



Blood and Transplant

GUIDELINES FOR DONOR CARE DURING MULTI-ORGAN RETRIEVAL PROCEDURES

Donation after Brain Death

(Donation after Death Confirmed using Neurological Criteria)

Guide for Anaesthetists and Theatre Staff

This was written by Dr Dermot McKeown, Royal Infirmary of Edinburgh and has been updated for use by NHS Blood and Transplant

1. Introduction

You will be providing critical care support to the donor during a multi-organ retrieval procedure. Maintaining stability during this procedure allows unhurried removal of organs in optimum condition. There is an opportunity to help multiple patients with the organs from this procedure and your role is important.

Prioritisation of the procedure within your hospital activity should recognise that timing may well be crucial for potential recipients, and that even in a well maintained donor organ function can deteriorate rapidly.

Senior input will be useful, and may be essential. The retrieval team will involve very experienced surgeons and they would reasonably expect an experienced anaesthetist from the donor hospital.

Maintaining an 'anaesthesia' record may help you identify trends during the procedure.

Essentially this is a laparotomy extended by median sternotomy (even if thoracic organs are not to be retrieved) which could take up to about three hours of 'anaesthesia' time.

The surgeons involved are excellent, and blood loss is usually minimal. You should however be prepared for significant blood loss if it occurs. The donor may be dependent on vasopressors to maintain cardiovascular stability.

Although many of these procedures will be entirely uncomplicated, during a one year period when four experienced consultant anaesthetists/intensivists provided this support for all donors there were a number of procedures which demanded all of their skills.

If you wish advice about any aspect of the procedure you can contact the transplant anaesthetist on-call at the Royal Infirmary of Edinburgh (0131 536 1000 and ask to speak to the Consultant Transplant Anaesthetist on-call).

KEY POINTS

- **Major intra-abdominal procedure**
- **Median Sternotomy**
- **Important to maintain stability-a record may help identify issues.**
- **Senior input essential**
- **Telephone advice available from Transplant Anaesthetist, RIE.**

2. Preparation

The donor will be in a critical care area, usually your local intensive care unit. Death will have already been confirmed using neurological criteria (“brain stem death testing”), by the ICU medical team. This should be clearly documented in the case notes and a death certificate should have been issued and/or the Procurator Fiscal informed as appropriate. The retrieval surgeons will need to see this documentation on arrival in theatre.

The donor will normally be in a stable condition. Attention will have been paid to ensuring normothermia, stability of clinical chemistry, protective lung ventilation, and cardiovascular support. Check recent blood counts, coagulation and chemistry, particularly K+, and ensure that blood, if required, will be rapidly available.

Vasopressin infusion may be in progress.

Before going to theatre it will have been decided if thoracic organs are likely to be retrieved. A Specialist Nurse for Organ Donation (SNOD) will be present who can tell you what the retrieval plan is and any specific requirements.

Lines and Access

Before leaving the intensive care unit ensure that there is reliable large bore intravenous access, central venous access and intra-arterial monitoring. If thoracic organs are to be used there are certain requirements; a *right* internal jugular vein central line is required and the retrieval team may ask one if it is not already in place. Intra-arterial monitoring should be placed in the *left* radial artery (because of the sequence of ligation of vessels during cardiac retrieval). A right sided arterial line may lose signal late in the procedure. If monitored, a femoral arterial trace will be lost during the retrieval procedure some minutes before cardiac retrieval but is usually acceptable for retrievals of abdominal organs alone.

The donor will be maintained on the lowest possible inspired oxygen if lungs are to be retrieved but transfer to the operating theatre will generally be done with raised inspired oxygen to allow for disconnections and transfers. Always re-recruit after disconnection or suction.

It is worth checking the amount of cardiovascular support. Vasopressin is commonly given to organ donors. Most donors are vulnerable to becoming hypovolaemic and it is important to ensure an adequate circulating volume at all stages. Observation of flow parameters, “swing” in the arterial waveform, and checking of CVP or pulmonary artery pressure if a pulmonary artery catheter is inserted can be beneficial. Dopamine, which is not frequently used in UK ICU practice, may be a preferred inotrope for cardiac teams. It can be titrated like Noradrenaline and has broadly similar effects.

Key Points

- **Ensure Cardiovascular stability-consider volume loading**
- **Check recent bloods**
- **Reliable access and monitoring**
- **Re-recruit lungs after disconnections, suction etc.**

3. Theatre

An appropriate 'surgical pause' should be undertaken to allow team introductions, plan for procedure, identification of donor, brainstem death documentation, and allergy history.

Position and Access

The donor is supine, with arms by the side to facilitate surgical access. Ensure your large bore access is patent and reliable. A large bore extension set and three-way tap is often useful if arm veins are used.

Ventilation

Ventilation will continue at the lowest possible inspired oxygen and +5 of Positive End Expiratory Pressure (PEEP) or as titrated. Ventilation should ensure limited peak inspiratory pressure yet avoid atelectasis. 6-8 mls per kg tidal volume is generally acceptable. Oxygen saturations >92% are acceptable. Re-recruit after disconnections.

