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Ethical Decision Diagrams on Donation After Cardiocirculatory Death Heart Transplantation Considering Organ Preservation Techniques

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Background. To overcome organ shortage, some centers accept hearts from cardiocirculatory determined death (DCD) donors for heart transplantation (HTx). DCD-HTx is attached with special ethical conflicts on the donor, family, and recipient side. Ethically motivated decisions also have to be made considering organ preservation techniques. However, ethical decision diagrams, which can be applied to find a final answer on the complex field of ethical questions, have not been developed yet. **Methods.** In an interdisciplinary group of clinical ethicists, transplantation surgeons, transplantation researchers, and perfusionists, after review of relevant literature, we focused on crucial ethical aspects on DCD-HTx in general and separated ethical conflicts with regard to the individual perspective of the donor, family, and recipient. **Results.** The leading aspect of discussion in the donor perspective mainly deals with the standoff period and with the definition of death. The perspective of recipients focuses on the wish to say farewell after the patient is deceased. In the recipient perspective ethical questions regarding organ procurement techniques occur. **Conclusions.** Ethical decision-making on DCD-HTx is complex, but it can be processed in a structured way by applying the decision diagrams that we have developed.

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INTRODUCTION

Heart transplantation (HTx) is an effective therapy for end-stage heart failure. However, the quantity of HTx is limited by the organ shortage.¹ To overcome this major problem, some centers have extended their acceptance criteria for

organ donors from classical brain-dead donors to marginal donors. Within this population, in some countries organs from nonheart beating donors are accepted for donation after cardiocirculatory-determined death (DCD).²

First clinical reports from centers show promising results from HTx after DCD that are comparable in a short-term follow-up study with HTx after donation after brain death (DBD).³ Nevertheless, DCD-HTx is involved in other ethical conflicts than DBD. These ethical conflicts exist not only on the donor side but also on the relatives and recipient side and have not yet been meticulously depicted. From a surgical and juridical point of view on HTx, the perspective of the recipient is not included in the process of organ source selection and preservation. But transplantation from nonheart beating donors is still in an experimental stage and from a humanistic point of view, it must be discussed whether in the special case of HTx, the recipient perspective should be regarded as well. Also, the impact of procurement and preservation on ethically motivated decisions has not yet been reviewed. Assuming, that all 3 perspectives might be considered to find a final answer on the complex field of ethical questions, we have developed 3 general decision diagrams.

CLASSIFICATION OF CARDIOCIRCULATORY DETERMINED DEATH ORGAN DONORS

Circulatory death donors were classified the first time in 1995 by the Maastricht categories.⁴ Only category III, called “awaiting cardiac arrest,” is clinically applied for HTx. In this donor population, circulatory death occurs after withdrawal

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of life-sustaining therapy, mainly mechanical ventilation, after doctors agree that further treatment is not in the best interest of the patient anymore.^{3,5}

When cardiocirculatory death occurs after withdrawal of life-sustaining therapy, warm ischemia time (WIT) and standoff period begin. The standoff period was determined as the time until a clinical status of death is reached. The White Paper By The President’s Council On Bioethics about controversies in the determination of death, as well as other publications states that the duration of the standoff period is defined by the irreversibility of death.⁶ Depending on the country, irreversibility of death is either defined by circulatory criteria or by brain death criteria.^{7,8} In case of circulatory criteria, irreversibility of death is defined as a status when autoresuscitation of the heart will not occur due to a specific time of warm ischemia after circulatory arrest.⁶ Nevertheless, the standoff period has been part of a controversy for years and decades and still appears variably with around 2–5 minutes in the United States and Australia, 5 minutes in United Kingdom, and 20 minutes in Italy.⁹⁻¹² As a consequence of these heterogenic institutional regulations, quality of the DCD-cardiac allograft, which is highly vulnerable to the duration of warm ischemia, varies. Besides the controversy about the duration of the standoff period, the definition of the onset of that period was also highly discussed, based on mechanical and electric criteria. A systolic blood pre-ssure below 50 mm Hg, arterial pulselessness, or electrical silence were under discussion to serve as the onset of the standoff period.¹³ At least a consensus was found for the onset of the standoff period, defined as the occurrence of mechanical asystole.^{14,15} An international consensus for the duration of the standoff period still needs to be found.⁷

