Management of the Organ Donor

Patrick Kim, MD
Objectives

- Understand importance of identifying potential organ donors
- Describe physiologic changes associated with brain death
- Articulate principles of determining brain death
- Describe management of potential organ donors

- No disclosures
The downstream benefits of organ transplantation

- One deceased donor provides up to seven life-saving solid organs
  - Kidney (2)
  - Liver
  - Pancreas
  - Heart
  - Lung (2)
Waiting list keeps growing

Sources of “life-saving” organs

- Living donor
- Deceased donor

<table>
<thead>
<tr>
<th>Death by Neurologic Criteria</th>
<th>Death by Cardiac Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>DND</td>
<td>DCD</td>
</tr>
<tr>
<td>“Brain dead” donor</td>
<td></td>
</tr>
<tr>
<td>“Heart-beating” donor</td>
<td>“Non-heart-beating” donor</td>
</tr>
</tbody>
</table>
Failures of our current system

- Only 42% of potential donors actually donate...
  - Lack of identification
  - Lack of consent
  - Systems issues
- 600,000 life-years lost

The downstream benefits of organ transplantation

- **Cost-effective**
  - Less expensive than dialysis
- **One deceased donor adds…**
  - 30.8 life-years to recipients (2.9 organs)
  - 55.8 life-years (projected; 7 organs)
- **250,000 additional life-years (potential)**

The “Chain of Benefits”

- An increase in donated organs...
  - Shortens wait list time
  - Averts recipient mortality while listed
  - Adds life-years to population

DHHS Commitment to Increase Transplantation

- Increase the number of deceased organ donors
  **GOAL:** 75% conversion rate

- Increase the average number of organs transplanted per deceased donor
  **GOAL:** 3.75 organs/donor

Former U.S. Department of Health and Human Services Secretary Tommy Thompson
Do what he says!

Separated at birth?

Former bad-ass U.S. Marshal Tommy Lee Jones

Former U.S. Department of Health and Human Services Secretary Tommy Thompson
Factors influencing consent to donation

- **Factors positively influencing families’ consent to donation**
  - Positive beliefs about organ donation
  - Knowledge of donor card or previous discussion with patient about donation
  - Non-physician HCP making initial request
  - Number of conversations and total time with OPO staff

- **Factors negatively influencing families’ consent to donation**
  - Asking apologetically
  - Perception of HCP not caring or concerned

- **Factors not affecting families’ consent to donation**
  - Family's education or income
  - Timing of donation request in relation to time of death

Other interesting findings

- HCP accuracy in predicting family response: 47%
- Flip of coin: 50%

Optimizing organ recovery

- Wide surveillance to identify possible donors
- Uniform policy for determining brain death
- Consistent method of obtaining consent
- Optimal critical care management of donor
Wide surveillance to identify donors

- Comatose, vent-dependent
- Non-recoverable neurologic injury/illness
- Grave prognosis discussion
- Advancing DNR discussion
# Team Huddle

Ensures Optimal Communication with Care Team and Family

<table>
<thead>
<tr>
<th>Criteria for Team Huddle:</th>
<th>Participants:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ After medical suitability has been determined</td>
<td>• Gift of Life Coordinator</td>
</tr>
<tr>
<td>✓ Shift change</td>
<td>• Bedside Nurse</td>
</tr>
<tr>
<td>✓ Family/care team are discussing DNR or withdrawal of support</td>
<td>• Treating Physician</td>
</tr>
<tr>
<td>✓ Family brings up donation</td>
<td>• Resident</td>
</tr>
<tr>
<td>✓ Brain death has been determined</td>
<td>• Support Staff (when appropriate)</td>
</tr>
<tr>
<td>✓ Patient is hemodynamically unstable</td>
<td>• Pastoral Care</td>
</tr>
<tr>
<td>✓ At the request of the care team or Gift of Life Coordinator</td>
<td>• Social Work</td>
</tr>
<tr>
<td></td>
<td>• Respiratory Care</td>
</tr>
<tr>
<td></td>
<td>• Other</td>
</tr>
</tbody>
</table>

A Gift of Life Coordinator (with a designated member of the care team) will facilitate the team huddle at important junctures of the case.

