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Evolution of the Criteria of "Brain Death": A Critical Analysis Based on Scientific Realism and Christian Anthropology

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Abstract

"Brain death" (understood in the sense of "whole brain death" and not in the sense of "brainstem death") was introduced into clinical practice in 1968 when the Harvard Ad Hoc Committee defined irreversible coma as a new criterion for death (understood in the full sense of the word). According to the Uniform Determination of Death Act (UDDA), promulgated in 1981 by the President's Commission (which also formally advanced the first conceptual rationale for brain death), the legal declaration of death using the brain death standard requires the irreversible cessation of all functions of the entire brain, including the brain stem. The brain death standard has since evolved, however, to include significant modifications even though, on a literal reading, its clinical test criteria have remained unchanged. This article gives an account of why and how the brain death standard has been updated, leading to the currently practiced guidelines for the determination of brain death put forth by the American Academy of Neurology. According to the updated standard, the presence of certain brain or spinal cord functions does not invalidate the diagnosis of brain death. By analyzing these guidelines critically on the basis of scientific realism and Thomistic hylomorphism, this article demonstrates that the updated brain death standard contradicts both the UDDA and the tenets of sound anthropology held by the Catholic Church.

Summary: This article examines the evolution of the "brain death" standard from the time of its introduction by the Harvard Committee until the current guidelines established by the American Academy of Neurology. This evolution consists mainly of a selective discarding of certain brain and spinal cord functions that are deemed insignificant. Based on the principles of scientific realism and a Thomistic substance view of human nature, this article shows that the evolved standard contradicts both the Uniform Determination of Death Act definition of brain death and the fundamental tenets of Christian anthropology as taught by the Catholic Church.

Keywords

American Academy of Neurology guidelines, Aristotelian–Thomistic anthropology, Brain death, Catholic Church, Scientific realism

"Brain death" made its abrupt entrance into clinical medicine when the Ad Hoc Committee of the Harvard Medical School published its report in August 1968.[1] After more than fifty years, the Harvard report has remained a notable document primarily for two reasons: (i) it gives irreversible coma a new name, brain death, and (ii) it "define[s] irreversible

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coma as a new criterion for death" (Harvard Medical School 1968, 337). Although brain death has become widely established as a medicolegal policy for the determination of death, it has remained a source of unrelenting controversies, drawing in scholars from disciplines beyond the medical field as well as the involvement of the Catholic Church. The most notable interventions on the part of the Church are of two types: (i) the magisterial intervention of John Paul II (2000), including his address to the Eighteenth International Congress of the Transplantation Society in August 2000, and his letter to the Pontifical Academy of Sciences working group on the *Signs of Death* in February 2005 (John Paul II 2005); and (ii) the working groups organized by the Pontifical Academy of Sciences (a consultative body to the Holy See with no magisterial authority) in 1985 (Chagas 1986), 1989 (White, Angstwurm, and Carrasco de Paula 1992), 2005 (De Mattei and Byrne 2009),[2] and 2006 (Sorondo 2007).[3]

During the course of continual controversies, some important revisions were made to the clinical criteria that constitute the original Harvard brain death criterion (henceforth referred to as the brain death standard, protocol, or paradigm for the purpose of clarity). The result is that the brain death standard has evolved to its current form as found in the guidelines advanced by the American Academy of Neurology (AAN; Wijdicks 1995; Wijdicks et al. 2010). However, it seems that within the Catholic circle, the revised elements of the updated brain death standard were overlooked by John Paul II's address in 2000 as well as omitted from the discussions of most scholars on both sides of the brain death debate. Therefore, the aim of this article is to examine systematically the evolution of the brain death standard in order to evaluate whether its revised criteria are medically justified, and more importantly, whether they are in accord with the fundamental tenets of Christian anthropology held and taught by the Catholic Church.

Evolution of the Clinical Criteria of Brain Death

To the public at large and many nonmedically trained scholars, including those involved in the long-standing brain death controversy, it seems that the brain death standard has remained basically unchanged. A brief look at the published literature reveals that such is not the case, however.

The Original Harvard Brain Death Criterion

The redefinition of irreversible coma by the Harvard Committee as a new standard for the determination of death represents a major paradigm shift since, according to medical dictionaries and encyclopedias prior to 1968,

> the medical definitions of death revolve around [. . .] one central theme: the cessation of all vital functions of the human body. In formulating the criteria for determining death, these traditional medical definitions do not isolate the function of any one organ; rather, they emphasize the total stoppage of all vital bodily functions, [. . .] as evidenced by absence of heartbeat and respiration, [. . .] beyond the possibility of resuscitation. These classical medical definitions of death give no special significance to the vital function of the brain, [rather, they] place *the definition of death on an integrated basis*, stressing the idea of total stoppage of bodily functions. (Arnet 1973, 221–22, emphasis added)

In other words, that the traditional medical definition of death is not centered on any organ (or organ system) necessarily indicates that it is drawn from a holistic vision of human beings in which no organ, however "noble" an organ it might be, holds supreme control over other organs or organ systems. In introducing the paradigm shift, the Harvard report set forth the following diagnostic criteria of brain death: (i) "unreceptivity and unresponsivity [, that is,] complete unresponsiveness [. . .] even [to] the most painful stimuli" (Harvard Medical School 1968, 337), (ii) no spontaneous breathing as documented by the apnea test, (iii) "no spontaneous muscular movements" (Harvard Medical School 1968, 337), (iv) no reflex, that is, not only brainstem reflexes are absent, but also "as a rule the stretch tendon reflexes cannot be elicited" (Harvard Medical School 1968, 338), and (v) flat encephalogram (EEG).

As pointed out by Adams (2001, xi), who was one of the thirteen members of the Harvard Committee and the neurologist responsible for drawing up the criteria of brain death, the essential characteristic that defines brain death is "a permanent state of 'complete unreceptivity and complete unresponsivity'." This means that every stimulus of any sort (e.g., excitatory, reflexive, and others) has no effect on the brain-dead individual, such that

clinical testing shows the absence of "all responses, whether brain stem, *spinal* or cerebral in origin" (Adams 2001, xi, emphasis added). Put differently, the diagnosis of brain death requires that the whole central nervous system (which consists of the brain and spinal cord) be silent.

