Transplant International

REVIEW

In-hospital logistics: what are the key aspects for succeeding in each of the steps of the process of controlled donation after circulatory death?

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SUMMARY

Donation after circulatory death (DCD) donors are becoming an increasingly important population of organ donors in Europe and worldwide. We report the state of the art regarding controlled DCD donation describing the organizational and technical aspects of establishing a controlled DCD programme and provide recommendations regarding the introduction and development of this type of programme.

Transplant International 2016; 29: 760–770

Key words
controlled, donation after cardiac death, donation after circulatory death, nonheart beating donation

Received: 13 May 2015; Revision requested: 19 June 2015; Accepted: 19 October 2015

Introduction/Background

Controlled DCD programmes have become established in three European countries; Belgium, the Netherlands and the United Kingdom [1], and also make significant contributions to deceased donation in Australia, Canada and the United States [2]. Controlled DCD (cDCD) is only possible when death follows a planned withdrawal of life-sustaining treatments from a critically ill ventilated patient, and it follows that the potential for this form of donation will be determined by the frequency with which decisions to withdraw life-sustaining treatments are made. Although there is significant variation in how often decisions to withdraw treatments are made in European intensive care units (ICUs) [3], it nevertheless seems likely that at least some other European countries have a potential for this form of donation.

Successful introduction of cDCD depends upon the provision of detailed local policies that are based upon comprehensive national policies that cover professional, ethical and legal aspects of the pathway [4–10]. The aim of this paper is to describe the state of the art existing cDCD programmes from an organizational and technical perspective and to provide recommendations for the introduction and development of this type of donation. Ethical and legal aspects of cDCD are considered elsewhere in this issue [11].

Methods

A dedicated questionnaire was prepared to collect information on the regulatory background and the practice of cDCD in European countries with the most activity, namely, Belgium, the Netherlands, Spain and the United

doi:10.1111/tri.12708

Kingdom. The topics addressed were structured in different areas:

1. general information;
2. consent;
3. care before treatment withdrawal;
4. management of treatment withdrawal;
5. donor selection criteria;
6. diagnosis of death; and
7. organ preservation measures.

At the 6th International Conference in Organ Donation held in Paris in 2013 an established expert European Working Group reviewed the responses to these questionnaires, which were then considered along with the available published literature to develop recommendations based on the accumulated European experience of cDCD.

Scope of the state of the art: key elements of controlled DCD

Controlled DCD takes place after death that follows the planned withdrawal of treatments that have been considered to be 'futile' or of no overall benefit to a gravely ill patient. Potential cDCD donors almost always lack the capacity for decision-making at the time of their final illness and will be cared for in an intensive care unit or emergency department. It is of note that cDCD can be supported in almost any hospital that admits critically ill patients and which can be accessed by an organ retrieval team, and it follows that all critical care and emergency department clinicians should be familiar with the pathway, even those who work in small hospitals that have a small potential for deceased donation.

The key elements of the cDCD pathway are outlined in Fig. 1. Most notably, cDCD requires

- **A decision to withdraw life-sustaining treatments.** Controlled DCD can only occur if a decision to withdraw life-sustaining treatments has been made and has a fundamental dependency upon the integrity of such decisions.
- **Donation to be considered before death,** including
  - consent from the donor family;
  - donor referral and assessment; and
  - offering and possibly allocation of the patient's organs.

The involvement of donor coordination and retrieval team personnel before a patient has died may generate conflicts that must be guarded against.

- Alteration to various aspects of end-of-life care
  - Treatment withdrawal must be delayed whilst the necessary preparations for donation are made.
  - Clinicians may be asked to consider ante-mortem interventions to limit ischaemic injury to the transplantable organs prior to retrieval.
  - Some elements of the care given at the time of treatment withdrawal and death must be adjusted if donation is to be possible. These include the location of treatment withdrawal, the speed with which death is diagnosed and the time that a family have to spend with their loved one after death is confirmed.

