Donation after circulatory death

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Key points

At present, demand for organs for transplantation greatly outstrips supply and donation after circulatory death (DCD) may provide a method to address this imbalance.

DCD should be considered for all patients in whom treatment is being withdrawn.

All potential donors should be discussed with the local transplant co-ordinator at an early opportunity.

Most organs from DCD donors are associated with similar long-term outcomes as those from donation after brain death donors.

Not all potential donors are able to donate if the dying process is prolonged.

With the advent of organ transplantation, patients suffering from end-stage organ failure no longer face inevitable death or a lifetime of complex medical care and those receiving a transplanted organ can often return to a normal lifestyle. As a result of this success, coupled with an ageing population, there are increasing numbers of patients seeking organ transplantation. However, the advances in transplant medicine have brought about a demand which has outstripped the availability of organs. There are currently around 8000 people listed as waiting for an organ transplant in the UK but less than half that number received a transplant last year. Current trends show that as demand for organ transplants increases, the actual numbers of organs available have decreased. Additional measures are necessary to meet this deficit. One such measure is donation after circulatory death (DCD) and this article will explore some of the associated practical challenges.

Types of donation

DCD can be considered in a patient who does not fulfil brain death criteria but has no hope of recovery, and it is in the best interest of the patient to withdraw life-sustaining treatment. Initially, all retrieved organs came from DCD donors. However, after the recognition of brain stem death, there was a preference for retrieving organs from heart-beating donors (or donation after brain death/DBD) to minimize organ hypoxia. During DBD organ retrieval, the organ continues to be perfused as cardiac output is maintained. Potential DBD donors are in unresponsive apnoeic coma resulting from an identifiable irreversible cause. Before organ retrieval, the patient must have been declared dead after brain stem testing by at least two independent clinicians.

The main difference between DCD and DBD organs is the duration of warm ischaemia. Warm ischaemia commences when there is inadequate oxygenation or perfusion of the organ as defined by an SAP <50 mm Hg, oxygen saturation <70%, or both such as during withdrawal of treatment or cardiac standstill. The period of warm ischaemia continues until the initiation of cold perfusion. Cold ischaemic time extends from initiation of cold preservation until restoration of warm circulation after transplantation. Cold perfusion will slow down tissue metabolism, resulting in a reduction in the rate of ischaemic injury. During DBD, organs undergo cold perfusion before organ retrieval and thus warm ischaemia is minimal. However, DCD by definition will incur some degree of warm ischaemia as there will be an interval after asystole where organs are not being perfused and have not yet been cooled. As a result, organs from DCD donors have the potential to develop irreversible damage due to the accumulation of ischaemic metabolites.

The number of patients fulfilling brain stem death criteria has decreased in recent years. This is because fewer young people are dying as a result of severe injury or catastrophic cerebrovascular events and advances in the treatment of traumatic brain injury and intracranial haemorrhage have led to improvement in outcome. With the number of DBD donors declining, there has been renewed interest and an increased drive for referring DCD donors to reduce the current organ shortfall. Currently, DCD makes up ~35% of all deceased donors. This is increasing on an annual basis thanks to the increased drive for all organ donation.

DCD selection criteria

Consideration of DCD should be given to all patients in whom life-sustaining therapy is being withdrawn and whose death is expected to be imminent. The decision to withdraw life-sustaining treatment should be made independently of any decision to donate organs or tissue.

DCD donors can be categorized as controlled or uncontrolled. In controlled DCD, the retrieval of organs is planned before death occurs. Uncontrolled donors are those patients who have already died before consideration of organ donation.
Potential DCD patients can be classified according to the modified Maastricht classification which identifies five categories of potential donors (Table 1). In the intensive care unit, controlled DCD is predominantly from Category III patients as this allows warm ischaemic time to be minimized and organ outcomes optimized. Occasionally, Category III patients are located elsewhere in the hospital emergency departments or general wards. Category IV patients who have already been pronounced dead and are awaiting organ donation to occur but suffer cardiac arrest can still become DCD donors.