ORGAN PRESERVATION TECHNIQUES

Three major techniques are applied for preserving the DCD-heart during transportation: (1) direct procurement and perfusion (DPP); (2) normothermic regional perfusion

(NRP) followed by cold static storage (CSS); and (3) NRP followed by ex vivo machine perfusion (EVMP).¹ A fourth option, which is rarely practiced, is direct procurement (DP) followed by CSS. In DPP, the heart of the deceased donor is explanted and resuscitated in the EVMP device with warm donor blood.¹¹ While beating within this device, the heart is transported to the transplantation center. In NRP, circulation in the donor is restored by venoarterial extracorporeal membrane oxygenation or cardiopulmonary bypass. During restoration of circulation, reperfusion of the brain is prevented by clamping the aortic arch vessels.⁵ This technique allows evaluation of functional parameters of the donor heart. Following this, the heart is preserved either the traditional way by CSS or by EVMP.³

DECISION-MAKING CHANNELS

Donor Perspective

The donor perspective can either be used to reflect the potential perspective of an organ donor on DCD or it can be applied as a guidance for a human being to decide, whether he or she can accept becoming a DCD-donor 1 day (Figure 1).

The first question to answer is if consent or definite refusal for organ donation, in particular heart donation, exists. In Europe, a presumed consent solution is established in many countries, assuming that everybody who did not explicitly disagree to become an organ donor, agrees to serve as a possible organ source for transplantation 1 day.¹⁶⁻¹⁸ Whether DCD is ethically justified or not is decided by higher instances instead of by the individual patient. But as DCD still is part of an ethical controversy in many countries all over the world, it should be taken into consideration if the potential donor could have had the wish that death should be diagnosed by neurologic criteria. Only when brain death should not be diagnosed after occurrence of circulatory death, DCD-HTx is possible. Otherwise the standoff period must be drastically enlarged until brain death is ensured. As a consequence, the ischemic injury of the heart would eliminate the option for a successful transplantation.