The decision to withdraw life-sustaining treatments

As noted above, cDCD is possible when a consensus has been reached to withdraw life-sustaining treatments from a critically ill patient. On almost all occasions the patient will be unable to make decisions for him/herself, and instead, they will be made by the clinical staff caring for the patient in collaboration with the next of kin.

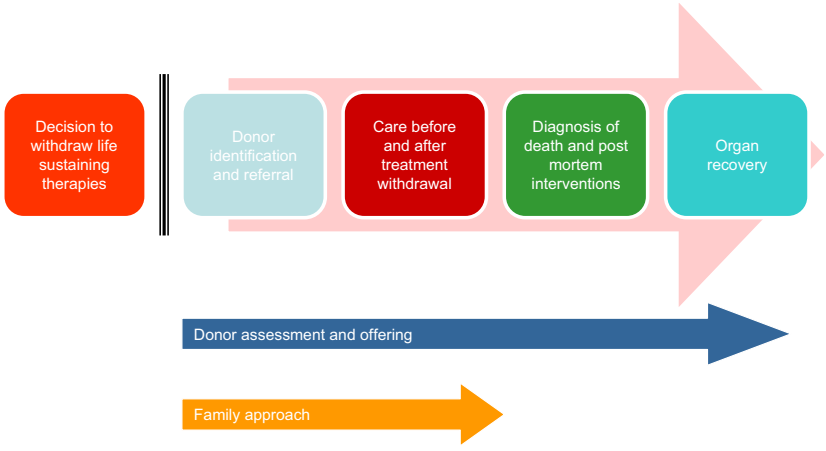

Figure 1 The process of controlled Donation after Circulatory Death.

The next of kin will also be involved in any subsequent decision regarding organ donation.

The decision to withdraw life-sustaining treatments must be robust, transparent and independent from any subsequent consideration of organ donation. In particular, it is vital that there is no suspicion or perception that the decision to withdrawal life-sustaining treatments is motivated by anything other than the best interests of the patient. The decision-making should be in accordance with agreed local policies that are based upon established national guidance and, where relevant, legislation. There is a strong view amongst clinicians involved in cDCD programmes that the decision to withdraw life-sustaining treatments should be the result of a multidisciplinary discussion that is 'collegiate' or 'consensus', rather than the opinion of a single practitioner, and that it should be recorded in writing in the patient's medical records, preferably using an agreed pro forma [12].

Substitution

The majority of cDCD donors have suffered severe acute brain injury, and this has raised concerns that any emphasis on cDCD may lessen the number of patients who become brain dead and thereby reduce the number of potential DBD donors. The risk for so-called 'substitution' remains uncertain however, and recent data from the UK Potential Donor Audit, conducted by NHS Blood and Transplant, reveals that 15% of all actual DCD donors die from non-neurological conditions, most notably acute respiratory failure.

Considering donation

Very occasionally it is possible to discuss cDCD donation with the potential donor, for instance when withdrawing noninvasive ventilatory support from a competent patient with end-stage neuromuscular disease or when terminally ill patients are considering euthanasia [13]. However, such instances are rare, and on most occasions donation is raised with the patient's legal representative (s) or close relatives. How and when donation is raised varies. The primary objective is to ensure that the next of kin have confidence in clinical decision-making and at no time sense that treatment withdrawal is driven by a need for donor organs. Whilst it might be desirable to have completely separate discussions about treatment withdrawal and donation, this may not always be possible. Indeed, it may be natural for a family who accept treatment withdrawal to ask about what is to happen next, and in these circumstances, a prior assessment of the clinical potential for organ donation will help with end-of-life care planning. The key is that donation is only raised when it is clear that a family have understood and accepted the inevitability of their loss [14]. It is important that clinicians are provided with clear guidance on how and when donation should be considered and when it is permissible to involve donor coordination services.

Recommendations

1 Centres supporting cDCD should have a clear and transparent policy for decision-making around withdrawal of life-sustaining treatments that are based upon and consistent with relevant national policies and guidelines. Palliative care/bereavement teams can contribute to standardizing quality end-of-life care practices in the DCD process and provide education for involved personnel.

