



Rethinking Brain Death: A Physiological, Philosophical and Ethical Approach

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ABSTRACT

The term 'brain death' is a rather untenable description to be defended ethically. This needs to be sorted out to 'cortical brain death', 'whole brain death' and WBD should include the brainstem. Organ transplants confound the difference between WBD and 'biological death', that is, the complete cessation of body function. It is clearly an ethical issue of taking a life, however, I argue for the greater good, IF it is clearly documented that irreversibility presents itself through multiple criteria (apnea, brainstem function, lack of long onset EEG, etc.). If meeting these criteria, we can have medical, physiological and moral standards and it is ethical to declare brain death, thus allowing organ transplants, and by definition, create biological death by doing so. This is a very consequentialist approach, but it does appease the dualistic ethics by separating the brain, or, more to the point, the concept of the 'conscience', and the possibility of defining 'personhood' or lack thereof. I believe the 1968 Harvard 'declaration of death' doesn't fit the above criteria and the AMA declaration (formally adopted in 2003) states that: "a determination of death must be made in accordance with accepted medical standards", however, those medical standards were not described. This paper addresses those standards.

Keywords: Brain death, Whole brain death, End of life.

1 Introduction

In the mid 1990s, I finished my first PhD and started a Post-Doc at a regional School of Medicine. I took on the task of working on the neurophysiological basis of learning and memory. We developed a technique of removing the entire brain from a turtle, and placing it in a recording dish. Turtles have a remarkable tolerance for anoxia, so keeping it neurologically viable for weeks was not really a problem. We found we could activate certain pathways and demonstrate classical conditioning of an isolated brain. We could record neuronal outputs to the heart, identify respiratory rhythms, acoustic startle responses and train a conditioned eyeblink reflex. A brain, in an oxygenated dish.

Many, many late hours in the basement of a 100+ year old med school leads to lots of staring and pondering. Clearly, the brain/brainstem was neurologically functioning. It certainly wasn't going to go back into the body, but what if the sensory inputs were still functioning. However, as Charles Sherrington famously wrote in 1906 'the only output of the brain is the motor system'. What if there was reception and possibly perception, but no expression of perception? This started to be philosophically problematic to me, so I just started to remove the cerebrum (they really don't have a true cortex) to justify my ethical approach to neuroscience.

It is certainly a stretch to equate turtles to humans (although ethically and morally I would argue that if you remove a human cortex you in fact have a turtle as well as sentience), but does this rather odd example question the ideals of 'brain death'?

It is extraordinarily difficult to properly dissect out (no pun intended, or maybe unintentional) a scientific or philosophical idea of brain 'death'. Ultimately it lies in the concept of consciousness, however defined, yet we cannot decide on a true definition. I tend to defer to an easy out: 'emergent properties of the brain'. But that alone is insufficient, nor easily measurable. Consciousness in and of itself is relative to



the observer (although some philosophers of the mind would disagree). Dualism completely disputes that consciousness is part of a physical construct of the body, which makes little philosophical, let alone medical/physiological or ethical sense and I contend is incorrect. It is a fascinating question to ask ‘what if I removed consciousness and what would be left’. That is an intractable experiment.

I am going to make the case that ‘death’ is defined by ‘whole brain death’ as defined by the American Academy of Neurology in 1995 as an ‘impossibility of recovery, regardless of any medical intervention’ (cited in Aboubakr and Alameda, 2021, Greer, 2020), however, this is not a complete definition and also difficult to discern. The concept of a persistent vegetative state (PVS) does not separate the concept of a ‘coma’ from other forms of severe brain damage, and recovery is extraordinarily difficult to ascertain with certainty. This has still been unresolved from a philosophical and ethical condition, but aids in the patients’ families and physicians to choose to utilize organs for transplantation if WBD occurs.