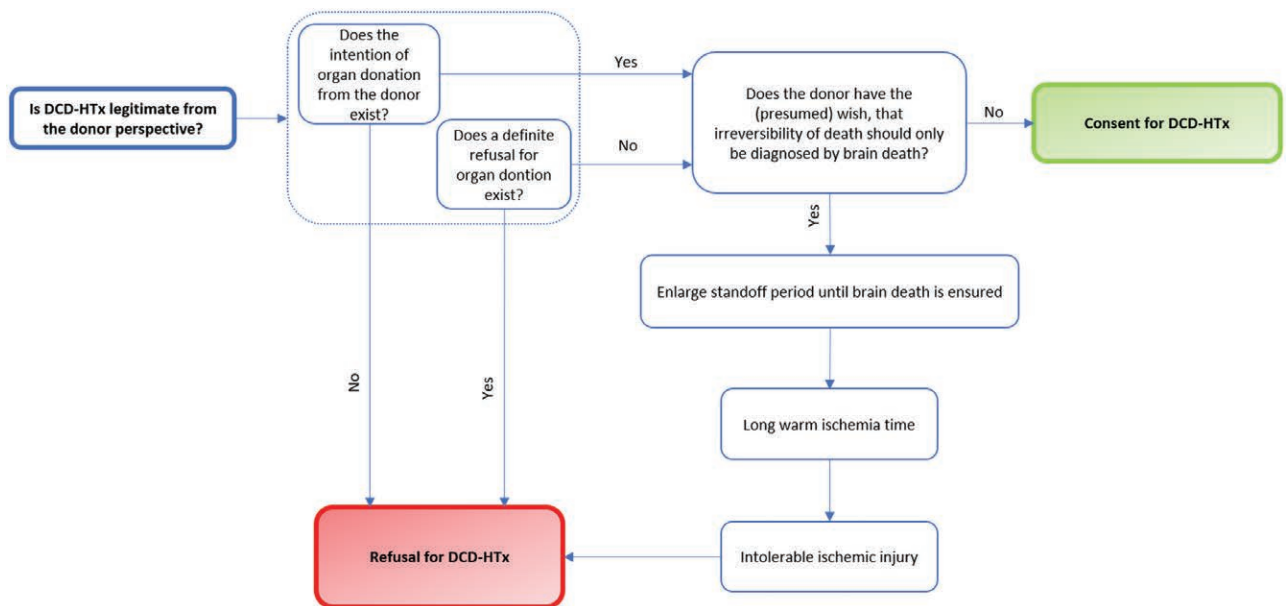


FIGURE 1. Donor perspective. DCD-HTx, heart transplantation from donation after cardiocirculatory death.

Some might still question the proposition, that the assumed individual decision of the patient regarding the preference of circulatory versus neurologic criteria for determination of death has to be respected. In this case, it should be pointed out that in every country where DCD is officially accepted, a DCD-HTx would probably not be performed if it is known that the patient actively disagreed during his or her lifetime to become a DCD-donor.

This decision diagram can also be used to provide guidance to a human being who individually ponders to serve as an organ donor if future circumstances may terminate life. As already mentioned, even in countries where DCD is accepted, some people might not be willing to serve as a DCD-donor but feel comfortable with becoming a DBD donor. As saving the body integrity and respecting the wish of the patient is of high priority, this will probably be considered as relevant also in DCD-transplantation areas.

Family Perspective

Again, initial questions regarding the general consent or refusal on organ donation which the patient might have directly or indirectly expressed during his or her lifetime must be answered (Figure 2). Often the closest relatives of a beloved one are somehow involved in end-of-life care or at least have the chance to say farewell. Saying farewell after the patient is deceased is difficult to perform, as WIT should be kept short to prevent organs from excessive ischemic damage. Complying with the wish of giving more time for saying farewell to the deceased than the country-specific standoff period provides will likely result in an intolerably long WIT.

Recipient Perspective

The different procurement as well as preservation techniques play a major role in the recipient perspective (Figure 3). In case of NRP, preservation is secondary considering ethics, but the artificial reperfusion process even when cerebral circulation is excluded must be legitimated as well. NRP was also part of a separate discussion within the ethical justification of DCD-HTx.¹⁹ NRP requires cannulation for venoarterial extracorporeal membrane oxygenation. Cannula placement pre-mortem was highly criticized to harm body integrity of the patient, as it is not part of the original therapy and consequently not in the best interest of the patient.²⁰ Prevention of cardiac circulation next to prevention of brain circulation by an intraaortic occlusion balloon or aortic clamp to fully avoid a resuscitative stage was also discussed in other fields of transplantation than HTx.²¹ A specific informed consent to address postmortem ECMO reperfusion of the donor was also demanded by some authors.²⁰ If the recipient prefers to avoid NRP because of ethical reasons, DP must be performed. Although rarely applied, DP followed by CSS would inhibit the option of functional assessment of the DCD-cardiac allograft. In DPP, instead of full functional evaluation the metabolic state can be assessed by lactate as a surrogate parameter. If NRP, which is the only technique for direct functional assessment, is refused, DPP would be the method of choice. Otherwise, the option for receiving a DCD-heart would have to be refused totally.

