

Thoraco-abdominal Normothermic Regional Perfusion (TA-NRP) Resuscitates Moral Doubts about Donation after Circulatory Death (DCD)

Modern transplant medicine continues to innovate techniques that Catholic health care can adopt as more effective ways to honor the charity of those donating their vital organs upon death. Yet by creatively extending principles from accepted techniques into controversial territory, transplant innovations can also reveal that those previously accepted procedures themselves were adopted on less than morally sure grounds. Thoraco-abdominal normothermic regional perfusion (TA-NRP) is an innovation for improved heart transplantation that promises to increase the number and quality of heart transplants in a cost-effect manner and already in practice in Europe and the United States.¹ It extends the principles of donation after circulatory determination of death (DCD), itself an innovation that has grown more than ten-fold in two decades.² In the last five years, the number of DCD heart transplants has exploded from only 7 in 2019 to 612 in 2023, many of these likely done by TA-NRP.³ This new procedure has not been without controversy in the general medical literature and now in Catholic bioethics in particular.⁴

Certain features of TA-NRP, raise the question of whether DCD donors are actually dead when their vital organs are explanted. Arguments in favor of TA-NRP often avoid this question by a legalistic focus on the co-validity of the neurological and the circulatory-respiratory criteria for declaring death in federal and state law. If the patient is legally dead, so it goes, the patient just is dead. In opposition, if DCD and TA-NRP patients are not known with strict moral certainty to be dead after five-minute waiting periods after asystole, then Catholic health care should reject both TA-NRP and DCD donation. Instead, physicians, mission leaders, ethicists, and bishops should reassess every non-brain-death donation technique that involves a waiting period from asystole to vital organ harvesting of less than twenty minutes. I fall among those who hold that DCD and TA-NRP are continuous in principle, but that therefore both are evil as currently practiced. Ironically, I am in a sense closer in argument to those who hold both are permissible and furthest from those who accept DCD but reject TA-NRP.⁵

TA-NRP is best described as a modification of a controlled DCD procedure. Common to both transplantation techniques is the removal of life support from a critically injured donor whose death is ethically accepted. Asystole occurs, then a “hands-off period” of five minutes, and next a declaration of death by the circulatory-respiratory criteria by the attending physician.⁶ Only then does the transplant team initiate organ explantation. Where TA-NRP differs from cDCD is in the transplant team’s actions to improve heart transplantation following access to the thoracic cavity: the team resuscitates the donor’s heart in situ by canulation and ECMO, perfusing the heart with warm, oxygenated blood (“normothermic”), both to reduce damage from warm ischemia and also to assess heart function. This perfusion is kept “regional,” however, by the ligation of the cervical vessels which could carry blood to the donor’s brain, typically by clamping or exposing the vessels to atmosphere. The intention is to avoid the resuscitation of brain function. Proponents differ in their explanation of the necessity of this step. Some argue that the patient is legally dead by virtue of irreversible loss of respiratory-circulatory function, so allowing general circulation would negate the basis of the declaration of death. Other speak of “switching the patient over” to the brain death criterion, the loss of brain function now made irreversible by occluding circulation, in order to restore legally the circulatory function of the heart. Yet others speak of ensuring that the donor, legally dead, may not experience any pain from the process of organ retrieval. Apart from a shared concern to fulfill at least one legal criterion for death, these justifications are contradictory with each other and even with themselves. The donor is dead, yet the transplant team must do

something to protect the donor from becoming undead in some way.⁷

We can at least say that TA-NRP by design eliminates the risk of resuscitating the donor’s brain function, but by this very aspect the procedure reveals that no moral certitude exists that the donors are dead when the typical five-minute or less waiting period after asystole is observed. Rather, the fact that their brain functions can be resuscitated technically raises a genuine doubt that they have experienced the definitive separation of body and soul required in any Catholic account of death. This lack of moral certainty with a mere five-minute waiting period that the donor is dead before vital organ explantation proves that both TA-NRP and cDCD are morally unacceptable. St. John Paul II came to accept vital organ donation in cases of brain death only if the neurological criteria gave strict moral certainty that the donor was in fact dead.⁸ The same standard of moral certainty of the donor’s death must also apply to DCD and TA-NRP.