Of note is the fact that, in advancing brain death as the new definition of death, the Harvard Committee did not provide any philosophical rationale to explain why a patient in irreversible coma (*coma dépassé*) should be considered dead. The justifications stated in the opening paragraph of the Harvard report (Harvard Medical School 1968, 337) pertain solely to the pragmatic and utilitarian order. The Committee's pragmatic approach reflected the mind-set of its chairman, Beecher (1968), for whom it is not only a waste of resources to keep the hopelessly unconscious patient on the ventilator, but society cannot "continue to condone the discard of [their] tissues and organs [. . .] when they could be used to restore the otherwise hopelessly ill but still salvageable individual" (p. 1425). Elsewhere, Beecher stated: "At whatever level we choose to call death, it is an arbitrary decision. Death of the heart? [. . .] Death of the brain? [. . .]. It is best to choose a level where, although the brain is dead, usefulness of other organs is still present" (Beecher and Dorr 1971, 120). In making such statements, Beecher seemed entirely unconcerned with the question of whether or not the Harvard new definition of death corresponded to a morally certain judgment of biological death.[4]

The Harvard criteria of brain death were endorsed by the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research in 1981. The Commission advanced a philosophical justification for brain death by adopting Bernat's thesis of the brain as the supreme master and central integrator of the body (Bernat, Culver, and Gert 1981)[5] and promulgated the Uniform Determination of Death Act (UDDA) which states:

> 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*. (President's Commission 1981, 2, emphasis added)

Thus, according to the UDDA, a diagnosis of brain death means that there should be no detectable brain activity of any sort. A brief look at the published reports over the last few decades, showing the evolution of the criteria of brain death, reveals a different picture, however.

Modifications to the Criteria of Brain Death Prior to the UDDA

The earliest modification to the brain death standard, which occurred well before the intervention of the President's Commission, has to do with EEG testing. The Harvard Committee strongly recommended EEG testing and stressed its importance (Harvard Medical School 1968, 338). Nevertheless, the EEG became an ancillary test and "was dropped from all U.S. criteria in the 1970s" (Teresi 2012, 102). Interestingly, this change came about in the wake of the Minnesota study in 1971. The study consisted of twenty-five patients, of whom only nine had EEG testing and two of these had "low voltage fast activity when they were pronounced dead" (Mohandas and Chou 1971, 216). On the basis of these results, the authors inexplicably concluded that an EEG is not necessary for the determination of brain death.[6] Objectively speaking, however, what de facto took place in the Minnesota study amounts to an overt disregard of the empirical evidence indicative of residual brain functions, which then permits patients to be declared brain-dead and, therefore, dead despite the fact that not all the criteria of brain death were met. As shown below, this has since become a recurrent pattern during the evolution of the brain death standard, following its formal establishment in 1981 by the President's Commission as a medicolegal policy enshrined in the UDDA.

With regard to the clinical criteria of brain death, the main difference between the Harvard Committee and the President's Commission is that in the latter case, tests such as EEG, cerebral blood flow, or brainstem-evoked potentials are considered optional. In other words, the standard clinical tests performed at the bedside are deemed sufficient for the determination of brain death. This very fact, together with the ambiguous clause in the UDDA, which states that death is determined "in accordance with accepted medical standards" (President's Commission 1981, 2), seems to be factors that perhaps have permitted the criteria of brain death to be altered even after the promulgation of the UDDA, to the point of contradicting the definition of brain death itself, which is "the irreversible *cessation of all*

functions of the entire brain" (President's Commission 1981, 2, emphasis added).

Modifications to the Criteria of Brain Death after the UDDA

The changes made to the brain death standard are of two broad categories. First, certain brain functions are classified as insignificant. Second, certain sensorimotor functions are deemed of spinal origin and thus considered irrelevant to the diagnosis of brain death. In defending these modifications, Bernat, whose philosophical rationale for brain death (Bernat, Culver, and Gert 1981) was adopted by the President's Commission, refined his original thesis, arguing that the definition of brain death refers to the "irreversible cessation of all *clinical* functions of the entire brain" (Bernat 1998, 18; 1999, 85, emphasis added) rather than the irreversible cessation of all functions of the entire brain. By "clinical functions," it is meant only those brain functions that can be tested at the bedside, namely, brainstem reflexes and respiratory drive.

Discarding the presence of alleged insignificant brain functions. Subsequent to the 1981 publication of the President's Commission report, it came to light that many patients, who met all the clinical test criteria of brain death, still demonstrated persistent brain functions or even spontaneous movements and elicitable reflexes. At least two types of continued brain functioning have been documented in brain-dead individuals.[7]

First is persistent cortical functioning as documented on EEG recordings. Notable in this regard is the article by Grigg et al. (1987) who reported a series of fifty-six patients who fulfilled the clinical criteria of brain death, of whom eleven demonstrated persistent EEG activity following the diagnosis of brain death. There were three patterns of EEG activity: (i) low-voltage activity in nine patients, (ii) one of these had α-like activity on the first EEG, and (iii) sleeplike activity in two patients. Nevertheless, Grigg et al. and brain death advocates have argued that such EEG activity in clinically diagnosed brain-dead patients merely represents some patchy islands of functioning neurons with recordable "random and purposeless cellular electrical activity" (Bernat 1999, 87), but these "do not contribute to the operation of the critical system [the brain] of the organism" (Bernat 2002, 337).

Such an argument is medically problematic, however. On the basis of which established criteria, can a personal judgment be made about (i) which nests of neurons are significant (giving rise to purposeful EEG activity), and which ones are not, in contributing to the integrated functioning of the brain? and (ii) what is the maximum number of surviving nests of neurons (and their location) to be allowed in brain death? Questions such as these cannot be answered because, as pointed out by Nguyen (2018a, 104, footnote 322), despite much progress in neurosciences,

> we still do not know much about the intricacies of brain functions. [In particular,] the brain represents about 2% of the body's weight, but it accounts for at least 20% of the body's energy consumption, 60–80% of which is related to the function of the brain. Yet, the changes reported in functional neuroimaging studies are no more than 1%. This indicates that the bulk of brain functionality consists of activity (referred to as intrinsic activity) other than that which can be elicited as responses to external stimuli. Recent data suggests that "this intrinsic activity exists in a highly organized manner at all times, and for a long while has been viewed as 'noise' in functional neuroimaging studies" (Raichle 2007, 74). The nature of this intrinsic activity remains to be elucidated.

While the definition of brain death "does not imply, nor require, the death of each and every neuron" (Grigg et al. 1987, 954), the very presence of residual EEG activity in brain-dead patients or organ donors certainly contradicts the UDDA which "requires, without qualification, that *all functions of the entire brain* must be gone" (Veatch 1993, 19). Changing the requirement of EEG testing from mandatory to optional thus becomes de facto the most expeditious way to dismiss the occurrence of EEG activity (however infrequent it might be) in brain death.

