# Brain Death Declaration

*and*

# Organ Donor Management

Accountability • Quality • Excellence

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# Diagnosing and Declaring Brain Death

# Uniform Determination of Death Act

An individual who has sustained either:

(1) irreversible cessation of circulatory and respiratory function

or

(2) irreversible cessation of all functions of the **entire brain**, including the **brain stem**, is dead. A determination of death must be made in accordance with accepted medical standards.

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# Etiology of Brain Death

- Severe head trauma
- Aneurismal subarachnoid hemorrhage
- Cerebrovascular injury
- Hypoxic-ischemic encephalopathy
- Fulminant hepatic necrosis
- Prolonged cardiac resuscitation or asphyxia
- Tumors

# Diagnosis of Brain Death

- Brain death is a *clinical diagnosis*. It can be made without confirmatory testing if you are able to establish the etiology, eliminate reversible causes of coma, complete fully the neurologic examination and apnea testing.
- The diagnosis requires demonstration of the absence of both cortical and brain stem activity, and demonstration of the irreversibility of this state.

R. Erff, D.O., *Walter Reed Army Medical Center*

# Prerequisites to the Diagnosis

- **Evidence of acute CNS catastrophe compatible with brain death:**
  - Clinical or Neuroimaging

- **Exclusion of reversible medical conditions that can confuse the clinical assessment:**
  - Severe electrolyte, acid base and endocrine disturbance
  - Absence of drug intoxication and poisoning
  - Absence of sedation and neuromuscular blockade
  - Hypotension (suppresses EEG activity and CBF)
  - Absence of severe hypothermia (core temp < 32 C)

# Brain Stem Reflexes

## Cranial nerve examination:

- No pupillary response to light. Pupils midline and dilated 4-6mm.
- No oculocephalic reflex (Doll's eyes) – contraindicated in C- spine injury.
- No oculovestibular reflex (tonic deviation of eyes toward cold stimulus) – contraindicated in ear trauma.
- Absence of corneal reflexes
- Absence of gag reflex and cough to tracheal suction.
- Absence of facial muscle movement to a noxious stimulus.

# Apnea Testing

Once coma and absence of brain stem reflexes have been confirmed, Apnea testing should be performed.

- It verifies loss of most rostral brain stem function
- Confirmed by **PaCO2 > 60mmHg** and **PaCO2 > 20mmHg over baseline value with acidosis**
- It can cause hypotension, severe cardiac arrhythmias and elevated ICP. (Therefore, apnea testing is performed last in the clinical assessment of brain death.)

Consider **ancillary tests** if the apnea test is inconclusive.

# Apnea Testing Pre-Requisites

Following conditions **must** be met before the apnea test can be performed:

- Core temp > 32.0 C (90 F)
- Systolic blood pressure > 90mmHg
- Euvolemia
- Corrected diabetes insipitus
- Normal PaCO2 ( PaCO2 35 - 45 mmHg)
- Preoxygenation (PaO2 > 200mmHg)

# Ancillary Testing

- ***Purely optional*** when the clinical criteria are met unambiguously.
- A confirmatory test is needed for patients in whom specific components of clinical testing cannot be reliably evaluated
  - Coma of undetermined origin
  - Incomplete brain stem reflex testing
  - Incomplete apnea testing
  - Toxic drug levels
  - Children younger than 1 year old.
  - Required by institutional policy

# Types of Ancillary Tests for Brain Death Determination

- Cerebral Blood Flow (CBF) Studies
  - Cerebral Angiography
  - Nuclear Flow Study
- EEG (when brain scan is not utilized)

# Elements needed for a brain death declaration/death note

- Date and Time of Death
- Detailed documentation of Clinical Exam including specifics of Apnea Testing
- Physician signature

NEVADA DONOR NETWORK

# ORGAN DONOR MANAGEMENT

# Donor Management post Brain Death

- Therapy shifts in emphasis from cerebral resuscitation to optimizing organ function for subsequent transplantation.
- The normal sequelae of brain death results in cardiovascular instability & poor organ perfusion
- Medical staff must focus on:
  - Providing hemodynamic stabilization.
  - Support of body homeostasis.
  - Maintenance of adequate cellular oxygenation and donor organ perfusion.
- Without appropriate intervention brain death is followed by severe injury to most other organ systems. Circulatory collapse will usually occur within 48hrs.

# Donor Management Goals (DMG)

- MAP 60-110 mmHg
- HR 60-140 beats/min
- CVP 4-12 mmHg
- PAWP 7-12 mmHg
- Serum electrolytes WNL
- CBC and coags WNL
- SPO2 >95%
- pH 7.35-7.5
- PF ratio >300
- U/O 1-3 cc/kg/hr
- </= 1 pressor used

*NORMAL PARAMETERS!!*

# What to Expect after Brain Death

- Pathophysiology Changes: Loss of **brain stem function** results in systemic physiologic instability
  - Loss of vasomotor control leads to a hyper-dynamic state.
  - Cardiac arrhythmias, stunned myocardium
  - Loss of respiratory function - Atelectasis, bronchospasm, bronchial edema, hydrostatic fluid column pressing into lungs
  - Loss of temperature regulation – Hypothermia and Hyperthermia
  - Hormonal imbalance - Lack of endogenous ADH and resultant DI, lack of TSH

