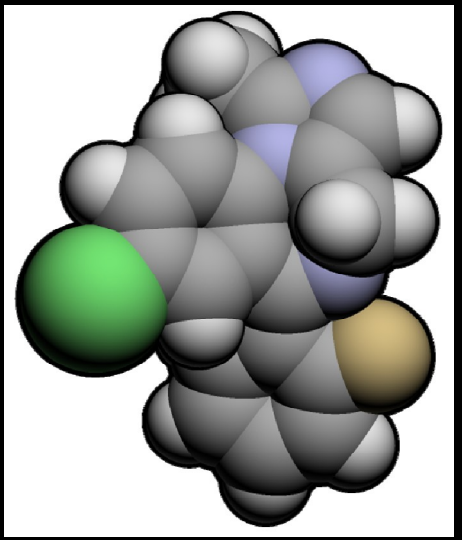
# Ancillary testing:

*technology has the answer?*

by Dale Gardiner

# I had a case…

- A young lady with traumatic brain injury
- Likely deceased
- 105 hours of sedation (4 days)
  - Midazolam 1291mg
  - Morphine 1285mg
  - Propofol 16240mg
- 21 hours after sedation was ceased midazolam level was…



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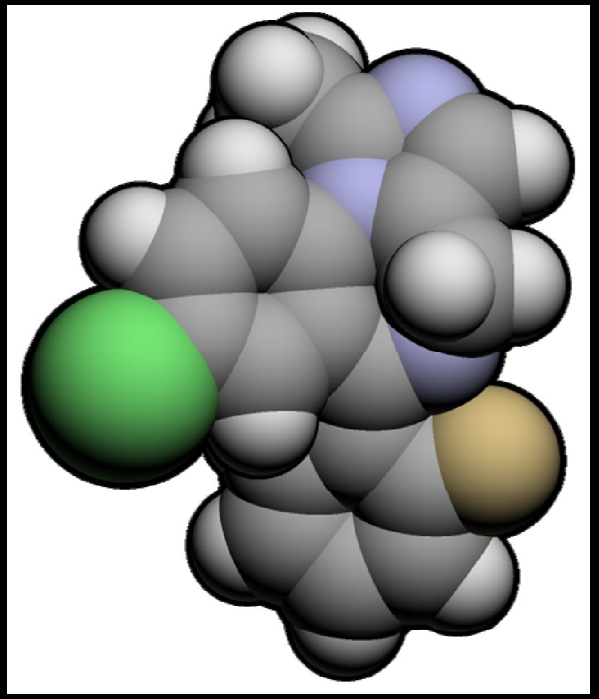
A CODE OF PRACTICE FOR
THE DIAGNOSIS AND
CONFIRMATION OF DEATH

2008

“If midazolam levels are available brain-stem testing should not be undertaken if the level is >10µg/L.”



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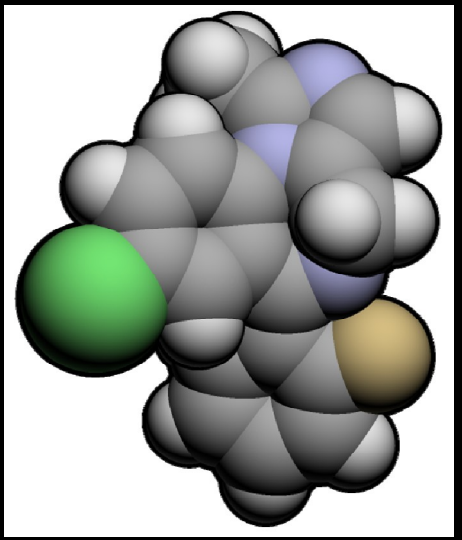