The second evidence of continued brain functioning is the function of the hypothalamo-pituitary axis as evidenced by the presence of antidiuretic hormone (ADH) secretion, which has been reported in many brain-dead patients (Arita et al. 1993, 64; Halevy and Brody 1993, 520). Persistent neuroendocrine ADH function is a more serious finding than the presence of EEG activity since the former, because of its critical role in water-electrolytes homeostasis, is responsible for maintaining the body in hemodynamic stability. Yet, brain death advocates such as Bernat (1999, 88) claim that "ADH secretion should not be classified as a clinical function because its

presence or absence is not assessed or detected on a usual clinical examination and requires a laboratory test for diagnosis." Here, Bernat (1999, 87) uses the term "clinical functions" to designate only those brain functions that can be evaluated at the bedside, such as brainstem reflexes. Such an argument, discounting the critical integrative function of ADH, is thus rather specious since it amounts to merely changing the meaning of the term "clinical functions" to suit the clinical criteria (i.e., the bedside clinical tests) of brain death. From the perspective of medical and scientific realism, it would be more objective to admit that the bedside clinical test criteria, which constitute the brain death protocol, are inadequate for the determination of brain death which, by definition and according to the UDDA, requires "the irreversible *cessation of all functions of the entire brain*" (President's Commission 1981, 2, emphasis added).

Discarding the presence of reflexes and spontaneous movements in brain death. As mentioned earlier, given that brain death defines death, there should be complete unresponsivity, that is, complete silence of the whole central nervous system, such that there should be no reflex of any sort and no spontaneous movements. However, there have been reports of reflex-reactions in brain-dead organ donors who, in response to surgical incision and sternotomy at the time of surgery for organ removal, manifested "dramatic increases in blood pressure and heart rate" (Wetzel et al. 1985, 126), "sweating and lacrimation" (Fitzgerald et al. 1995, 388),[8] as well as contraction of abdominal muscles upon incision of the parietal peritoneum, such that neuromuscular blocking agents or anesthesia had to be administered (Conci et al. 1986, 695).

In addition, there have been many reports of a wide range of stretch tendon reflexes and spontaneous movements (Ivan 1973; Ropper 1984; Heytens et al. 1989; Saposnik et al. 2000; Saposnik, Mauriño, and Bueri 2001; Saposnik et al. 2004, 2005; Saposnik, Basile, and Young 2009) including twitching of facial muscles, periodic leg movements similar to those occurring during sleep, respiratory-like movements, plantar withdrawal reflex, triple flexion reflex (in which tactile or noxious plantar stimuli trigger the flexion of the thigh, leg, and foot), among others. Most dramatic is the classic Lazarus sign, "a complex sequence of movements characterized by bilateral arm flexion, shoulder adduction, and hand raising to the chest/neck" (Saposnik et al. 2005, 312), which can be spontaneous or triggered by noxious stimuli such as the removal of the ventilator during apnea testing. According to the published literature, reflexes and spontaneous movements "are present in approximately 80% [of] patients up to 200 hours from brain death diagnosis" (Estol 2007, 14).

Brain death proponents have repeatedly asserted that the myriad of reflexes (autonomic and motor) and spontaneous movements in brain-dead patients are of spinal cord origin. As such, they are deemed insignificant; "they can be accepted without invalidating the BD [brain death] diagnosis and therefore organ procurement for transplantation" (Saposnik, Mauriño, and Bueri 2001, 210). Hand in hand with this assertion is the claim that the integrative functions of the spinal cord are not critical (Bernat 1998, 18). Such arguments raise difficulty, however, especially since the pathophysiological basis to account for movements in brain death has remained speculative, and there has been "no definitive empirical evidence to prove that the spinal cord is the *sole* source of sensori-motor reflexes and complex movements in 'brain death'" (Nguyen 2018a, 108, emphasis original). Moreover, as Karakatsanis (2008, 397) points out, not a few of these alleged spinal reflex movements "are very similar to some stereotyped movements mediated by the brain stem," which implies that some areas of the brain stem may still be viable and functioning.[9]

Even if reflexes and spontaneous movements in brain death were to be entirely from the spinal cord, the question still remains: on which basis can it be claimed that the integrative function of the spinal cord is noncritical? Anatomically,

> the spinal cord is an integral part of the central nervous system, in full continuity with the brain as there are neural tracts running in both directions. If no dividing line exists (whether macro- or microscopically) then why do the reflexes above the foramen magnum (brainstem reflexes) qualify as critical and clinical functions, while those below it (spinal reflexes) are dismissed as irrelevant? (Nguyen 2018a, 109; see also Veatch 1993, 21; Shewmon 2001, 469–70)

Indeed, it is rather difficult to assert that "brain stem reflexes are more integrative of bodily functions," when several of the spinal reflexes involve movements more complex than those of brainstem reflexes (Veatch 1993, 21). Here, it is also worth noting that the integrating role of the spinal cord is not as insignificant as claimed, since spinal cord

transaction at the level of the second vertebra (which causes no injury to the brain stem) produces irreversible apnea, as well as cardiovascular instability and hypothermia or poikilothermia, all of which are symptoms indistinguishable from those seen in brain death (Youngner and Bartlett 1983, 254; Shewmon 1999, 315, table 1). In other words, certain important integrative functions that have been emphasized to be unique to the brain stem are actually also handled by the spinal cord.

Scientific Realism: Difficulties with the Modified Criteria of Brain Death

As shown in the above discussion, the various alterations made to the clinical criteria of brain death reveal the following common pattern: the claims that certain laboratory findings (residual EEG activity and ADH secretion) are insignificant and that the bedside clinical evidence of bodily reflexes and spontaneous movements are irrelevant, yet without any convincing or firm medical grounds to account for such claims. Because biological functions and processes are natural phenomena and, as such, mind-independent realities, the distinction between significant and insignificant functions cannot be merely based on the subjective view of the observer but rather on "the objective nature and intrinsic end of the functions" themselves (Nguyen 2018a, 110), which is an approach grounded in scientific realism. The intrinsic end of reflexes, whether of brain stem or spinal origin, is to ward off a noxious stimulus. The main difference between brainstem and spinal reflexes has to do with their respective "field of operation: brainstem reflexes serve the facial organs, whereas spinal reflexes serve the rest of the body" (Nguyen 2018a, 110). In other words, on the basis of scientific realism, spinal reflexes are just as important as brainstem reflexes.

Since medicine is an empirical science, scientific realism should be a guiding norm of clinical medicine, especially when it comes to the determination of death.

> Realism demands that our concepts (along with the language we use to formulate those concepts) correspond as closely as possible to the reality outside our mind. Therefore, if a scientific thesis is not supported by empirical evidence, then it must abandoned, or if possible, substantially revised to reflect reality. (Nguyen 2018a, 260)

Therefore, on the basis of scientific realism, the fact that brain death was introduced as a new definition of death (albeit without any prior scientifically validating studies),[10] and formally established as a standard for the determination of death, necessarily requires that the concept of brain death, in order to be a valid concept, corresponds to the reality of the phenomenon of death. As a universal phenomenon applicable to all living things; death is biologically defined as "the permanent cessation of the organism as a whole" (Bernat, Culver, and Gert 1981, 390). As pointed out by Culver and Gert (1982, 182),

> death is a biological phenomenon and should apply equally to related species. When we talk of the death of a human being, we mean the same thing as we do when we talk of the death of a dog or a cat. This is supported by our ordinary use of the term death, and by law and tradition. It is also in accord with social and religious practices and is not likely to be affected by future changes in technology.

