**Guidelines for providing anaesthesia for Donation after Brain Death paediatric organ retrieval**

**Introduction**

The absolute number of paediatric (<16 years) organ donors in the United Kingdom (UK) between 2008/09 and 2017/18 has remained relatively low with a mean number of 50 donors per year (range 37 – 64). Most of these children were cared for in a Paediatric Critical Care Unit (PCCU) prior to donation, there are 27 PCCUs across the country. The likelihood of anaesthetising for organ retrieval in a child is small, therefore necessitating the need for guidance when this situation arises. The primary role of the anaesthetist is to ensure adequate perfusion, organ protection and optimal surgical conditions.

**Donation after Brain Death (DBD)**

Previously called Heart Beating Donors (HBD), the heart continues to beat, cardiac output is maintained but the patient is declared dead, the organs continue to be perfused. DBD requires anaesthetic input in theatre while the organs are removed.

**Donation after Circulatory Death (DCD)**

Previously called Non- Heart Beating Donors (NHBD). DCD occurs when the patient does not fulfil criteria for DBD, but has no chance of recovery and it is considered in the patient’s best interest to withdraw life sustaining treatment. DCD does not usually require anaesthetic support in theatre (except in lung donation) but may require anaesthetic support to transfer the patient to the anaesthetic room and discontinue organ sustaining treatments – such as ventilation/oxygenation/inotropes.

***Role of the Specialist Nurse for Organ Donation (SNOD)***

The coordination of organ donation, including organ retrieval is undertaken by the SNOD.

The SNOD will follow the ‘Organising Solid Organ Retrieval’ guidance. Ensure you have met and discussed the following with the SNOD prior to reviewing the patient and discussing with the parents/carers/next-of-kin:

* Check that the retrieval is going ahead and ascertain timing if possible
* Check that consent/authorisation and child assessment paperwork is complete
* Check whether the donation is DBD or DCD
* Check that the retrieval team will not have their own anaesthetist and what staff they will bring (cardiothoracic teams often bring a Donor Care Practitioner who can help provide anaesthetic support)
* Check that the theatre coordinator and ODP are aware, the retrieval team may need a Health Care Assistant and/or staff nurse to act as a ‘runner’
* Confirm which organs are being taken
* Confirm whether the retrieval team will leave immediately once organs are taken and if so check that the paediatric surgical team are aware that they will need to assist in closure
* Ensure that the Consultant Paediatric Anaesthetist is aware that the retrieval is taking place, they will need to be onsite during the retrieval

***Discussion with family/next-of-kin***

Ensure you introduce yourself to the family/next-of-kin, explain your role as the anaesthetist while considering what a difficult time this is for the family/next-of-kin and give them the opportunity to say goodbye to their relative, potentially in theatre if they wish. If the family has questions about the organs being retrieved or preparation/care of the body after donation direct them to speak with the SNOD.

***Preparation prior to going to theatre (DBD)***

Liaise with the theatre coordinator, ODP and SNOD about timing of the retrieval. Ensure that the consultant on-call is aware that the retrieval is going ahead.

Ensure that the pathophysiological changes during and after brainstem death are managed within the PCCU setting following the donor optimisation care bundle (Appendix 1). A left sided arterial line and right sided femoral central venous catheter should be sited if possible (If right-sided arterial line, trace will be lost early due to sequence of vessel ligation in cardiac retrieval). Prior to transfer to theatre check which pathophysiological changes have occurred, what managed was required and which management is ongoing.

* Cardiovascular
  + Monitor and manage hypertension, hypotension, bradycardia and arrhythmias
* Respiratory
  + Monitor and manage pulmonary oedema (neurogenic)
  + Maintain normal lung volumes and oxygen saturations where possible with appropriate fiO2, PEEP and PC/VC settings
* Endocrine
  + Monitor for and manage diabetes insipidus (hypovolemia, hypernatremia and dehydration)
  + Maintain normothermia
  + Maintain normoglycaemia
  + Monitor for sick euthyroid syndrome due to reduction in TSH secretion (seek advice from SNOD whether needs T3 replacement)
* Metabolic
  + Monitor for and correct electrolyte imbalances (sodium, magnesium and potassium)
* Haematological
  + Monitor for and manage DIC

