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Article

A philosophical assessment of TK's autopsy report: Implications for the debate over the brain death criteria

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In recent years, there has been increasing evidence that the totally brain-dead patient is able to continue to live and to maintain some integrated functions, albeit with the necessary assistance of mechanical ventilation. Several years ago, the autopsy report of a totally brain-dead patient named TK who was kept on life support for nearly twenty years was published in the Journal of Child Neurology. He remains the individual kept on life support the longest after suffering total brain failure. In this essay, I argue that the clinical data described in the autopsy report demonstrate that TK's long-term survival after total brain failure supports the claim acknowledged by the President's Council on Bioethics that the brain-dead patient retains his bodily integrity. As such, he is not dead. He is still a living, though severely disabled, human organism, a human person made in the image and likeness of God.

***Lay summary**:* Traditionally, the presence or absence of bodily integration has been used to definitively discern the presence or absence of life in the human being where decomposition of the body is the surest sign of death. The autopsy report of a patient named TK who was brain-dead for nearly twenty years demonstrates that brain-dead patients retain their bodily integrity. As such, TK and other brain-dead patients are not dead. They are living, though severely disabled, human organisms, who are human persons made in the image and likeness of God.

Keywords: Brain Death, Neurological criteria, Bodily integrity, TK

Introduction

Traditionally, the presence or absence of bodily integration has been used to definitively discern the presence or absence of life in the human being where decomposition of the body is the surest sign of death.[1] The cessation of heart and lung function anticipated this bodily disintegration. This is the criterion endorsed by Pope St. John Paul II when he taught that the "death of the person is a single event, consisting in the total disintegration of that unitary and integrated whole that is the personal self … This is then considered the sign that the individual organism has lost its integrative capacity" (John Paul II 2001, 91). For the Catholic tradition, this criterion for the loss of bodily integration at death emerges from the philosophical claim that death results from the separation of the soul, which is the principle of the organism's integrity and unity, from its matter.[2] Proponents have used this criterion to argue for the validity of the total-brain death (TBD) criterion for death, which proposes that the human being is dead when there is complete and

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irreversible cessation of functioning of all parts of his brain: Since the brain is the integrating organ of the human body, the irreversible loss of total brain function inevitably leads to loss of bodily integrity and thus to death (Bernat, Culver, and Gert 1981).

In recent years, however, there has been increasing evidence—primarily from the work of D. Alan Shewmon (1997, 1998, 2001, 2010)—that the TBD patient is able to continue to live and to maintain some integrated functions, albeit with the necessary assistance of mechanical ventilation. The medical evidence was compelling enough for the President's Council on Bioethics to conclude: "If being alive as a biological organism requires being a whole that is more than the mere sum of its parts, then it would be difficult to deny that the body of a patient with total brain failure [the council's preferred description for a brain-dead patient] can still be alive, at least in some cases" (President's Council on Bioethics 2008, 57).

Several years ago, the autopsy report for a totally brain-dead patient named TK was published in the *Journal of Child Neurology* (Repertinger et al. 2006). In the ongoing debate over the legitimacy of the brain death criteria, much has been made about this case because TK remains the individual kept on life support the longest after suffering total brain failure. He survived for nearly two decades after loss of recordable electroencephalographic (EEG) brain activity and clinical brainstem function.

In this essay, I summarize the clinical findings of TK's autopsy report, which are not familiar to many bioethicists and physicians, and provide a philosophical assessment of its implications for the ongoing debate over the legitimacy of the brain death criteria. I argue that TK's long-term survival after total brain failure supports the claim acknowledged by the President's Council on Bioethics that the totally brain-dead patient retains his bodily integrity. As such, he is not dead. He is still a living, though severely disabled, human organism, a human person made in the image and likeness of God.

A Summary of TK's Clinical History

TK's autopsy report includes a narrative of his clinical history with medical details that will be relevant for the philosophical analysis of brain death that follows below. In brief, TK was born in 1979. When he was four years old, he contracted *Haemophilus influenzae* meningitis that put him into a coma. While staying in a Nebraska hospital for treatment, he experienced an increase in intracranial pressure so severe that it separated the bony plates of his skull. An EEG revealed no electrocerebral activity, but his family was opposed to his removal from life support.

For several weeks following his initial infection, TK experienced severe temperature and blood pressure fluctuations that required days of dopamine infusion to support his blood pressure. Urine output fluctuated tremendously suggesting that he had diabetes insipidus. There were also dramatic shifts in his serum sodium. After this period of crisis, however, TK's temperature, blood pressure, urine output, and serum sodium levels became stable.

For the rest of his life, i.e., for the next twenty years, TK was dependent on a ventilator for breathing. He also received low caloric feedings (750 kcal/day) through a gastric tube. Infections and other complications were treated as necessary. Most infections responded to oral medications administered through the gastric tube, and aggressive intravenous antibiotics were only rarely used. Dopamine infusion was not necessary to maintain his blood pressure, except during one difficult urinary tract infection.