# Incidence of pathophysiologic changes following Brain Death:

- Hypotension 81%
- Diabetes Insipidus 65%
- DIC 28%
- Cardiac arrhythmias 25%
- Pulmonary edema 18%
- Metabolic acidosis 11%

# Autonomic/Sympathetic Storm

- Release of catecholamines from adrenals (Epinephrine and Norepinephrine) results in a hyper-dynamic state:
  - Tachycardia
  - Elevated C.O.
  - Vasoconstriction
  - Hypertension

# Pituitary Gland Failure

Failure of the Hypothalamus will lead to problems with the pituitary gland

- ADH ceases to be produced leading to Diabetes Insipidus
- Can lead to hypovolemia and electrolyte imbalances
- Leads to problems with the thyroid gland

# Thyroid Gland Failure

- The thyroid is responsible for the production of the hormones (T3 and T4) that increase the metabolic rate and sensitivity of the cardiovascular system.
- When the thyroid fails, it can lead to:
  - Cardiac instability
  - Labile blood pressure
  - Potential coagulation problems

# Disseminated intravascular coagulation (DIC)

- 90% of head injured patients will develop DIC if they become hypothermic (<30 C). Otherwise DIC will occur in fewer (25%) of donors
- DIC may persist despite factor replacement requiring early organ recovery
- Affected by hypothermia, release of catecholamines & hemodilution as a result of fluid resuscitation
- The following are indications of DIC:
  - prolonged PT
  - prolonged PTT
  - decreased platelet count
  - decreased fibrinogen level (<150 mg/dl)
  - decreased hemoglobin
  - bleeding

# Neurogenic Pulmonary Edema

- Brain death is associated with numerous pulmonary problems
- The lungs are highly susceptible to injury resulting from the rapid changes that occur during the catecholamine storm
- Left-sided heart pressures exceed pulmonary pressure, temporarily halting pulmonary blood flow
- The exposed lung tissue is severely injured, resulting in interstitial edema and alveolar hemorrhage, a state commonly referred to as *neurogenic pulmonary edema*

# Organ Donor Management

The following is what the Organ Coordinators focus on:

- Hypertension → Hypotension
- Excessive Urinary Output
- Impaired Gas Exchange
- Electrolyte Imbalances
- Hypothermia

# Cardiovascular System

- "Rules of 100's"
  - Maintain SBP > 100mmHG
  - HR < 100 BPM
  - UOP > 100ml/hr
  - PaO2 > 100mmHg

- Aggressive fluid resuscitative therapy directed at restoring and maintaining intravascular volume. SBP > 90mmHg (MAP > 60mmHg) or CVP ~ 10 mmHg.

# Hypotension Management

- Fluid Bolus – NS or LR
  - Followed by MIVF .9 NS, .45 NS or .2NS
- Colloids – 5% or 25% Albumin, Hespan
- Inotropes
- Vasopressin
- Levothyroxine (T4 protocol)

# T4 Protocol

Reason for use:

- Brain death leads to sudden reduction in circulating pituitary hormones
- May be responsible for impairment in myocardial cell metabolism and contractility which leads to myocardial dysfunction
- Severe dysfunction may lead to extreme hypotension and loss of organs for transplant

# T4 Protocol Mixture

## Bolus:

- 2 gm Solumedrol STAT
- 20 mcg $T_4$ (Levothyroxine) STAT
- 20 units of Regular Insulin IV STAT
- 1 amp $D_{50}W$ IV STAT
- Pull 50 mL of T4 mixture and give IV push

## Infusion:

- 500 mcg $T_4$ in 500 cc D5W (1:1 mix)
- Run at 10 mcg/hr (10 cc/hr), increase as needed by increments of 10 mcg/hr.
- Titrate to keep SBP >100

# Diabetes Insipidus

NEVADA DONOR NETWORK

Symptoms:

- Polyuria
- Serum sodium > 150 mEq/L
- Serum osmolality >310 mmol/L
- Urine osmolality < 300 mmol/kg
- Urine Specific Gravity < 1.005

- Leads to electrolyte depletion/instability monitor closely to avoid hypernatremia and hypokalemia

Donor Management:

- Vasopressin drip 0.5-2 units hr
- Hypotonic MIVF
- Free water bolus down NG/OG tube
- Electrolyte replacement

# Impaired Gas Exchange and Maximize Oxygenation

- Most organ donors are referred with:
  - Chest trauma
  - Aspiration
  - Long Hospitalization with bed rest resulting in atelectasis or pneumonia
  - Impending Neurogenic Pulmonary Edema
- Brain Death contributes to and complicates all of these conditions…

# Impaired Gas Exchange Goals…

- To maintain health of lungs for transplant while optimizing oxygen delivery to other transplantable organs
- Avoid over-hydration
- Ventilatory strategies aimed to protect the lung
- Avoid oxygen toxicity by limiting Fi02 to achieve a Pa02 100mmHg & PIP < 30mmHg.