CONCLUSION

DCD-HTx is an option to react to the organ shortage. Nevertheless, it is associated with specific ethical concerns

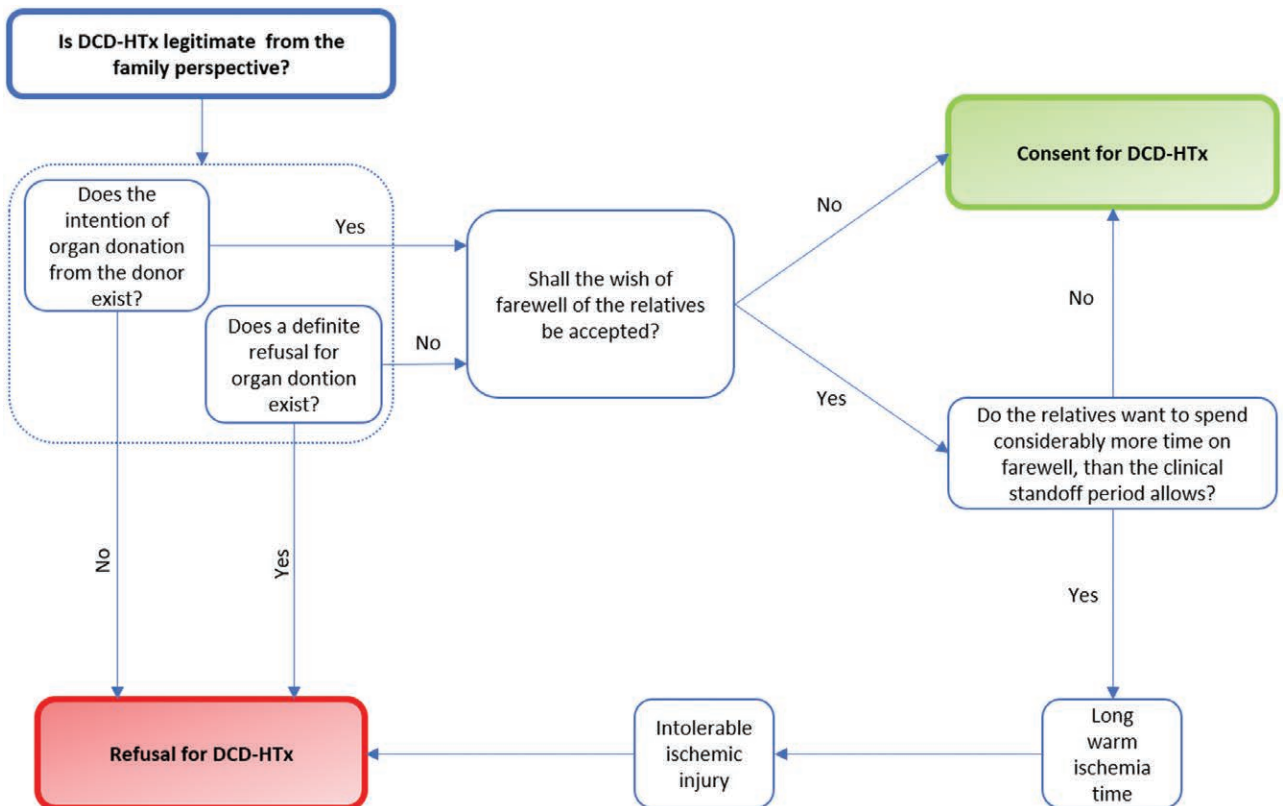


FIGURE 2. Family perspective. DCD-HTx, heart transplantation from donation after cardiocirculatory death.

