**Dr Wood:** Just as a follow-up, you have been able to increase your percentage of DCD donors as a part of your donor pool to approximately 25%. Where do you see this going in the next three to five years in your own group as you consider expanding on your experience? What percent do you think are actually going to become DCD rather than DBD donors?

**Dr Zych:** Looking at our progress, we started from around 10–12% increasing to our most recent percentage of 25%. What the dynamics of the process will be, I cannot predict. But as we know from one of the most recent publications from the Groningen group, almost 40–50% of their donations are DCD. Looking at the results, which are good, I think that the trend will be towards a higher percentage.

**Dr L. Hamilton (Newcastle-upon-Tyne, UK):** We too have an active DCD program, and I thank you for your very important clinical message that these lungs are just as good as DBD donors. But I would like to raise an ethical rather than a clinical question with you. The definition of ‘death’ continues to be controversial. In fact, the President’s group in the States recently produced a 167-page document dealing with the controversies, and that is 40 years after the Harvard group first defined brain death. In your presentation, you referred to DCD as donation after cardiac death and, in fact, there have been some reports in the literature of heart transplants from DCD donors, so clearly the heart is not dead. Do you think the public have concerns about DCD donation, and what can we as professionals to allay those concerns?

**Dr Zych:** I am not an expert in ethics, and whatever I say is just what I think. As we know, there is the very difficult process of discussing all the issues about the donation with the family. Everything is discussed with the family; it is carried out in accordance with the law. The donor after cardiac death is a donor who has been certified dead. If somebody expressed the wish, the family or the patient who is in an organ donor registry, that he might be an organ donor after death, I think that we are correct. Of course, I cannot tell you I am right because it is a very sensitive, delicate matter. As we know, donation after cardiac death is not legal in all countries. We in the UK cannot use heparin in the donors which is a common practice in other countries. We are not using heparin. We are not pre-treating the donors. We are not interfering at all with the ICU management. And our results, in fact the Royal Brompton and Harefield results, are very similar to American results which is very promising, and I think we should be satisfied.

**Dr Hamilton:** In using the term ‘DCD’, we should perhaps refer to donation after circulatory death. It might be easier to reassure/convince the public.

**Dr Zych:** Yes, I agree.

**Dr G. Gerosa (Padova, Italy):** A very quick question. When you are referring to ex vivo perfusion, are you referring to the TransMedics OCS, organ care system? If not, do you think that the OCS can play a role in DCD?

**Dr Zych:** I think yes. Nowadays we are using a different system, not OCS. I think that the advantage with using OCS is that it is a portable machine, very small. You can, in fact, put the lungs into OCS at the donor site, and the cold ischaemia is limited to a few minutes. But we have not used it yet. I wonder whether perhaps it will be possible in the future. Now we are using a different system based in the hospital, not a mobile one.

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**EDITORIAL COMMENT**

**Donation after circulatory death: an important expansion of donor organs for lung transplant patients**

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Donation after circulatory death (DCD) offers a large cohort of new potential lung donors and the possibility of decreasing the waiting list deaths that are the tragic consequence of limited brain death donors (BDDs). Zych et al. [1] have provided an impressive description of a DCD programme at their institution, and their initial and mid-term results. The authors should be congratulated for their report on expanding the donor pool for their end-stage lung disease patients. They demonstrated survival outcomes and incidence of acute chronic rejection that were comparable between the DCD and BDD lungs. However, it is important to note that upon arrival in the ICU the P:F ratios tended to be worse among DCD recipients and the incidence of grade III primary graft dysfunction twice as high. These trends did not reach a statistical significance; however, with a larger sample size, these differences likely would have indeed been significant. Likewise, the incidence of postoperative ECMO support was three times higher among DCD lung recipients. This is despite the fact that the donor PaO₂ levels were significantly higher in the DCD group prior to procurement. Primary graft dysfunction has been shown previously to be associated with a higher incidence of airway complications. The methods by which airway complications were identified and treated is not described in detail, but the incidence of airway complications, while low, is two times higher in the DCD group compared with the BDD group. Therefore, although donation after circulatory death is a meaningful and important source of allograft lungs, the enthusiasm for their use should be qualified and the strategies for their proper utilization need to be well considered.

The authors have stated that an hour of warm ischaemic time is acceptable. However, the literature that they cite to support this is based on dog and rabbit studies alone. At a UNOS-sponsored consensus conference convened in North America to
identify best practices, it was consistently stated that limiting this period of warm atelectatic ischaemia to an absolute minimum is critically important [2]. The authors’ experience may have been able to shorten this ischaemic time if the DCD donors were brought to the operating theatre prior to the declaration of circulatory death. In the USA, the DCD donor pool is almost exclusively composed of Maastricht category III donors. This is also the case in the Royal Brompton and Harefield experience. While the deleterious neurohemoral effects of brain death are not present in the DCD donor population, other hazards exist. Haemodynamic instability prior to procurement is one of the strongest risk factors for the development of primary graft dysfunction. Even in a relatively controlled experience with Maastricht category III donors, caution should be exercised before categorically embracing these donors in an unqualified fashion.

The use of \textit{ex vivo} lung perfusion will play a major role in lung transplantation in the near future. With an abundance of marginal lungs that can be resuscitated and assessed, there is broad potential in the DCD population. This is perhaps where utilization can be extended to other Maastricht category donors. Indeed, the Toronto group cites that their current practice involves \textit{ex vivo} perfusion and assessment for the majority of their DCD donor lungs [3]. Even in this instance, dysfunction is not always reversible and a significant discard rate persists. This would suggest that the authors of the current study are quite fortunate to have experienced the results that they did, but they might not be readily reproducible in other centres. Their incidence of primary graft dysfunction and need for ECMO support attest to the fact that these lungs are indeed injured before implantation.

Early experience from the University of Wisconsin and Washington University attest to the successful utilization of DCD lungs [4, 5], but outcomes fell short of those experienced with BDD organs. Perhaps, this related to a tendency to use these non-conventional donor organs for recipients too sick to survive additional time on the wait list or those that might not otherwise qualify for standard donor lungs. The combination of an inflamed lung and an impaired recipient would be expected to produce suboptimal results. More recently, a published experience in North America has suggested that, with the appropriate strategies, equivalent functional and survival outcomes can be achieved with DCD and BDD lungs [5]. The authors used DCD and BDD donor lungs more interchangeably and the recipient characteristics were well matched in the two groups. This may help explain why their results appear to be generally better than has been reported in some earlier experiences and consistent with the outcomes published over the last several years.

The contribution from Zych et al. is important. They have experienced success and added support to the notion that DCD donors can provide a safe and meaningful source of donor organs. The most appropriate utilization remains to be defined, however. Almost certainly, the intelligent use of DCD lungs will involve aggressive efforts to limit the period of warm and atelectatic ischaemia and a consistent use of \textit{ex vivo} lung perfusion for resuscitation and assessment prior to implantation.

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\textbf{REFERENCES}