# Impaired Gas Exchange Management

- Maintain PaO2 of >100 and a saturation >95%
- Monitor ABG's q4h or as requested by OPO
- PEEP 5 cm, HOB up 30$^{o}$
- Increase ET cuff pressure immediately after BD declaration
- Aggressive pulmonary toilet (Keep suctioning & turning q2h)
- CXR (Radiologist to provide measurements & interpretation)
- Bronchoscopy w/ Sputum GS, Cx, AFB and Fungal Cx
- CT of chest requested in some cases

# Electrolyte Imbalance Management

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Hypokalemia

- If K+ < 3.4 – Add KCL to MIVF (anticipate low K+ with DI & T4 administration)

Hypernatremia

- If NA+ >155 – Change MIVF to a more hypotonic solution, Free water boluses down NG tube (this is often the result of dehydration, NA+ administration, and free water loss secondary to diuretics or DI)

Calcium, Magnesium, and Phosphorus

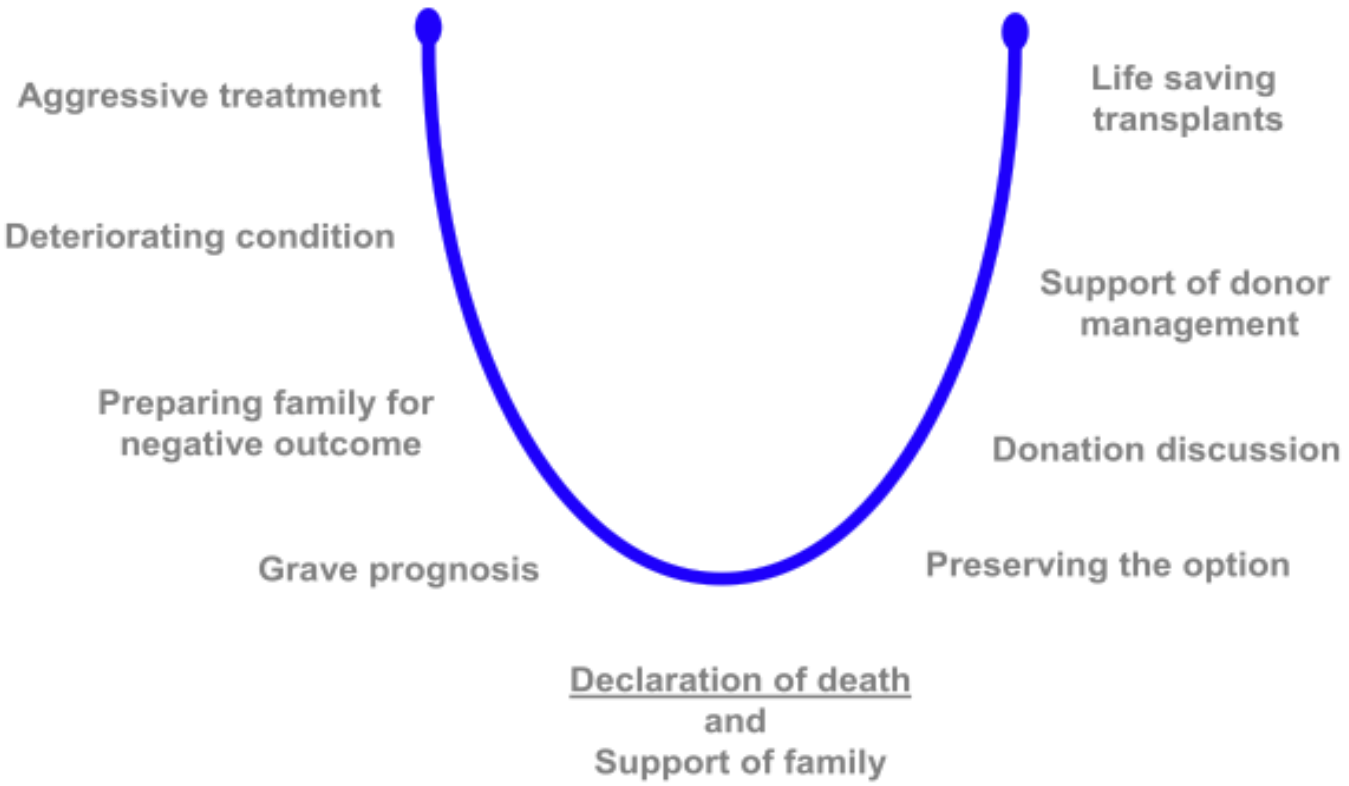
- Deficiencies are common…often related to polyuria associated with osmotic diuresis, diuretics & DI.

# Hypothermia Management

- Monitor temperature continuously
- NO tympanic, axillary or oral temperatures. Central only.
- Place patient on hypothermia blanket to maintain normal body temperature
- In severe cases (<95 degrees F) consider:
  - covering patient's head with blankets
  - hot packs in the axilla
  - warmed IV fluids

# Making The "U-Turn"

*When a patient dies, despite best efforts, organ donation becomes a positive outcome to a tragic situation.*



# Questions??