Organ donation: Who, when, how?

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Introduction

• The need for transplantable organs
• Types of organ donation
  - Living
  - Cadaveric
• How is death diagnosed?
• Tissue donation
• The pathways for cadaveric organ donation
The unmet need for organ donation

3 people die every day whilst waiting for an organ transplant

5th May 2011

The Society for Acute Medicine
How do you become a donor?

- Altruistic living donation
- Cadaveric organ donation
  - DBD donation after brain death
  - DCD donation after cardiac (circulatory) death
How is death diagnosed?
A code of practice for the diagnosis and confirmation of death

October 2008

www.aormc.org.uk
Confirmation of death following cardiorespiratory arrest (i)

- Irreversible apnoea and coma with absent circulation
- Reversible causes excluded
- One of 3 criteria are met:
  - Not for resuscitation
  - Failed resuscitation
  - Following withdrawal
Confirmation of death following cardiorespiratory arrest (ii)

• Observe for at least 5 minutes
  
ongoing respiratory arrest
  absent central pulses & heart sounds
  supplemented by asystole, flat a-line trace or echo

• Any return of activity requires further cessation and further 5 minute period

• After 5 minutes absent neurological function is confirmed:
  
  absent pupillary response to light
  absent response to supraorbital pressure
  absent corneal reflexes
Confirmation of brainstem death
Confirmation of brain stem death (i)

• **Conditions:**
  - Aetiology of irreversible brain damage
  - Exclusion of reversible causes of coma
  - Exclusion of reversible causes of apnoea

• **Brainstem Death tests**

“Sleep and his half-brother death”
Confirmation of brain stem death (ii)

Exclude reversible physiological, metabolic & endocrine disturbances

MAP  > 60 mmHg
PaO$_2$  > 10.0 kPa
PaCO$_2$  < 6.0 kPa
pH  7.35-7.45
Na$^+$  115-160 mmol/L
K$^+$  >2.0 mmol/L
Mg$^{++}$/Phos  0.5-3.0 mmol/L
Blood sugar  3-20 mmol/L

Exclude sedatives

Use pharmacokinetic principles (!)
Serum thiopentone < 5 mg/L
Serum midazolam < 10 mcg/L
Sanctions naloxone and/or flumazenil, but no suggested doses

Exclude hypothermia

Core >34°C
Performance of brain stem death tests

- Tests of cranial nerve function
- Apnoea test high cervical spine injury renders apnoea test redundant
- Two doctors perform 2 pairs of tests together
- Ancillary tests may be used in some situations:
  - extensive facial trauma
  - residual sedation
  - paediatric hypoxia
  - high cervical spine injury
  - primary metabolic/pharmacological derangement
Tissue Donation in the UK
What can be donated?

- Skin: Temporary replacement for severely burned patients
- Iliac crest: Made into blocks of bone for spinal fusion and tibial elevation
- Femoral head: Hip replacement surgery
- Cartilage/meniscus: Repair deformities and injuries
- Patella tendon: Knee repair and stabilization surgery
- Tibia and fibula: Whole or partial replacement; may also be segmented for repair work
- Achilles' Tendon: Knee and shoulder joint repairs
- Heart valves: Replace defective valves
- Humerus: Whole or partial replacement; may also be segmented for repair work
- Pericardium: Repair heart defects; also used in neurosurgery
- Femoral veins: Venous valves to replace defective valves in patients with chronic venous insufficiency; also used for hemodialysis access
- Long bones: Whole or partial replacement; may also be segmented for repair work
- Fascia lata: Tissue that overlies the thigh muscle used to repair droopy eyelids; also tympanic membrane
- Saphenous veins: Replace damaged arteries in heart bypass surgery; also used for peripheral vascular surgery
Which patients can donate tissues?