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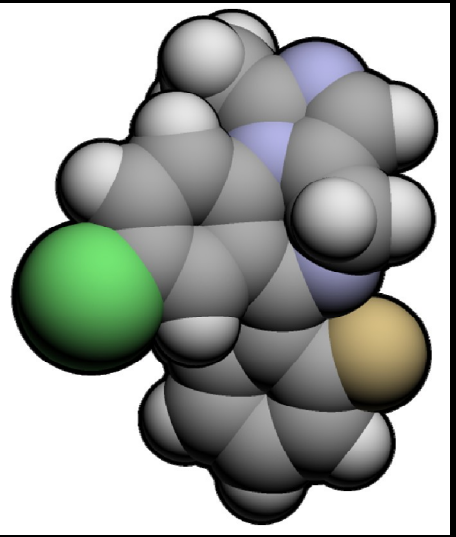
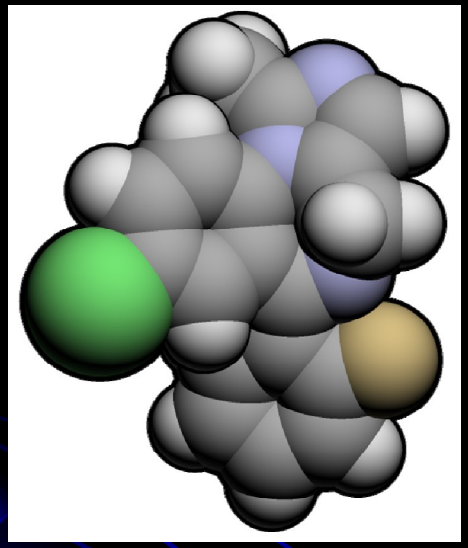
**5500 µg/L**



# When?



Sedation

Spinal Cord Injury

Can’t see either eye

# Choices?

Loss of bioelectrical activity

- EEG
- Evoked Potentials

Clinical

- Atropine
- Dolls Eyes

Cessation of cerebral circulation

- 4 vessel angio
- CTA / MRA / TCD
- Spect / PET

Two cases

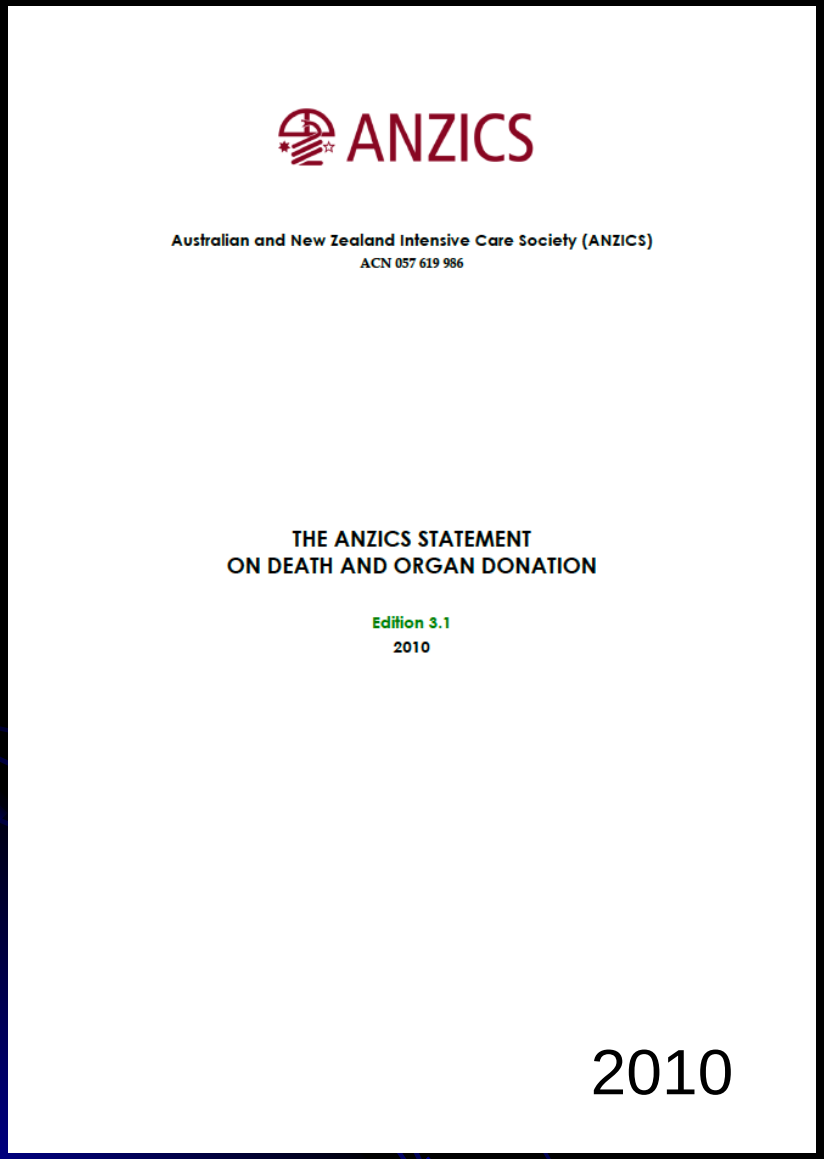
1. MRA after Dx Death
   (preserved flow)
   MRA after Dx Death and breathing
   (no flow)

