Examination

- Pupils nonreactive to bright light
- Corneal reflex absent
- Oculocephalic reflex absent
- Oculovestibular reflex absent
- No facial movements to stimuli
- Gag reflex absent
- Cough absent with tracheal suctioning
- No motor response in all 4 limbs
AAN 2010: Ancillary Tests

- EEG, nuclear scan, cerebral angiogram, TCD, CTA, MRI/MRA
- Not needed for diagnosis and cannot replace neurologic exam
- Potential disparity between test and clinical examination
- Reserved for pediatric patients or when apnea test cannot be safely performed
AAN 2010: Documentation

- Time of death is time the arterial $\text{pCO}_2$ reached target value.
- If apnea test aborted, time of death is when ancillary test interpreted.
- New York requires a second certifying signature for time of death for organ donors.
Brain Death Diagnosis

If a certain period of time has passed since the onset of the brain insult (usually several hours), 1 neurologic exam is sufficient to pronounce brain death. (AAN Evidence Based Guideline Update: Determining Brain Death. Neurology 2010)

One exam was 100% accurate for 1311 brain dead patients. (Lustbader. Neurology 2011)
Organ Donation After Cardiac Death
DCD

- Ventilator patient has life limiting illness
- Patient is not brain dead
- A decision is made to discontinue all life sustaining treatment
- DNR order
- Family consents to organ donation
Family Preparation for DCD

- Patient extubated in OR where donor viability and DCD duration determined by OPO
- Patient may not die
- Family may go to OR but perhaps not best practice
  - Hostile environment
  - Sterile gowns and masks
  - Bereavement support in ICU
DCD

- Premortem heparin bolus
- D/C all non comfort medications
- Pre extubation medications including opioids and benzodiazepines
  - Hourly dose or 10% of total daily dose
- Glycopyrrolate for terminal secretions
- Extubate to room air, remove trach or use trach collar
Death Pronouncement

• Apnea plus 2-5 minutes of PEA or asystole = death (varies by hospital policy)
• Death certificate completed
• Organ procurement occurs
A Good Death

- Optimal pain and symptom management
- Discuss fears, goals and burden patient willing to endure near the end of life
- Preserve opportunity for organ donation
- Create robust plan as death approaches
  - Medical decision maker
  - What is most important?