

Donor optimisation guideline for management of the brain-stem dead donor

Objective

To provide structured pathway for donor optimisation following confirmation of brain-stem death (death confirmed by neurological criteria). Donor optimisation builds on stabilisation of the patient prior to brain-stem death testing

Context

National professional guidance advocates the confirmation of death by neurological criteria (brain-stem death) wherever this seems a likely diagnosis. Brain-stem death is often associated with systemic effects that can negatively impact on organ function and donation and optimisation of organ function is essential to ensure the number and quality of organs retrieved are maximised.

Donor optimisation should follow the same principles used for stabilising the patient prior to brain-stem death testing, specific organ optimisation measures can be added when consent is obtained. This ensures that we continue to act in the patient's best interests as donor, protecting organs from further deterioration and improving function where possible.

This document follows on from the SOP on brain-stem death testing and should be read with this in mind.

Preparation

Staffing	<ol style="list-style-type: none"> 1. Intensive care staff: doctors (consultant / trainee), nursing staff, allied health professionals e.g. physiotherapists. 2. Specialist Nurse(s) - Organ Donation (SNOD) 3. Retrieval team
Location	<p>Most patients will already be in an Intensive Care Unit (ICU) following confirmation of brain-stem death, however some may also be in other critical care areas, e.g. the Emergency Department or Operating Theatre. As donor optimisation requires at least the same (and on occasion an increase) in resources to manage the patient, transfer to an ICU should be considered where possible.</p>
Equipment, drugs etc.	<p><u>Standard Intensive Care monitoring</u> Haemodynamic monitoring (continuous ECG, invasive arterial pressure, CVP) Pulse oximetry and end-tidal CO₂ monitoring Urinary Catheter Cardiac output monitoring Intermittent / continuous temperature measurement Arterial (and venous) blood gas analysis</p> <p><u>Drugs</u> Vaso-active drugs Methylprednisolone Insulin Other drugs may be required, depending on the patient's clinical status and organs considered for retrieval. These include liothyronine (T3), antibiotics according to local guidelines, N-acetyl cysteine</p>
	<p>The next of kin of the patient should be aware of the implications of a diagnosis of brain-stem death. During the consent process, the relatives should be made aware</p>

Next of kin	that donor optimisation is part of ensuring that the organs are maintained in as optimal condition as possible
Donor optimisation	Donor optimisation is a combined effort between the intensive care staff, SN-ODs, the theatre and retrieval teams. Retrieval team input may occur in the intensive care unit (sometimes a 'scout' is sent ahead of the retrieval team to facilitate optimisation), but most commonly happens in the operating theatre.
Key considerations	
<ol style="list-style-type: none"> 1. Confirmation of brain-stem death and certification of death 2. Optimising volume status and cardio-vascular function 3. Optimising respiratory function 4. Hormonal management 5. General critical care management 6. Additional investigations <p>Following stabilisation of the patient prior to brain-stem death testing, clinical targets need to be reviewed to ensure that organ optimisation is maintained. Active donor management may increase the levels of nursing care required, the SN-ODs will be able to support the staff at the bedside.</p> <p>The following are a summary of the first important measures to take:</p> <ol style="list-style-type: none"> 1. Assess fluid status and correct hypovolaemia with fluid boluses as required 2. Perform lung recruitment manoeuvre(s) 3. Identify, arrest and reverse effects of diabetes insipidus 4. Introduce vasopressin infusion 5. Give methylprednisolone, 15 mg/kg to max of 1g, as soon as possible 	
Fluid and Cardiovascular management	
<p>On-going cardiovascular instability will lead to rapid deterioration in organ function and this should be managed aggressively.</p> <p><u>Monitoring and investigations</u></p> <ul style="list-style-type: none"> • Ensure continuous ECG monitoring is in place, as well as invasive arterial and central pressure monitoring. If invasive pressure monitoring is not in place, consider inserting the arterial line in the left upper limb (radial or brachial artery) and the CVC on the right side (internal jugular or subclavian vein). This will facilitate the retrieval procedure. • If not already in place, cardiac output / flow monitoring will facilitate titration of fluids and vaso-active treatment and should be considered at an early stage. The aim is to ensure rapid restoration of intra-vascular volume, but preventing overload. • Drugs such as vasopressin will restore vascular tone, and may be helpful in not only reducing catecholamine infusion requirements, but also with slowing or arresting diabetes insipidus • A12-lead ECG is required and should be repeated if any subsequent changes are noticed. • Where trans-thoracic echocardiography is available, this should be performed. Poor initial function may improve with active management, and repeating echocardiography (trans-thoracic or trans-oesophageal) may be helpful. • Regular clinical assessment to monitor response to treatment is essential. Adequate urine output, normal acid-base balance and lactate and normal mixed (or central) venous oxygenation suggest effective resuscitation. • In all cases of out-of-hospital cardiac arrest, a Troponin level should be sent. This should be repeated where the patient was in ICU > 24 hours. 	