2 National guidance notwithstanding, it is recommended that the decision to withdraw life-sustaining treatments should be a multidisciplinary or 'collegiate' one and that none of the clinicians making the decision should be involved in the subsequent coordination, retrieval or implantation of organs from that patient.

3 National agencies should be aware of the risk of substitution of cDCD for DBD and provide clinicians with clear guidance on the care of patients in whom brain death is likely.

Donor identification and referral, assessment and offering

Identification and referral

Most cDCD donors have suffered severe acute brain injury of aetiologies similar to those that can result in brain death. There is an expectation that such patients will only be identified as potential cDCD donors in circumstances when brain death criteria are not likely to have been met and an evolution towards brain death with maintenance of circulatory function is not likely to take place at the time of treatment withdrawal. Although the majority of actual DCD donors die from acute brain injury, data from both the Netherlands and the United Kingdom suggest that it may be possible in other circumstances, for example profound respiratory failure or end-stage neuromuscular disease [15]. Clinicians require clear and workable criteria for the identification and referral of potential cDCD donors. These

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policies should cover who should be referred as a potential donor, when the referral should take place and how the patient should be cared for whilst the initial assessments of donation potential are made.

In the UK and across Europe, national organ procurement organizations such as NHS Blood and Transplant in the UK offer guidelines for the identification and referral of potential donors [16,17]. They suggest that hospital staff should initiate discussions with the donor coordinators as soon as the decision to withdraw life-sustaining treatment in patients has been made. The possibility of organ donation should only be raised when it is clear that a family have understood and accepted the inevitability of their loss. In addition, available evidence suggests that families are more likely to agree to DCD donation if it is raised by a transplant coordinator and is considered best practice to involve them at this stage [18].

Assessment

Eligibility

Contra-indications to donation can be patient or organ specific. In general, the absolute contra-indications to cDCD donation refer to the donation of any organ and are similar to those for DBD. In contrast, organ-specific criteria tend to be more stringent than for DBD, particularly with regard to donor age and medical co-morbidities. Although the final decision over whether to accept an organ from a cDCD donor rests with the implanting transplant centre, minimum standards for acceptance are helpful and support consistent practice. Relevant national agencies and professional societies have an important role in developing such standards.

Withdrawal of treatment and asystole

Warm ischaemic injury in DCD donor organs results in primary nonfunction, delayed graft function and organ-specific ischaemic injury such as biliary strictures in liver grafts. To limit ischaemic injury, it is necessary to set limits for the time that elapses from treatment withdrawal to asystole/cold perfusion.

Two time intervals are used to limit ischaemic injury and have a significant impact upon whether DCD donation will occur following treatment withdrawal. The first is the so-called agonal period and is the time that elapses from treatment withdrawl to asystole. It is currently two hours in Spain and the Netherlands and three hours in the UK.

The second interval, which is considered a better measure of ischaemic injury, is the functional warm ischaemic time. This is defined as the time from when the systolic blood pressure drops below 50 mmHg (irrespective of oxygen saturation) for at least 2 min after withdrawal of life-sustaining treatment until organ preservation. As each organ has a difference tolerance to this ischaemic injury, the maximal functional warm ischaemic time for each organ varies (kidney 120 min, liver 30 min, pancreas 30 min and lung 60 min) [15,19].

It is important that these time intervals, are subjected to regular review and adhered to by retrieval teams.

In the UK, nearly 40% of cDCD donations are stood down after treatment withdrawal, usually because the three hour time interval is exceeded. A number of tools have been developed in an attempt to predict the speed of progression to cardio-respiratory arrest [20–22], some of which (such as the University of Wisconsin scoring tool [20]) involve tracking the degree of physiological decline during a trial period of disconnection from mechanical ventilation. Other studies suggest that how treatments are withdrawn – specifically whether the patient is extubated – may influence the speed with which asystole occurs, although this remains controversial [22]. Regardless of the details, such tools are yet to be validated prospectively, do not take into account the use of pharmacological comfort cares following treatment withdrawal and remain of uncertain benefit. For these reasons, others consider that because it is not possible to reliably identify potential cDCD donors who will die within 1–3 h after life-sustaining treatment has been withdrawn, donation assessment should be initiated in every potential donor [23].