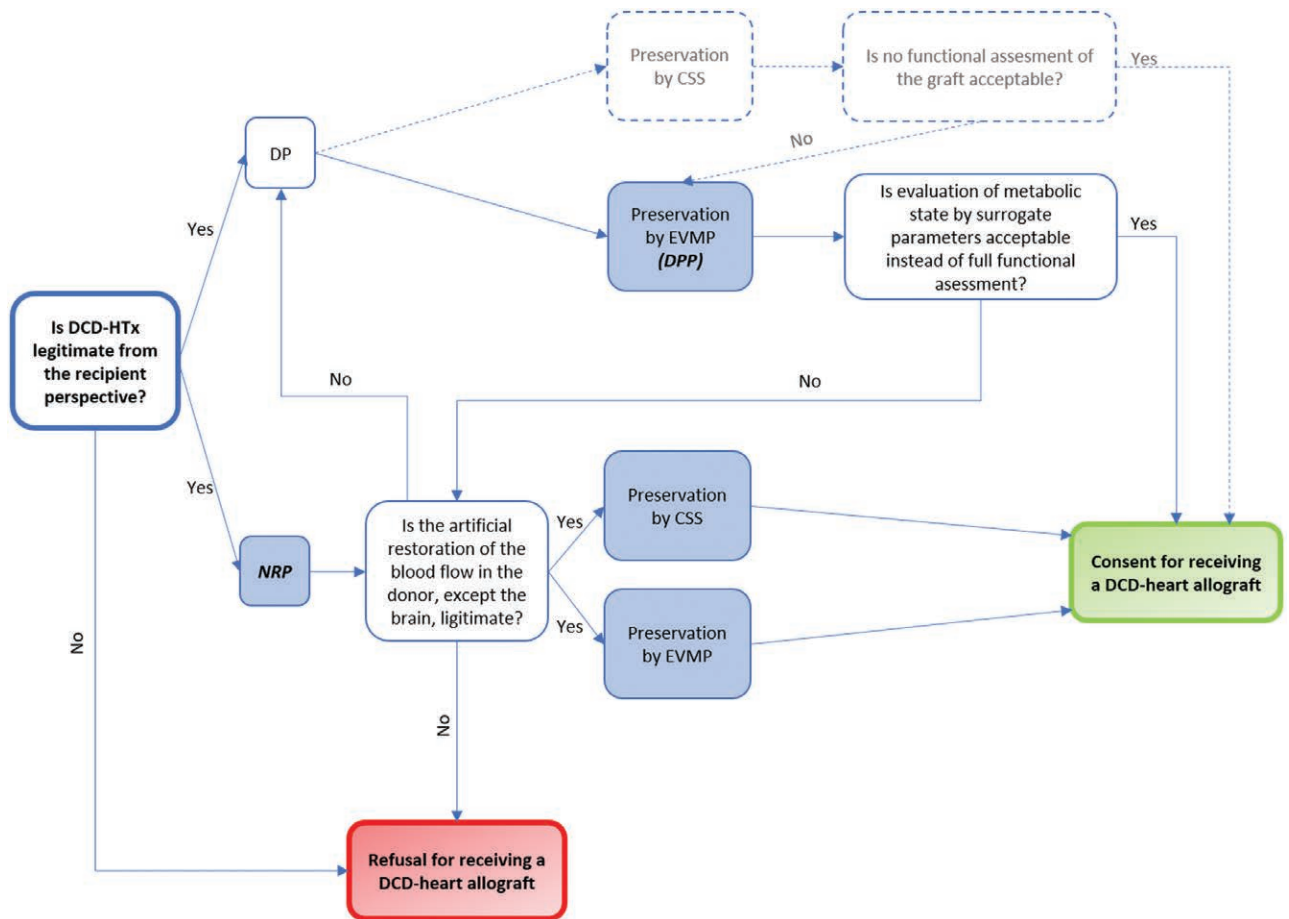


FIGURE 3. Recipient perspective. DP following CSS is technically possible but usually not applied and therefore, grayed out and dashed. CSS, cold static storage; DCD, donation after cardiocirculatory death; DCD-HTx, heart transplantation from donation after cardiocirculatory death; DP, direct procurement; DPP, direct procurement and perfusion; EVMP, ex vivo machine perfusion; NRP, normothermic regional perfusion.

on the donor, relatives, and recipient side that are difficult to be comprehensively addressed. These ethical concerns can be followed in a structured way by applying the decision diagrams presented in this work. Whether DCD-HTx should be adopted or not and if all 3 perspectives should be included to generate a final decision will depend on specific attitudes toward moral and ethics within a population.