2. Radionuclide Angio after Dx Death
   (preserved flow)

One case

1. EEG pre Dx Death
   (no electrical activity)

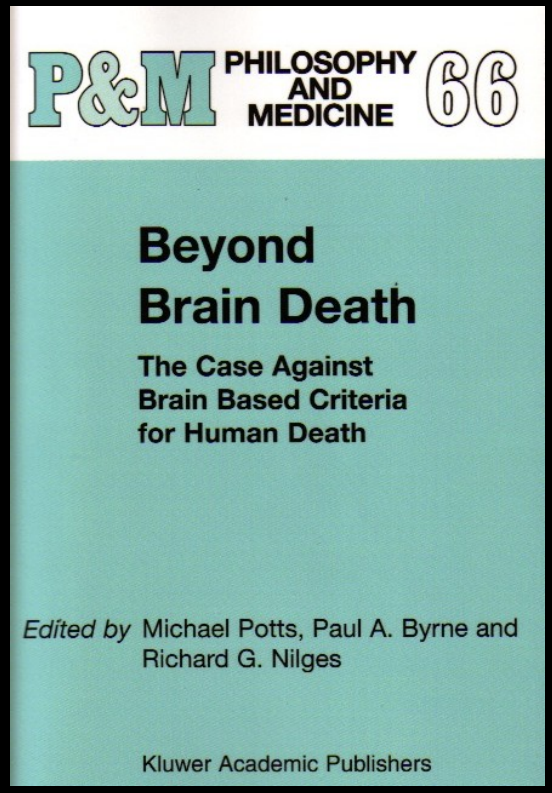
   EEG after Dx Death
   (no electrical activity)




"Brain death cannot be determined when there is still blood flow to the supratentorial part of the brain."

From my reading of the literature:

1-10% of cases who have death confirmed using neurological criteria are likely to radiologically demonstrate residual cerebral blood flow.




"Although we were unable to restore his consciousness or spontaneous breathing, the boy lived several more years." (page 195)

# Pronounced dead, man takes 'miraculous' turn

## Doctors can't explain why 21-year-old Zack Dunlap recovered from accident

**By Mike Celizic**
TODAYshow.com contributor
updated 10:23 a.m. ET March 24, 2008

Zack Dunlap doesn't remember much from the day he died, but he does remember hearing a doctor declare him brain-dead. And he remembers being incredibly ticked off.

"I'm glad I couldn't get up and do what I wanted to do," the strapping Oklahoman said in a soft drawl in an exclusive appearance on Monday on TODAY in New York.

And what would he have done, asked TODAY's Natalie Morales, who has followed Dunlap's miraculous recovery from a Nov. 17 ATV accident that left him with a catastrophic head injury.