Uncontrolled DCD, although uncommon, is worth considering, provided strict protocols are instituted to minimize warm ischaemic time. For Category I, patients to be considered death would need to have been witnessed and the time documented and also any pre-admission resuscitation. Category II patients in whom resuscitation has been attempted require additional information about the duration and efficiency of resuscitation to be known. For these uncontrolled DCDs, the transplant co-ordinator and surgical retrieval team need to attend promptly which may not be feasible for most units.

There is no longer an upper or lower limit to the age of potential donors, although with older donors there is a higher risk that organs will not be of sufficient quality. Absolute contraindications to donation include:

- active invasive cancer within the last 3 yr (excluding non-melanoma skin cancer and primary brain tumours);
- haematological malignancy;
- untreated systemic infection;
- variant Creutzfeldt-Jakob disease;
- HIV disease (though not necessarily HIV infection).

Contraindications should not be assumed and if any doubt discuss with local donor coordinator.

### Organs available from DCD

Organs from DCD considered suitable for transplantation include the kidneys, liver, pancreas, lung, and tissue (cornea, bone, skin, and heart valves). Kidneys are the largest group of transplanted DCD organs and although may be slow to function, the 10 yr success rate may be the same as kidneys from DBD donors. However, this delay in function leads to increased morbidity in the recipient with prolonged length of post-transplant dialysis and extended duration of postoperative stay which contributes to the higher cost of DCD donor kidney transplants.

The organ shortage for patients suffering end-stage liver disease is a serious problem, given the lack of efficacious alternatives. At present, only donors who have minimal warm ischaemic time can be used for liver transplantation. Compared with DBD, there is a higher incidence of primary non-function of transplanted livers and also poorer 1 and 3 yr graft survival. Currently, DCD makes a modest but rising contribution to the donor pool.

The lung may be the ideal organ for DCD because unlike other solid organs, it tolerates the absence of a circulation, provided the lungs remain inflated with oxygen. At present, lung transplantation from DCD is in its infancy but has been associated with good outcomes.

Either the whole pancreas (often in combination with a renal transplant) or islet cells alone can be used. For combined pancreas–kidney transplant, there is no difference in outcome between those retrieved from DCD and DBD donors.

### Organ-specific recommendations

#### Renal donors

- Warm ischaemic time of <2 h (although this can be extended at the discretion of the retrieval surgeon).
- No history of chronic renal impairment (glomerular filtration rate <30 ml min\(^{-1}\) or on dialysis) or acute cortical necrosis on current renal biopsy.
- Kidney retrieval should be re-evaluated, if the thresholds for warm ischaemia have not been reached within 2 h of treatment withdrawal.

#### Liver donors

- Warm ischaemic time of <30 min.
- No history of liver cirrhosis or portal vein thrombosis.
- Liver retrieval should be stood down if the thresholds for warm ischaemia have not been reached within 1 h of treatment withdrawal.

#### Pancreas donors

- Warm ischaemic time of <30 min.
- No history of diabetes.
- BMI <35, age <65 yr.
- Pancreas retrieval should be stood down if the thresholds for warm ischaemia have not been reached within 1 h of treatment withdrawal.

#### Lung donors

- Warm ischaemic time of <1 h.
 Donation after circulatory death

- Contraindications include a history of previous thoracic surgery (not cardiac surgery or thoracocentesis) or empyema, and lung disease (chronic obstructive pulmonary disease, pulmonary embolism, or asthma requiring systemic steroids).
- Age < 65 yr.
- Bronchoscopy may be deemed appropriate before withdrawal of treatment if it does not cause the patient distress and the family are in agreement.
- Note, smoking history, length of ventilation, and positive gram stain are not absolute contraindications.