2 The root of the issue historically

BF Skinner struggled with the concept that consciousness did not exist, but rather a simple set of behavioral ideals strengthened through reinforcement. Minsky and Papert (originally proposed in 1969) argued that it is a programmed computer system. Both I contend are rather short sighted and only tangentially linked to neural structure. My favorite is the Boltzman’s brain thought experiment (now, let us pause and ponder for a moment on the concept of what exactly ‘thought’ is). The idea of thermodynamic entropy producing thermal fluctuations complete with memories of a past non-existence is wonderful, but extraordinarily non-probable (but still, the probability is not zero).

So, the concept of brain death in and of itself, is not that complicated. Originally it was listed as ‘putrefaction’, and one would argue decapitation, although as I’ve shown in turtles and some experiments on the guillotine it is alone not necessarily correct. The most famous studies came from France where the humanity of the guillotine was questioned. French doctors monitored the head and body post beheading and a famous scientist, a scientist ‘Dr. Beurieux’ monitored eye movements and facial expressions in humans up to approximately 10 seconds. So not really definable, but a useable criteria. But is 10 seconds of ‘consciousness’ sufficient to be considered unethical? The last documented case of death by guillotine was 1977 in France.

Van Rijn et al. (2011) ask the question if rats suffer from a swift beheading or if they quickly lose consciousness and avoid much pain. To do this, they monitored EEG activity, a classic identity of brain ‘death’. Post decapitation, the EEG disappeared after an average of 17 seconds. However, they identified large electrical activations, rather random, throughout the brain. They identified this a ‘wave of death’. This was continued with Zandt et al. (2011) by monitoring chemical activity, who also identified a ‘wave of death’ but didn’t agree that it was irreversible and sometimes lasting for minutes and in some cases days. This will become an important ethical and legal consideration. In a 1981 paper in the journal *Stroke*, Bounds et al. monitored the timing declaring death in humans and found ‘*of the treatable extracerebral causes of death determined at autopsy, only 34% were recorded premortem in the clinician’s death*’. Therefore, the determination of death has been clearly poorly identified.

Throughout history, it was considered ‘death’ when there was a cessation of breathing (Daroff, 2007). This became problematic when resuscitation and ventilators came into existence and the Pontifical Academy of Sciences, among others, modified their religious ideals of death.

As far back as what is known as the Smith papyrus (discovered and translated in 1862 and often attributed to Imhotep in C. 1600 BCE first, but still disputed as possibly a copy). This is the first known definitions of brain surgery and death (for a good summary, read Finger, 1994).

In this text that covers 48 cases of brain/spinal cord injury, it is translated as diagnosing brain surgery as:

- a) An ailment that I will treat
- b) an ailment that I will try to treat
- c) an ailment that I will not treat.

This was widely acknowledged as the ‘state of the art reasoning for modern practice’ (Middendrop, 2010). Therefore, problem solved. Except, not treating doesn’t necessarily indicate death. After all, Phineas P. Gage was never actually treated and he lived for a number of years post-accident (for a quick refresher on probably the most famous case in brain injury, see https://en.wikipedia.org/wiki/Phineas_Gage).

Triage on the battlefield has been relatively well documented, but I have yet to find a reference to brain injuries. In the French revolution (‘triage’ is from the French word for ‘trier’, meaning ‘to sort’) began to describe the process of

- a) minimally wounded,
- b) seriously but treatable wounded, and
- c) mortally wounded.

Thus, up until World War I, the Egyptian ideals (which, weren’t translated until the 1920s) were the gold standard. In WWI, a consequentialistic approach was that ‘a single case, even if it urgently required attention, should wait. the greatest good for the greatest number of people was the rule’ (Slawson, 1994). This became the common reasoning on the battlefield and death was almost never defined.

As medical advances arose to the point of evaluating brain injuries (one must remember that the neuron doctrine and theories of isolated brain functions wasn’t until the 1950s), medicine began to identify the nature of death and thus question the dualistic nature of brain/body.