Video

Launch

**Back from the dead**
March 24: Zack Dunlap and his family talk about his "miraculous" recovery after an ATV accident.
Today show

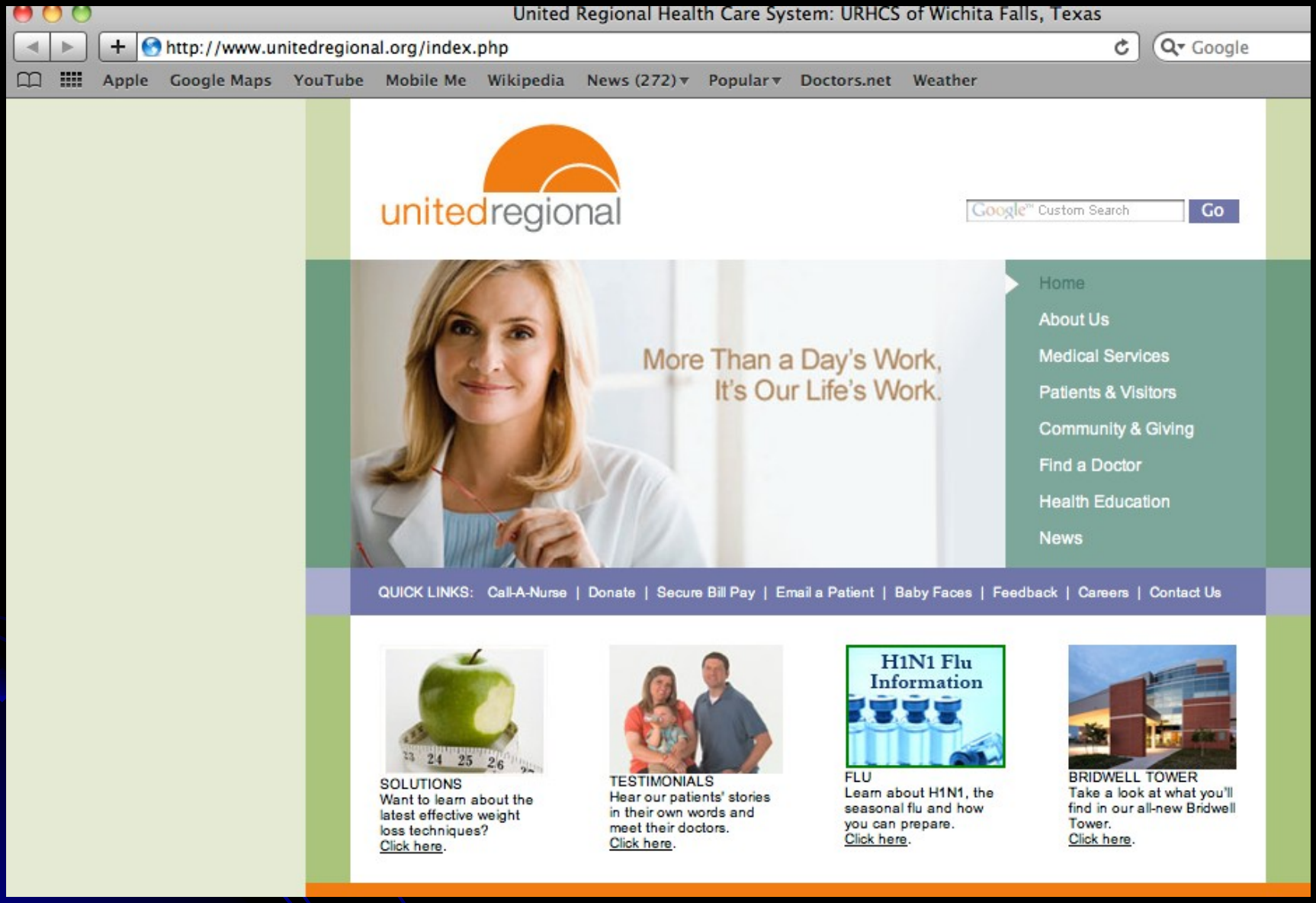
Taken first to a local hospital, he was airlifted 50 miles away to United Regional Healthcare System in Wichita Falls, Texas, where there was a trauma unit that might be able to treat the severe damage he had done to his brain. But 36 hours after the accident, doctors performed a PET scan of his brain and informed his parents, along with other family members who had gathered to keep vigil at the hospital, that there was no blood flowing to Zack's brain; he was brain-dead.

