

# The rise and rise of donation after cardiac death: a solution to the shortfall in organs for transplantation?

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Rates of organ donation and transplantation in Australia have increased in recent years after implementation of a Commonwealth-funded national reform agenda, led by a newly formed Organ and Tissue Authority. In 2011 there were 337 deceased organ donors, an increase of 64% on the average number of 205 donors per year between 2000 and 2008 before the reform.<sup>1</sup>

This improvement has arisen from initiatives to increase donation through both the brain death and cardiac death pathways, with about 48% of the growth in donors over the 2 years from 2009 coming from donation after cardiac death (DCD). DCD has increased rapidly, with 86 such donors in 2011 and 77 in 2012 (equal to 26% of all deceased donors in 2011 and 22% in 2012), whereas before 2007, donation occurred almost exclusively after brain death.<sup>1</sup> In the same period since 2009, there has been a 22% increase in the number of donors after brain death (DBD) in Australia. This contrasts with the experience in the United Kingdom, where rising DCD has been accompanied by a proportionate decline in DBD.<sup>2</sup> Facilitating DCD earlier in severely brain injured individuals, rather than waiting for brain death with subsequent heart-beating donation, results in poorer donation and transplantation outcomes due to loss of the opportunity for heart donation and worse outcomes in recipients of livers from DCD donors.

In this edition of the Journal, Sampson et al<sup>3</sup> add further evidence that the practice of diverting patients who might develop brain death to donate earlier via the DCD pathway is not occurring to any significant extent in Australia. Analysis of ventilation hours shows that the duration of mechanical ventilation in brain dead donors has not fallen over the period of increasing DCD, and that patients donating via the DCD pathway had longer ventilation periods than brain dead donors. The contrary would be expected if patients with the potential for brain death were proceeding earlier to DCD donation.

There is likely to be considerable ability to expand the donor pool through greater uptake of DCD. In 2011 the rate of DCD varied across Australia, accounting for 21% of donors in Western Australia, 23% in South Australia, 27% in Queensland, 23% in New South Wales and 30% in Victoria, suggesting some unrealised potential in at least some states.<sup>1</sup>

For DCD to be feasible, death generally needs to occur within 90 minutes of extubation, and shorter time frames

are required for successful liver transplantation, because of warm ischaemia causing organ damage. When embarking on withdrawal of treatment in patients with irrecoverable illness, predicting if death will occur within the time frames required for donation and successful transplantation may be difficult.<sup>4</sup> In about 20% of planned DCD cases the full donation workup and mobilisation of surgical retrieval services occurs without donation proceeding to organ procurement because the patient dies beyond the necessary time frame.

One of the Organ and Tissue Authority national reform initiatives is for hospital deaths to be reviewed so as to identify all potential donor cases. This is undertaken in 74 Australian hospitals with embedded donation specialist staff. These audits indicate that there is a very low rate of failure to identify and offer donation in patients with brain death. Identifying missed opportunities for DCD through retrospective audit is possible by looking at the time to death of patients who may have been suitable potential DCD donors and who underwent withdrawal of treatment. Preliminary data suggest that there is considerable potential to expand this pool of donors.

Opportunities for DCD may be overlooked by clinicians due to suitable patients having different characteristics to potential brain dead donors. Stroke and trauma predominate as causes of death in brain dead donors, whereas hypoxic-ischaemic brain injury is common in patients donating after cardiac death. Donation is also possible in patients without a neurological injury, and in Australia DCD has occurred after irreversible heart, lung and liver failure, and isolated high spinal cord trauma.

At times, clinicians consider donation not feasible, believing that the patient will die beyond the time frames required for DCD, only to find that the patient dies quickly after extubation. This can be particularly distressing for families who have indicated a high level of support for donation. Developing better means to accurately predict time to death is desirable, although this may prove difficult.

Pursuing DCD in a broader range of patients, including those in whom it is uncertain whether death will occur quickly, is likely to result in a lower conversion of planned to actual donation. Surgical retrieval teams are currently stretched by the high rates of donation activity, with many of the same clinicians participating in the ensuing transplant surgery. Existing services accommodate and accept

the current 20% of planned DCD cases that do not proceed. Sufficient resourcing and planning of surgical retrieval and other downstream transplantation services is required if DCD is to be offered in a broader cohort of patients.

The main beneficiaries of DCD have been kidney and lung recipients, with outcomes similar for kidney and possibly superior for lung transplantation compared with organs derived from brain dead donors. Liver transplants performed using organs from DCD donors have been restricted due to concern about the higher incidence of primary graft non-function and ischaemic cholangiopathy.<sup>5</sup> Little advance has been made in utilising hearts for transplantation from DCD donors. Three successful paediatric heart transplantation procedures from DCD donors occurred between 2004 and 2007 at a single United States paediatric centre.<sup>6</sup> The adequacy of the relatively brief time of 75 seconds from cessation of circulation to the declaration of death and initiation of organ retrieval procedures in two of the donors was a focus for debate.<sup>7</sup> Also questioned is the ability to transplant the heart after cardiac death, suggesting that this may defy the dead donor rule.<sup>8</sup> The non sequitur of heart donation and transplantation after cardiac death is resolved with the use of the more precise terminology “donation after circulatory death”. This terminology accurately reflects the legal requirement for death determination, which is “irreversible cessation of the circulation” and not the heart per se.

Machine perfusion technologies, which have gained routine use after kidney donation in some countries, have the potential to broaden the usability of organs in the setting of DCD, including organs from extended criteria donors and also possibly the heart and liver.<sup>9,10,11</sup> The ability to functionally assess organs ex vivo, particularly in the setting of prolonged warm ischaemia, before committing to transplantation may provide the means in which sufficient confidence is attained, leading to improved organ utilisation from DCD donors.

Also gaining greater acceptance among clinicians is DCD itself,<sup>12</sup> and this has been aided by robust national guiding documents.<sup>13,14</sup> Initial concerns about the process have largely disappeared as clinicians have gained direct experience. One of the early apprehensions was that families may have difficulty accepting the DCD process. Those involved in organ donation report that DCD is generally well accepted and may be more in keeping with families’ prior notions of donation than that occurring after brain death.

Implementation of DCD in Australia is still in its early stages but has already contributed to substantial improvements in transplantation outcomes. There are likely to be additional individuals suitable to donate through this path-

way, although optimising DCD as an outcome requires improved potential donor recognition and adequate resourcing of donation, retrieval and transplant services. Ex-vivo perfusion techniques may increase the utility of marginal organs including the heart and liver from individuals donating via this pathway.

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