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REFERENCES

- Page A, Messer S, Large SR. Heart transplantation from donation after circulatory determined death. *Ann Cardiothorac Surg.* 2018;7:75–81.
- Macdonald P, Dhital K. Heart transplantation from donation-after-circulatory-death (DCD) donors: back to the future-evolving trends in heart transplantation from DCD donors. *J Heart Lung Transplant.* 2019;38:599–600.
- Messer S, Page A, Axell R, et al. Outcome after heart transplantation from donation after circulatory-determined death donors. *J Heart Lung Transplant.* 2017;36:1311–1318.
- Kootstra G, Daemen JH, Oomen AP. Categories of nonheart-beating donors. *Transplant Proc.* 1995;27:2893–2894.
- Messer S, Page A, Colah S, et al. Human heart transplantation from donation after circulatory-determined death donors using normothermic regional perfusion and cold storage. *J Heart Lung Transplant.* 2018;37:865–869.
- Veatch RM. Donating hearts after cardiac death—reversing the irreversible. *N Engl J Med.* 2008;359:672–673.
- Gardiner D, Shemie S, Manara A, et al. International perspective on the diagnosis of death. *Br J Anaesth.* 2012;108(Suppl 1):i14–i28.
- Truong RD, Miller FG. The dead donor rule and organ transplantation. *N Engl J Med.* 2008;359:674–675.
- Thuong M, Ruiz A, Evrard P, et al. New classification of donation after circulatory death donors definitions and terminology. *Transpl Int.* 2016;29:749–759.
- Academy of Medical Royal Colleges. A code of practice for the diagnosis and confirmation of death. Available at http://www.aomrc.org.uk/wp-content/uploads/2016/04/Code_Practice_Confirmation_Diagnosis_Death_1008-4.pdf. Accessed March 9, 2020.
- Dhital KK, Iyer A, Connellan M, et al. Adult heart transplantation with distant procurement and ex-vivo preservation of donor hearts after circulatory death: a case series. *Lancet.* 2015;385:2585–2591.
- Curfman GD, Morrissey S, Drazen JM. Cardiac transplantation in infants. *N Engl J Med.* 2008;359:749–750.
- Pavey WA, Ho KM. Late, transient return of pulsatility: should we change donation after circulatory death protocols? *Anaesth Intensive Care.* 2018;46:357–359.
- White CW, Messer SJ, Large SR, et al. Transplantation of hearts donated after circulatory death. *Front Cardiovasc Med.* 2018;5:8.
- Dalle Ave AL, Bernat JL. Uncontrolled donation after circulatory determination of death: a systematic ethical analysis. *J Intensive Care Med.* 2018;33:624–634.
- Shepherd L, O'Carroll RE, Ferguson E. An international comparison of deceased and living organ donation/transplant rates in opt-in and opt-out systems: a panel study. *BMC Med.* 2014;12:131.

17. Janssens U, Michels G, Karagiannidis C, et al. Widerspruchslösung bei der Organspende? *Med Klin Intensivmed Notfmed.* 2020;115:239–244.
18. Abouna GM. Organ shortage crisis: problems and possible solutions. *Transplant Proc.* 2008;40:34–38.
19. Large S, Tsui S, Messer S. Clinical and ethical challenges in heart transplantation from donation after circulatory determined death donors. *Curr Opin Organ Transplant.* 2017;22:251–259.
20. Dalle Ave AL, Shaw DM, Bernat JL. Ethical issues in the use of extracorporeal membrane oxygenation in controlled donation after circulatory determination of death. *Am J Transplant.* 2016;16:2293–2299.
21. Gries CJ, White DB, Truog RD, et al. An official American Thoracic Society/International Society for Heart and Lung Transplantation/Society of Critical Care Medicine/Association of Organ and Procurement Organizations/United Network of Organ Sharing statement: ethical and policy considerations in organ donation after circulatory determination of death. *Am J Respir Crit Care Med.* 2013;188:103–109.