Editorial

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DCD donors: A unique source to significantly increase organ donation

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Donation after cardiac death (DCD) represents a unique source to significantly increase organ donation.

Organ donations after cardiac death (DCD) are a potential donor source that for years have caused great controversy due to a higher rate of complications that result in a decreased survival rate [1]. Nevertheless, from the time the first articles were published, in which the possibility of using these potential donors was broached, up to the present date, the use of organs from this source has increased progressively [2] and, at present, in this author's view, offer the best chance for objectively increasing the number of donors, in a setting in which the lack of organs for all of the patients in need of a liver graft is the norm.

A number of aspects should be underlined, some of which have been noted in the article by Jay *et al.* in this issue of the *Journal*.

Differences between donor types

Not all DCD are equal. In our view, there are two main categories that are representative of two distinctly different types.

Maastricht category III donors [3] are patients in the ICU for whom the decision is made to withdraw life-support treatment and for whom cardiac arrest is expected. These are donors whose stay in the ICU has been lengthy, who have typically been fed parenterally and who have undergone some sort of aggressive treatment whether it is surgery or multiple antibiotic treatments. They are therefore classified as marginal or extended criteria donors (ECD).

Then, there are Maastricht category II donors, who are people who have undergone attempts at advanced cardiopulmonary resuscitation that have proved unsuccessful [3]. These donors present a totally different situation in which sudden death is associated with failed lifesaving measures that put a person into a position to donate, and in which long stays in the ICU are rare and the risk of infection is highly unlikely [4,5]. Therefore, at first sight, these donors may be considered to be of reasonable quality.

Differences in the types of procedures for obtaining organs

The handling of the donor throughout the organ retrieval process is a primary concern, as an effort must be made to limit ischemic injuries associated with cardiac arrest [6,7]. Globally, there is an absence of any type of measures insofar as category III (controlled) donors are concerned. Cardiac arrest is expected and if it exceeds 30 min, most groups do not proceed with the removal. In this sense, it is important to point out that long before cardiac arrest happens, there is a total lack of arterial and portal blood flow through the liver [8]. Only the Michigan group associates the use of an extracorporeal membrane oxygenation machine (ECMO) with the whole retrieval procedure in an effort to reduce or reverse some of the injuries that happen during this warm ischemia time. Their results show that the use of this device improves the quality of the organs and increases the potential donor pool by 33% [9]. Even so, the number of ischemic-type biliary lesions associated with this type of donation is high and is the most frequent cause for graft loss and re-transplantation.

As far as Maastricht category II donors are concerned, worldwide they represent a minority of all cases and the most important aspect in which they are involved, the development of procedures that allow the body to be preserved after death, has been confirmed through the systematic use of ECMO at 37 °C (Normothermic Recirculation, NR) [4]. Though small to date, experience confirms that it is possible to use these organs safely and suggests that the incidence of ischemic-type biliary lesions can be substantially reduced [5].

Normothermic Extracorporeal Machine Oxygenator (NECMO), therefore, becomes a system that, when used after cardiac arrest (both in category II and category III donors), is able to reduce and even reverse injuries that occur during the warm ischemia time. It eliminates the sense of urgency, allowing the removal of organs to be carried out safely. Some groups have suggested the use of substances during this period, to keep the vascular bed intact and thus avoid ischemic injury to the biliary tract [10].

Difference in results

There is no doubt, as the authors of this study confirm, that in the present circumstances DCD is associated with lower chances of survival and a higher rate of re-transplantation. However, as the authors show, the survival rate for re-transplants is the same whether the initial graft came from a DCD or a DBD. Nonetheless, there is no question that this practice has proved to be very

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efficient and has allowed the number of patients who receive transplants to increase. That said, both types of DCD (category II and III) are associated with very low efficiency, i.e. the whole procedure for organ retrieval is often aborted due to suspicions about the quality of the graft [5]. This makes obvious the need for improving the conditions surrounding organ retrieval, in order to improve the quality of the organs harvested. This means using some sort of device to keep the organs functioning after removal [11–13]. Perfusion machines are nothing new, but until now their clinical application has been negligible.

There is not yet much clinical experience. Only the Guarrera group has used *ex situ* hypothermic machine perfusion on occasion, on grafts that were a priori marginal, and which showed its usefulness. The authors [14] suggest that hypothermic machine perfusion preservation significantly reduces pro-inflammatory cytokine expression when compared with cold storage. Two recently published experimental studies highlight the importance of *ex situ* normothermic perfusion (37 °C) in improving DCD graft quality. The Oxford group designed a perfusion machine capable of keeping the organ (after a 60 min cardiac arrest) for 20 h and achieving a survival rate of nearly 90% after transplantation [12]. Our group has also been able to verify the efficiency of *ex situ* normothermic perfusion after 90 min of cardiac arrest and the use of NECMO during the procedure to obtain the liver graft. In the first place, this experimental study underlines the importance of using NECMO during the procedure to retrieve organs from DCD donors, thereby confirming all the previous data, and secondly, that the chance of organ recovery, following 4 h of *ex situ* normothermic machine perfusion (37 °C), allows the achievement of a 100% post-transplant survival rate [13].

To summarize, DCDs are a unique source that could produce a significant increase in organ donation. Nevertheless, and according to the authors of the paper published here, the present results could be improved. In our opinion, mechanisms should be added during (NECMO) and after the procedure to obtain the graft (Hypo or Normothermic Machine Perfusion), which would clearly improve two aspects: the overall efficiency of the organ retrieval and assurance as to the quality of the organ, by preventing ischemic complications such as cholangiopathy.

Conflict of interest

The author declared that he does not have anything to disclose regarding funding or conflict of interest with respect to this manuscript.

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