Neurological Determination of Death
International (and personal..) Perspectives

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NHS Blood and Transplant
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Summary

1. Brain death was discovered, not invented

2. Globally, brain-based determinations of death are fundamentally similar and based on the absence of consciousness, motor responses, brainstem reflexes and capacity to breathe

3. With advances of technology, brain-based determinations of death have become more relevant

4. Death after cardiac arrest is a neurological determination based on the absence of brain blood flow.
National Health Policy for ICU Organ Donation

1. Severe Brain Injury to Neurological Determination of Death (Brain Death)
   April 2003    Shemie (FRG) et al, CMAJ, 2006

2. NDD to Organ Procurement: (Donor Management)
   Feb 2004      Shemie (FRG) et al, CMAJ, 2006

3. Donation after Cardiocirculatory Death (DCD/NHBD)
   Feb 2005      Shemie (FRG) et al, CMAJ, 2006

4. Brain Blood Flow (Brain Death)
   Nov 2006      Shemie (FRG) et al, CJNS, 2008

5. Donation Physician Specialists in a National System
   Feb 2011
References of Further Information

1. Severe Brain Injury to Neurological Determination of Death
   Shemie et al, CMAJ, 2006

2. Brain Death in Adults, American Academy of Neurology
   Wijdicks et al, Neurology 2010

3. A Code of Practice for the Diagnosis and Confirmation of Death
   Academy of Medical Royal Colleges (UK) 2008
Brain Death Instructional Video
open access

http://video.bloodservices.ca/Streaming/nddvideo/

Canadian Blood Services
Société canadienne du sang

www.blood.ca
Death Determined 3 Ways
1. Somatic
2. Neurological
3. Circulatory
Somatic Death

Complete & irreversible loss of all biological functions of all cells & organs that constitute a living organism.
Evolution of Our Understanding

- Cardiopulmonary physiology and resuscitation
- Cardiac surgery and cardiopulmonary bypass
- ICU life support
- Extracorporeal life support and ECMO
- Cell biology
- Organ donation, preservation, transplantation
Airways and Mechanical Ventilation

1. Mollaret and Goullon, Coma Depasse, 1958
2. Havard ad hoc Committee in 1968
To promote donation, organs are animated with a life force that can be gifted, allowing the person to ‘live on’ in the bodies of recipients.

However, the language of medicine insists that human body parts are material entities, entirely devoid of identity....
Biology of Life

Organs as Mechanical Parts

- Lungs load oxygen
- Heart is the pump
- Blood vessels are conduit pipes
- Liver metabolizes
- Kidney filters
Technology, Organ Donation & Transplantation

• Forces reflection on:
  – What it means to be alive, or dead
  – Where our personal identity resides
    • Body, heart, brain or soul?
All vital organs:

Heart, Lung, Liver and Kidney,

can be supported by technology
or replaced by transplantation.
Except the Brain

Is the only organ that cannot be functionally supported or replaced.

Brain-based determination of death is more relevant today.
Brain Function in Critical Illness

1. Consciousness
   - cognition
   - awareness/ receptivity
   - interaction
2. Motor function/response
3. Sensory function/response
4. Autonomic function
5. Respiratory drive
6. Brainstem reflexes including airway control
1. Unresponsive coma with a known proximate cause and absence of reversible conditions
2. Absence of centrally-mediated motor responses
3. Absent brainstem reflexes & the capacity to breathe

Brain Death Determination
Variable and Inconsistent?

Variability in brain death determination practices in children.
Mejia and Pollack JAMA 1995

Brain death worldwide. Accepted fact but no global consensus in diagnostic criteria.
Wijdicks, Neurology, 2002

Variability among hospital policies for determining brain death in adults.
Powner et al, CCM, 2004

Variability of hospital based brain death guidelines in Canada.
Hornby et al, Can J Anes, 2006
Major differences in procedures for diagnosis of brain death in adults and children:

- apnea testing
- observation time
- age related criteria
- required expertise of physicians
- provisions for anoxic BD
- confirmatory lab tests
- legal standards
2003 Canadian Hospital-based Brain Death Document Survey

Brainstem Reflexes

Hornby et al, Can J Anes, 2006
Trauma
Cerebrovascular Accident
Cardiac Arrest

Severe Brain Injury

Mechanical Ventilation and ICU based Life Support

Brain Protective Therapies

Brain Death

- Recognition
- Diagnosis
CORTEX - EEG -

BRAINSTEM - clinical criteria -
Complete and irreversible loss of all clinical functions of the brain.

= BRAIN ARREST

Is the loss of function based on clinical evaluation and/or functional assessment/imaging?
USA

= Whole Brain Death

United Kingdom

= Brain Stem Death

Canada

= Both

There is no test that can evaluate & isolate brainstem integrity
The work of the organism, is expressed in it’s commerce with the surrounding world:
1. Receptivity to stimuli & signals
2. Drive to act
3. Ability to act
Death is a biological phenomenon:

Must distinguish:

The profound, religious, social & psychological customs around death,

From the biology of being dead or alive.

James Bernat 2007
Brain Death is a social construct created for utilitarian purposes, primarily to permit organ transplantation.

Taylor, Semin Neurol, 1997

Brain Death is driven not by a clear understanding of death, but by a need for organs.