Streamlining the pathway

The prompt and streamlined management of donor referral and assessment, organ offering and retrieval carries clear advantages for referring units, retrieval teams, organ recipients and most of all the families of potential cDCD donors. In this regard, specific attention needs to be given to two areas of practice, namely blood sampling and the offering process:

- Early tissue typing and virological screening allows the prompt identification of suitable recipients and reduces cold ischaemia times and in doing so may reduce delays in treatment withdrawal. Although there are clear benefits to performing these investigations as soon as possible, this should only be carried out in accordance with the legal conditions relevant to a particular jurisdiction. National agencies have a responsibility to ensure that staff are aware of these conditions and work to them.

• The assessment of a potential cDCD donor and the offering and allocation of donor organs can be a lengthy process. UK experience suggests that this can deter a family from giving their consent to donation because treatment withdrawal, and the anticipated death of a loved one, is delayed. Whilst some delay is inevitable, retrieval and transplantation teams need to be sensitive to these issues and adjust their practices wherever possible. For example, offering organs to several implanting centres simultaneously rather than sequentially may reduce delays considerably.

There should be regular dialogue between critical care, retrieval and transplant teams that is informed by ongoing audit of key elements of the cDCD pathway. This should include donor identification and referral, family approach and consent, organ utilization and outcomes, stand down rates and duration of the pathway.

Recommendations

4 National agencies should provide critical care staff with clear and applicable criteria for the identification and referral of potential donors, develop criteria for the acceptance of potential cDCD donors and implement processes to streamline key stages of the cDCD pathway.

5 There is an ongoing need to improve the specificity and sensitivity of tools that predict the time interval from treatment withdrawal to asystole. However, until such tools are available, cDCD should be considered whenever the withdrawal of life-sustaining treatment is planned.

6 All healthcare professionals involved in the care of potential cDCD donors should have the appropriate knowledge and skills and should be supported by senior clinical staff.

Care before and after withdrawal of life-sustaining treatments

As noted previously, if cDCD is to be possible it is necessary to adjust elements of the care that a patient receives both before and after treatment withdrawal. Such changes may include

• delaying the timing of treatment withdrawal until arrangements for organ retrieval are completed – this will almost always be necessary.

• the possible application of some ante-mortem interventions designed to improve the condition of the retrievable organs. This varies between programmes and will be dependent upon the ethical and legal standards that apply to any given jurisdiction.

• a change to the location of treatment withdrawal in order to minimize the warm ischaemic time. This may be influenced by local factors such as the location of the ICU/Emergency Department in relation to the operating department, as well as national policies

Crucially, whilst the patient remains alive, all decisions made on his/her behalf must be compliant with the relevant professional, ethical and legal standards of care that apply to any given jurisdiction. Whilst this may be covered by specific primary legislation, in other circumstances it may require interpretation of legislation that was enacted for other reasons. In the Netherlands these issues are overcome by informed consent from a patient's next of kin. In contrast, in Spain and the UK such changes to the end-of-life care pathway are justified, both ethically and legally, on the grounds of best interests – if they facilitate the wishes of a patient to donate, and if they do not cause harm or distress to that patient or his/her relatives in doing so [24].

Ante-mortem interventions

There is understandable concern over the ischaemic injury that the organs from cDCD might suffer, and there have been several suggestions over specific interventions that might be made before death to lessen such injury. These include the administration of drugs such as antibiotics, heparin and vaso-dilators, and femoral cannulation (the latter to enable immediate perfusion of the abdominal organs once death has been diagnosed, either with cooled crystalloid preservation fluids [25] or normothermic oxygenated blood).