Short of putrification or incineration, it became apparent in modern medicine that identification of ‘death’, let alone brain death was problematic. It is important to discuss ‘brain death’, ‘whole brain death’ and ‘biological death’ as separate concepts. By definition, ‘brain death’ is measured by EEG, ‘whole brain death’ defines the brain stem, and ‘biological, or organismal death’ includes an array of organ systems, usually respiratory and cardiac.

3 A modern conceit

In 1968, Harvard Medical School published a landmark report to identify a new definition of death. There was recognition of a serious problem; a patient’s condition was considered ‘hopeless’ but life support continued normal body function.

This council took a rather utilitarian idea to consider the burden on the patient and the families as well a consideration of the need for hospital beds. Additionally, they recognized the growing need for the increasingly important aspect of organ transplants. If the organ is to be ‘harvested’ for transplant, the body is, by definition not ‘dead’, but is brain death sufficient and how is it defined?

The Hastings Center (formally the Institute of Society, Ethics and the Life Sciences) in 1970 convened a panel at the American Association for the Advancement of Science conference. Henry Beecher (one of the original members of the Harvard committee) presented a paper on ‘a *New Definition of Brain Death: Some Opposing Views*’, (eventually published as Beecher and Dorr, 1971). He defined this as an irreversible loss of “*personality, his conscious life, his uniqueness, his capacity for remembering, judging, reasoning, acting, enjoying, and so on.*”

In the *Presidents Commission for the Study of Ethical Problems in Medicine and Biomedical Behavioral Research* (1981), in the United States ‘whole brain’ death became the legal standard, that requires an ‘*irreversible cessation of all functions of the brain, including the brainstem*’. This is fraught is vagaries.

The obvious concern is the concept of ‘irreversibility’. To this day, this is extraordinarily difficult to discern, if not medically an impossible conclusion to arrive at. Defining a loss of personality is ethically contemptable as Beecher argued, as should a catatonic human be simply used for an organ harvest? A capacity for remembering is most certainly not an ethical criteria.

To approach this from a legal perspective, the definition of brain death is “*An individual who has sustained either (1) irreversible cessation of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brain stem, is dead. A determination of death must be made in accordance with accepted medical*

standards.” This was approved in 1980 by the American Medical Association and in 1981 by the American Bar Association.

Veatch (2018) writes that there were three primary categories of the definition of death.

1. **Circulatory or somatic definitions.** A loss of circulation is not definitely a loss of heart function, so this appears a false dichotomy
2. **Whole brain definitions.** Spinal reflexes and considerations of continued functions of the diencephalon, hypothalamic and even pituitary functions were often excluded from this definition of complete central nervous system collapse and not included in the idea of death
3. **Higher brain functions.** The definition of ‘higher brain’ is fraught with difficulties. Some argued for lack of EEG activity. As was discussed above, EEG is limited to a small part of the neocortex and clearly has been shown to not be an accurate indicator of ‘whole brain’. Most have based ‘higher brain’ function on the concept of an irreversible loss of consciousness. In 2010, the American Academy of Neurology considered the question ‘is there a cessation of neurological function [that] is permanent’ (Wijdicks, 2010 Wijdicks, 2015, Bernat, 2021). Again, permanence is rather untenable in certainty of observation.

Truog, et al. (2020) in a JAMA editorial offers the following tropes:

- 1) *Is the patient unconscious?*
- 2) *Has the patient lost the capacity for spontaneous respiration?*
- 3) *Are the conditions of unconsciousness and apnea irreversible?*

Again, can one medically or ethically measure ‘consciousness’? There are also many cases of respiratory responses returning repeatedly after what one would consider ‘respiratory shock’. Irreversibility is, at the moment, undefinable.