The risk of brain function revival with TA-NRP is real. A recent porcine study of TA-NRP indicates that, when nothing is done to prevent blood flow to the brain, the donation procedure revives brain function, including the drive to breath, cortical signals, and sensation.⁹ The researchers performed TA-NRP on two pig groups in which they induced asystole with an extended hands-off time of eight minutes. One of the groups had cervical vessel occlusion by clamping and another did not. In the clamped group, TA-NRP induced no cortical electrical activity nor somatosensory evoked potentials (SSEP) nor agonal breathing. In other words, clamping prevented any resurgence of brain activity, from cortex to brain stem. There was

some concern prior to this experiment that ligation would be insufficient to ensure that no brain functions were revived through collateral circulation. After this porcine experiment and empirical investigation of human TA-NRP donations, ligation does appear sufficient to prevent brain function revival.¹⁰ Yet the absence of a function does not entail by itself an organism's lack of ability to perform a function. What happened to the non-clamp group?

In the non-clamp group, all eight pigs either had a revival of cortical electrical activity (EEG) or EEG plus SSEP upon normothermic perfusion. Furthermore, six of the eight pigs in this non-clamp group began agonal breathing. Admittedly the study is an imperfect analogue to human cases, for they induced cardiac death in otherwise healthy pigs, whereas the human donors in cDCD and TA-NRP cases are very severely injured. What the study does show, however, is that the respiratory-circulatory criterion of death can be fulfilled while the organism still has the potential for brain function resuscitation, a reversible absence of activity. In the current state of medical technology and knowledge, one can no longer claim that the respiratory-circulatory criterion for death declaration, based as it is on a mere five-minute waiting period, is a sufficient medical sign that a patient has died. What one should say is that an organism meeting the respiratory-circulatory criterion will inevitably die by the death of the brain that will follow.

The need to ligate the cervical vessels of donors in TA-NRP to prevent brain function revival confirms the doubt that some Catholic ethicists had earlier expressed about whether a mere five-minute waiting period in DCD would be sufficient to guarantee the actual death of

the donor prior to vital organ explantation.¹¹ Now the principles underlying both techniques appear identical and in fact I agree with those who claim that TA-NRP is simply an extension of DCD. If DCD were morally acceptable, then TA-NRP should be, as well. Those who hold that there is a significant physical or moral distinction between these techniques are mistaken.¹² Both techniques understand the irreversible loss of either brain or circulatory function as "permanent," taken in the sense that the patient cannot for himself or herself revive those functions and not that they are unrevivable. Both techniques at their best are based ethically on the idea that, with the consent of the donor whose own body cannot long remain informed by the soul, the vital organs are no longer of the patient nor for the patient. With the appropriate isolation of the heart's function as described above, there is no real ethical difference between in situ reperfusion in TA-NRP and removing the heart for reperfusion ex situ in DCD.¹³ Yet this similarity is the very reason why both should be rejected until a waiting period is established that truly ensures an irreversible loss of brain function. Indeed, both cDCD and TA-NRP cause the irreversible loss of brain and circulatory-respiratory function by the removal of the heart in the former or the isolation of the heart's function in the latter.¹⁴ The loss of the capacity for auto-resuscitation is not identical to the irreversible loss of vital functioning or the loss of life. Double effect would not apply to such an act, for the saving of the organ recipients is mediated by causing the irreversible loss of vital function by either regional isolation (TA-NRP) or vital organ removal (DCD).

I must relegate to another piece my full argument from the metaphysics of death and the priority of the neurological signs of death over the circulatory-respiratory criteria. Neither do I presume here that skepticism about the validity of the neurological criteria of death would require agreement with my case.¹⁵ TA-NRP exploits the legal co-validity of the two death criteria that was established before the innovation of TA-NRP itself. If a donor's vegetative and sensitive functions at least could be revived by perfusion of the brain, as TA-NRP with a short hands-off period intrinsically risks, then that donor still retains an active potentiality for such functions and is therefore not dead. Indeed, we all know that such a donor may have cardiac function revived by attempts at resuscitation for a prolongation of life, even if it would be immoral to so attempt resuscitation when contrary to the patient's reasonable will. Again, the patient is not "ethically" dead nor really dead, but dying.

The practical implication of TA-NRP revealing that DCD patients are not known to be dead with a mere five-minute waiting period is that Catholic hospitals and health systems should cease cooperation with all DCD and TA-NRP protocols to preserve their witness to the dignity of all human life.¹⁶ Even if done for a good intention (e.g., increasing the number of vital organ transplants), these procedures perpetrate grave moral evil due to the lack of moral certainty that the donor has died. For the same reason that euthanasia of a patient with five minutes to live remains a direct killing, so the direct elimination of vital organ functioning, even if only the active potentiality for such functioning, in a dying patient is homicide. As Jonah Rubin, MD, a critical care physician and ethicist with Massachusetts