The lawfulness and acceptability of such interventions is likely to vary from country to country. In the UK, best interests legislation rules out any intervention that exposes the patient to risk of significant harm, and the current interpretation of such legislation appears to exclude the organ-specific interventions outlined above [24]. However, a recent survey of practice in England suggests that a small number of units do carry out such interventions and has called for clearer national guidance [26]. In Belgium and other countries such as the United States and Canada, the use of heparin and/or other interventions is allowed providing valid consent has been obtained. In any event, the evidence base for the effectiveness of such interventions is weak. In jurisdictions where their use is permitted, retrieval and

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transplant teams have an important role is assessing their impact on transplant outcomes, together with any complications of their use.

Location of treatment withdrawal

Warm ischaemic injury represents a significant threat to cDCD, and it is legitimate for all involved to consider how it might be minimized. One element of the ischaemic burden is that accumulated during transfer of the patient from the place of death to the operating theatre. This is most significant when treatment withdrawal and death occurs in the intensive care unit or the emergency department and the transfer to the operating theatre that follows is lengthy or complicated. Such issues have prompted some teams to transfer the patient to the theatre area prior to treatment withdrawal. However, whilst changing the location of treatment withdrawal in this way might reduce warm ischaemic injury, this should be balanced against other considerations, particularly

- the need of the patient and family for comfort, privacy and dignity,
- the provision of ongoing support for the family after the death of their loved one,
- a clear plan for ongoing care should the donation be stood down
- the staffing implications of withdrawal in theatre, because the patient has an ongoing need for nursing care with end-of-life care expertise, and a doctor will be required to diagnose death
- the risks of a potential donor being in very close proximity to a retrieval team, therefore giving the opportunity for the retrieval team to be involved in the care of the dying patient before they die

Management of treatment withdrawal

Most, if not all cDCD programmes are founded on the principle that treatment withdrawal should not be adjusted to accelerate death and thereby promote organ retrieval [10]. Indeed, there is a risk that clinicians will be more conservative in treatment withdrawal when cDCD is being considered for fear of being seen to promote donation. Furthermore, there is considerable variation in how life-sustaining treatments are withdrawn, particularly with regard to airway management and the use of pharmacological comfort cares, and this may generate uncertainty amongst staff and threaten confidence in the process [26]. Agreed end-of-life care protocols and the involvement of palliative care teams can make a significant contribution to the care of the patient and family in the organ donation process, standardizing practices in treatment withdrawal and providing education and support for involved personnel.

Involvement of the transplant coordinator

The transplant coordinator is the interface between the clinical team caring for the potential cDCD donor and organ retrieval and transplantation. The coordinator may play an important role in the consent process and supporting both family and staff through the cDCD pathway. They are responsible for collecting all the information necessary to assess the patient's medical suitability for donation, and this inevitably requires them to have some physical contact with the patient. However, although they have an established and important part to play in the physical care of the brain dead donor (e.g. general nursing cares, donor optimization etc.), they risk being conflicted if they are involved in the care of a potential cDCD donor and for this reason are generally prohibited from such involvement. It is important that relevant national agencies developing cDCD policies consider these matters carefully and issue clear guidance that gives reassurance and protection to all involved.

Recommendations

7 Each country/jurisdiction should produce clear guidance on the lawfulness of ante-mortem interventions designed to maintain organ function and/or reduce warm ischaemia. In circumstances where ante-mortem interventions are used, retrieval and transplantation teams should continue to assess their effectiveness in promoting transplantation.

8 Each country/jurisdiction should issue guidance regarding location of treatment withdrawal and in doing so consider both the benefits to transplantation and also the impact upon the care given to the patient and their family.

9 Each country/jurisdiction should provide clinicians who care for potential cDCD donors with clear guidance on how and where life-sustaining treatments are withdrawn.

10 Each country/jurisdiction should issue clear guidance regarding the role of the transplant team and transplant coordinators in cDCD pathway, mindful of the risks of any involvement in the end-of-life care of a potential DCD donor.

11 Education of healthcare staff is essential as many are uncomfortable at the clinical interface between end-of-life care and organ donation.

12 Healthcare professionals who are uncomfortable with controlled DCD may choose not to be involved in the care of such patients. However, there should be systems in place to ensure that this does not deny the opportunity for a suitable patient to donate his/her organs after their death in accordance with agreed local and national policies.

