

Review

Pro/con ethics debate: When is dead really dead?

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Abstract

Contemporary intensive care unit (ICU) medicine has complicated the issue of what constitutes death in a life support environment. Not only is the distinction between sapient life and prolongation of vital signs blurred but the concept of death itself has been made more complex. The demand for organs to facilitate transplantation promotes a strong incentive to define clinical death in a manner that most effectively supplies that demand. We consider the problem of defining death in the ICU as a function of viable organ availability for transplantation

The scenario

A 45 year old female patient arrives in the emergency department after having complained of a headache and progresses to unresponsiveness. She is placed on

mechanical ventilation and a CAT scan of her brain shows massive intracranial bleed. The family is assured she will probably progress to brain death but she doesn't. After two days in the intensive care unit she continues with gasping ventilations and some flexion to pain in one arm. All other brain functions are absent. Her hemodynamics and other organ function are stable. The family desires the patient to be an organ donor but she is clearly not brain dead. It is suggested to the family that the patient can still donate under the 'Donation after Cardiac Death' (DCD) rules. Life support can be withdrawn and she can be pronounced dead using asystole as a criterion rather than brain death, following which organs can be taken for transplantation after a variable period of time to rule out 'auto-resuscitation'. Would you recommend this procedure?

Patients cannot donate organs until they are dead

Leslie Whetstine

The question that arises from this case is: Is the DCD donor truly dead at the moment of organ recovery? The answer depends on two things: first, on what concept of death we are using; and second, what version of irreversibility we find most compelling. It is beyond the scope of this analysis to examine the appropriate conceptual definition of death, but suffice to say that the traditional concept of death is the irreversible cessation of the integrated functioning of the organism as a whole. I will argue that DCD does not fulfil this definition.

The Uniform Determination of Death Act (UDDA) [1] established that death could be declared by either the irreversible cessation of circulatory functions or the irreversible cessation of the entire brain, including the brain stem [2]. DCD advocates cite this statute as evidence that DCD is a legitimate practice using the circulatory criterion. The UDDA may appear to support DCD but only if we construe a bifurcated rather than a unitary definition of death that does

not require the permanent cessation of the organism as a whole but only of certain parts of it. The UDDA claimed it did not suggest two different types of death but that either of the two criteria were necessary and sufficient conditions for death. We cannot embark on a critical analysis of this legislation here but it has three primary shortcomings: First, it failed to define the critical term 'irreversible'; second, irreversible absence of circulation is sufficient for death but not necessary; and third, irreversible absence of circulation may be a mechanism of death, but it is not death itself, which has always been regarded as brain death. As quoted from the *New England Journal of Medicine* [3], "It is clear that a person is not dead until his brain is dead. The time honoured criteria of the stoppage of the heart beat and circulation are indicative of death only when they persist long enough for the brain to die."

Advocates of DCD take a soft-line interpretation of irreversibility. They argue that if resuscitation has been

proscribed and if the person cannot spontaneously resuscitate (auto-resuscitation), the person is irreversibly dead as a practical matter. But a moral decision to not restore function does not ensure the clinical state of death has been fulfilled. Moreover, inability to auto-resuscitate cannot be used to determine when death has occurred as many people who cannot auto-resuscitate can be resuscitated with an intervention. Finally, the time period in which auto-resuscitation may occur has not been sufficiently studied to make a determination that two or five minutes of asystole will preclude it. The fact that a person proscribes resuscitation or cannot auto-resuscitate does not make one dead at that precise moment, but prognosticates death and suggests one has entered a dying process that may ultimately lead to irreversible death.

Organ donation operates under the dead donor rule (DDR), which stipulates that organs may not be removed prior to death nor may organ procurement cause or hasten death. DCD fails

to satisfy the DDR on three counts: First, it manipulates the definition of irreversibility based on a moral position not to resuscitate; second, it appeals to fallacious logic that because one cannot auto-resuscitate then one is dead; and third, it focuses solely on the circulatory criterion endorsed by the UDDA, which does not immediately correlate with brain status. Generally speaking, using the circulatory criterion would not be problematic as its absence will inevitably cause total brain failure. In DCD, however, the need for speed becomes a factor such that organs will be removed before the requisite time it takes for the brain to die as cessation of cardio-respiratory functions does not cause the brain to die immediately.

If the body can be resuscitated, we have to question if it was ever really dead given our conventional notion of death as a finality from which one cannot be returned or resurrected from under any circumstances. DCD protocols remove organs from a donor who is not irreversibly dead; if the whole brain is not yet dead, the patient cannot be dead.