The above passage contains the timeless common sense truth about death, namely that, because humans are warm-blooded mammals, the constellation of biological signs indicative of human death is no different from that seen in the death of other types of mammals. Thus, a side-by-side reading of the above passage and the current guidelines of the AAN for the determination of brain death brings into relief the difficulties posed by the evolution of the brain death protocol. According to the AAN guidelines:

(i) EEG testing and other laboratory studies such as cerebral blood flow are optional. Specifically, the 2010 AAN guidelines specify, that "in adults, ancillary tests are not needed for the clinical diagnosis of brain death and cannot replace a neurologic examination" (Wijdicks et al. 2010, 1916).

(ii) "normal blood pressure and absence of diabetes insipidus [which confirm the presence of persistent ADH] are compatible with brain death" (Wijdicks 1995, 1007),

(iii) "spontaneous movements of the limbs [deemed to be] from spinal mechanisms, [. . .], respiratory like movements, [. . .] profuse sweating, blushing, tachycardia, and sudden increase in blood pressure, [. . .], muscle stretch reflexes, superficial abdominal reflexes, and Babinski reflexes [. . .] do not invalidate a diagnosis of brain death" (Wijdicks 1995, 1007).

The AAN guidelines pose at least three difficulties. First, "without the use of ancillary tests, the determination of the US-based 'whole brain death' is *identical* to that of the UK-based 'brainstem death'" (Nguyen 2016, 262, emphasis added). Yet, as pointed out by Shewmon (1989, 603) in the passage below, while "brainstem death" can be predictive of death, it is not the death of the human organism.

> That "brain-stem death" is not personal death follows from the fact that cerebral dysfunction induced by the former is, in theory, potentially reversible, by means of the stimulation of the reticular activating system rostral to the brain-stem lesion. In fact this has actually been accomplished in humans who have become comatose from various brain-stem lesions.

In other words, it is rather specious to insist that brain death means the death of the whole brain and, at the same time, limit the criteria of brain death to those of "brainstem death." Such a conflation of "whole brain death" with "brainstem death" has an ethical impact: how many brain-dead donors with brain activity, but without EEG testing, have been sent to and will be sent to organ removal?

Second, as previously shown, the claim that persistent secretion of ADH is compatible with brain death is basically a direct violation of the UDDA, according to which brain death signifies "the irreversible *cessation of all functions of the entire brain*" (President's Commission 1981, 2, emphasis added).

The third difficulty concerns reflexes and spontaneous movements. On the one hand, the AAN states, "the three cardinal findings in brain death are coma or *unresponsiveness*, absence of brainstem reflexes and apnea" (Wijdicks 1995, 1005, emphasis added). On the other hand, it also declares that the presence of autonomic and motor *responses*, as well as spontaneous movements of the limbs, does not invalidate a diagnosis of brain death. These two statements clearly show an inherent self-contradiction in the reasoning of the AAN, since they basically assert that brain death is a state of unresponsiveness in which the patients can manifest autonomic and motor responses.

Even brain death advocates have to admit that "the occurrence of movements in a dead person is no doubt a counterintuitive phenomenon" (Estol 2007, 13). The concept of brain death was introduced as a new definition of death, and human death, biologically speaking, is no different from the death of a dog or cat. As mentioned above, the UDDA was promulgated by the President's Commission as part of its endorsement of the Harvard brain death standard that requires the complete silence of the nervous system. Therefore, the inclusion of reflexes and movements as something compatible with brain death effectively falsifies the judgment that a particular patient is brain-dead according to the UDDA. Stated differently, because death entails "the permanent cessation of the organism as a whole" (Bernat, Culver, and Gert 1981, 390), the AAN guidelines for brain death directly contradicts the reality of the phenomenon of death.

Death is both a metaphysical event (the separation of the soul from the body) and a biological phenomenon that consists of a constellation of recognizable signs indicative that a person has died. Cantor (2010, 76–77) gives the following succinct description of the phenomenon of death, that is, the natural disintegration of a dead body (a corpse):

> A corpse will unfailingly putrefy and disintegrate. The process begins within minutes of death. [. . .] Blood drains from the surface capillaries and enters the deeper veins, leaving the skin paler than in life. [. . .] Within a couple of hours, [. . .] blood accumulates in the lower body parts, creating there a purple discoloration known as "livor mortis." [. . .] The discoloration disappears in the embalming process when blood is drained from the corpse. Within forty-eight hours a greenish black palette of bacteria growth appears on patches of skin. [. . .] Putrefaction—the dissolution of the corpse into liquids and gases generally begins within minutes of death and becomes noticeable within two to three days. [. . .] The microbial action of the bacteria, together with the destructive enzymes flowing from cell breakdown, gradually liquefies soft tissue. Organs are the first parts to liquefy, starting with the eyes and proceeding to the brain, stomach, and liver. [. . .] Higher temperatures speed up the decay process, while lower temperatures retard it. Artificial interventions such as chilling, freezing, or embalming delay decay.

The above-described natural biological phenomenon of death corresponds to what is known as the process of unstoppable increasing entropy

(Schrödinger 1956, 71–73), which takes place immediately after true death and which no technological intervention can reverse (Culver and Gert 1982, 182; Shewmon, 2012, 440). Since this phenomenon applies equally to related species, namely, warm-blooded mammals, it is necessarily a universal phenomenon and, as such, it transcends cultural, religious, social, and legal practices. This means that the phenomenon of death is mind independent and therefore not "open to revision or stipulation" (Nair-Collins 2010). Scientific realism demands that we formulate our concept of death (i.e., our medical definition of death as well as the criteria employed for the determination of death) in a way that it reflects the reality of the phenomenon of death as closely as possible. In other words,

> changing the meaning or definition of death (word or concept)—that is, changing the criterion or determining death to make it correspond to something else—does not and cannot alter the nature of biological death (phenomenon). Conflating words or concepts with external reality as if the latter could be manipulated by manipulating the former, can only result in epistemic confusion. (Nguyen 2018a, 261)

Some pro-brain-death scholars have argued that "in the past, death implied immobility. However, the criteria of BD [brain death] have evolved as a result of increasing scientific evidence and legal and ethical requirements" (Saposnik, Basile, and Young 2009, 158; see also Saposnik et al. 2005, 222; Estol 2007, 15), such that today it is permissible to declare a patient with irreversible coma dead who manifests reflexes and spontaneous movements. On the basis of the above discussion on the phenomenon of death, it seems that, in advancing such an argument, these scholars have overlooked the fact that modifying the criteria for death can never change the nature of the phenomenon of death.