Management and goals

- The overall aim is to achieve an effective circulating volume, avoiding fluid overload, maintaining a normal urine output and plasma electrolytes, avoid fluid overload and if possible achieve a negative fluid balance.
- Restoring an effective circulating volume should be the first priority. If intravascular volume is depleted, give 3-5 ml/kg of a balanced crystalloid or colloid should be given as a rapid bolus, and repeated if necessary. The response should be carefully assessed and where there is a poor response to fluid administration, advanced cardiac output monitoring is essential to guide further treatment. Fluid overload should be avoided, and following restoration of intravascular volume, fluids should be restricted.
- Where hypotension persists, and signs of vasodilatation are present, restoration of vascular tone with vasopressin may be the most effective measure to restore blood pressure. (Dose: 1 unit slow bolus, repeated if ineffective, followed by infusion of up to 4 units/h). Where higher doses are required, intra-vascular volume status should be reassessed for hypovolaemia, and this corrected as required.
- If the cardiac index does not respond to fluid resuscitation and restoration of vascular tone, inotropic support is required. The choice of catecholamine will be dictated by clinical and invasive monitoring results. Dopamine is now more regularly considered as an appropriate first line drug, with dobutamine as an alternative. It is essential to remember that high dose catecholamine therapy esp. with norepinephrine are associated with poor graft function and cardiac retrieval may be reduced.
- Where the response to catecholamine infusion is inadequate, consider a trial of hydrocortisone 50-100 mg intravenously.
- Early studies showed that Liothyronine (T3) as part of a package of measures was associated with increased numbers of organs retrieved and improved organ function post-transplantation. More recent studies suggest that T3 supplementation may add little to an intensive donor management protocol which includes vasopressin and methylprednisolone, and suggest its use only if cardiac performance is unresponsive to volume loading and restoration of vascular tone. T3 is given as an infusion of 3 mcg/h (with or without a 4 mcg bolus at the onset of the infusion). Whether this is used as first line treatment or as a 'rescue' therapy may vary between centres.
- A normal urine output of 1 -2 ml/kg/h is usually attainable. Marked rise in urine output (>4 ml/kg/h) may well be due to the development of diabetes insipidus, and should be treated early.
- Diabetes insipidus should be treated at an early stage. If there is a dramatic unexplained rise in urine output treatment should be commenced even before confirmation by urinary and plasma electrolytes. Vasopressin infusion as used for cardiovascular management will often effectively treat diabetes insipidus, or DDAVP 1-2 micrograms intravenously bolus.
- Electrolyte disturbances (such as low potassium, magnesium, calcium or phosphate) may be associated with cardiac irritability and arrhythmias and should be should be treated using appropriate local protocols.
- Hypernatraemia in the donor is associated with poor liver graft function. Where hypernatraemia remains problematic (aim for a serum sodium of less than 155 mmol/l) water can be given enterally. Alternatively, a low sodium containing fluid such as 5% glucose can be used judiciously. Glucose containing solutions may lead to hyperglycaemia and osmotic diuresis, and the insulin infusion may need to be adjusted to maintain normoglycaemia.

Initial cardiovascular goals

- Sinus rhythm 60-100 beats per minute

- Central Venous Pressure 4 – 10 mm Hg
- Pulmonary arterial pressure < 12 mm Hg
- Mean arterial pressure 60 - 80 mm Hg
- Cardiac Index >2.1 l/min/m²
- Mixed venous oxygen saturation >60% (if measured)

The above goals are guidelines only and clinical assessment and will be influenced by clinical conditions and response to treatment. Regular review of clinical status and cardiovascular monitoring is essential and discussion with the retrieval team may be helpful in determining further treatment.