Donation after cardiac death is consistent with good medical practice

Stephan Streat

The issue of how death is certified, if this is 'according to good medical practice', does not determine my approach to organ donation. Whetstine, however, finds this "the question" for non-heart-beating donation and advances three arguments why this should be so. First, I am unconvinced that death hasn't occurred because 'irreversibility' hasn't been established. Strictly speaking, no prospective definition of 'irreversibility' is possible. Only after all possible reversal strategies have failed can a situation truly be said to have been, in retrospect, 'irreversible'. In the circumstance of possible non-heart-beating donation, such strategies would be morally repugnant and contrary to acceptable clinical practice. I agree with Cole [4] that inclusion of the concept of 'irreversibility' is a deficiency of the Uniform Determination of Death Act (UDDA) [1]. But this semantic difficulty does not arise in many countries, including my own, that do not have a statutory definition of death.

Second, I understand how Whetstine's concern with 'irreversibility' has led her to consider the concept of auto-resuscitation but the UDDA is silent on this concept, as it is on the means by which death should be determined, requiring only that it must be "in accordance with accepted medical standards" [1]. Although "lack of auto-resuscitation after a certain time interval" might be a reasonable "accepted medical standard", there is no general consensus on whether this is an appropriate operational approach to "irreversibility" or on what that "certain time interval" might be and a dearth of reported evidence to inform that discussion.

The phenomenon of return of spontaneous circulation (ROSC) after discontinuation of cardiopulmonary resuscita-

tion (CPR) was first reported in 1982 [5] and later termed the 'Lazarus phenomenon' [6]. A more recent review of 25 reported cases found that the exact timing after stopping CPR until the detection of ROSC was usually uncertain but could have been as long as 20 minutes in one case [7]. These authors suggested, "after cessation of CPR, each patient should be further monitored (at least clinically and with an ECG) for at least 10 minutes (the typical time interval for a Lazarus phenomenon)." However, the phenomenology of similar events after circulatory arrest following extubation in the presence of severe brain damage may or may not be the same as those occurring after discontinuation of CPR (which has usually included, for example, several doses of adrenaline and other therapies).

In most jurisdictions where non-heart-beating organ donation occurs, a 10 minute period of circulatory arrest (asystole on ECG and no pulsatility by arterial line) has been accepted as sufficient to determine that "death has occurred" [8], whereas the US Institute of Medicine recommended that a five minute period was sufficient [9]. Dutch law requires a further five minute 'no touch' period after death has been declared before any measures to procure organs can begin, similar to recommendations by the US Institute of Medicine.

Finally, Whetstine suggests that non-heart-beating donation springs solely from the circulatory criterion endorsed by the UDDA and, because the cessation of circulation does not cause the brain to die immediately, that the brain, and thereby the patient, might still be alive at the time that organ procurement begins. Although I agree that some parts of the previously severely damaged brain might be able to function if

oxygen transport was immediately restored (even after perhaps 10 minutes of circulatory arrest), I see this concern as similar to her concern with irreversibility of circulatory arrest. There is no way to tell if the brain is dead after such a period of circulatory arrest, other than by restoring and maintaining oxygen transport and determining whether any signs of brain activity return. Such an operational approach to 'brain death' is not required by the UDDA or good clinical practice.

My own concerns in non-heart-beating organ donation are for the medical acceptability of the methods used to certify death, the independence of this process from the organ retrieval process, the manner in which the option of organ donation is discussed with the family and the acceptability of all of these processes to everyone involved. I do not believe that organ donation should ever be 'recommended' to families, only that under appropriate clinical circumstances, perhaps including this one, it is an 'option' that should be 'sensitively offered'.

A thoughtful analysis of death in the ICU

Mike Darwin

death \ˈdeth \ n 1:

a permanent cessation of all vital functions: the end of life

Webster's New Collegiate Dictionary

The fundamental questions are, simply, what and when is death? This problem is not new: In the seventh century, Celsus wrote, "Democritus, a man of well merited celebrity, has asserted that there are in reality, no characteristics of death sufficiently certain for physicians to rely upon" [10].

Both Streat and Whetstine essentially concede defeat in dealing with these two pivotal questions in the first paragraph of their respective analyses. While sidestepping the core issue of what is the "appropriate conceptual definition of death", Whetstine then argues compellingly that DCD does not meet either the intent or the criteria set forth in the UDDA. Streat argues compellingly that the issue of irreversibility is a practical impossibility to determine, and that because of this, utilitarian criteria should prevail in determining when death is pronounced and when organs may be retrieved.