'Anaesthesia'

Death has been confirmed using neurological criteria (brain death), and anaesthesia is not necessary.

Although there is no need for 'anaesthesia' as such, donors tending towards hypertension are well managed by the introduction of low concentrations of volatile anaesthetic agents such as sevoflurane if tolerated, which may also have some beneficial pre-conditioning effects on organs. Spinal reflexes will still be present and can be marked, and it is important to ensure full paralysis. Any relaxant is suitable.

Steroids and Antibiotics

Methylprednisolone will almost certainly have been given in the intensive care unit but if this is not the case 1g of methylprednisolone should be given intravenously. Antibiotics may be drawn up for you by the Operating Department Practitioner with the organ retrieval team and often consist of a cephalosporin, penicillin, and gentamicin in patients who are not allergic. Alternative antibiotics will be given if there is a significant history of penicillin allergy– please check.

Vasopressin

Vasopressin may be being infused and acts as both vasopressor and treatment for diabetes insipidus. Rapid changes in infusion rate are not usually necessary.

Heparin

The retrieval team ODP may also at this stage give you a syringe of heparin. This should not be given until later in the procedure.

Blood Sampling

The ODP will ask for blood samples (up to 100mls, sometimes more) which can be taken from arterial line or central venous catheters.

Problems during procedure

It is important to communicate clearly and effectively with the surgical teams if it is becoming difficult to maintain donor stability. Multiple boluses or rising infusion rates of vasopressors, continued volume requirement, or excessive bleeding can all lead to rapid deterioration.

Early warning may allow modification of surgical technique.

Rarely the team may have to proceed in such circumstances to rapid access and retrieval of organs.

With adequate planning and communication such 'crash' retrievals can be avoided

KEY POINTS

- **Position with arms by side**
- **Avoid atelectasis**
- **Lowest possible inspired oxygen**
- **Antibiotics**
- **Paralysis**
- **Blood samples**
- **Communicate early with surgical teams if donor unstable**

4. Surgical Procedure, preparation

The donor is prepared and draped. The surgeon will proceed to perform an exploratory laparotomy. The purpose of this is to ensure no obvious intra-abdominal contra-indication to proceeding with the operation. Generally there are few cardiovascular changes at this time providing intravascular volume is well maintained.

After an assessment of the abdominal organs and some initial dissection the team will proceed to perform a median sternotomy using a powered saw. During the incision of skin and dissection round the sternum it is worthwhile increasing the inspired oxygen to 100% to allow for the disconnection during the actual sternotomy. To facilitate sternotomy it is ideal to have "table down, lungs down". The operating table is lowered to its maximum extent and the ventilator is disconnected to allow lungs to deflate. At the conclusion of the sternotomy inspired oxygen can be reduced again to the minimum necessary to maintain good saturations, with a recruitment manoeuvre if required.

The pericardium is opened at which point you will be able to assess cardiac contactility and atrial size as an index of filling.

KEY POINTS

- **Laparotomy**
- **100% Oxygen prior to sternotomy**
- **Disconnect during sternotomy. 'Table Down, Lungs Down'**
- **Reconnect, recruit, drop oxygen concentration.**

5. Surgical Procedure, continued

The abdominal organ team will continue with dissection now aided by the median sternotomy and insertion of a sternal retractor. This affords good surgical access for dissection of the abdominal organs. This can take some time particularly when pancreatic retrieval is proposed.

If cardiothoracic retrieval is to be performed they will usually arrive in theatre at around this time. Initially they will perform a bronchoscopy (raise inspired oxygen to 100% and ensure a catheter mount with a bronchoscopic port is used.) This will be given to you by the retrieval team ODP. After ensuring that the airways are clear they will scrub and further assess the heart and lungs.

KEY POINTS

- **Bronchoscopy-ensure good oxygenation**

6. Assessment of Heart & Lungs

The cardiac surgeon will examine the heart externally for function and evidence of coronary artery disease. It may be at this stage that unsuspected coronary artery disease is revealed or regional wall motion abnormality. These may influence the decision as to whether or not cardiac retrieval is to proceed. The cardiac team should communicate well with you at this stage.

Assessment of the lungs will often involve taking differential blood gases from right and left superior and inferior pulmonary veins. Increase inspired oxygen to 100% for five minutes beforehand and four syringes should be available which are compatible with your local blood gas analyser. It is important that the syringes are able to be aspirated rather than self-filling syringes because of lower pressures in the pulmonary veins. Manipulation of the heart during sampling may reduce cardiac output and blood pressure dramatically. The cardiac surgeons will be aware of this but you should keep them informed if blood pressure does not recover rapidly when the heart is returned to its normal position.

Marked cardiac irritability should prompt you to check potassium which may be markedly low if diabetes insipidus is present. Magnesium supplementation is also sometimes required.

Rarely Cardiac Arrest has occurred at this stage, internal paddles would be required for defibrillation.

Following assessment of the blood gases inspired oxygen can be reduced again to the lowest level compatible with good saturations.