## Points for Discussion

Patient Status, Clinical Plan, Donation Options, Family Communication/Support, Next Steps
Uniform policy for determining brain death

- **Principles**
  - Irreversible coma, known cause
  - Areflexia of brainstem
  - Apnea

- **UPHS policy: see Intranet**

- **Specifics for**
  - Who may examine
  - How to do exam
  - CHECKLIST
  - Don’t make it up!
Death by Neurologic Criteria: prerequisites

A. Prerequisites (all must be checked)
   - Coma, irreversible and cause known
   - Neuroimaging explains coma
   - CNS-depressant drug effect absent (if indicated toxicology screen; if barbiturates given, serum level <10 µg/mL)
   - No evidence of residual paralytics (electrical stimulation if paralytics are used)
   - Absence of severe acid-base, electrolyte, endocrine abnormality
   - Normothermia or mild hypothermia (core temperature >36°C)
   - Systolic blood pressure 100 mm Hg or greater
   - No spontaneous respirations
Death by Neurologic Criteria: exam

B. Examination (all must be checked)

- Pupils nonreactive to bright light
- Corneal reflex absent
- Oculocephalic reflex absent (tested only if C-spine integrity is ensured)
- Oculovestibular reflex absent
- No facial movement to noxious stimuli at supraorbital nerve, temporomandibular joint
- Gag reflex absent
- Cough reflex absent to tracheal suctioning
- Absence of motor response to noxious stimuli in all 4 limbs (spinally mediated reflexes are permissible)
Death by Neurologic Criteria: apnea

C. Apnea testing (all must be checked)

- Patient is hemodynamically stable (even with the use of vasopressors)
- Ventilator adjusted to provide normocarbia ($P_{aco_2}$ 35–45 mm Hg)
- Patient preoxygenated with 100% $Fi_o_2$ for greater than 10 minutes to $P_{ao_2}$ greater than 200 mm Hg
- Patient well oxygenated with a positive end-expiratory pressure of 5 cm of water
- Provide oxygen via a suction catheter to the level of the carina at 6 L/min or attach T-piece with continuous positive airway pressure at 10 cm $H_2O$
- Disconnect ventilator
- Spontaneous respirations absent
- Arterial blood gas drawn at 8 to 10 minutes, patient reconnected to ventilator
- $P_{aco_2}$ 60 mm Hg or greater, or 20 mm Hg increase from normal baseline value
- Apnea test aborted
D. Ancillary testing (only 1 needs to be performed; to be ordered only if clinical examination cannot be fully performed because of patient factors, or if apnea testing inconclusive, contraindicated, or aborted)

- Cerebral angiogram
- Hexamethylpropyleneamine oxime single-photon emission computed tomography
- EEG
- Transcranial Doppler

...”when used correctly and supported by ancillary testing when necessary, the AAN practice guidelines...correctly diagnose brain death with certainty.”

Wijdicks et al, Neurology 2010
Consistent method for obtaining consent

- Gift of Life representative, not provider
- NEVER the transplant team
- AVOID any appearance of conflict of interest
Criteria for Consulting Gift of Life for Critical Care Patients

To provide donation as an option for families and preserve the opportunity, please contact Gift of Life *if any one* of the following conditions exists:

For potential organ donation (*ventilator-dependent patients*):

- Irreversible neurological injury (traumatic or non-traumatic causes);
- Brain death protocol being considered;
- Severe anoxic encephalopathy;
- **Multi-trauma with hemodynamic instability**;
- Prior to the initiation of family discussions regarding DNR status for all patients with an irreversible neurological injury (including DNAR-C status).

Call Gift of Life at 1-800-KIDNEY1 (1-800-543-6391)

*PER HUP PROTOCOL, PLEASE ALLOW GIFT OF LIFE TO INITIATE ALL FAMILY DISCUSSIONS REGARDING ORGAN DONATION*
# Phases of Communication for Families of Potential Organ Donors

<table>
<thead>
<tr>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Phase IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ has suffered severe damage to his/her brain. We are doing everything we can, but it’s possible that s/he may not recover.</td>
<td>Despite everything we are doing, things are getting worse. There is nothing more we can do to help him/her recover.</td>
<td>It looks like _____’s brain has been completely destroyed and s/he appears to be dead. We have begun a series of tests to confirm this. We want to be extremely thorough and careful to ensure that we are absolutely correct.</td>
<td>We have finished the testing and found that ______ has died @ ___.</td>
</tr>
</tbody>
</table>

(Show pictures of CT scan, etc.)