If we declare brain death on the basis of ‘personhood’, we must by default discuss what creates that ‘person’, and thus wander into the realm of what is consciousness. Consciousness is not a measurable outcome, but rather a physical emergent property of the brain that results in behavior, but not necessarily a quantifiable system. Some authors argue for consciousness as ‘anticipatory behavioral control’, (Kotchoubey, 2018), but that by itself not a tenable answer because many argue that consciousness, while clearly based in neurobiological processes, is none the less qualitatively subjective (Searle, 2000). I argue that objectivity in behavior is most certainly not left only to humans, therefore consciousness, or personhood is a poor descriptor of cortical brain death. We are again reminded what Charles Sherrington so eloquently said in 1906 “the only output of the brain is the motor system”. As mentioned in the introduction it is impossible to determine if reception and perception were not occurring even if the motor out was not possible. If, as Nagel wrote in 1974, in *‘What it is like to be a bat?’* that if a bat possessed consciousness, there must be something that exists to be ‘bat like’. Thus, consciousness is qualitative and experiential. So, are there neurological correlates of conscious states (NCC)? Numerous authors have argued that there are. There has been a description of roughly 40Hz neurons firing in the brain that collectively account for a combined perceptual experience (Llinas, 1990; Crick, 1994, et al.). If we accept an attempt to approach consciousness from a neurobiological definition, it creates an obsolete usage of the philosophical idea of dualism.

The version from the UK (Passis, 1983) focuses not as much on the cortex, but rather the brainstem and, specifically the reticular activating system (RAS) (Wijdicks, 2002). While appealing, this also has its ethical issues to consider. Sleep and hence a temporal reduction in consciousness is regulated by the RAS on a daily basis.

Under the US Uniform Determination of Death Act (1980, revised 2002), it includes the ‘entire brain’, but in detail, it only encompasses the neocortex and the brainstem, yet it precludes continual activation of the heart. This is rather problematic, as the neocortex is primarily for conscious perception and output and if we preclude the activation of the heart, therefore the brainstem is not ‘dead’. There are

multiple criteria of death for different reasons. The UDDA clearly spells it out on medical terms, but is this sufficient? It can be intention driven and to some extent, belief driven. For example, Troug and Miller (2008) clearly state that the ‘dead donor rule’ (meaning that a legal definition of death) is required before organs can be transplanted) is neither medically or ethically sufficient.

“The uncomfortable conclusion to be drawn from this literature is that although it may be perfectly ethical to remove vital organs for transplantation from patients who satisfy the diagnostic criteria of brain death, the reason it is ethical cannot be that we are convinced they are really dead.”

Thus, I conclude that the whole brain death criteria is incomplete because is not a complete cessation of brain function and does not define biological death, however, it can be considered a proper ethical approach especially with respect to the patients’ families and considerations of organ transplants.

4 Philosophical and religious approaches to understanding brain death

Troug and Miller argue that the ‘dead donor rule’ fails in being convincing because it has a large potential to undermine the ethical trust in medicine by making a loop-hole around the concept to ensure that the organs are in the most favourable condition for transplant. The ethical consideration of organ donations will, by almost all criteria, define therefore whole body death. The ethical goal then should be that organs shall not be harvested if the body would not otherwise die.

There have been multiple religious approaches to defining this. To summarize a few examples: In the Pontifical Academy of Sciences (2008) they write *“an important initial clarification is that brain death is not a synonym for death, does not imply death, or is not equal to death, but ‘is’ death.”* However, there are some interesting variables they considered. The Academy did recognize that organ transplants were a conundrum. Yet, they took a rather dualistic approach to this as Pope John Paul II viewed death as “removing the ‘soul’ from the body *“consisting in the total disintegration of that unitary and integrated whole that is the personal self”*

Historically, Jewish halachic law defined death as a complete multi-organ systemic failure. This was quite recently modified most notably after the 1968 Harvard Medical School report. They posit that the neurological definition of death was moved significantly earlier based on monumental breakthroughs in the ability of organ transplantations to maintain viability, the allocation of resources for medical care and the greater good for the extended care of the patient’s family. This still was confounded by the wide held belief that removal of an organ was ‘tantamount to murder’ (Yitzchok and Breitowitz, 1992). Jewish law further defines brain death beyond suggesting that a lack of an EEG is insufficient, but rather takes a more profound definition that involves the following:

- (1) a determination that the patient is in a deep coma and is profoundly unresponsive to external stimuli;
- (2) absences of elicitable brain-stem reflexes such as swallowing, gag, cough, sigh, hiccup, corneal, and vestibulo-ocular (ear);
- (3) absence of spontaneous respiration as determined by an apnea test; and
- (4) performance of tests for evoked potentials testing the brain-stem's responsiveness to a variety of external stimuli.

“These tests are to be repeated between 6-24 hours later to insure irreversibility - with life support supplied for the interim - and a specific cause for brain dysfunction must be identified before the patient will be declared dead” (Yitzchok and Breitowitz, 1992).

Buddhism has pursued a rather neurological approach to identify the potential difference between classical Buddhist teachings and what is referred to as the ‘medicalization and legalization’ of the concepts of death (Keown, 2010). For example, EEG activity, as introduced above, has been measured following what medical professionals determined was post-mortem (Chawla et al., 2009, Blundon, 2020). Many religious cultures present the idea that death occurs over time and thus the complete identity of the time of death is problematic to precisely identify. Many Tibetan Buddhists follow the idea of *tukdam*, that a spiritual

release occurs at the occurrence of death. Remarkably, this has been tested (Lott et al., 2021) with support of His Holiness, the Dalai Lama. 12 monastic *tukdam* subjects were monitored for EEG activity immediately (24-48 hours) after diagnosed clinical death. Although no clinical EEG activity was able to be recorded, it further pursued the question of the philosophical and ethical acceptance of organ transplants. The Buddhist concern in one of the five moral precepts is ‘do no harm’, not unlike the Hippocratic oath. If an intensivist (board certified physician in critical care) believes that the current state is a clear indicator of complete biological death of a human, Buddhism appears to still be concerned that death is defined a loss of the body’s ‘organic integrity’ (Keown, 2017) and therefore faces a moral conundrum that is currently unanswered. The not permitting an organ transplant therefore implies that lives will be lost, but the organic integrity of the patient will be lost by doing so.

5 Fiscal and Moral Approaches

It important to also recognize the burden, both mentally and fiscally how these decisions are made for the family of the patient and the physicians and associated health care workers. Care in the ICU is quite costly in 2 ways. First, a 30-day stay in the ICU under delirium and coma is very expensive monetarily—according to internal hospital estimates, on the order of \$9,000 to \$18,000 in direct marginal costs before considering the cost of infrastructure and overhead (Vasilevskis, 2018) and up to \$216,000/year not including medications. Second, an ICU patient requires around-the-clock devotion of time, energy, and concern from nurses and physicians. Even if the family reimburses the federal government for the entire monetary cost of care, the medical staff may still have a complaint: they are being asked to devote themselves to a decision that may compromise their commitments and put other patients at potential risk. The mental and physical toll on the families and the health care professionals. In addition, there is a concern whether a patient may exhibit responses to painful stimuli that are extremely difficult to detect and yet whether or not an absence of consciousness is demonstrated by a lack of a response his highly debated (Multi-Society Task Force on PVS, 1994).

6 Conclusion

It is important to separate cortical brain death from whole brain death. This additionally should be delineated from organismal death. Whole brain death should include a consideration of the brainstem as well as the non-cortical functions of the brain. The fundamental concept of brain death and organismal death are not plausibly separable, however a consideration of whole brain death, including the brainstem is an ethically acceptable definition for the use of organ transplants with the obvious discussion that medical science has not completely settled this definition and is therefore subject to further debate and study.

7 Declarations

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7.2 Competing Interests

The author declares no current or potential competing interests.

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