Diagnosis of death and post-mortem interventions

Professional frameworks for the diagnosis and confirmation of death

Death has clinical, legal and societal elements, and for this reason, the diagnostic criteria for its diagnosis may vary between countries and jurisdictions [27]. International guidelines have been developed in collaboration with the World Health Organization in an attempt to reach consensus on the scientific, biological and medical aspects of death in a way that supersedes such differences and which may form the basis of more consistent and globally applicable diagnostic criteria [28]. A number of over-arching principles have emerged from this work that should help inform professional frameworks for the diagnosis of death within the context of cDCD

- death is a biological event and should be diagnosed using biological parameters
- the criteria used to diagnose death should remain valid regardless of any subsequent post-mortem intervention (e.g. organ retrieval) and should preserve the integrity of the 'dead donor' rule.
- the criteria (and terminology) used to diagnose death should be functional rather than anatomical and be based upon loss of vital circulatory and neurological functions.
- death is in essence a neurological event and occurs when there is a permanent loss of
  - the capacity for consciousness
  - all brain-stem function, including respiration

  where 'permanent' refers to loss of function that cannot be restored spontaneously and which will not be restored artificially.
- The state of death can be arrived at in various ways, for example through permanent loss of circulatory function or following more direct injury to the brain.

Circulatory criteria for the diagnosis of death

It is generally understood that organ retrieval must begin within minutes of the onset of circulatory collapse if successful transplantation is to be possible. It is also widely believed that the brain remains responsive to the restoration of its blood flow for some time after the onset of asystole. As a result, if organ retrieval is not to breech the dead donor rule all the following conditions must be satisfied:

1. asystole, that is loss of mechanical activity of the myocardium, has occurred
2. brain function has been lost
3. the possibility of *spontaneous* return of cardiac function has passed
4. there will be no subsequent intervention that restores cerebral perfusion for the period of time during which the brain would be responsive to restoration of the supply of oxygenated blood

Three observations usefully inform the development of criteria for diagnosis of death following loss of the circulation that meet these conditions. Firstly, all neurological function – including consciousness and those of the brain-stem – is lost within seconds of circulatory arrest [29–32] and will only return if cerebral blood flow is promptly restored. (The minimum duration of circulatory arrest necessary to ensure that the brain would not respond to subsequent restoration of its circulation is unknown and likely to be influenced by multiple variables, for example temperature or a pre-existing brain injury, that are difficult to control). Secondly, ECG activity can persist for up to ten minutes after the onset of mechanical asystole and is therefore an unreliable marker for it [33]. Finally, there have been no reported cases of spontaneous return of the circulation following the withdrawal of life-sustaining treatments [34,35].

There are three essential elements to any schedule for the diagnosis of death in these circumstances:

- recognition of the onset of mechanical asystole
- a period of observation to ensure that the possibility of spontaneous return of the circulation has passed
- demonstration of the essential features of death (loss of consciousness and brain-stem functions, including respiration).

Details on these three elements are provided in Table 1.

It is emphasized that such schedules are applicable to the diagnosis of death following withdrawal of life-sustaining treatments regardless of whether organ retrieval is planned. It is important that these schedules are developed and agreed by relevant national agencies. Members of the coordination or retrieval team should never be involved in the diagnosis and confirmation of death if donation is being considered.

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Table 1. Guidance for the diagnosis of death using circulatory criteria following withdrawal of life-sustaining treatments.

Setting	Planned withdrawal of life-sustaining critical care treatments. Invasive arterial pressure monitoring, pulse oximetry and continuous surface ECG monitoring likely
Identification of asystole	Asystole is best identified using correctly functioning arterial line or by transthoracic echocardiography. Reliance on an isoelectric ECG may unnecessarily extend warm ischaemic injury, but is recommended if invasive pressure monitoring or echocardiography are unavailable. (Digital palpation of a central pulse and plethysmography from a pulse oximeter are unreliable and should be avoided.)
Period of observation	Published recommended observation periods range from 2 to 20 min. There should be no retrieval related intervention during the time recommended for the country/jurisdiction. Any return of circulatory function mandates a further full period of observation on resumption of asystole
Diagnosis of death	Confirmed through absence of consciousness, respiration and other brain-stem functions after the agreed period of observation

Recommendation

13 Clinicians should be provided with clear criteria for the diagnosis and confirmation of death following circulatory arrest. These criteria should cover how asystole is recognized, and the minimum period of observation following the onset of asystole that must elapse before death can be confirmed. There should be no donation-related intervention during this 'no touch' period. (Published recommended observation periods range from 2 to 20 min; however, in most countries a period of 5 min is recommended).