General and Harvard Medical School, says of TA-NRP, "Ultimately, the cause of death is either the cerebral artery clamping-inducing presumed—not proven—brain death or vital organ explantation, both by direct surgical intervention. This is euthanasia, if not simply killing, even if voluntary."¹⁷ Rubin then draws the same illation I have been arguing: "Indeed, this raises questions even about classical cDCD. A condition is reversible if it can be reversed, even when it is not. NRP has proven what we already know—irreversible cessation of circulatory function occurs after the commonly accepted waiting period after cardiac arrest."¹⁸

On the other hand, DCD or TA-NRP with a "hands off" period long enough to ensure brain death along with pre-mortem injection of anticoagulants and vasodilators prior to death may be an ethical alternative for cardiac recovery. How long would such a waiting period have to be for ethical validity? Twenty minutes has been suggested by some moral theologians who do not assume that a lack of cardiac auto-resuscitation equates to death.¹⁹ The validity of such a period would need confirmation in conversation with neurologists. In the meantime, Catholic hospitals may not need to give up all cooperation with OPOs but should continue to support vital organ donation by strict protocols for determining death by "whole brain death" neurological criteria.²⁰ As DCD and now TA-NRP rapidly increase in their proportion of donations done in the United States, the task of discernment and moral renovation will be difficult. The pressures from CMS, OPOs, and from the genuine desire to help those who organs are failing are great. Yet transplantation medicine is full of dedicated people who can innovate

within ethical boundaries set by Catholic health care institutions. Even if not, one must not do evil to bring about good. The reward of an evangelical witness to life leading to ethical innovation consistent with that witness would be increased public trust in the U. S. transplant system and a greater sense of the dignity of human existence, even unto the moment of death. ✚

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ENDNOTES

1. Emad Alamouti-fard et al., "Normothermic Regional Perfusion is an Emerging Cost-Effective Alternative in Donation after Circulatory Death (DCD) in Heart Transplantation," *Cureus* 14.6 (2022); Eduardo Miñambres et al., "Spanish experience with heart transplants from controlled donation after the circulatory determination of death using thoraco-abdominal normothermic regional perfusion and cold storage," *Am. J. Transplantation* 21 (2021): 1597-1602; Les James et al., "Donation after circulatory death heart transplantation using normothermic regional perfusion: the NYU protocol," *JTCVS Techniques* 17.C (2023): 111-120.
2. According to the data from the Organ Procurement and Transplantation Network, DCD donations have grown from 757 in 2004 to 9963 in 2023 (<https://optn.transplant.hrsa.gov/data/>). There is another form of NRP that just perfuses the organs of the abdominal cavity (abdominal or A-NRP). I'm concerned in this paper with TA-NRP because it threatens brain reoxygenation and restarts cardiac activity. For A-NRP in particular, see A. L. Dalle Ave, D. M. Shaw, and J. L. Bernat, "Ethical Issues in the Use of Extracorporeal Membrane Oxygenation in Controlled Donation after Circulatory Determination of Death," *Am. J. Transplantation* 16 (2016): 2293-2299.
3. OPTN does not have a separate code for TA-NRP donations and codes these as DCD donations, but the advent of TA-NRP's use in the United States and the explosion of heart transplants from DCD donors correlates well. Contributing to the rise are *ex situ* machine perfusion techniques, which are more expensive.
4. American College of Physicians, "Ethics, Determination of Death, and Organ Transplantation in Normothermic Regional Perfusion (NRP) with Controlled Donation after Circulatory Determination of Death (cDCD): American College of Physicians Statement of Concern," April 17, 2021; Brendan Parent, Arthur Caplan, Nader Moazami, and Robert A. Montgomery, "Response to American College of Physician's statement on the ethics of transplant after normothermic regional perfusion," *Am. J. Transplant.* 22 (2022): 1307-1310; see also debates in recent issues of *Chest* (August 2022) and *American Journal of Bioethics* (February 2023), the latter of which with a focus on whether TA-NRP can sidestep the ethical pitfalls of DCD; Robert D. Truog, Andrew Flescher, and Keren Ladin, "Normothermic Regional Perfusion—the Next Frontier in Organ Transplants?" *JAMA* 329.24 (June 27, 2023): 2123-2124.
5. For similar positions that entail doubting the moral liceity of both cDCD and TA-NRP, see: Kyle Karches, Erica K. Salter, Jason T. Eberl, and Patrick McCrudden, "Dead Enough? NRP-cDCD and Remaining Questions for the Ethics of DCD Protocols," *Am. J. Bioethics* 23.2 (2023): 41-43; L. Syd M. Johnson, "DCD Donors are Dying, but Not Dead," *Am. J. Bioethics* 23.2 (2023): 28-29; and Stephen Napier, "The Dead Donor Rule is Not Morally Sufficient," *Am. J. Bioethics* 23.2 (2023): 57-59. For those who see both DCD and TA-NRP as licit, see: Anji Wall and Giuliano Testa, "Defining the Cause of Death and Vitality of Organs in the Ethical Analysis of Controlled Donation after Circulatory Death Procedures," *Am. J. Bioethics* 23.2 (2023): 35-38; James L. Bernat et al., "Understanding the Brain-based Determination of Death When Organ Recovery Is Performed With DCDD In Situ Normothermic Regional Perfusion," *Transplantation* (2023); Christos Lazaridis, "Normothermic regional perfusion: Ethically not merely permissible but recommended," *Am. J. Transplant.* 22 (2022): 2285-2286; Les James, Brendan Parent, Nader Noazami, and Deane E. Smith, "Does Normothermic Regional Perfusion Violate the Ethical Principles Underlying Organ Procurement? No," *Chest* 162.2 (2022): 290-292. For those who hold that cDCD is permissible but TA-NRP is not, see: Anne L. Dalle Ave and Daniel P. Sulmasy, "Death Lost in Translation," *Am. J. Bioethics* 23.2 (2023): 17-19; Lainie Ross, "The Dead Donor Rule Does Require that the Donor is Dead," *Am. J. Bioethics* 23.2 (2023): 12-14; Alexandra K. Glazier and Alexander M. Capron, "Normothermic regional perfusion and US legal standards for determining death are not aligned," *Am. J. Transplant.* 22 (2022): 1289-1290; ACP Board of Regents, "Statement of Concern," April 17, 2021..
6. The five-minute threshold has been justified by the fact that the donor's heart function will not revive on its own. See S. Dhanani et al., "Resumption of Cardiac Activity

