Guidelines for Multiple Organ Procurement in the Brain Dead Organ Donor

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Please note that these guidelines may need modification according to the condition of the patient. Please check with the attending anesthesiologist assigned to the case.

General Information
Donors for multiple organ procurement are brain dead. The current criteria for brain death include:
- loss of all cortical and brainstem functions as evidenced by physical exam and apnea testing
- exclusion of reversible causes such as hypothermia or intoxication

The most common causes of brain death in multiple organ donors are head trauma, intracranial hemorrhage, and intracranial malignancy.

Brain death is often characterized by a number of common metabolic and physiologic derangements:
- autonomic dysfunction
- elevated intracranial pressure (ICP)
- hemodynamic instability
- inability to regulate body temperature
- intracranial hypertension
- neuroendocrine dysfunction: diabetes insipidus, thyroid hormone deficiency, hyperglycemia, catecholamine release, endorphine release

Dependent of the causes of brain death, the brain dead donor may have multiple other medical problems which have to be cared for to maintain all organs in as viable a state as possible. The organ procurement takes about 1-2 hours, and large volume blood loss and fluid requirements of the brain dead organ donor may be possible. If the venous access the donor comes to the OR with is insufficient for large volume fluid replacement therapy, insert 1-2 14-G IV lines or sheaths into the internal jugular vein and/or the femoral vein.
In Seattle, the Life Center Northwest organ procurement coordinator is dealing with the logistics of the organ procurement and may have specific requests.

**Procurement**

Depending on the number and kind of organs to be procured, the operation may involve several surgical teams to procure both abdominal and thoracic organs, such as heart, lung(s), liver, kidney(s), and pancreas.

During the surgical preparation of the abdominal organs, blood loss can be considerable. If resulting hypotension is not to control by volume replacements, the surgeon can clamp the infrarenal aorta. If heart and/or lung(s) are to be procured, arrhythmias and hypotension may occur.

Once dissection of all organs to be procured is complete, the donor gets fully heparinized (30,000 units heparin) before cross clamping of the aorta. After cross clamping of the aorta the organs are flushed with preservative solutions. Note down the time of aortic cross clamping as this represents the beginning of the organs ischemic time.

The anesthesiologist can then turn off the anesthesia machine, and after having completed the anesthesia worksheet supplied by Life Center Northwest, retire from the scene.

If one or both lungs are procured, low frequency ventilation (4-6 breaths / minute) has to continue to prevent atelectasis of the lung(s) until flushing the lungs with preservative solution has been completed.

The anesthesia machine can then be turned off, but the anesthesiologist will be required to fully inflate the lungs manually, and withdraw the endotracheal tube while the trachea is divided and stapled. After having completed the anesthesia worksheet supplied by Life Center Northwest, the anesthesiologist can retire from the scene.
**OR set-up**

- 1 arterial line
- CT anesthesia cart
- CVP line
- 1-2 14-G IVs
- Belmont infusor / fluid warmer
- R2 pads and defibrillator
- Calcium Chloride, 1000 mg, 10 ml syringe(s)
- Cefazolin, 2000 mg
- Epinephrine, 10 μg/ml, 10 ml syringe
- Epinephrine, 100 μg/ml, 10 ml syringe
- Frusemide, 100 mg
- Heparin, 30,000 units (in 30 ml syringe -> concentration : 1000 units heparin / ml)
- Mannitol, 25 mg, 3-4 vials
- NaHCO$_3$, 50 mmol, 50 ml syringe(s)
- Triple antibiotic solution for nasogastric installation, infusion rate : 250 ml/hr via NG-tube. The solution is supplied by Life Center Northwest and only to be given if requested! (Usually for pancreas harvest).

- **Infusion solutions (spiked and on Alaris infusion pumps):**

<table>
<thead>
<tr>
<th>Infusion solution</th>
<th>Infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dopamine, 400 mg, 250 ml D5W</td>
<td>3.0 μg/kg/min (infuse throughout procurement), unless diabetes insipidus is present</td>
</tr>
<tr>
<td>NACL, 500-1000ml</td>
<td>50 ml/hour (infuse throughout procurement)</td>
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- **Infusion solutions (available but unspiked):**

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<tr>
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<tr>
<td>Epinephrine, 5 mg, 250 ml D5W</td>
<td>0.01 μg/kg/min to desired effect</td>
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<tr>
<td>Insulin, 25 units, 250 ml NaCl</td>
<td>(see algorithm below)</td>
</tr>
<tr>
<td>Isoproterenol, 1 mg, 250 ml D5W</td>
<td>0.15 μg/kg/min to desired effect</td>
</tr>
<tr>
<td>Lidocaine, 1000 mg, 250 ml D5W</td>
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<td>Thyroid hormone, give 0.4 μg/kg bolus, then</td>
<td>0.1 μg/kg/min (over 6 hours)</td>
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Start insulin infusion according to algorithm to keep serum glucose levels 70-100 mg/dl. 
If despite insulin infusion, serum glucose levels are > 300 mg/dl, give additional insulin boluses until serum glucose levels are 200 mg/dl or less.

<table>
<thead>
<tr>
<th>Blood Glucose (mg/dl)</th>
<th>IV-Infusion Rate (ml/hr)</th>
<th>Insulin Infusion Rate (U/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 70</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>70 – 99</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>100 – 119</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>120 – 149</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>150 – 199</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>200 – 249</td>
<td>25</td>
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</tr>
<tr>
<td>&gt; 250</td>
<td>30</td>
<td>3.0</td>
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- **Blood products**: 4 units packed cells. Precautionary check them in case of sudden profuse bleeding. If donor is CMV negative, all blood must be either **CMV negative** or **leukocyte depleted**, but not both.
- **Plasmalyte** is the preferred crystalloid i.v.-solution. Albumin, Ringer’s Lactate and Normal Saline can also be used for i.v.-infusions.

**Intraoperative management**

- Though the brain dead donor doesn’t require inhalation agents per se, inhalation agents may helpful to control blood pressure
- Administer non-depolarizing muscle relaxant boluses to ablate movements from spinal chord reflexes (Lazarus phenomenon)
- Draw baseline arterial blood gas and bloods requested by Life Center Northwest. **Draw all bloods prior to any transfusions!**
- For lung harvests, maintain SaO₂ > 95%, or PaO₂ ≥ 100 with lowest FiO₂ possible. If unable to maintain the desired oxygen saturation, increase FiO₂ before increasing PEEP. Try to keep FiO₂ < 0.4 and PEEP ≤ 7 cm H₂O. If that doesn’t work, discuss with lung procurement surgeon whether to increase FiO₂, PEEP, or both.
- Avoid alpha agents because they can affect organ viability
- Prior to aortic cross clamp draw BUN and creatinine (green top tubes) and give it to the Life Center Northwest Coordinator.

**Treatment goals**:

- Body temperature 35-37° C
- CVP 3-7 mmHg
- Electrolytes : keep within normal limits
- Glucose 80-100 mg/dl
- Hct 25-30
- PaCO₂ 35-40
- PaO₂ ≥ 100
- Systolic blood pressure ≥ 90 mmHg or MAP ≥ 60 mmHg
- Urine output > 100 ml/hr.
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FLOW CHART

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