The earliest definitions of death are arguably religious and largely binary; a person is either clearly dead or alive on the basis of whether a metaphysical spirit, soul, or life force continues to animate the physical body. The departure of the soul is synonymous with unequivocal death of the person and the only obligations that remain are ritually appropriate corpse disposal. This worldview is extremely valuable as it satisfies the practical and emotional needs of people for certainty, closure and clarity. With the advent of CPR and life support systems, the formerly binary status of life and death became increasingly analogue. The advent of transplantation served only to further degrade the binary view of death by allowing the continued 'survival' of the organism in a fragmented way in the bodies of others.

Because all other functions of human life could be medically enabled to persist after the loss of personal identity, the Harvard Committee properly focused its attention on the sole organ that enables or produces this property; the brain. As both Streat and Whetstine agree, however, the problem of

what constitutes 'irreversible' was left unaddressed, and this is a critical flaw in any absolute definition of death. It is obvious that a solid majority of patients dying today could be resuscitated and supported artificially with intact mentation, albeit only at tremendous cost, both in terms of resources and suffering.

The brain is a discrete pattern of atoms, each as effective as the next as long as the unique pattern of their arrangement persists. Presumably all of the attributes of personhood are encoded in this lattice. This view allows us to view the person as 'information beings', defined by the arrangement of particular atoms that comprise our brains at any moment. So long as that pattern of information can be recovered, the person is not dead. If a cookbook is ripped to pieces it is no longer functional; it is impossible to read or use. The torn pages still contain all the information required, however, to allow for the book to be pieced back together and restored to a functional, useful state. By contrast, if the book is burned and the ashes stirred, the loss is irreversible given our current understanding of physical law (the limitations imposed by both the laws of thermodynamics and information theory). This approach to defining death, which is rooted not in relative, changing technology and vitalistic worldviews, but rather in the fundamentals of physical law, is known as the information theoretic criterion of death [11].

As Merkle [11] has stated:

"A person is dead according to the information theoretic criterion if their memories, personality, hopes, dreams, etc. have been destroyed in the information theoretic sense. That is, if the structures in the brain that encode memory and personality have been so disrupted that it is no longer possible in principle to restore them to an appropriate functional state then the person is dead. If the structures that encode memory and personality are sufficiently intact that inference of the memory and personality are feasible in principle, and therefore restoration to an appropriate functional state is likewise feasible in principle, then the person is not dead."

The utility of the information-theoretic criterion of death to this case and this discussion is to point out that few if any patients pronounced dead by today's physicians are in fact truly dead by any scientifically rigorous criteria. A further and even more disturbing complication is the rapidly advancing technology of organ cryopreservation [12]. Using ice-free cryopreservation methods (vitrification), reversible long-term function of the mammalian kidney has been achieved after cooling to -135°C (Fahy GM: *Vitrification as an approach to cryopreservation [abstract]*. Presented at the 42nd Meeting of the Society for Cryobiology, Minneapolis, Minnesota, USA, July 24-27, 2005). Using essentially the same techniques, investigators have been able to achieve indefinite cryopreservation of the mammalian brain with intact ultrastructure and substantial preservation of metabolic and electrophysiological activity [13]. Long-term reversible cryopreservation of the mammalian brain would, in effect, enable most of today's terminally ill or even 'DCD' patients to engage in speculative medical time travel in pursuit of a cure [14], further complicating the issue of when death is.

But speculative science notwithstanding, we must return to the conundrum of when and how to pronounce death in the case at hand, and others even more vexing, where there is an unarguably uninjured and intact brain at the time medicolegal death is pronounced. Real-world examples are conscious and competent patients on ventilator, left ventricular assist device (LVAD) support, or other kinds of life support who wish for the withdrawal of treatment and subsequent donation of vital organs [15]. Rigorously defined, death is a slow process and can only be assured when autolysis of the brain is far advanced or completed. Both the stability of brain ultrastructure and the recovery of viable neurons after hours of cardiac arrest are well documented [16]. Clearly, such a lengthily post-arrest interval for declaring medicolegal death is neither practical nor humane.

Both medicine and the law should respond to this problem with common sense, compassion and flexibility. It is only the ideologue or the fool who acknowledges noon and midnight, but denies all the states of light and darkness that smoothly shade together in the real world to create day and night. Patients who are not candidates for further medical intervention to save or prolong their lives should be pronounced dead based not on the absolute or theoretical irreversibility of their pathology, but rather on the basis of the permanence of this condition; namely, that there will be no attempt to resuscitate, revive, or otherwise seek to continue the patient's life. In the current milieu, this means the use of whatever clinical criteria under the law are appropriate at a time when further therapeutic interventions are medically ineffective, or are rejected by the patient, or his duly authorized medical surrogate.

Streat summarizes the course physicians should follow succinctly:

"My own concerns in non-heart-beating organ donation are for the medical acceptability of the methods used to certify death, the independence of this process from the organ retrieval process, the manner in which the option of organ donation is discussed with the family and the acceptability of all of these processes to everyone involved. I do not believe that organ donation should ever be 'recommended' to families, only that under appropriate clinical circumstances, perhaps including this one, it is an 'option' that should be 'sensitively offered'."

