Medical Management of the Potential Organ Donor

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Goals and Objectives

Goal:
- To provide insight and a guideline for management of potential organ donors to facilitate organ procurement.

Objectives:
- Reiterate why this is important
- Discuss pathophysiological effect of brain death
- Elucidate how to optimize potential organ procurement
Maybe if we took better care of the ones we have we wouldn’t need more?
Why are we focusing on this at all?

- 105,000 patients awaiting transplant
- Waiting list grows by 16% per year

<table>
<thead>
<tr>
<th>Average Wait</th>
<th>% Death on the List</th>
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</thead>
<tbody>
<tr>
<td>Heart 350 days</td>
<td>14%</td>
</tr>
<tr>
<td>Lung 788 days</td>
<td>12%</td>
</tr>
<tr>
<td>Liver 817 days</td>
<td>10%</td>
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<tr>
<td>Kidney 1131 days</td>
<td>5%</td>
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</tbody>
</table>

Health Services and Resources Administration
One donor can impact 6 lives with major organs

Current average is 2.5 organs per donor
How to Increase Supply?

- Early identification of potential donors
  - Surveillance
- Timely diagnosis of brain death
  - Declaration
- Increase conversion rate
  - Consent
- Optimal donor management
  - Aggressive Donor Management
  - Extended Criteria (Australia - good outcomes with centers of excellence)
1 in 5 Americans die using ICU Services

- 38% of deaths in hospital with 22% after ICU admission
- 540,000 deaths after ICU admission /year
- Avg LOS and Costs
  - Terminal ICU admission
    - 13 days and $24,541
  - Non-ICU Terminal Hospital
    - 8.9 days and $8,548

- Use of intensive care at the end of life in the United States: An epidemiologic study

Angus CCM 2004;32:638-643
Declaration – When are you Dead?

- Dead Donor Rule
- Brain Death
  - irreversible cessation of all functions of the entire brain, including the brainstem, is dead
- Donation after Cardiac Death
Active Donor Management

- Stay Connected – OPO manage donor after declaration
  - Logistics
  - Cost
  - Consistency
- Shift from cerebral protective strategies to improving donor organ survival
- Critical care of organs for multiple patients
Care of Potential Organ Donor

- Restore & maintain hemodynamic stability
- Ensure vital organ’s perfusion
- Prevent & treat complications of brain death

What happens when the brain dies?
Complications of Brain Death

- Hemodynamics
  - Autonomic Surge
  - Instability
- Pulmonary system
  - Capillary Leak
  - Cytokine expression
  - Neurogenic pulmonary edema
- Endocrine system
  - Endocrinopathy
    - Thyroid, cortisol, insulin
Hemodynamic Changes

- Initial phase (sympathetic storm)
  - ↑HR, ↑BP, ↑SVR, ↑O2 consumption
  - Myocardial necrosis

- Next phase (sympathetic depletion)
  - ↓BP, ↓SVR, ↓CO
  - Decreased coronary perfusion pressure
  - Myocardial ischemia with impaired function

- Hypovolemia (actual or relative)
Optimizing Myocardial Function

- Invasive monitoring
- Short acting B blockers / Vasodilators
- Specific Algorithms for:
  - CI >2.5 L/min m²
  - CVP and PCWP <12 mmhg
  - MAP 65-85
  - SVR 800-1200 dynes/cm/sec
- Volume resuscitation
- Vasopressors & inotropes
- Hormonal replacement

Audibert Transplantation 2006;82:1031-1036
Venkateswaran Eur Heart J 2009
Wheeldon J Heart Lung Txp 1995; 14:734-742
Role of thyroid hormone
- ↓ circulating thyroxine ($T_4$)
- ↓ Myocardial energy stores – aerobic to anaerobic metabolism
- ↓ hemodynamic instability, ↑ inotropic support

Controversial

Pulmonary System

- Only 15% of lungs from brain dead donors utilized for transplantation
- Primary Graft Dysfunction affects 15 to 50% of the lung transplant recipients
- PGD is a significant cause of early morbidity and mortality (42% vs. 6% in PGD free recipients)

Punch Am. J. Transplant 2007; 7:1327-1338
Christie Chest 2005; 127:161-165
Christie Chest 2003; 124:1232-1241
Pulmonary edema
  ◦ Neurogenic
    • Sympathetic surge, increase hydrostatic pressure, cap leak
  ◦ Inflammatory
    • Cytokines (IL-6, IL-8, IL-1β)

ALI/ARDS
Aspiration
Infection
Contusion
VILI

Alvontitis Transplantation 2003;75:1928-1933
Gabbay AJRCCM 1999;160:256-271
Angel AJRCCM 2006;174:710-716
Optimizing Lung Function

- **Fluid Management:**
  - Minimize crystalloid, utilize diuretics
  - CVP < 12

- **Ventilation:**
  - Recruitment (PIP 25 mmHg, PEEP 15 mmHg for 2 hours)
  - 10 cc/kg TV, PEEP 5, P/F ratio > 300

- **Bronchoscopy:**
  - R/O infection

- **Antibiotics**

- **Pulmonary toilet**
  - Aspiration precautions

Angel AJRCCM 2006;174:710-716
Ineligible donor lungs have high level of inflammation and capillary leak.

IL-10 anti-inflammatory cytokine inactivates antigen-presenting cells and decreases pro-inflammatory cytokine production.

Adenoviral vector encoding human interleukin-10 treated lungs showed improved function (↑ PaO₂ and PVR), ↑ anti-inflammatory markers and less capillary leak.

Fig. 1 The EVLP system.

Endocrine System

- Hypothermia
- Adrenal insufficiency
- ↓T3 & T4 → anaerobic metabolism / ↓BP
- ↓Insulin / Hyperglycemia
- ↓Vasopressin → DI

- Keep em’ warm
- Steroid Replacement
  - Stabilize cellular membranes
  - antiinflam
- Thyroxin
- Insulin
- Vasopressin
Coagulopathy

- Thromboplastin
- Fibrinogen
- Tissue plasminogen
- Consumptive coagulopathy
- Hypothermia
Metabolic Abnormalities

- Hypernatremia
- Hypokalemia
- Hypomagnesemia
- Hypocalcemia
- Hypophosphatemia
Impact of Donor Management protocols on donation and recipient outcomes

- Increases retrieval rate of lung transplants
- Increased organs procured per donor
- Transformed Unacceptable Donors
  - 92% of initially unacceptable organs were capable of functional resuscitation
  - 84% alive (13-48 months)
- Antagonistic competing organ interests
  - Good for lungs, bad for kidneys

Angel AJRCCM 2006;174:710-716
Follette TXP Proceed 1999;31:169-70
Wheeldon J Heart Lung Txp 1995;14:734-742
Summary

- Organs are scarce
- Many potential donors are lost during the process
- Brain death leads to significant hemodynamic instability
- This has a negative effect of organ perfusion and graft function
- Aggressive Donor management improves retrieval
BUT Show me the Money $150,000.00/transplant

- OPO estimated donor management costs:
  - $82,500.00 (ICU, OR, Labs, pharmacy, radiology, bronchoscopy, ecg/echo)

- OPO Billing to transplant centers:($82,704)
  - Lungs   Dbl $32K Single $29K
  - Heart   Adult $29K
  - Liver   $30K
  - Kidney  Single $26,500

- Transplant Center Costs:
  - $30K (transport, perfusion, OR, surgeons fee)
  - Care of organ recipient
Questions?