KEY POINTS

- **100% oxygen for differential gases**
- **Ensure gases analysed promptly**
- **Cardiac manipulation will lead to blood pressure changes**
- **Check potassium if arrhythmias. Consider magnesium.**

7. Abdominal Dissection

Abdominal dissection will be continued and cannulae inserted for abdominal organ perfusion. The cardiac team will re-scrub and insert their cannulae for cardioplegia and 'palmoplegia'. At this stage there will be discussion between the cardiac and abdominal retrieval teams as to timing of heparin administration.

When abdominal and cardiac teams are happy ensure that the heparin is given intravenously and well mixed in the circulation. The dose is usually 20,000-40,000 units of heparin according to the retrieval teams' requirements.

The next phase of the operation will be perfusion and organ retrieval.

KEY POINTS

- **Discuss heparin with surgical teams**
- **Administer heparin, ensure mixing, inform teams**

8. Perfusion and Organ Retrieval

This will vary depending on whether or not thoracic organs are to be retrieved. In all cases the heparin will have been injected, and time allowed for circulation. If thoracic organs are not to be retrieved, the aorta is cross-clamped and perfusion commenced via the abdominal aorta below the cross-clamp. Ventilation can cease immediately and the heart will rapidly arrest.

If cardiothoracic organs are to be retrieved the heart will be arrested using 1 litre of cold cardioplegia solution. It is useful if you can work with the cardiac team to ensure adequate cardioplegia and 'pulmoplegia'.

1L of cold cardioplegia solution will be provided by the retrieval team ODP. This will be run through a standard blood giving set (ensuring that no air is present) and is pressurised to 150mm Hg. Communicate with the cardiac team as to who will have control of turning the cardioplegia solution on. 3.8 litres cold Pulmonary perfusion solution (Perfadex) is provided and is run through a large bore set- again ensuring no air bubbles - and is raised on a drip stand.

Occasionally the cardiac team will inject prostacyclin just before cardioplegia-blood pressure will fall but there is no need to treat as cardioplegia is imminent.

Cardiac team will clamp the aorta and say "run cardioplegia". Cardioplegia solution is turned on, ensure that it is running well. Maintain the bag pressure at least 150 mm Hg. The heart should rapidly stop in asystole. If the heart continues to beat, quickly check that there is no clamp on the cardioplegia line or if pressure has fallen in the pressure bag.

Shortly after cardiac arrest the cardiac team will ask for the Perfadex to be run for lung preservation, this should be opened and checked that it is running well. Usually open the one litre bag first to ensure that it is emptying well.

Ventilation should continue throughout the sequence if lung retrieval is contemplated.

Dissection will continue and at a later stage the surgeon will ask for the lungs to be maximally inflated and the endotracheal tube withdrawn. At this time they will staple across the trachea ensuring the lungs are well inflated.

Portable heart ex vivo perfusion / monitoring system – Organ Care System (OCS)

The cardiothoracic team unit at GJNH in Glasgow has been working with NHSBT and others to progress with the new Transmedics Organ Care System (OCS) technology and to expand the ex vivo heart programme to Scotland. The donor heart is procured in the standard procedure in theatre and then cannulated onto the OCS machine and perfused with warm O₂ nutrient rich blood in which the heart returns to its beating state for transportation to the recipient hospital for transplantation.

Ex vivo techniques in heart donation have the following benefits:

1. Improved preservation techniques reducing heart muscle damage at reperfusion
2. Expanding the potential geographic zones for organ procurement
3. Reducing the detrimental effects of cold ischaemic storage
4. Decreasing donor heart ischaemic times
5. Increase the donor heart pool to extended criteria marginal donors
6. In future, will facilitate DCD heart transplantation

This development is unlikely to impact on your service as this will take place in the theatre environment however the SNODs are aware of some important modifications in their practice to consider when OCS is being considered which include:

1. Being mindful of the size of operating theatre being used
2. Awareness of the need to crossmatch for 4 units of blood (HEV negative)
3. Waiting for the proctor to arrive - may be similar in timings to an out of Scotland retrieval team arriving.
4. Awareness that a full hour should be allocated as set up time when the retrieving team arrive at the donating unit.

KEY POINTS

- **IS THE HEPARIN IN?**
- **If no thoracic organ retrieval, aorta clamped and heart will arrest. Stop ventilating.**
- **If heart or lungs to be retrieved, heart will be arrested with cardioplegia**
- **Cold cardioplegia, no bubbles, pressurise >150mm Hg**
- **Start fluids at Cardiac Team request.**

9. Conclusion & Paperwork

The organs have now been perfused. Time to replantation is now of the essence, and the team will be fully occupied with preparing organs for transport.

Thank you for your assistance with this procedure. The organ retrieval team are currently busy, and have some hours of work still to do. They may not have time to thank you adequately for the hard work you have done during the last few hours. Please be assured that this has been invaluable and does ensure the best chances of the retrieved organs functioning well.

Please ensure that a record of physiology during the procedure is available for the transplant coordinator. A short note in the patient record is also usual.

The coordinator will let you know at a later stage the fate of the organs from the retrieval.

Retrieval teams welcome feedback-please pass on any points which you feel would have made the procedure more efficient or less disturbing to your hospital.

KEY POINTS

- **THANK YOU**
- **Short documentation of procedure**