Post-mortem interventions and organ retrieval

Standard retrieval interventions

Most cDCD protocols allow the retrieval laparotomy and organ perfusion with cooled crystalloid or colloid solutions as soon as death has been confirmed, although others require an additional brief period of 'no touch' after death has been diagnosed. Specific precautions may be necessary should other interventions be planned prior to organ retrieval:

- **Regional normothermic reperfusion:** There is emerging experimental and clinical evidence that warm ischaemic injury to vulnerable transplantable organs can be improved if the transplantable abdominal organs are re-circulated with oxygenated blood prior to explantation by restoring cellular substrates and reducing levels of degradation products [36,37]. It is vital that protocols supporting such interventions describe how reperfusion will be reliably restricted to the relevant organ bed(s), thereby avoiding inadvertent restoration of cerebral blood flow. A recent trial of normothermic regional perfusion in Scotland and England, in which the myocardial and cerebral circulations were isolated by cross-clamping the descending aorta, has shown the benefits of such an approach [38].
- **Lung retrieval:** cDCD donors may be an important possible source of transplantable lungs [39]. However, lung retrieval requires the trachea to be re-intubated and the lungs re-inflated after death, and there is anecdotal evidence that this might trigger return of myocardial contractility. Protocols describing the retrieval of lungs from cDCD donors should ensure that appropriate steps are taken to prevent the inadvertent restoration of the cerebral circulation.

Recommendations

14 Death should be regarded as a state in which a patient has permanently lost the capacity for consciousness and all brain-stem function, including respiration.

15 Clinical staff should be provided with a clear and unambiguous code of practice for the diagnosis of death following loss of circulatory function that include

(a) the minimum monitoring requirements and
(b) the minimum period of observation required to confirm the permanent loss of circulatory and neurological function

These criteria must be independent of organ retrieval and in no way determined by the ischaemic tolerances of transplantable organs.