To reiterate, the revised brain death standard set by the AAN guidelines brings into focus the very question that has been at the center of the brain death debate: are brain-dead organ donors dead at the time of organ removal? In other words, is brain death synonymous with human death? Here, the words of Saposnik, a pro-brain-death scholar, are revealing:

> In the AAN guidelines, the presence of spinal reflexes does not preclude the BD [brain death] diagnosis. The occurrence of movements in HBCs ["heart-beating cadavers"] sometimes causes confusion among caregivers and family members, who may question the very diagnosis, and ultimately delay organ procurement for transplantation. *A patient fulfilling the criteria for BD ultimately succumbs to cardiac arrest,* which usually occurs within a few days following the diagnosis.[11] (Saposnik, Basile, and Young 2009, 158, emphasis added)

The above passage basically describes that brain death is a condition predicting that cardiac arrest will occur within a short period of time. A patient who will succumb to a cardiac arrest within a few days is necessarily a dying patient and not a dead body (a corpse). In other words, declaring a patient dead on the basis of the AAN guidelines for brain death amounts to conflating *dying* with *dead*.[12] The first is a process at the very end of life, the second an irreversible event and, in metaphysical terms, an instantaneous substantial change (Ramellini 2009, 45).

Catholic Anthropology and the Clinical Criteria of Brain Death

From the Judeo-Christian perspective, death is a single and irreversible metaphysical event (lest divine intervention occurs), the separation of the soul from the body, the exact moment which "*no scientific technique or empirical method can identify directly*" (John Paul II 2000, no. 4, emphasis original). On the one hand, the Church acknowledges that the determination of death "cannot be deduced from any religious and moral principles" (Pius XII 1957) and that it pertains to the medical profession to identify "*the biological signs that a person has indeed died*" (John Paul II 2000, no. 4, emphasis original). On the other hand, the Church recognizes that she bears the moral "duty of comparing the data offered by medical science with the Christian understanding of the unity of the person" (John Paul II 2000, no. 5). Therefore, to engage herself in the brain death controversy means that the Church must evaluate whether or not the brain death standard coheres with the sound tenets of Christian anthropology. In other words, the Catholic discourse on brain death cannot remain solely or primarily on the philosophical or ethical level, but rather it must also critically consider the clinical criteria that constitute the brain death protocol. This is necessary for two reasons. First, the investigation of a bioethical issue entails a triangular approach: (i) it begins with a critical examination of the empirical data, (ii) it then proceeds to a discourse on philosophical anthropology,

and (iii) it finally arrives at an ethical conclusion (Nguyen 2018a, 496). Second, the Church's anthropology follows the Aristotelian–Thomistic substance view of human nature, which is a view grounded in a realism-based approach.

In light of the above discussion, a look at the publications of Catholic scholars on the brain death controversy reveals two important differences between those who stand against brain death and those who are pro-brain death. The first difference regards the interpretation of the empirical medical evidence. The first group recognizes that brain-dead patients, instead of undergoing the rapid process of somatic disintegration seen in cadavers (of humans or of warm-blooded mammals) left at room temperature (Cantor 2010, 76–77), manifest a whole host of life-integrative functions, ranging from the capacity of assimilating nutrients and excreting waste to the capacity to undergo bodily growth and sexual maturation (Shewmon 1998, 2001; Austriaco 2016). The second group, however, discounts the same medical evidence with the following argument: the brain-dead patient is dead but, because of the prowess of medical technology, there remains coordination between the organs of the body, thus producing a semblance of somatic integration (Condic 2016, 272–74). In other words, according to this argument, "death is camouflaged or masked by the use of [an] artificial instrument" (Battro et al. 2008, 13), namely, the ventilator and the use of pharmacological agents. Such a claim that artificial devices can mask death and make the brain-dead body to appear integrated contradicts the principle of proportionate causality, however. According to this principle, what is present in an effect must also be in some way present in its cause, that is, a cause cannot produce that which it does not have in itself. As pointed out by Accad (2015, 224), the "masking death" claim necessarily implies that

> the ventilator [. . .] which only manifests a simple power of insufflation, can account (momentarily for the very complex effect of bodily integration. [. . .] But the ventilator has no power to control homeostasis, circulation, digestion, growth, or any other such function, even for a millisecond. Insufflation of air in and out of the chest—even if supplemented by intravenous infusions of metabolically active drugs—cannot extend in time the myriad motions which must occur to keep the body integrated and working as a unitary whole.

Most of the rationales in defense of brain death include the abovementioned 'masking death' argument since they are variations of Bernat's thesis of the brain as the master organ necessary for organismic integration. An exception to this is the rationale advanced by Lee and Grisez which, instead of following Bernat's thesis, acknowledges that the medical evidence presented by Shewmon (1998, 2001) has disproved Bernat's thesis. Thus, Lee and Grisez admit that organismic life is present after brain death. Nevertheless, they argue that because brain death results in the loss of the radical capacity for sentience, and since sentience is a prerequisite for rational operations, "what is alive after total brain death is neither the individual whose brain died nor a whole member of the human species" (Lee and Grisez 2012, 277). In other words, according to their thesis, "the loss of the radical capacity for sentience [. . .] involves a substantial change, the passing away of the human organism" (Lee and Grisez 2012, 275). What is left is "a large living entity" (Lee and Grisez 2012, 279, 281) of an unknown species. Lee and Grisez's rationale raises several difficulties that cannot be fully discussed in this article.[13] Suffice it to say that the most overt difficulty is that it seems to contradict biological reality. If it is true that the postbrain death large living entities are nonhuman organisms, then how is it possible that they perform vegetative functions in a human way, such as the gestation of a human baby (with genetic features of its brain-dead mother) to the stage when the latter can be delivered safely and that they "harbor organs composed of matter perfectly well disposed for transplantation into humans?" (Accad 2015, 228). As Nguyen (2018b, 419) points out,

> What is puzzling, however, is that although the human patient no longer exists, the very same corporeal features which are characteristic of the human species and specific to that particular patient perdure in the new nonhuman [large living] entity, both structurally and functionally (e.g., the identical organization of bodily organs working together in an integrated human way). In Scholastic language, this is a situation in which the original *subiectum* has disappeared, yet its proper accidents still persist in existence. In other words, in defense of their thesis of substantial change, Lee and Grisez must provide a coherent metaphysical account to explain how "certain accidents might be kept in existence [. . .] even when their original and proper subject no longer exists" (Wippel 2000, 229). According to the

> Aristotelian-Thomistic tradition, such a phenomenon in the natural order is metaphysically impossible. The one and unique instance in which a substantial change occurs and yet the original accidents remain belongs to the supernatural order: the case of Eucharistic transubstantiation.