Practical process of DCD

All potential donors should be discussed with the local transplant co-ordinator at the earliest opportunity. The transplant co-ordinator is able to confirm whether or not the patient is on the UK Organ Donor Register and advise as to their suitability. After referral, the transplant co-ordinator will attend the donor unit to undertake donor assessment and instigate appropriate investigations.

In cases where there is any doubt as to the cause of death or suspicion as to the nature of death, then the case requires to be discussed with the Coroner (or the Procurator Fiscal in Scotland) to ensure that they have no objections to donation proceeding. In these cases, organ donation can often proceed with steps taken to preserve potential evidence. Given that only good-quality organs are deemed suitable for transplantation, any organ connected to the cause of death is likely to be inappropriate. However, other organs can be retrieved without interfering with evidence. Further measures during the retrieval procedure may also be required including photography, additional sampling, and the presence of a home office pathologist.

The request for donation of organs may be made by the medical staff or transplant co-ordinator. Before any approach, the family must first understand the concept of futility of further medical intervention and assent to the withdrawal of organ support. Issues to discuss with the family:

- The transplant co-ordinator must establish if there are any medical, social, or behavioural risk factors.
- The family may specify which organs may or may not be used but are prohibited from stating conditions relating to potential recipients.
- Research specimens may only be taken with the family’s consent.
- A realistic timescale for proceedings should be indicated to the family.
- If death occurs quickly after treatment withdrawal, they will not have much time with the patient if organ donation is to proceed.
- If death does not occur quickly, organ donation may not be possible.
- Any specific requirements for last offices.
- It should be stressed that the relatives can stop the donation process at any stage.

A major cornerstone of DCD donor management is the reduction of ischaemic time, particularly warm ischaemia. Much importance is therefore placed on the rapid institution of cooling post cardiopulmonary arrest to reduce warm ischaemia. Cold ischaemia can be minimized by virological screening and tissue typing of the potential donor before death, thereby allowing early mobilization of potential recipients for advanced tissue typing.

Withdrawal of treatment

Arrangements for the withdrawal of treatment should be agreed between the family and critical care staff. In the interim, the current level of support ought to continue, but there is controversy regarding escalation of treatment to facilitate donation. Legal guidelines only recommend measures that facilitate donation but that do not cause the donor harm or distress. This can include increases in oxygen concentration and ventilatory support where required, changing the rate of fluid administration or inserting venous cannulae. Agents can be used to maintain arterial pressure (if in accordance with local policy) but should not be used to elevate the pressure higher than that at the time when the decision was made to withdraw treatment. Antibiotics should not routinely be given unless clinically indicated.

Once the retrieval team is prepared in the operating theatre and the family are ready, the team should proceed with withdrawal of treatment. This should be in accordance with the usual practice of the unit and not be altered because organ donation is being considered. In some patients, respiration will continue after withdrawal of support and may lead to abandonment of organ donation due to prolonged warm ischaemic time and subsequent loss of organ viability.

Confirmation of death

After cardiorespiratory arrest, death is confirmed by a medical practitioner independent from the retrieval team. Examination should be made according to the recommendations from the Academy or Royal Colleges. Cessation of cardiorespiratory function should be monitored for a period of 5 min before certification of death. Absence of a circulation can be confirmed by using an arterial line or, in the absence of an arterial line, asystole on an ECG. Palpation of a central pulse is not sufficient for diagnosis.

In the unusual event that cardiac or respiratory activity returns during this 5 min observation period, a further 5 min observation after further cessation should occur.

After certification of death, the relatives may spend, up to 5 min with the patient, before transfer to the operating theatre. If the relatives require longer with their loved one, the donation process should be reviewed. The process of retrieving donor organs does not begin until at least 10 min have elapsed from circulatory arrest. For most cases, this is taken up with the initial family and subsequent transfer time.