- after Withdrawal of Life-Sustaining Measures, *NEJM* 384.4 (2021): 345-352. Whether lack of ability to auto-resuscitate is a sufficient for vital organ transplantation to occur is a distinct question, one that I answer in the negative. Still, the assumption that auto-resuscitation is sufficient for vital organ removal is commonly assumed, e.g., Michael A. DeVita, "The Death Watch: Certifying Death Using Cardiac Criteria," *Progress in Transplantation* 11 (2001): 58-62; Stephen Napier, "Out of the Frying Pan and Into the Fire," *American Journal of Bioethics* 11.8 (August 2011): 60-61.
7. An exception to these lines of argument is Nicanor Pier Giorgio Austriaco's position that the non-heart-beating donor remains alive after asystole but that the heart is at that point no longer a vital organ, thereby permitting explantation (*Biomedicine and Beatitude*, 2nd ed. [Washington, DC: Catholic University of America Press, 2021], 302).
 8. John Paul II, "Address to the 18th International Congress of the Transplantation Society," August 29, 2000: "Acknowledgement of the unique dignity of the human person has a further underlying consequence: vital organs which occur singly in the body can be removed only after death, that is from the body of someone who is certainly dead. This requirement is self-evident, since to act otherwise would mean intentionally to cause the death of the donor in disposing of his organs ... The death of the person is a single event, consisting in the total disintegration of that unitary and integrated whole that is the personal self. It results from the separation of the life-principle (or soul) from the corporal reality of the person ... Here it can be said that the criterion adopted in more recent times for ascertaining the fact of death, namely the complete and irreversible cessation of all brain activity, if rigorously applied, does not seem to conflict with the essential elements of a sound anthropology. Therefore a health-worker professionally responsible for ascertaining death can use these criteria in each individual case as the basis for arriving at that degree of assurance in ethical judgement which moral teaching describes as 'moral certainty'. This moral certainty is considered the necessary and sufficient basis for an ethically correct course of action" (emphasis original).
 9. Frederick F. Dalsgaard et al., "Clamping of the Aortic Arch Vessels during Normothermic Regional Perfusion after Circulatory Death Prevents the Return of Brain Activity in a Porcine Model," *Transplantation* 106.9 (2022): 1763-1769.
 10. Alex Manara et al., "Maintaining the permanence principle for death during in situ normothermic regional perfusion for donation after circulatory death organ recovery: A United Kingdom and Canadian proposal," *Am. J. Transplant.* 20 (2020): 2017-2025; Jennifer A. Frontera et al., "Thoracoabdominal normothermic regional perfusion in donation after circulatory death does not restore brain blood flow," *J. Heart and Lung Transplantation* 42.9 (2023): 1161-1165.
 11. Don Marquis, "Are DCD Donors Dead?," *Hastings Center Report* (May-June 2010), 24-31; Christopher Kaczor, "Organ Donation following Cardiac Death: Conflicts of Interest, Ante Mortem Interventions, and Determinations of Death," in *The Ethics of Organ Transplantation*, ed. Steven J. Jensen (Washington, DC: Catholic University of America Press, 2011), 111; Gina Sanchez, "Objections to Donation after Cardiac Death: A Violation of Human Dignity," *National Catholic Bioethics Quarterly* (Spring 2012): 55-65; Matthew T. Warnez, BH, "The Ethics of Donation after Cardiac Death," *National Catholic Bioethics Quarterly* (Winter 2020): 745-758.
 12. For example, James DuBois, "Determining Death," in *Catholic Health Care Ethics*, ed. Edward J. Furton (Philadelphia: National Catholic Bioethics Center, 2020), 18.9: "in establishing an irreversible loss of circulatory-respiratory functions, one does not need to consider the possibilities of modern resuscitative medicine, but rather the parameters for spontaneous recovery set by nature." While DuBois's conclusion is very common in both non-Catholic and Catholic bioethics, the argument moves invalidly from the true premise that one ought not revive the dying against informed consent to the assumption that irreversibility is fulfilled with passing the point of spontaneous revival of function and that such a point is identical with death. For the same critique of DuBois, see Jason T. Eberl, *Thomistic Principles and Bioethics* (Routledge, 2006), 124. Likewise erroneously assuming that DCD and TA-NRP are in principle ethically different, see the recent, "Submission fo the NCBC and USCCB to the Uniform Determination of Death Committee of the Uniform Law Commission," July 12, 2023.
 13. While disagreeing with their approval of TA-NRP, I agree in this specific point with Angi E. Wall et al., "Applying the ethical framework for donation after circulatory death to thoracic normothermic regional perfusion procedures," *Am. J. Transplant.* 22 (2022): 1314a: "When a standard cardiac DCD procedure is performed, the heart is removed from the body and put on a machine, restarted and circulates blood and perfusate through the machine. While there is an optical difference between the circulatory function of the heart being restored within the corpse rather than outside of the body, there is no ethical difference." So long as we state the obvious point with Austriaco, that the donor remains alive at this moment (see n. 7 above), those who embrace DCD and TA-NRP together seem the most logically consistent to me.
 14. To express this more metaphysically, both DCD and TA-NRP must assume that "irreversible" or "permanent" mean the loss of an active "capacity in hand". Yet these techniques can violate the other active capacity, the "natural potentiality", which can remain in severely injured and dying people. For the distinction between