Majority of patients who die can donate tissues:

- Emergency Department
- Critical care areas
- Hospice
- General Wards
- Home
General contraindications to tissue donation

- Positive virology (Hep B & C, HIV)
- Diseases of unknown aetiology
- High risk patients
- Recipients of Human Growth Hormone
- CJD or Family history
- Degenerative neurological disease
- Untreated major sepsis
- TB, malaria or rabies
- Previous tissue/organ transplant recipients
Corneal donation

- Age criteria: >3 yrs
- Retrieved up to 24 hours after asystole
- Specific contraindications:
  - Leukaemia, lymphoma & myeloma
  - Intraocular malignancy
  - Ocular inflammation
- Reduced visual acuity is not a contraindication
- Retrieved in the mortuary by trained NHS staff
- Enucleation of entire eye, but contour of globe is reconstructed and no external signs of procedure
Donation of heart valves

• Administered by National Blood Service
• Age criteria – <60yrs
• Retrieved up to 48 hrs following asystole
• Specific contraindications:
  – Valve abnormalities
  – Endocarditis
  – Malignancy
  – Prolonged steroid use
• The entire heart is removed by the pathologist in the mortuary
Notes on tissue donation

• Tissue donation will not delay funeral
• Relatives can see the donor afterwards & appearance of patient unaltered
• Coroners cases can still donate tissues (formal permission gained by SNODs)
• Use SNODs for consent
• role of ODR
Cadaveric organ donation
Cadaveric organ donation

DCD

• what is it?
• pathway
• issues
DCD aka “Controlled non-heart beating organ donation”

Maastricht classification of DCD

- Uncontrolled
  1. Dead on arrival
  2. Unsuccessful resuscitation
- Controlled
  3. Awaiting cardiac arrest
- Uncontrolled
  4. Cardiac arrest while brain stem dead
Donation after cardiac death

10 fold increase in DCD past 10 years
35% of all donation

Number

Year

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Contraindications to DCD

**Absolute**
- Active invasive cancer in last 3 y *excluding* non melanoma skin Ca and 1º brain tumour
- Haematological malignancy
- Untreated systemic infection
- Variant CJD
- HIV disease (not HIV infection)

**Further work needed to define**
- Upper age limit
- Inotrope limit
- MOF
- Max FiO₂
Organ-specific contraindications to DCD

Liver
- Known cirrhosis
- Known portal vein thrombosis

Kidney
- CRF GFR <30 ml/min
- ACN

Pancreas
- DM - type 1 or 2

Lung
- Age >65 y
- Existing lung disease (COPD, PE)
- Previous thoracic surgery, empyema
Definitions of optimal donors for each organ

Liver
- Age < 50 y
- Weight < 100 kg
- ICU LOS < 5 days
- Functional WIT < 20 min
- CIT < 8 h
- <10% steatosis

Pancreas
- Age < 45 y
- BMI < 30
- ICU LOS < 5 days
- Functional WIT < 20 min
- Steatosis - subjective

Kidney
- Age < 50 y
- No hypertension
- No CVA
- Creatinine < 133 µmol/L
- WIT < 1 h

Lung
- Age < 55 y
- FiO₂ < .4
- No thoracic surgery
- Clear CXR previous 24 h
DCD pathway (i)

- Decision to withdraw (separate)
- Consult ODR
- Structured request
- Early referral to Specialist Nurse in Organ Donation (SNOD) aka Transplant Co-ordinator
- Full explanation to family
- If organs accepted agree time of withdrawal
DCD pathway (ii)

- Immediate diagnosis of death (5 mins)
- Rapid transfer to operating theatre
- On arrival in theatre, the aorta is cannulated and the organs rapidly cold perfused
- Last offices in theatre
- Family followed up by SNOD

Retrieval is stood down on 40% of occasions

It is important to keep ischaemia to a minimum: From entering theatre to cold perfusion of the organs takes <2 minutes
Process following withdrawal of treatment in a DCD donor

Action after withdrawal of treatment

Withdrawal of R

Asystole

Diagnosis of death

Organ Perfusion

Transplantation

Agonal period

Asystolic WIT

CIT

Functional WIT
systolic BP < 50 mmHg

SaO₂ <70%
Functional Warm Ischaemic Time

- Duration of functional WIT related to outcome
- Minimal functional warm ischaemic time
- Organ specific
  - Liver 30 min (20 min ideal, age also a factor)
  - Pancreas 30 min
  - Lungs 60 min time to inflation
  - Kidney 120 min

Aerobic metabolism switches to inefficient anaerobic
  - 38 ATP per glucose molecule
  - 2 ATP per glucose molecule

Lactic acid accumulates ATP depletion
Membrane pump failure
Cellular integrity destroyed

Organs tolerate cold ischaemia less well when depleted of energy
## Pros & Cons of the DCD donation pathway?