The second difference regards the critical examination of the clinical criteria of brain death. While this work has been carried out by some critics of brain death (Shewmon 2001, 469–70; Nguyen 2016, 263–67; 2017, 164–65), it is notably absent in the writings of pro-brain-death Catholic scholars and those of the Pontifical Academy of Sciences. Such a lack can be explained by the fact that many of these scholars are not scientists but philosophers whose focus, therefore, is to examine the brain death issue from the philosophical perspective. Nevertheless, as mentioned earlier, a key step in the investigation of a bioethical issue is a critical evaluation of the empirical evidence. In this regard, the question at stake is whether the criteria of brain death are compatible with the Church's anthropology which is grounded in Aristotelian–Thomistic hylomorphism (known in contemporary terminology as the holistic substance view of human nature).

According to Aquinas's view of human nature,

> the first principle by which the body lives is the soul. And as life is manifested through various operations among the different degrees of living things, that by which we primarily perform each of all these vital actions is the soul. For *the soul is the primary principle of our nourishment, sensation, and local movement; and likewise of our understanding*. (Thomas Aquinas 1947, ST I, q. 76, a. 1, emphasis added)

The above passage contains the most fundamental tenets of the Church's anthropology: a living human person is the substantial union of body and soul. To be alive and to be ensouled are coextensive. By substantial union, it is meant that the soul "must necessarily be in the whole body and in each part thereof" (Thomas Aquinas 1947, ST I, q. 76, a. 8), that is, the presence of the soul in the body is nonlocalized; the soul is not "tied" to the functioning of any specific organ. Because the soul is the life principle of the body, without the soul, the body is not a body properly speaking, but a corpse, a cadaver. Precisely because life is made manifest though a wide range of activities that include vegetative, sensorimotor functions, and cognitive functions, "we say that a thing lives if but one of these [functions] is present" (Aristotle 2002, Book II, 413a23–25). The vegetative, sensorimotor, and intellective capacities are related to one another in a strict ontological hierarchy in which the lower functions are a prerequisite for the existence of the higher functions (Aristotle 2002, Book II, 414b28–32). The "lowest" (i.e., the most foundational) capacity which is the precondition for the existence of other capacities, and in virtue of which a living thing has life, is the vegetative capacity. Put differently, the presence of vegetative functions is by itself a necessary and sufficient condition to indicate that the body is alive and still ensouled. Conversely, death necessarily entails the loss of the vegetative capacity and therefore the stoppage of all vital bodily functions.

On the basis of the above discussion, the question, whether the current brain death standard for the determination of death is compatible with the fundamental tenets of the Church's anthropology, can be answered in a straightforward manner. According to the AAN guidelines, normal cardiovascular hemodynamics and persistent ADH secretion are compatible with brain death. According to the tenets of sound anthropology, these are functions that manifest the vegetative capacity of the soul in brain-dead patients, however. Likewise, the AAN also considers the occurrence of reflexes (autonomic and motor) and spontaneous movements as being compatible with brain death. However, such reflexes and movements are manifestations of the sensorimotor power of the soul and thus the presence of the soul itself. Thus, it is self-evident that the current brain death standard, which has been in effect since 1995, is overtly incompatible with the Church's anthropology. That a protocol for the determination of death also includes criteria corresponding to the signs of life is in itself incoherent.

Thus, it is rather puzzling that, in his address to the Eighteenth International Congress of the Transplantation Society in August 2000, John Paul II (2000, no. 5) states, "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."[14] In all likelihood, it appears that the pope's address did not taken into consideration the 1995 AAN guidelines for brain death nor the many published reports about persistent signs of life in brain-dead patients, especially chronic brain death survivors (Shewmon 1998).

More puzzling is the official statement of the Pontifical Academy of Sciences (i.e., the summary

statement of its 2006 working group) *Why the Concept of Brain Death Is Valid as a Definition of Death*. The Academy's statement affirms that (i) "brain death is not a synonym for death, does not imply death, or is not equal to death, but 'is' death" (Battro et al. 2008, 5) and (ii) "the criterion of brain death is in conformity with the 'sound anthropology' of John Paul II" (Battro et al. 2008, 9).[15] In other words, the Academy asserts that brain death is death *simpliciter* and that it is compatible with the Church's anthropology. What is rather troubling is that the Pontifical Academy of Sciences made these affirmations despite knowing fully about the occurrence of movements in brain death. This topic was presented by Estol (a signee of the Academy's statement) at the 2006 working group. Estol (2007, 13–16) wrote:

> The occurrence of movements in a dead person is no doubt a counterintuitive phenomenon. [. . .] These include spinal cord reflexes that are present in approximately 80% of patients up to 200 hours from brain death diagnosis. [. . .] These movements may occur spontaneously and also with stimulation during tube and other device removal from the dead body usually within minutes from the determination of death. [. . .] Movements observed at the surgical table during organ harvesting have been used as the argument to question the reliability and validity of the concept of brain death. [. . .] In this context, death is not necessarily a synonym of immobility and movements can be seen in certain patients with [a] recent diagnosis of brain death. These movements do not question the accuracy of a brain death diagnosis.[16]

It is rather inexplicable that none of the prelates who attended the 2006 working group and signed the Academy's statement raised any critique on the issue of the occurrence of movements in brain death. At the same conference, it was also accepted that persistent ADH secretion (and, therefore, the lack of diabetes insipidus and hemodynamic instability) "cannot be taken as evidence against the concept of brain death" (Deecke 2007, 191).[17] In its official statement, the Academy also explicitly indicates that the persistent production of ADH is merely one of the "spurious arguments" against brain death (Battro et al. 2008, 10). Thus, in declaring that brain death is death, the Pontifical Academy of Sciences de facto fully accepts the AAN guidelines,[18] even though such a position directly contradicts the Church's anthropology.

What then is the anthropology undergirding the brain death protocol? At the core of most arguments in defense of brain death is the thesis that the brain is the critical organ responsible for the somatic unity (i.e., the integration) of the human organism. Stated differently, the brain is exalted as the master part to which all other parts of the organism are functionally subordinated. Such a thesis necessarily entails that the master part (the brain) is "self-regulating [i.e.,] functionally subordinate to itself" (Hoffman and Rosenkrantz 1996, 128). The question raised, however, is as follows: how does the master part account for itself, given that no material thing, especially when it is composed of heterogeneous elements, can "be its own cause of integration since an external agent is necessary for efficient causality" (Accad 2015, 222). Another part would have to be the agent to integrate and regulate the master part, in which case that part itself becomes the master part, thus leading to an infinite regress.