## trauma unit

United Regional
Healthcare System
Wichita Falls, Texas

## PET scan brain

no blood flowing


United Regional Health Care System: URHCS of Wichita Falls, Texas
http://www.unitedregional.org/index.php
Google
Apple
Google Maps
YouTube
Mobile Me
Wikipedia
News (272)
Popular
Doctors.net
Weather
unitedregional
Google™ Custom Search
Go
More Than a Day's Work,
It's Our Life's Work.
Home
About Us
Medical Services
Patients & Visitors
Community & Giving
Find a Doctor
Health Education
News
QUICK LINKS: Call-A-Nurse | Donate | Secure Bill Pay | Email a Patient | Baby Faces | Feedback | Careers | Contact Us
SOLUTIONS
Want to learn about the latest effective weight loss techniques?
Click here.
TESTIMONIALS
Hear our patients' stories in their own words and meet their doctors.
Click here.
H1N1 Flu Information
FLU
Learn about H1N1, the seasonal flu and how you can prepare.
Click here.
BRIDWELL TOWER
Take a look at what you'll find in our all-new Bridwell Tower.
Click here.


USA Trauma Center
Level I - Highest
to
Level III - Lowest

# UK PET scanners

| | NHS SCANNER(S) (PET/CT AND/OR PET) |
|---|---|
| **ENGLAND** | |
| **LONDON** | |
| Guy's & St Thomas' Hospital | ✓ |
| Hammersmith (Imanet, NHS, GSK) | ✓ |
| UCL Hospital | ✓ |
| Royal Marsden Hospital | ✓ |
| Mount Vernon Hospital | ✓ |
| Barts & The London Hospitals | Planned for 07 |
| **OUTSIDE LONDON** | |
| Cambridge | ✓ |
| Manchester | ✓ |
| Birmingham | ✓ |
| Clatterbridge | |
| Cheltenham | ✓ |
| Keele | |
| Newcastle | Planned for 07 |
| Nottingham | ✓ |
| Preston | Planned for 07 |
| Coventry | Planned for 07 |
| Oxford Radcliffe | ✓ |
| Bristol | Proposed, not yet tendered |
| Brighton | Planned for 07 |
| Grove Centre, Amersham | |
| Royal Surrey Hospital, Guildford | ✓ |
| Dinnington, Yorkshire | |

| | |
|---|---|
| **SCOTLAND** | |
| Aberdeen | ✓ |
| Glasgow | Planned for 07 |
| Edinburgh | Proposed, not yet tendered |
| Dundee | Proposed, not yet tendered |
| **WALES** | |
| Cardiff | Planned for 08 |
| **N. IRELAND** | |
| Belfast | ✓ |

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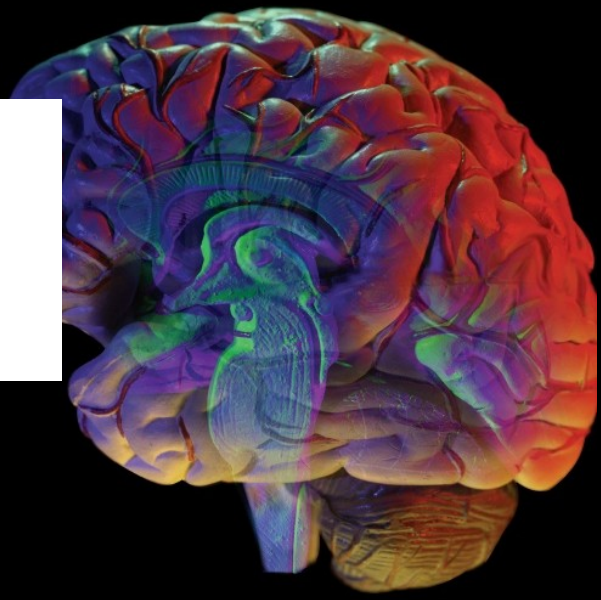


# Where to from here?

# Lesson 1


BRITISH MEDICAL JOURNAL 13 NOVEMBER 1976 1187

*Clinical Topics*

**Diagnosis of brain death**

**Statement issued by the honorary secretary of the Conference of Medical Royal Colleges and their Faculties in the United Kingdom on 11 October 1976**

*British Medical Journal*, 1976, **2**, 1187-1188

With the development of intensive care techniques and their wide availability in the United Kingdom it has become commonplace for hospitals to have deeply comatose and unresponsive patients with severe brain damage who are maintained on artificial respiration by means of mechanical ventilators.