Alan Shewmon MD
Pediatric Neurologist UCLA

The Neurological Determination of Death: What Does it Really Mean?

Ari Robin Joffe, M.D., FRCP(C)*

Scaring Us To Death?
Alarming Language & the Need for Responsible Scholarship
Naffine et al, J Law Med, 2009

• Fear of death
• Fear of mistaken diagnosis of death
• Fear of premature declaration of death

Academia and Media
‘truly dead?’”
“almost dead?”
“as good as dead?”
“nearly but not quite dead?”
“not completely dead but dead enough?”
“legal fiction”
Words Matter & Punctuation Saves Lives

You never listen to me, you only hear what you want to hear

Sure, I'll have a beer

Let's eat Grandma
or
Let's eat, Grandma
Words Matter

1. ‘Complete’
2. ‘Irreversible’
3. ‘Permanent’
4. “Whole’
5. ‘Unity’ ‘Integration’
6. ‘Vital’ functions
7. ‘Clinical’ functions
8. Ancillary, confirmatory, supplemental
9. ‘Death’
   • Concept
   • Definition
   • Determination
   • Declaration
   • Criteria and tests
**Evolving Brain Protective Therapies**

Direct ventricular drainage  
(Brain Trauma Foundation J Neurotrauma, 2000)

Hypothermia

**Head Injury**  (Hutchison et al)

**Cardiac Arrest**  (Bernard et al NEJM, 2002)  
(HCASG et al NEJM, 2002)

Decompression Craniectomy  
(Schneider et al Acta Neurochir Suppl 2002)
Decompressive Craniectomy

rescueICP.com
Effects of Cerebral Ischemia

Nominal Cerebral blood flow = 100 ml/min/100g

- ATP
- pH
- PCR
- CMRG
- Lactate
- Protein synthesis
- Selective gene expr.

- K⁺, Ca²⁺ (Infarct)
- EEG suppressed (Penumbra)
- Selective neuronal loss
- Glutamate release

Cerebral blood flow (ml/min/100g)

Time from Circulatory Arrest to Isoelectric (Flat) EEG
Less than 20 seconds

1. Arrest of cerebral blood flow in mammals
   = 10-15 seconds (Hossmann and Kleihues, Arch Neurol 1973)

2. Arrest of cerebral blood flow in primates
   = 10-15 seconds (Steen et al, Anesthesiology, 1985)

3. Brief cardiac arrest in humans
   10 seconds (Clute and Levy, Anesthesiology, 1990)
   12 seconds (Lasasso et al, Anesth Analg 1992)
   12 seconds (Moss and Rockoff, JAMA 1980)
Brain Blood Flow as the Basis of Life?
Cerebral Metabolism and States of Consciousness
Positron Emission Tomography (PET)

Laureys, Lancet Neurol, 2004
Complete and Irreversible Brain Arrest

1. Associated with absence of brain blood flow

1. Presence of some residual brain blood flow of unclear significance
Absent Brain Blood Flow?

1. Radionuclide angiography
2. CT angiography
3. Traditional 4 vessel cerebral angiogram
4. MR angiography
5. Transcranial doppler
6. CT or MR perfusion

The most reliable confirmation of the absence of brain blood flow is a cardiocirculatory arrest
It no longer matters whether the heart is beating inside the body or outside the body.

It only matter if that beating heart generates circulation to the brain.
Extracorporeal Support for Organ Donation after Cardiac Death

Magliocca et al, J Trauma, 2005
Monitoring cardiocirculatory & neuro determinants after cardiac arrest:
1. ECG
2. Arterial pressure
3. Cerebral oximetry
4. Respiratory effort
5. EEG
6. Evoked potentials

Funding PSI, CHEO, CIHR
Ongoing Concerns

- Incidence of brain death is unknown
- Professional and public confusion/controversy
- Inconsistency of criteria/ancillary testing
- Effect of CNS depressing medications
- Impact of therapeutic hypothermia
- Pediatric and neonatal age adjustments
- Credibility
  - Sporadic case reports of ‘reversibility’
Words do Matter
Dying, Death, Determination & Declaration

Death of the person versus death of the organism and its parts

• Dying is a process

• Procedures to determine death are a process

• The *declaration* of death is a moment in time
The Declaration of Death is the point in time after which:

1. No requirement to continue/provide resuscitation
2. Loss of personhood and most individual rights
3. Autopsy
4. Organ and/or tissue procurement for donation/transplantation
5. Burial/cremation proceedings
6. Execution of legal estate and life insurance
7. Loss of a loved one and family grieving
2009 Global Deceased & Living Donation Rates

Global Observatory on Donation and Transplantation, WHO, 2009
deterioration in the health condition of commercial living “donors”

long-term financial disadvantage following nephrectomy (compromised ability to work)

social rejection and regret about donation
Brain death: time for an international consensus

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Why Canada?
We are Peaceful, Cooperative and Collaborative

The Only Place We Conflict is Playing Hockey
Global Consensus on Death Determination
Canadian Blood Services in collaboration with WHO
Montreal May 2012

How to mitigate illegal organ trade and victimization of the poor?
Countries must become ‘self sufficient’

= Improvements in deceased donation

Predicated on:
Understanding, acceptance and implementation of death determination practices
Even a Bunch of Asses Can Work Together

Human Caterpillar
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