Thus, the exaltation of the brain over the rest of the body effectively produces a brain–body dualism reminiscent of Descartes's mind–body dualism (Shewmon 2009, 249; Nguyen, 2018a, 355–56).[19] In other words, the thesis of the brain as the master part treats the brain as if it were an independent entity in its own right and not an organ of the body, even though biologically, the brain itself is an organ of the body, and as such, it is a part of the organic whole. Both the Aristotelian–Thomistic substance view and holistic contemporary biophilosophy uphold the twofold axiomatic principle, that the organic whole is greater than the sum of its parts and that it is *ontologically prior* to its parts. The corollary of this axiomatic principle is that no part can account for itself, let alone for the organic whole which, in this case, is man, the living human organism (Nguyen 2018a, 354–55, 367–78). This corollary may raise the following objection: it is false to say that no single part can be necessary for the continued existence of the whole since the soul itself is a part of the whole and accounts for the life of the whole. If this is true of the soul, why should it not be true of the brain? The answer to such an objection is straightforward. First, the term "parts" in the twofold axiomatic principle refers to material parts. The soul is immaterial, however. Second, metaphysically speaking, the soul is the substantial form of the body, that is, the *principle* that brings the organism (and therefore, the body) into existence. This means that the human soul is the principle of life, the *entelechia* that makes the human body to become what it is; hence, the soul is ontologically prior to the body, that is, the organic whole (Aristotle 2002, Book II,

412a27). In contrast, the brain is ontologically posterior, arising from within the body of the human organism as the latter grows and develops from a zygote to a newborn.[20] As Persson (2002, 22–23) points out,

> humans [. . .] begin to exist and live [as a zygote] before they acquire a brain. Being alive, they can obviously die, i.e. lose their life, but their death cannot possibly consist in the death of their brains, since they have no brains. Consequently, the death of a brain cannot be a logically necessary condition for the death of a human being or animal organism.

Thus, every bodily organ and part—be it the heart, the brain, or some other organ—comes into existence after the human organism itself has come into existence. This is why no part can be the master organ to account for the organic whole. This concordance between the empirical biological evidence and the twofold axiomatic principle about the organic whole and its parts is further confirmed by recent studies in holistic contemporary biophilosophy.[21]

With the shift in contemporary biophilosophy from a Cartesian mechanistic to a holistic approach (i.e., the systems view approach) since the mid-twentieth century, scholars in biophilosophy have come to understand "that living organisms are complex, dynamic, hierarchically organized closed network systems"[22] (Nguyen 2018b, 425). Along with this understanding is the recognition that one of the key characteristics of living organisms (from a simple unicellular organism such as an ameba to a highly complex mammal such as the human organism) is "*the reticular or circular character of their organization*" in which the parts are connected in a complex network of circular functional codependencies (Bich and Damiano 2012, 392, emphasis original). The following simplified sketch is an example of such circularity:

> (i) every part in the body depends on blood circulation to receive its required nutrients and eliminate its waste; (ii) but the blood itself must be pumped, hence its dependence on the heart; (iii) the blood must also be properly oxygenated and cleared of excess carbon dioxide, hence its dependence on the alveolar lining of the lungs; (iv) the inflation of the lungs, in turn, needs the activity of the diaphragm (and intercostal muscles); (v) the activity of the diaphragm requires the neural input from the midbrain respiratory center; and (vi) the latter, in turn, needs to be triggered by some increase of carbon dioxide in the blood. (Nguyen 2018a, 373–74, footnote 1166)

The biological phenomena described in the above simplified example shows that, in the human organism, "the activity of regulation is due to a circular causal interaction" among the organs and parts (Bich and Damiano 2012, 393). In other words, although some parts may be more important than others, no specific part, organ, or process is the center of causal control to account for the integration of the living organism (Marcum 2009, 6).

Conclusion

Although the practice of brain death has spread worldwide because of the needs of organ transplantation,[23] today "doubt [about its validity] has become an international consensus" (Brugger 2016, 355). This has come about as scholars from various disciplines have demonstrated the many serious flaws inherent in the brain death paradigm itself, both at the empirical–medical and conceptual–philosophical levels. The medico–legal–political climate has been such that many physicians and the general public have remained for the most part uninformed about theses flaws, however.

This article has shown that one of these serious flaws is found in the clinical criteria of brain death itself. The modifications of these criteria, put into effect in order to uphold the clinical practice of brain death, have actually brought this particular flaw into focus. This flaw is none other than the intrinsic incoherence of "brain death": it is a definition of death (by which it is meant that brain death is death *simpliciter*), and at the same time, it permits the declaration of death to be made on patients who still manifest the signs of life. The proof of this very fact is contained in the AAN guidelines themselves, which admit the presence of ADH secretion and the occurrence of reflexes and movements as being compatible with brain death and, therefore, with death *simpliciter* itself. By such an admission, the AAN criteria contradict not only the UDDA but also the sound tenets of Catholic anthropology.

The determination of death is a practical and serious issue. Hence, the question which every person needs to pose, especially if he or she is a Catholic physician, irrespective of whether or not he or she has a full grasp of the complexities of the brain death controversy, is the following: is it permissible that a protocol (here, brain death) is being used for the

determination of death (i.e., to establish that a person has died) when it includes among its clinical criteria various signs of life? Put more bluntly: "which undertaker would be willing to proceed with funeral procedures [. . .] on individuals with the diagnosis of 'whole brain death' prior to the removal of their organs" (Nguyen 2019)?