- potentialities, see Jason T. Eberl, *The Nature of Human Person: Metaphysics and Bioethics* (Notre Dame, IN: University of Notre Dame Press, 2020), 149-150.
15. Indeed, some skeptical of the neurological criteria nevertheless argue for retaining DCD and other vital organ transplantation procedures (Austriaco, OP, *Biomedicine and Beatitude*, 301-303; Charles C. Camosy and Joseph Vukov, "Double Effect Donation," *Linacre Quarterly* 88.2 [2021]: 149-162)
 16. USCCB, *Ethical and Religious Directives for Catholic Health Care Services*, 6th ed. (Washington, DC: USCCB, 2018), nn. 63, 70, 71.
 17. "The Irreversible Cannot Be Reversed: Normothermic Regional Perfusion is Euthanasia," *J. Cardiothoracic and Vascular Anesthesia* 38 (2024): 608-609, at 608b.
 18. Rubin, "Irreversible cannot be Reversed," 608b-609a, emphasis added.
 19. Kaczor, "Organ Donation following Cardiac Death," 111: "twenty to thirty minutes"; Jason T. Eberl, *Thomistic Principles and Bioethics*, 126: "at least ten to fifteen minutes". Kevin J. Clarke, SJ, offers an analysis seemingly based on proportionalist reasoning, yet still recommends at least a ten-minute hands-off period ("A Catholic Perspective on Organ Donation After Cardiac Death," in *Contemporary Controversies in Catholic Bioethics*, ed. Jason T. Eberl [Springer, 2017], 499-515).
 20. Whether the revised American Academy of Neurology guidelines are strict enough for moral certainty is a separate question. Compare David M. Greer et al., "Pediatric and Adult Brain Death/Death by Neurologic Criteria Consensus Guideline: Report of the AAN Guidelines Subcommittee, AAP, CNS, and SCCM," *Neurology* 101.24 (December 2023): 1112-1132, against Michael Nair-Collins & Ari R. Joffe, "Frequent Preservation of Neurologic Function in Brain Death and Brainstem Death Entails False-Positive Misdiagnosis and Cerebral Perfusion," *AJOB Neuroscience* 14.3 (2023): 255-268.