### Advantages
- Shorter time line
- Kidneys transplanted locally
- Better acceptance of diagnosis of death

### Disadvantages
- Donation may not happen
  - Difficult to predict time to asystole
  - Families can withdraw consent
  - Transfer to theatre
- Fewer transplantable organs & worse graft function of some organs than DBD donors

*Controlled DCD is a complex process that requires the support and engagement of a committed and diligent team*
DCD Outcomes (i)

Potentially retrievable organs and tissue

- Kidneys
- Liver
- Pancreas
- Lungs
- Tissues
DCD Outcomes (ii) - Kidneys

Kidney transplantation from donors without a heartbeat
Weber et al
NEJM 2002; 347: 248-255
Patient survival for adult (≥ 17 years) recipients after first elective deceased non-heartbeating donor liver only transplants is shown in Figure 8.13. The majority of non-heartbeating liver transplants have been performed since 1 January 2002, so there are insufficient data available to analyse long-term patient survival, but patient survival at one year is 83% (95% confidence interval: 70-91).

83% survival at 1 year
Should lung transplantation be performed using donation after cardiac death? The United States experience


Mason DP, Thuita L, Alster JM et al
Optimal care of retrieved organs

Clinical Transplant from EVLP

Figure 3: Illustration of the LifePort™ pump perfusion machine
What is the future?
Normothermic in situ regional perfusion

• Re-establishing a warm oxygenated blood supply to organs before cold perfusion using ECMO: “recharging the batteries”

• Currently used in Spain & France
Cadaveric organ donation

DBD

pathway

issues

donor management
Donation after brain death

- Progressive Fall in DBD donors
- Decompressive craniectomy
- Early coiling in SAH
- Earlier diagnosis of futility
DBD pathway

- Perform BSD tests & check ODR
- Maintain optimal organ function and manage complications of BSD
- Refer to SNOD
- Obtain consent for donation in a planned manner
- Transfer to theatres, administer anaesthetic drugs
- Retrieval procedure
Unit experience of DBD donation

- 65% of ICUs have <2 DBD donors pa
- 23% of all DBD donors are from ICUs with 1-2 donors pa
- 4% of units have >10 donors pa (28% of total donor population)
### Complications of BSD and their incidence

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

*Physiologic changes During Brain Stem Death – Lessons for Management of the Organ Donor. The Journal of Heart & Lung Transplantation Sept 2004 (suppl)*
What is donor management?

• Increase numbers of donors who proceed

• Increase number of organs per donor

• Improve or maintain function of transplantable organs

Evidence for donor management is of variable quality:

Totsuka *Transplant Proc.* 2000; 32;322-326
High sodium in liver donor doubles graft loss

Rosendale *Transplantation* 2003. 75 (4): 482-487
Protocol increased organs per donor 3.1 to 3.8. Increased probability of transplant
General management of a DBD donor

- Continue ICU care
- Maintain normothermia
- Give methylprednisolone
- Follow local Donor Management Guideline
- Consider escalation of monitoring
- n.b Relatives may be at bedside
# Goals of donor management

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<thead>
<tr>
<th>CVS</th>
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<tr>
<td><strong>Mean Arterial Pressure</strong></td>
<td><strong>Head up positioning</strong>&lt;br&gt;Lung protective ventilation&lt;br&gt;PEEP and lowest possible FiO2&lt;br&gt;Recruitment&lt;br&gt;Avoid over-hydration&lt;br&gt;Early steroids</td>
<td>Common in BSD&lt;br&gt;Posterior pituitary&lt;br&gt;Polyuria, electrolyte disturbance&lt;br&gt;Hypovolaemia&lt;br&gt;Fluids&lt;br&gt;Vasopressin/DDAVP</td>
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<tr>
<td><strong>CVP</strong></td>
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<td><strong>Heart Rate</strong></td>
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<td><strong>Rhythm</strong></td>
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<td><strong>Cardiac Index</strong></td>
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- Mean Arterial Pressure: 60-80 mmHg
- CVP: 4-10 mmHg
- Heart Rate: 60-100
- Rhythm: sinus
- Cardiac Index: >2.1 l/min/m²
Ideal Heart Donor

< 55 Female, < 50 Male, Good PMH

- No diabetes
- Non-smoking
- No drugs

CVS stable

- Rhythm, normal ECG, no or minimal support
- Good function on ECHO, no LVH
Expanded heart criteria

Age < 65

- No cardiac PMH that precludes transplantation
- ECG without definitive pathology
- Consider smokers, hypertension, arrest or arrhythmia, drug abuse, vasopressor use
- Driven by recipient characteristics
The Ideal Lung Donor