***In theatre (DBD)***

* The duration of surgery is likely 3-6 hours
* Ensure the WHO checklist is completed
* It is important to liaise closely with the retrieval team/surgeons as they will talk you through specifics of the case
* Continue to manage pathophysiological changes as above/appendix 1 - There is a high risk of significant blood loss, hypothermia and cardiovascular instability, these need to be monitored for and stability maintained to enable optimum conditioning for organ removal until cross clamping of the aorta
* The organ donation procedure will involve a midline incision from the suprasternal notch to the symphysis pubis, to enable access to all abdominal and chest organs for further information see appendix 2
* Drugs required:
  + Fentanyl: (moderate to large dose 3-5 mcg/kg)
  + Muscle relaxant: for optimal ventilation, surgical access and to obtund spinal reflexes.
  + Antibiotics as advised by retrieval team
  + Discuss inotrope choice and vasopressin use with retrieval team
  + Steroid and Hormone Replacement:
    - Methylprednisolone 15mg/kg or 1g prior to skin incision (only if not given in ICU)
    - Triiodothyronine (T3) – 4mcg iv bolus then 3mcg/hr (continue if started in ICU)
  + Heparin: 300u/kg or 25 000u (prior to cannula placement, on surgical request)
  + May require magnesium/potassium replacement for myocardial stability – to discuss with retrieval team
* It is not clear if an anaesthetic agent is required for organ donors, however volatile anaesthetic agents may induce ischaemic preconditioning in hepatic and cardiac surgery and can be used to manage hypertension and may therefore be beneficial for these reasons
* Blood and blood products may be required to maintain Hb>80-100g/l discuss with retrieval team prior to transfusing
* In Diabetes Insipidus (UO> 200mls/hr) – give DDAVP 2 to 4 mcg every 2-6 hr and replace hourly losses
* Ventilation aims:
  + Minimum FiO2 to keep PaO2 > 10kPa /SpO2 >94%
  + PEEP 5-10
  + Tidal volume 6-8ml/kg
* If cardiopulmonary retrieval is planned, use catheter mount with bronchoscopy port
* Pulmonary assessment requires FiO2 to be increased and serial ABGs taken – check with surgeons
* Manipulation of the heart will cause haemodynamic instability – ensure the surgeons are aware of any dramatic reduction in cardiac output. VT/VF should be treated with cardioversion using internal defib pads (2J/kg)
* Once organ retrieval is complete closure may be undertaken by the organ retrieval surgeons or by local paediatric general surgeons
* The theatre coordinator/SNOD will need to organise who can lay out the body (provide last offices) in accordance with hospital policy and arrange transfer to the mortuary. Relatives may wish to view the body before it is taken to the mortuary

***Debriefing after the retrieval***

Involvement in organ retrieval can be a difficult experience and it is important that all members of staff feel supported during and after a retrieval, either from the consultant on-call or from educational supervisors or the clinical lead for paediatric anaesthesia. If possible the case should be discussed in the weekly Morbidity and Mortality meeting.

**Retrieval flow chart overview**

**SNOD confirms retrieval to go ahead – anaesthetic SpR contacted by SNOD/theatre coordinator**

**Anaesthetist SpR to inform Consultant paediatric anaesthetist of retrieval**

**Once appropriate information obtained from SNOD review child on PCCU, complete anaesthetic chart**

**Liaise with theatre coordinator for updates on liking timing of retrieval and pass information on to consultant anaesthetist**

**Retrieval team arrive – discuss regarding sequence of events in theatre and any specific anaesthetic requirements**

**Child collected from PCCU and transferred to theatre**

**Retrieval proceeds**

**Surgery complete either by retrieval team or RLH paediatric general surgeons**

**Last offices provided as organised by SNOD/theatre coordinator**

**References**

NHS Blood and Transplant 2019. ODT Clinical. Paediatric Care

<https://www.odt.nhs.uk/deceased-donation/best-practice-guidance/paediatric-care/>

NHS Blood and Transplant 2018. Theatre Manual for Deceased Organ Donors SOP5499/1 <https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/10887/theatre-manual-sop5499.pdf>

NHS Blood and Transplant 2017. Integrated Care Plan for the Referral and Consideration of Paediatric/Neonatal Deceased Organ and Tissue Donation

<https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/11379/integrated-care-plan-for-paediatric-organ-and-tissue-donation-v2-january-2018.pdf>

Kong ML, Lubis N, McWhirter L et al. Organ Retrieval Anaesthesia Guidance. Barts Health 2015

NHS Blood and Transplant 2013. Neonatal and Infant Organ Donation Standard Operating Procedure SOP5058/2

<https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/4665/neonatal-and-infant-organ-donation-sop5058.pdf>

McKeown DW, Bonser RS, Kellum JA. Management of the heartbeating brain-dead organ donor. BJA 2012, 108(s1), i96-i107

<https://academic.oup.com/bja/article/108/suppl_1/i96/237125>

**Appendix 1 – ‘*Integrated Care Plan for Paediatric Organ and Tissue Donation V2 January 2018’***

[**https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/11379/integrated-care-plan-for-paediatric-organ-and-tissue-donation-v2-january-2018.pdf**](https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/11379/integrated-care-plan-for-paediatric-organ-and-tissue-donation-v2-january-2018.pdf)