In cases of lung donation where the patient has been extubated, reintubation will be required after confirmation of death. This is either performed by the treating clinician or by a member of the
remains a contentious issue within the critical care community. Although there are now many DCD programmes across the UK, it has been a return of circulation in those in whom resuscitation was not successful. A return of circulation, either through natural means or induced by therapeutic hypothermia, can begin within the first 10 min of cardiac arrest. If circulation returns after the 10 min period, it is generally considered that it is too late to proceed with organ donation. Concerns over the minimum acceptable period of cardiac standstill are based on anxieties that a return of spontaneous circulation after the onset of apparently irreversible asystole might result in a return of neurological function. There is no evidence that spontaneous circulation has ever returned after a period of 7 min asystole in patients who have undergone resuscitation; nor has there been a return of circulation in those in whom resuscitation was not attempted. In the UK, both the ICS and the Academy of the Royal Medical Colleges recommend that death should be confirmed after a minimum of 5 min of continued cardiorespiratory arrest. In addition, there is a further 5 min grace period after pronouncement of death before organ retrieval, giving a total time of 10 min asystole.

**Increasing organ donation**

In December 2006, the UK Government set up the Organ Donation Taskforce to identify barriers to organ donation and recommend actions needed to increase procurement within the current legal format. The Taskforce published its first report ‘Organs for Transplants’ in January 2008. It made a number of recommendations (Table 2) to the Government which could potentially result in a 50% increase in organ donation in the next 5 yr, ultimately saving thousands of lives.

In November 2008, the Taskforce published its second report outlining the potential impact of an opt-out system for consent to organ donation in the UK. It concluded that an opt-out system states that patients must be declared dead before the removal of any vital organs for transplantation. For DBD, this is by brain stem testing and pronouncement of brain death. The circulatory definition of death requires the irreversible cessation of cardiac function. This is the requirement for DCD.

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### Table 2 Organ Donation Taskforce Recommendations

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<th>Organ Donation Taskforce Recommendations 2008</th>
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<tbody>
<tr>
<td>1. A UK-wide Organ Donation Organization should be established under the responsibility of NHSBT</td>
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<td>3. An independent UK-wide Donation Ethics Group should be established</td>
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<td>4. All parts of the NHS must embrace organ donation as a usual, not an unusual event with an identified clinical donation champion and a donation committee</td>
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<td>5. Minimum notification criteria for potential organ donors should be introduced on a UK-wide basis</td>
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<td>6. Donation activity in all Trusts should be monitored</td>
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<td>7. Brain stem death (BSD) testing should be carried out in all patients where BSD is a likely diagnosis even if organ donation is an unlikely outcome</td>
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<td>8. Financial disincentives to Trusts facilitating donation should be removed</td>
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<td>9. The current network of donor transplant co-ordinators (DTCs) should be expanded and strengthened</td>
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<td>10. A UK-wide network of dedicated organ retrieval teams should be established</td>
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<td>11. All clinical staff likely to be involved in the treatment of potential organ donors should receive mandatory training in the principles of donation</td>
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<td>12. Increased public recognition of individual organ donors, where desired</td>
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<td>13. Increased promotion of organ donation to the general public</td>
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<td>14. Development of formal guidelines for coroners concerning organ donation</td>
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would not provide significant increases in organ donors and may have the potential to undermine the concept of donation as a gift and erode trust in the NHS and the Government. These factors may have a negative impact in the number of potential donors. It therefore concluded that an opt-out system should not be implemented in the UK at the current time.

Summary
Organ transplantation has the potential to reduce burden of disease and also improve quality and quantity of life. With the number of patients waiting for transplants increasing, it seems prudent to consider all possible sources of organs. In addition to the important health benefit acquired by the recipient after successful transplantation, organ donation can provide benefits to the donor family. This altruistic act may be the most comforting aspect of an otherwise tragic event and DCD gives previously excluded potential donors the opportunity to donate. At present, DCD donors are an under-utilized resource and given the positive outcomes after DCD, it should be considered for all eligible patients.

Conflict of interest
None declared.

References

Please see multiple choice questions 4–7.