- Age <55 yrs
- CXR clear
- PaO$_2$ > 39.4 kPa (300mmHg) when FiO$_2$ = 1.0 & PEEP = 5cmH$_2$O
- Absence of chest trauma, aspiration or sepsis
- Absence of purulent secretions on bronchoscopy
- Absence of organisms on sputum gram stain
- No history of primary pulmonary disease
- Tobacco history <20 pack-years
- ABO compatibility
- No prior cardiopulmonary surgery
- Size match
The Expanded Criteria for a Lung Donor

- Age 55 - 70 yrs
- CXR infiltrates are not important
- Purulent secretions
- Treated chest sepsis
- Pack-years > 20
- Unilateral lung damage
- \( \text{PaO}_2 > 30\text{kPa (FiO}_2 \ 1.0, \text{PEEP} \ 5\text{cmH}_2\text{O}) \)
The Conflicts between organs & teams

- Kidneys want full circulation, lungs don’t
- Kidneys like inotropic support, hearts and lungs do not
- Lung protective ventilation prevents ARDS
  
  *Low Vt and high PEEP*

  *minimises baro- and volutrauma*

Retrieval team protocols use high Vt and low PEEP
Standard DBD Donor Treatment

- Full monitoring
- Discontinue neurological observations
- Mechanical ventilation at lowest required FiO2 to maintain PaO2 > 10 KPa with PEEP 5
- Maintain 30 degrees head of bed elevation
- Maintain 1-2 hourly pulmonary suctioning with side to side positioning and hourly recruitment procedures
- Arterial Line: Lt Radial or Brachial
- CVC: Rt Int Jugular or Rt Subclavian
- Maintain body temp at 35.5 – 37 degrees Celsius
Investigations

• Send blood for:
  ➢ U&E’s, LFT’s (including Gamma GT and Amylase), FBC, Clotting,
  ➢ Blood Group and X-Match 4 units.
  ➢ Virology
  ➢ Tissue Typing

• ECG
• CXR
• ECHO
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<th>CARDIAC BLOCK - Not-Offering</th>
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<tr>
<td><strong>HEART</strong> - On Offer</td>
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<tr>
<td>Offer declined by Harefield, Harefield Hospital - Donor unsuitable - virology, 15/09/09 13.55</td>
</tr>
<tr>
<td>Offer declined by Birmingham, Queen Elizabeth Hospital - Donor unsuitable - virology, 15/09/09 13.42</td>
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<tr>
<td>Offer declined by Papworth, Papworth Hospital - Donor unsuitable - virology, 15/09/09 13.53</td>
</tr>
<tr>
<td>Offer declined by Newcastle, Freeman Hospital - Donor unsuitable - virology, 15/09/09 13.41</td>
</tr>
<tr>
<td>Offer declined by Glasgow, Golden Jubilee National Hospital - Donor unsuitable - virology, 15/09/09 13.51</td>
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<th>LUNG PAIR - Not-Offering</th>
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<tbody>
<tr>
<td><strong>LEFT LUNG</strong> - Accepted</td>
</tr>
<tr>
<td>Offer accepted and used by Newcastle, Freeman Hospital - Not reported, 15/09/09 13.43</td>
</tr>
<tr>
<td><strong>RIGHT LUNG</strong> - On Offer</td>
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<tr>
<td>Offered to London, Great Ormond Street Hospital For Children, 15/09/09 13.44</td>
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<th>UNSPECIFIED KIDNEY - Not-Offering</th>
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<tr>
<td>LEFT KIDNEY - Not-Offering</td>
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<tr>
<td>RIGHT KIDNEY - Not-Offering</td>
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<tr>
<td>WHOLE EYE A - Not-Offering</td>
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<td>WHOLE EYE B - Not-Offering</td>
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<tr>
<td>PANCREAS - Not-Offering</td>
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- SNOD will continuously update the EOS as information becomes available
- Once EOS is complete the SNOD will commence the offering process
- Offering is only complete when the organs have all been accepted or declined by all centres and EuroTransplant
Retrieval Teams

Once offering is complete SNOD arranges for the retrieval teams to be activated

Retrieval teams should be at hospital within 4 hours of initial call

Multiorgan retrieval is a complex procedure

Use of anaesthetic agents

In theatre SNOD acts as patient advocate and carries out last offices
Any questions?