Respiratory management

Monitoring and investigations

- Routine ventilator parameters should be measured and recorded, alongside SpO₂ and intermittent blood gas analysis. Some cardiothoracic retrieval teams may require blood gas analysis with a FiO₂ = 1.0 for calculation of oxygenation indices.
- A recent chest X-ray should be available, or a new one obtained and reviewed.
- Where secretions (are present, these should be sent for microscopy and culture if not done previously. Antibiotic therapy may be indicated where secretions are purulent, and choice of drug should be guided by the local microbiological advice.
- Bronchoscopy (diagnostic or therapeutic) should be performed if clinically indicated. Where this is not possible to be performed by the local hospital, the retrieval teams may perform this. In addition, bronchoscopy forms part of lung assessment at retrieval.

Management

- Essential first steps are to ensure that a recruitment manoeuvre after the apnoea test has been performed and that lung protective ventilation strategies are in place.
- Recruitment manoeuvres can dramatically improve oxygenation and reduce FiO₂, the technique used should be that routinely employed in the unit. These manoeuvres should be repeated after suctioning or where oxygen saturations are falling.
- Tidal volumes should be 4-8 ml/kg ideal body weight, with peak inspiratory pressures limited to <30 cm H₂O. Positive end-expiratory pressure (PEEP) should be applied to maintain open lung units, values generally ranging between 5 – 10 cm H₂O.
- The FiO₂ should be adjusted to ensure a PaO₂ of >8.0 kPa and maintain the SpO₂ 92 - 95%. Minute ventilation can be adjusted to allow permissive hypercapnia, maintaining pH > 7.25.
- Haemodynamic changes during recruitment manoeuvres and ventilation should prompt a review of volume status and vaso-active support.
- Maintain measures to prevent aspiration, atelectasis and clearing of secretions as per unit practice, this includes ensuring appropriate ETT position and cuff pressures, 30 – 45 degree head-up position, turning, suctioning and physiotherapy.

Metabolic and Haematological management

Management

- Administering methyl prednisolone (15mg/kg to a maximum of 1g) has proven benefit in lung transplantation by reducing the pro-inflammatory environment caused by brain-stem death. While the evidence for other organs is less convincing, the overall principle of reducing the inflammatory response applies to all.
- Insulin may provide the benefits of anti-inflammation and reduced cytokines in addition to the

benefits of good glycaemic control. Aim for a blood glucose levels between 4 and 10 mmol/l. At least 1 unit/h of insulin should be infused and additional glucose provided if necessary.

- Review of the full blood count and coagulation screen (or thrombo-elastography) is essential to optimise oxygen delivery and plan for the retrieval operation. Transfusion triggers should be those locally used. While a haemoglobin level of 10 g/dl is traditionally quoted, there is no evidence of harm with a lower target. There is evidence emerging that blood transfusions may adversely affect organ function post-transplantation.
- Any coagulation derangement should only be treated if there is significant on-going bleeding, but preparation for the retrieval operation should include availability of targeted blood products as per normal practice.
- Blood and blood products are transfused as indicated clinically. The relevant transfusion trigger should allow for any potential for on-going losses or operative losses at the retrieval operation. For some units Group and Save will be adequate. If, however, the donor is some distance from a blood bank, consider having 2 units of blood immediately available for the donor operation, with a recent cross-match sample and arrangements for further units if required.

General Critical Care

General care measures as per unit protocols and guidelines should be continued.

Management

- Hypothermia is very common and often requires active warming devices to maintain normothermia. In addition, consider warming the intravenous fluids, especially where fluid resuscitation is on-going. Maintain or initiate thrombo-embolic prophylaxis with graduated compression stockings, external calf compression devices and / or low molecular weight heparin.
- Initiate or continue enteral feeding unless otherwise instructed by the retrieval team. For bowel retrieval, the team may be asked to give N-acetyl cysteine. As the volume of fluid can be large, close monitoring of fluid balance is essential and diuretics could be considered.
- Review all drugs being administered and discontinue those that are not required.
- Head-up positioning and regular turning to minimize the risk of VAP and pressure sores
- Chest physiotherapy and suctioning to be continued as clinically indicated.

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