As Streat notes above, the critical factors are informed consent, lack of advocacy or conflict of interest in the organ retrieval process, and a medical determination of the permanence of the condition (i.e., inappropriateness of further life prolonging efforts).

The issue of auto-resuscitation, which is so problematic to Whetstone, should be considered in the context of a simple, real-world test. If a patient who terminates LVAD or ventilator support is duly and legally pronounced dead at the time of cardiorespiratory arrest, would it be homicide to fire a bullet into his brain one minute later? The contemporary medical and legal answer is clearly 'no'. Thus, the administration of appropriate drugs to prevent medically contraindicated auto-resuscitation in the context of a modality that would not otherwise be applied to the dead patient without his consent is morally and legally permissible, as well as being a great humanitarian good. Post-pronouncement administration of a cardioplegic dose of potassium chloride, in addition to an electrocortically suppressive dose of barbiturate or diprivan, to prevent ROSC and possible recovery of some degree of consciousness during post-pronouncement CPR, extra-corporeal support, or rapid *in situ* blood washout with organ preservation solution, would seem not merely desirable, but an ethically mandated part of the standard of care. You cannot kill a patient who is already medicolegally dead.

Defining death in morally absolute terms is technologically, if not scientifically, impossible at this time. Attempts to use rigid, binary, black or white, all or none approaches will only serve to recreate the bitter futility of similarly barren arguments that have characterized the debate over when life begins (and the attendant social and medical issue of abortion). In the real world, death is a continuum, and it should be dealt with as such. That means thoughtful judgment on the part of patients, physicians and lawmakers as to where to draw lines in that shifting sand. If the informed consent of the patient is the foremost value, there will be little moral risk in deciding just how dark it must be before night has fallen.

DCD: a work-around of the rules we need to consider carefully

David Crippen

The rules for the interpretation of death by whole brain death (WBD) criteria were formulated over 20 years ago in an age of only moderate technological innovation. In 2005, it may be that modern critical care medicine has modified the entire concept of WBD, mandating replacement by a new paradigm taking into account our ability to discern shades of grey in brain function. Those shades of grey have become the focus of much debate as we try to find the line separating 'alive enough to donate' and 'dead enough to bury'.

These paradigm shifts notwithstanding, the rules set out for the determination of death as it pertains to organ donation are very clear even in 2005. Patients must be dead before organs can be taken for transplantation. Traditionally, 'brain death' has been necessary for a patient to be declared legally dead for procurement of organs for transplantation [3]. The concept of DCD is a creative interpretation of the DDR [17], equating the aftermath of cardiac death with the presence of brain death. Many more patients could be used for donorship using cardiac death criteria.

But these concepts are not synonymous. Brain death is a diagnosis that death has occurred. Cardiac death is a prognosis that death is inevitable (using WBD criteria). The rules set down by the UDDA [1] suggest that death must be irreversible. Patients with cardiac standstill may not necessarily be brain dead, and may actually be resuscitatable if anyone chose to do it [18]. The criteria to make that determination must be both necessary and sufficient for death. It is necessary and sufficient that the entire brain has irreversibly ceased to

function. Loss of a heartbeat is sufficient but not necessary in the presence of WBD. In this regard, DCD is a very creative interpretation of the DDR using utilitarian criteria. Patients may not be necessarily 'dead' by the rules, but they're 'dead enough' after cardiac standstill if death is inevitable. A seemingly small issue, but with big picture implications.

The big picture of all workarounds and creative interpretation of the rules is more daunting than the short-term benefits. The rules for organ donation are poorly amenable to bending, lest we find ourselves bidding for organs on eBay [19] or harvesting suspicious operating room deaths as in *Coma* [20]. Enthusiasm and aggressive marketing techniques to raise public consciousness about organ donation are not necessarily compatible with rules in place to protect public rights.

Now that this workaround has been popularized, further creative interpretations of the rules are inevitable. Anything that increases the desired supply of organs could be fair game. Why not allow families to simply authorize mining for paired organs from incompetent relatives before death, and then withdraw life support on the basis of futility? Further, why not mandate that everyone is a donor unless they sign up with an 'I don't want to donate' registry? Now that the foot is in the door, and not much cry of foul has been forthcoming, more workarounds are on the way and each one will be an escalation of creative interpretation slanted toward increasing demand, perhaps at the cost of individual rights. This is the major reason why a very public discourse must continue on the subject of how we interpret the rules for organ donation.

Competing interests

The author(s) declare that they have no competing interests.

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