(timeframe provided for testing)

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**Hospital staff introduces GLDP coordinator**

**Phase V**

This is ____________, who works with our team. S/he is a specialist who works with families such as yours.
Effects of Brain Death

Catecholamine storm
- Elevated
  - ICP
  - HR
  - BP
- Rise in hormones
  - Epinephrine
  - Norepinephrine
  - Dopamine
- ECG Changes
  - Sinus tach
  - Multifocal PVCs

Normal Brain

Herniation and Brain Death

Courtesy Dr. Kenneth Wood UWHC
Pathophysiology of Brain Death

- Destruction of vasomotor center and complete vasodilation
- Free water loss due to lack of ADH
- Secondary diuresis and dehydration due to prior cerebral resuscitation
- Loss of hypothalamic temperature regulation (blood is continually cooled through peripheral circulation and not rewarmed by central mechanism)
Optimal critical care management of donor

- Most of the principles are the same as for living patients...
  - Assessment
  - Monitoring
  - Resuscitation

- …with some important differences
  - Hormonal resuscitation
  - Transplant suitability: Serologies, bronch, echo, cath, etc
“Vigilant medical management ensures that the greatest number of organs can be recovered in the best possible condition to provide optimal outcomes for the recipients.”

Hypovolemia

Absolute hypovolemia
  Initial injury
  Inadequate resuscitation
  Fluid leaking into interstitial space
  Decreased intravascular oncotic pressure after crystalloid resuscitation
  Treatment for intracranial pressure
    Fluid restriction
    Urea
    Diuretics
    Mannitol
    Hyperglycemia-induced osmotic diuresis
    Diabetes insipidus
    Hypothermic "cold" diuresis

Effective hypovolemia
  Loss of vasomotor tone and pooling in venous capacitance bed
  Hypothermia treated with rewarming

Cardiac dysfunction

Preexisting disease
  Initial injury
  Myocardial contusion
  Pericardial tamponade
  Myocardial ischemia or infarct
  Process of brain death
  Catecholamine damage
  Ischemia–reperfusion injury
  Metabolic depression
    Acidosis
    Hypothermia
    Hypophosphatemia
    Hypocalcemia
    Hypoxia
    Endocrinopathy of brain death
  Volume overload resulting in congestive heart failure
  Arrhythmias
    Catecholamines
    Ischemia
    Hypokalemia
    Hypomagnesemia

Vasodilatation

Spinal shock
  Catecholamine depletion
  Loss of vasomotor control and autoregulation
  Relative adrenal insufficiency as a result of trauma or critical illness
  Endocrinopathy of brain death
  Acquired sepsis
Cardiovascular

♦ **Problem**
  - Hypovolemia
  - Sympathetic storm followed by CV collapse

♦ **Assessment**
  - Echo?
  - Noninvasive CO?
  - PA catheter?

♦ **Treatment**
  - Volume repletion
  - Pressors (all of these are the agent of choice!)
    - Vasopressin
    - Dopamine
    - Norepinephrine
    - Phenylephrine
Pulmonary

- **Problem**
  - Neurogenic pulmonary edema
    - Systemic vasoconstriction
    - Proinflammatory state
  - Competing priorities
    - Abdominal vs thoracic organ function

- **Assessment**
  - CXR
  - ABG P/F
  - Bronchoscopy

- **Treatment**
  - Judicious resuscitation
  - Bronchoscopy
  - Low stretch protocol?
  - Recruitment maneuvers?
  - Aerosolized terbutaline?
Endocrine

- **Problem**
  - Sympathetic storm, then endocrine death
  - Loss of cortisol, thyroid, ADH, insulin
  - Hypotension, hypothyroid, DI, hyperglycemia