16 Clinical staff responsible for the diagnosis of death of a potential cDCD donor should have appro-

Recommendation	Grade	References
Centres supporting cDCD should have a clear and transparent policy for decision-making around withdrawal of life-sustaining treatments that are based upon and consistent with relevant national policies and guidelines. – -Palliative care/bereavement teams can contribute to standardizing quality end-of-life care practices in the DCD process and provide education for involved personnel.	B	[4–10]
National guidance notwithstanding, it is recommended that the decision to withdraw life-sustaining treatments should be a multidisciplinary or 'collegiate' one and that none of the clinicians making the decision should be involved in the subsequent coordination, retrieval or implantation of organs from that patient	D	[12]
National agencies should be aware of the risk of substitution of cDCD for DBD and provide clinicians with clear guidance on the care of patients in whom brain death is likely.	D	
National agencies should provide critical care staff with clear and applicable criteria for the identification and referral of potential donors, develop criteria for the acceptance of potential cDCD donors and implement processes to streamline key stages of the cDCD pathway.	D	
There is an ongoing need to improve the specificity and sensitivity of tools that predict the time interval from treatment withdrawal to asystole.	C	[20–23]
All healthcare professionals involved in the care of potential cDCD donors should have the appropriate knowledge and skills and should be supported by senior clinical staff	D	
Each country/jurisdiction should produce clear guidance on the lawfulness of ante-mortem interventions designed to maintain organ function and/or reduce warm ischaemia. In circumstances where ante-mortem interventions are used, retrieval and transplantation teams should continue to assess their effectiveness in promoting transplantation.	C	[25]
Each country/jurisdiction should issue guidance regarding location of treatment withdrawal and in doing so consider both the benefits to transplantation and also the impact upon the care given to the patient and their family.	D	
Each country/jurisdiction should provide clinicians who care for potential cDCD donors with clear guidance on how and where life-sustaining treatments are withdrawn.	C	[25,26]
Each country/jurisdiction should issue clear guidance regarding the role of the transplant team and transplant coordinators in cDCD pathway, mindful of the risks of any involvement in the end-of-life care of a potential DCD donor.	D	
Education of healthcare staff is essential as many are uncomfortable at the clinical interface between end-of-life care and organ donation.	D	
Healthcare professionals who are uncomfortable with controlled DCD may choose not to be involved in the care of such patients. However, there should be systems in place to ensure that this does not deny the opportunity for a suitable patient to donate his/her organs after their death in accordance with agreed local and national policies.	D	
Clinicians should be provided with clear criteria for the diagnosis and confirmation of death following circulatory arrest. These criteria should cover how asystole is recognized, and the minimum period of observation following the onset of asystole that must elapse before death can be confirmed. There should be no donation-related intervention during this 'no touch' period. (Published recommended observation periods range from 2 to 20 min; however, in most countries a period of 5 min is recommended).	B	[29–35]
Death should be regarded as a state in which a patient has permanently lost the capacity for consciousness and all brain-stem function, including respiration.	B	[28–32]
Clinical staff should be provided with a clear and unambiguous code of practice for the diagnosis of death following loss of circulatory function that include- The minimum monitoring requirements The minimum period of observation required to confirm the permanent loss of circulatory and neurological function These criteria must be independent of organ retrieval and in no way determined by the ischaemic tolerances of transplantable organs.	B	[29–32]
Clinical staff responsible for the diagnosis of death of a potential cDCD donor should have appropriate knowledge, skills and experience. A member of the coordination, retrieval or transplant team must never make the diagnosis of death.	D	
Controlled DCD organ retrieval protocols should recognize the potential risks around post-mortem interventions that might inadvertently restore cerebral perfusion	D	

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priate knowledge, skills and experience. The diagnosis of death must never be made by a member of the coordination, retrieval or transplant team.

17 Controlled DCD organ retrieval protocols should recognize the potential risks around post-mortem interventions that might inadvertently restore cerebral perfusion.

Non-proceeding cases

Not all donors will die within the time constraints put in place to minimize ischaemic injury to the organs, and it is vital that the necessary arrangements are in place to ensure that the dying patients continues to be treated with the dignity and respect when donation is stood down.

The family should be informed, as part of the consent process of the possibility that donation may not be possible.

There should be a clear plan for where further care will be delivered, particularly when the patients has been transferred from the critical care unit to the operating theatre prior to treatment withdrawal [40]

Final remarks

The potential for cDCD is likely to vary between countries, with the biggest determinant being the frequency with which decisions to withdraw the life-sustaining treatments of gravely ill patients are made. Experience in Belgium, the Netherlands, Spain and the United Kingdom indicates that cDCD can be successfully introduced into practice and that such programmes can make important contributions to deceased donor transplantation. It is of note that a controlled DCD programme has recently been launched in France and is actively being considered in Sweden [41]. Controlled DCD presents new challenges for both clinicians who care for potential donors and also retrieval and transplantation specialists. Successful implementation depends upon effective communication and planning as well as mutual respect and cooperation between these two professional groups.

When introducing cDCD into practice, it is best to begin in larger units with an audited potential for it. These will usually be regional neurosurgical centres. Whilst it may be desirable to have a fully described professional, ethical and legal framework for cDCD before such programmes are introduced, this may not always be possible. Furthermore, the experience gained with initial cases is invaluable when developing such national frameworks. In the United Kingdom, the key to overcoming many of the obstacles to controlled DCD has been the realization that donation should be part of the care that patients are offered when they die [12,42–45].

Funding

The authors have declared no funding.

Conflicts of interest

The authors declare no conflict of interest.

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