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Notes

1. The term "brain death," which in this article refers to "whole brain death," is placed in quote marks because of its inherent semantic ambiguity. Since the use of such quote marks may be construed as polemical, they are only used in the title of this article, and the first time the term is used in the abstract, the summary, the body of this article itself, and where it appears originally in citations. For details on the semantic ambiguity of brain death, see Shewmon (1992).
2. Note that this book has two titles: (i) the title as cited here, which sums up the content of the book itself, is found on the title page inside the book and (ii) the title *Finis Vita: Is "Brain Death" True Death?*, mentioned only on the cover page.
3. Note that both the working group of February 2005 and that of September 2006 carry the same name, *The Signs of Death*. It is not the scope of this article to discuss the politics within the walls of the Vatican with regard to these two working groups. Suffice it to mention two notable points of divergence: (i) the 2005 working group was critical of the validity of "brain death," while the 2006 working group (being composed quasi-exclusively of pro-brain-death scholars) affirmed that brain death is death; and (ii) the Pontifical Academy of Sciences cancelled the publication of the proceedings of the 2005 working group, whereas it reissued the summary statement of the 2006 working group, *Why the Concept of Brain Death Is Valid as a Definition of Death*, in a special monograph in 2008 and at the same time adopted it as its official statement on brain death.
4. For more details on Beecher's approach to medical ethics, see Belkin's (2014) chapter "The Justification: Beecher's Ethics" (pp. 51–91).
5. On page 391, Bernat's thesis asserts that "the brain is necessary for the functioning of the organism as a whole. It integrates, generates, interrelates, and controls complex bodily activities. A patient on a ventilator with a totally destroyed brain is merely a group of artificially maintained subsystems since the organism as a whole has ceased to function." It is not the scope of this article to discuss the validity of Bernat's thesis of the brain as central somatic integrator. Suffice it to mention, however, that Bernat's assertion of "totally destroyed brain" has not been confirmed by postmortem studies. Moreover, postmortem examinations of the brains of brain-dead organ donors are rarely performed.
6. The authors of the Minnesota study argued that "a decision of brain death can be made based on clinical judgment alone" on the grounds that "to insist that electroencephalographic confirmation is necessary for brain death 'would be unduly restrictive on the practice of medicine and would take from the physician the value of competent judgment and relegate it to a machine'" (Mohandas and Chou 1971, 217).
7. Conceptually, there is a distinction between the notions "functioning," "activity," and "function." On the one hand, the "functioning" of an organ, however suboptimal it might be, implies that one or more of its functions are still present. On the other hand, the terms "function" and "activity" are interchangeable with one another in most instances, but not always. For instance, "neuroendocrine function" is synonymous with "neuroendocrine activity" as both terms refer to the presence of the secretion of one or more of the pituitary hormones, each of which affects the systemic functioning of the human organism. The presence of neuroendocrine function/activity, such as the production of antidiuretic hormone by the posterior hypothalamic axis is thus indicative of brain functioning. The electrical activity of the brain (encephalogram [EEG] activity) in brain-dead patients, however, does not seem to correspond to any purposeful function (i.e., function in response to inputs external to the brain) that we can measure or know of at this point. Thus, it may be concluded that the presence of mere electrical activity cannot be taken as evidence of brain functioning. This would be a rather oversimplified conclusion for two reasons, however. First, we have very little knowledge about the *intrinsic functions* of the brain (i.e., those functions that are not responses to inputs external to the brain), which, in terms of the brain energy consumption, seem to be the more significant aspect of brain functioning. It cannot be excluded that the EEG activity observed in some brain-dead patients could reflect such intrinsic functions. In his discussion on the intrinsic function of the brain, Raichle (2007) states: "the challenge we face is how to evaluate an aspect of brain functionality that is not directly related to the

performance of an observable task" (p. 74). Second, we do not even have an adequate knowledge about those functions that we know about. A paradigmatic example is consciousness. Consciousness has at least two dimensions: (i) the *level* of consciousness that refers to the level of wakefulness and is quantifiable (e.g., by the Glasgow Coma Scale) and (ii) the *content* of consciousness that refers to the first-person experience of being aware of something. Conscious "awareness is a deeply private matter, inaccessible to observation by third parties," however (Zeman 2006, 371). What is there to exclude that the EEG activity observed in a brain-dead patient could reflect the fact that he has perceptual awareness of his surroundings even though he is unable to produce a response?

8. Karakatsanis (2008, 399) points out that "lacrimation in brain-dead patients is an evidence that the lacrimatory nucleus in the brain stem is viable."
9. The two examples given by Karakatsanis (2008, 397) are "the rotational movement of the head (controlled by the interstitial nucleus) and the raising and flexing movements (controlled by the prestitial and precommissuralis nuclei, respectively) of the head and body."
10. "Medicine is an empirical science; every test procedure and medical product must be validated through various phases of rigorous testing before they can be put to use in clinical practice. Yet, the Harvard report cited no medical studies or any patient data that would validate the clinical tests put forth for establishing 'brain death' and equating it with death" (Nguyen 2016, 264). The only reference in the Harvard report was the speech of Pope Pius XII on the Prolongation of Life.
11. See also Saposnik et al. (2000). Saposnik's statement echoes the words of Soifer and Gelb (1989, 815–16, emphasis added) who stated: "After brain death has been declared, the management of patients [heart-beating donors] consists of intervening in the natural course of events leading to somatic death. *Somatic death closely follows the declaration of brain death*. Despite all efforts to maintain the donor's circulation, irreversible cardiac arrest usually occurs within 48 to 72 hours of brain death in adults. [. . .] Indeed, *general acceptance of the concept of brain death depended on this close temporal association between brain death and cardiac arrest*."
12. This serious issue of conflating death with dying has been raised by several authors. See, for instance, Truog (1997, 30), Karakatsanis (2008, 400), Verheijde and Rady (2014, 556).
13. For a detailed critique of Lee and Grisez's rationale, see Nguyen (2018a, 159–78, 271–72, 292–301; 2018b, 410–22).
14. For a critical analysis of John Paul II's address, see Nguyen (2017; 2018a, 463–80).
15. The sound anthropology of John Paul II is the same Christian anthropology held and taught by the Church, according to which death signifies the separation of the soul from the body and consequently, somatic disintegration.
16. During the same conference, Lüder Deecke (a neurologist and signee of the Academy's Statement) also stated that such movements can occur when "the nurse gives an injection or the [blood pressure] cuff is laid on or the [blood] specimen is taken for compatibility [in preparation for organ harvesting]. Then the dead patient can make withdrawing movements, even those that would give points in the Glasgow Coma Scale" (Sorondo 2007, 20).
17. At the same conference, Ropper (a signee of the Academy's statement) also affirms that "the retention of antidiuretic hormone" does not negate brain death (Ropper 2007, 245). See also Sorondo (2007, LX).
18. Note that many of the signees coauthoring the Academy's official statement that brain death is a valid definition of death are themselves well-known pro-brain-death scholars, such as Bernat, Ropper, and Widjdicks, the author of the AAN guidelines for the determination of brain death.
19. For more details on the connection between the Cartesian mind–body dualism and the contemporary brain–body dualism, see Nguyen (2018a, 348–57).
20. Modern embryology confirms that the brain is ontologically posterior to the human organism as a whole: the neural grove, the earliest evidence of the development of the central nervous system, does not appear until the third to fourth week of gestation when the heart has already developed and begun to pump blood.
21. Holistic contemporary biophilosophy, also referred to as systems biology, involves various disciplines. It can be considered as the modern counterpart of Aristotle's philosophy of nature. For a detailed treatment of contemporary biophilosophical understanding about life and death, especially with respect to the issue of brain death, see Nguyen (2018a, 359–425).
22. An example of hierarchical organization is the organization of cells into tissues, tissues into organs, organs into organ systems, and organ systems into the organism as a whole. The term "hierarchical organization" does not imply a causal center (a master organ) responsible for the functioning or integration of the living whole (Bich and Damiano 2012, 393).
23. Even scholars who support organ transplantation have admitted that "without the needs of transplantation medicine, 'brain death as death' would not exist at all, but would be seen as the most extreme and irreversible form of coma (Coma dépassé)" (Kompanje and de Groot 2015, 1837).

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