- **Assessment**
  - VS, presumptive dx

- **Treatment**
  - Volume, hypotonic fluid PRN
  - “3-drug protocol”: Methylprednisolone + T3/T4 + AVP
    - Improved graft function
  - Glycemic control
Hormonal replacement therapy

<table>
<thead>
<tr>
<th>Medications</th>
<th>Dose (Intravenous)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methylprednisolone</td>
<td>20–30 mg/kg</td>
<td>May need to be dosed every 8–12 h</td>
</tr>
<tr>
<td>Levothyroxine</td>
<td>0.8–1.4 µg/kg/h</td>
<td>May be bolused 1–5 µg/kg. Can contribute large amounts of fluid at high doses</td>
</tr>
<tr>
<td>Triiodothyronine</td>
<td>0.05–0.2 µg/kg/h</td>
<td></td>
</tr>
<tr>
<td>Regular insulin</td>
<td>0.05–0.1 units/kg/h</td>
<td>Need to monitor glucose. Can use D50% if normoglycemic</td>
</tr>
<tr>
<td>Desmopressin (DDAVP)</td>
<td>2–4 µg</td>
<td>May be given as frequently as every hour. Titrate for UOP 3–4 mL/h</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>0.5–1 milliunits/kg/h</td>
<td>Titrate for mean arterial pressure &gt;70 and then titrate for UOP 3–4 mL/h</td>
</tr>
</tbody>
</table>

Demetriades and Lam, in Novitsky and Cooper, eds. The brain-dead donor: pathophysiology and management. Springer 2013.
Endpoints of resuscitation?

- HR 60 – 100
- UOP 0.5 – 3 mL/kg/hr
- MAP 60 – 65 mmHg
- P/F > 300

Donor management goals?

**TABLE 1. Donor Management Goals**

<table>
<thead>
<tr>
<th>Critical Care End Points</th>
<th>DMG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean arterial pressure</td>
<td>60–100 mm Hg</td>
</tr>
<tr>
<td>Central venous pressure</td>
<td>4–10 mm Hg</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>Pressors</td>
<td>≤1 and low dose*</td>
</tr>
<tr>
<td>Arterial blood gas pH</td>
<td>7.3–7.45</td>
</tr>
<tr>
<td>( P_{A\text{O}<em>2} : F</em>{I\text{O}_2} )</td>
<td>&gt;300 on PEEP = 5 cm H(_2)O</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>135–160 mEq/L</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>&lt;150 mg/dL</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>&gt;10 mg/dL</td>
</tr>
<tr>
<td>Urine output</td>
<td>1–3 mL/kg/h for preceding 4 h</td>
</tr>
</tbody>
</table>
DMGs improve organ transplantation

### TABLE 2. Impact of DMGs on Organ Yield

<table>
<thead>
<tr>
<th>DMGs Met</th>
<th>DMGs Not Met</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>% SCDs with ≥4 OTPD</td>
<td>70.1%</td>
<td>38.7%</td>
</tr>
<tr>
<td>Mean OTPD ± SD</td>
<td>4.35 ± 1.61</td>
<td>3.32 ± 1.56</td>
</tr>
</tbody>
</table>

**Transplanted**

<table>
<thead>
<tr>
<th></th>
<th>DMGs Met</th>
<th>DMGs Not Met</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right lung</td>
<td>37.1%</td>
<td>14.3%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Left lung</td>
<td>36.1%</td>
<td>14.3%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Heart</td>
<td>56.7%</td>
<td>30.5%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Liver</td>
<td>93.8%</td>
<td>81.6%</td>
<td>0.005*</td>
</tr>
<tr>
<td>Pancreas</td>
<td>40.2%</td>
<td>24.7%</td>
<td>0.005*</td>
</tr>
<tr>
<td>Right kidney</td>
<td>95.9%</td>
<td>87.4%</td>
<td>0.021*</td>
</tr>
<tr>
<td>Left kidney</td>
<td>94.8%</td>
<td>88.8%</td>
<td>0.088*</td>
</tr>
<tr>
<td>Intestine</td>
<td>2.1%</td>
<td>1.3%</td>
<td>0.641‡</td>
</tr>
</tbody>
</table>

SD, standard deviation.

* Pearson’s χ².
† Student t test.
‡ Fisher’s exact test.