**Donor Optimisation Care Bundle – Paediatric (37wks CGA – 15 years)**

**Cardiovascular**

1. Monitor cardiovascular state aim for normal parameters
2. Measure CVP (4-10mmHg) (if suitable access available)
3. Review intravascular fluid status and correct hypovolaemia with isotonic boluses (10ml/kg aliquot)
4. Measure central venous oxygen saturation (maintain >70%)
5. Measure cardiac output if appropriate (non-invasive monitoring is appropriate if available)
6. Commence vasopressin where vasopressor required, wean or stop catecholamine pressors as able
7. Commence dopamine/noradrenaline to maintain MAP as required
8. Introduce adrenaline/dobutamine if echo indicates poor cardiac function
9. Consider esmolol/labetalol in cases of persistent hypertension in the absence of vasopressors

**Respiratory**

(>1 month old – pH >7.25 PaO2 >= 10 kPa)

(37 wk CGA - <1 month old pH >7.2 PaO2>8kPa)

1. Perform lung recruitment manoeuvres (following apnoea tests, disconnections, suctions, de-saturations)
2. Review ventilation, ensure lung protective strategy (Tidal volumes 6-8ml/kg (<1 month old 4-6mls/kg) and optimum PEEP (5-10cm H2O), PIP <30cmH2O)
3. Maintain regular chest physio incl. suctioning as per unit protocol
4. Maintain 30-45 degrees head of bed elevation
5. If appropriate use a cuffed endotracheal tube and ensure it is adequately inflated (consider changing to cuffed tube if indicated)
6. Patient positioning (side, back, side) as per unit protocol
7. Where available, and in the context of lung donation, perform bronchoscopy, bronchial lavage and – toilet for therapeutic purposes

**Fluids and metabolic management**

1. Review fluid administration. IV crystalloid maintenance fluid (or NG water where appropriate) to maintain Na+ <150mmol/l
2. Maintain urine output between 1.0-2.0ml/kg/hr (if 4ml/kg/hr, consider Diabetes Insipidus and treat promptly with vasopressin and/or DDAVP)
3. Administer methylprednisolone
4. Start insulin infusion if necessary to maintain blood sugar (4-12mmol/l)
5. Continue NG feeding as appropriate, ensure prescribed gastric protection as unit policy
6. Correct electrolyte abnormalities (maintain Na, K, Ca, Phos and Mg within normal ranges)

**Thrombo-embolic prevention**

1. Ensure prevention measures in place as per unit policy

**Lines, Monitoring and Investigations (if not already completed)**

1. Insert arterial line
2. Continue hourly observations as per critical care policy
3. Perform CXR (post recruitment procedure where possible)
4. Perform a 12-lead ECG
5. Send Troponin level in all cardiac arrest cases
6. Where available, perform an echocardiogram

**Other**

1. Maintain normothermia using active warming/cooling where required
2. Review and stop all unnecessary medications
3. Consideration for blood sampling volumes
4. Family considerations and support throughout

**Appendix 2 – Overview of the surgical retrieval procedure**

|  |  |
| --- | --- |
| **Organ** | **Retrieval surgery required** |
| **Liver & pancreas** | Mobilised by division of the falciform and triangular ligaments. The left hepatic artery is identified and preserved. The common bile duct is ligated and divided. The gall bladder is opened, and the biliary tree flushed with cold saline. The liver and pancreas are removed together. The common and external iliac arteries and veins are retrieved and transported with the liver and pancreas |
| **Bowel** | The small and large bowel are mobilised to reveal the abdominal vessels. The distal abdominal aorta and the inferior mesenteric vein are identified and prepared for cannulation. The descending thoracic aorta is prepared for cross clamping. |
| **Kidneys** | Mobilisation of the kidneys may occur after mobilisation of the bowel or be left until the end of the procedure. |
| **Heart** | The superior vena cava and Inferior vena cava (IVC) are isolated and the ascending aorta is cannulated. The donor is given heparin at this stage. Cannulation of the descending aorta (to perfuse the abdominal organs) and the inferior mesenteric vein (to perfuse the liver) follows. The aorta is cross-clamped. The IVC is incised below the pericardium and the heart and liver are allowed to empty. The heart is removed and ventilation stopped. The pericardial sac and the abdominal cavity are filled with cold saline and sterile ice slush. Cardioplegic solution arrests the heart and cools the myocardium.  If the heart is being taken only for valves the abdominal surgeons may remove it. |
| **Lungs** | If the lungs are being retrieved, they are removed together with the heart. Ventilation, however, must continue until the lungs are perfused via the pulmonary artery with a preservation solution and the trachea has been stapled with the lungs fully inflated. |
| **Lymph nodes & spleen** | Lymph nodes and spleen are removed to provide cells for tissue typing |
| **Cornea** | Corneal retrieval may take place in theatre, or later (may be retrieved up to 30 hours after circulatory arrest), once the deceased is in the mortuary |