This state has been recognised for many years and it has been the concern of the medical profession to establish diagnostic criteria of such rigour that on their fulfilment the mechanical ventilator can be switched off, in the secure knowledge that there is no possible chance of recovery.

There has been much philosophical argument about the diagnosis of death, which has throughout history been accepted as having occurred when the vital functions of respiration and circulation have ceased. With the technical ability to maintain these functions artificially, however, the dilemma of when to switch off the ventilator has been the subject of much public interest. It is agreed that permanent functional death of the brain stem constitutes brain death and that once this has occurred further artificial support is fruitless and should be withdrawn. It is good medical practice to recognise when brain death has occurred and to act accordingly, sparing relatives from the further emotional trauma of sterile hope.

Codes of practice, such as the Harvard criteria,[1] have been devised to guide medical practitioners in the diagnosis of brain death. These have provided considerable help with the problem and they have been refined as the knowledge gained from experience has been collated. More recently Forrester has written on established practice in Scotland[2] and Jennett has made useful observations.[3]

The diagnostic criteria presented for brain death here have been written with the advice of the subcommittee of the Transplant Advisory Panel, the working party of the Royal College of Physicians, and the working party of the Faculty of Anaesthetists and the Royal College of Surgeons and have been approved by the Conference of Medical Royal Colleges and their Faculties in the United Kingdom. They are accepted as being sufficient to distinguish between those patients who retain the functional capacity to have a chance of even partial recovery from those in whom no such possibility exists.

**Conditions for considering diagnosis of brain death**

All of the following should coexist.

(1) *The patient is deeply comatose.*

(*a*) There should be no suspicion that this state is due to depressant drugs. Narcotics, hypnotics, and tranquillisers may have prolonged durations of action, particularly when some hypothermia exists. The benzodiazepines act cumulatively and their effects persist, and they are commonly used as anticonvulsants or to assist synchronisation with mechanical ventilators. It is therefore recommended that the drug history should be carefully reviewed and adequate intervals allowed for the persistence of drug effects to be excluded. This is of particular importance in patients whose primary cause of coma lies in the toxic effects of drugs followed by anoxic cerebral damage.

(*b*) Primary hypothermia as a cause of coma should have been excluded.

(*c*) Metabolic and endocrine disturbances that can cause or contribute to coma should have been excluded. Metabolic and endocrine factors contributing to the persistence of coma must be carefully assessed. There should be no profound abnormality of the serum electrolytes, acid base balance, or blood glucose concentrations.

(2) *The patient is being maintained on a ventilator because spontaneous respiration had previously become inadequate or had ceased altogether.*

Relaxants (neuromuscular blocking agents) and other drugs should have been excluded as a cause of respiratory inadequacy or failure. Immobility, unresponsiveness, and lack of spontaneous respiration may be due to the use of neuromuscular blocking drugs, and the persistence of their effects should be excluded by eliciting spinal reflexes (flexion or stretch) or by showing adequate neuromuscular conduction with a conventional nerve stimulator. Equally, persistent effects of hypnotics and narcotics should be excluded as the cause of respiratory failure.

(3) *There should be no doubt that the patient's condition is due to irremediable structural brain damage. The diagnosis of a disorder which can lead to brain death should have been fully established.*

It may be obvious within hours of a primary intracranial event such as severe head injury, spontaneous intracranial haemorrhage, or after neurosurgery that the condition is irremediable. But when a patient has suffered primarily from cardiac arrest, hypoxia, or severe circulatory insufficiency with an indefinite period of cerebral anoxia or is suspected of having cerebral air or fat embolism then it may take much longer to establish the diagnosis and to be confident of the prognosis. In some patients the primary condition may be a matter of doubt and a confident diagnosis may be reached only by continuous clinical observation and investigation.