“DMGs met” is defined as meeting any 8 or more of the 10 DMGs before organ procurement. “DMGs not met” is defined as meeting less than 8 of the 10 DMGs before procurement.

<table>
<thead>
<tr>
<th>ARR</th>
<th>NNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>~23%</td>
<td>5</td>
</tr>
<tr>
<td>~22%</td>
<td>5</td>
</tr>
<tr>
<td>~26%</td>
<td>4</td>
</tr>
<tr>
<td>~12%</td>
<td>9</td>
</tr>
<tr>
<td>~15%</td>
<td>8</td>
</tr>
<tr>
<td>~8%</td>
<td>13</td>
</tr>
<tr>
<td>~6%</td>
<td>17</td>
</tr>
<tr>
<td>0.8%</td>
<td>&gt;100</td>
</tr>
</tbody>
</table>
Controversies

- Premortem anticoagulation
- Premortem femoral vessel cannulation
## Wisconsin DCD criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assigned points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous respirations after 10 min</td>
<td></td>
</tr>
<tr>
<td>Rate &gt; 12</td>
<td>1</td>
</tr>
<tr>
<td>Rate &lt; 12</td>
<td>3</td>
</tr>
<tr>
<td>Tidal volume &gt; 200 ml</td>
<td>1</td>
</tr>
<tr>
<td>Tidal volume &lt; 200 ml</td>
<td>3</td>
</tr>
<tr>
<td>Negative inspiratory force &gt; 20 mmHg</td>
<td>1</td>
</tr>
<tr>
<td>Negative inspiratory force &lt; 20 mmHg</td>
<td>3</td>
</tr>
<tr>
<td>No spontaneous respirations</td>
<td>9</td>
</tr>
<tr>
<td>Body mass index</td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>1</td>
</tr>
<tr>
<td>25–29</td>
<td>2</td>
</tr>
<tr>
<td>&gt;30</td>
<td>3</td>
</tr>
<tr>
<td>Vasopressors</td>
<td></td>
</tr>
<tr>
<td>No vasopressors</td>
<td>1</td>
</tr>
<tr>
<td>Single vasopressor</td>
<td>2</td>
</tr>
<tr>
<td>Multiple vasopressors</td>
<td>3</td>
</tr>
<tr>
<td>Patient age</td>
<td></td>
</tr>
<tr>
<td>0–30</td>
<td>1</td>
</tr>
<tr>
<td>31–50</td>
<td>2</td>
</tr>
<tr>
<td>&gt;51</td>
<td>3</td>
</tr>
<tr>
<td>Intubation</td>
<td></td>
</tr>
<tr>
<td>Endotracheal tube</td>
<td>3</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>1</td>
</tr>
<tr>
<td>Oxygenation after 10 min</td>
<td></td>
</tr>
<tr>
<td>O₂ saturation &gt; 90%</td>
<td>1</td>
</tr>
<tr>
<td>O₂ saturation 80–89%</td>
<td>2</td>
</tr>
<tr>
<td>O₂ saturation &lt; 80%</td>
<td>3</td>
</tr>
</tbody>
</table>

**Scoring:** 8–12 high risk for continuing to breathe after extubation, 13–18 moderate risk for continuing to breathe after extubation, 19–24 low risk for continuing to breathe after extubation
## Donor management: Roles of team members

<table>
<thead>
<tr>
<th></th>
<th>MD/AP</th>
<th>Nursing</th>
<th>OPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide care</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><em>Predict</em> suitability for donation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refer to OPO</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Support family</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Declare death</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Decide</em> suitability for donation</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
Integrating the elements

- **Commitment at the institutional and individual level**
  - High priority
  - Resources
  - “Buy-in” at point of care

- **Evidence-based practice**
  - Best practices in critical care of patients
  - Best practices in donation process

- **Sensitivity**
  - Difficult patient care, difficult situations
  - Professionalism
References

- Wood et al., NEJM 2004.
- Frontera et al., Neurocrit Care 2010. (DND)
- Frontera, Neurocrit Care 2010. (DCD)
- Dare et al., Curr Neurol Neurosci Rep, 2012.
- Youn et al., Crit Care Clin 2014.