**Tests for confirming brain death**

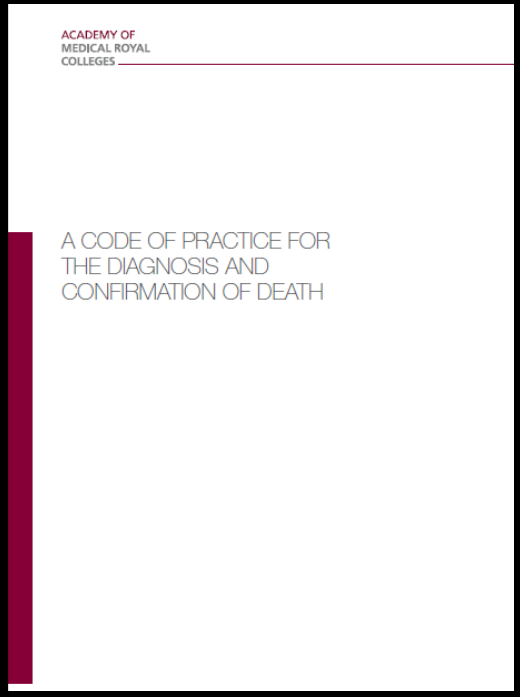
*All brain-stem reflexes should be absent.*

(*a*) The pupils are fixed in diameter and do not respond to sharp changes in the intensity of incident light.

(*b*) There is no corneal reflex.

(*c*) The vestibulocular reflexes are absent. These are absent when no eye movement occurs during or after the slow injection

1976



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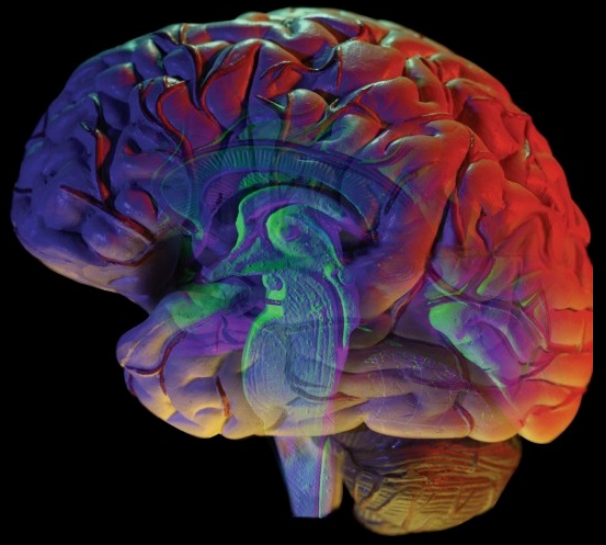
*Lesson 2*

# To Dx

# Use



## *Lesson 3*

*Take your time*

- Atypical presentation
- Hypoxic brain injury
  - >24 hours

## *Lesson 4*

Induced hypothermia has unpredictable consequences

See Lesson 3

*Lesson 5*

*NO EEG*

# *Lesson 6*

*Start with Lesson 2 =*
*use your brain and examine your patient*

# *Lesson 6*

*Start with Lesson 2 =*
*use your brain and examine your patient*

---

*CT Angiogram*

*4 Vessel Angiogram*

# *Lesson 6*

*Start with Lesson 2 =*
*use your brain and examine your patient*

---

1. Clinical brain death + NO flow

= *Death*

# *Lesson 6*

*Start with Lesson 2 =*
*use your brain and examine your patient*

---

1. Clinical brain death + NO flow

= *Death*

2. Clinical brain death + flow

= *Wait*

See Lesson 3 =
take your time and ask
'Is reversibility possible?'

THE COCHRANE COLLABORATION®

CT Angiography

Specificity – not likely to be possible

Sensitivity – we hope to provide you in 2013

NeuroCritical Care

NETWORK

BSNR

BRITISH SOCIETY OF NEURORADIOLOGISTS

2012

Consensus statement?

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# A CODE OF PRACTICE FOR THE DIAGNOSIS AND CONFIRMATION OF DEATH

2008

# Some Resources

- Video from Canada on Brain Death Testing

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

- International perspective on the diagnosis of death. BJA January 2012
- My web site of Forms, Talks, Guidance

www.clodlog.com

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