TK was initially transferred from the hospital where he was first treated, to a chronic care facility. Eventually, he was taken to a small apartment in the basement of his mother's house where he remained for nearly two decades. Towards the end of his life, he returned to the chronic care facility where he developed increasingly frequent respiratory infections, necessitating more vigorous antibiotic therapies. In his final two months of life, TK was hospitalized twice for pneumonia. During his second hospitalization, he developed transient diabetes insipidus, which had not been evident for many years. On discharge from his last hospitalization, his mother agreed that no further resuscitative efforts should be undertaken, putting a DNR order in his medical records. TK experienced a heart attack and died in January 2004. He was 24 years old.

Neurologically, TK's initial EEG after his bout with meningitis revealed no cerebral activity. Subsequent EEGs showed similar results despite extreme recording sensitivities (up to 2μV/mm). At eighteen years of age, he underwent neurodiagnostic testing including both MRI and evoked potential studies. The MRI revealed "marked [skull] thickening, extensive calcification, [and] no identifiable normal brain structures" (Repertinger et al. 2006, 592). Brainstem auditory evoked potentials were absent following stimulation of either the right or the left ear suggesting the absence of brainstem function. No apnea test was performed.

A Summary of TK's Autopsy Report

At the time of his brain-only autopsy, TK's body measured approximately 3½ feet long with an approximate weight of 155 pounds. His extremities were symmetric, but poorly developed with muscles of severely reduced mass. His head was disproportionately small for his body size, probably because he did not have a growing brain to keep expanding the skull.

When the skull was opened, the autopsy revealed a hard, nearly spherical mass of approximately four inches in diameter with an irregular surface. No definite posterior brain structures including neither the cerebellum nor the brain stem were identifiable. CT analysis revealed irregular densities and signal changes consistent with calcification throughout the interior of the mass. MRI of the same sample revealed no identifiable specific anatomic brain structures. Sectioning of the mass with a saw revealed that the specimen consisted of a hollow hard-calcified shell containing semi-solid material resembling clotted blood surrounding cyst-like spaces. There were no identifiable cerebral structures within the mass. Microscopic examination revealed mineralized deposits and material that resembled blood clots that had become, as the autopsy described it, "mummified." No nerve cells or nerve cell structures were recognizable under the light microscope. No signals for any neuronal specific markers were detected by immunohistochemistry.

The pathology report concluded: "Our pathologic findings at autopsy confirmed that [TK's] brain had been destroyed by the events associated with the episode of *H. influenzae* type b meningitis, whereas his body remained alive (brain death with living body) for an additional two decades, a duration of survival following brain death that far exceeds that of any other reports" (Repertinger et al. 2006, 594).

A Philosophical Assessment of TK's Autopsy Report: TK Is an Integrated Whole

Defining organismal integration

The presence or absence of bodily integration has traditionally been used to

definitively discern the presence or absence of life in the human being where decomposition of the body is the surest sign of death. The cessation of heart and lung function anticipated this bodily disintegration. Thus, for many philosophers and bioethicists, the resolution of the debate, especially within the Catholic tradition, over the legitimacy of the brain death criteria must begin by defining bodily integration and determining if it remains in the brain-dead patient.

Though I certainly agree with this conceptual assessment, and acknowledge the efforts of others to define and to articulate, what some have called, a philosophy of integration—I am especially thinking of the work by Tonti-Filippini (2011), Shewmon (2012), and Condic (2014)—I contend that agreement on what constitutes organismal integration is *not* needed to determine if TK is an integrated whole. A consensus already exists that living human beings are integrated, and, in my view, this consensus is sufficient to determine if TK is an integrated whole.

Identifying organismal integration in TK

I propose that there are at least three bodily functions described in TK's autopsy report that demonstrate that he is still an integrated whole: blood pressure homeostasis, a robust immune response, and proportionate growth. Significantly, both defenders and critics of the neurological criteria for death agree that the first two functions are indicative of organismal integration. Tonti-Filippini, a defender of the TBD criterion for death, argues that integration is mediated in the human body by the hormonal, i.e., endocrine, system:

> The transfer of information merely between one part of the body and another is insufficient to establish that the soul has not separated from the body. For instance, circulation in itself is not a transfer of information that integrates the body. Rather it is a means by which information might be transferred such as happens through the endocrine system. (Tonti-Filippini 2011, 319)

As we will discuss in greater detail below, blood pressure homeostasis is one bodily function that is mediated by hormones. Maureen Condic, also a defender of the TBD criterion for death, accepts that the immune system would be one example of a bodily system that is unequivocally integrated in the healthy individual but is not integrated—in her words, it is only coordinated—in the totally brain-dead patient (Condic 2014, 2). Alan Shewmon, a critic of the TBD criterion for death, includes these two activities in his list of organismal activities that he had identified in brain-dead patients, a litany quoted essentially verbatim by the President's Council on Bioethics (2008, 56). The third organismal function—proportionate growth—is a function that is indicative of organismal integration in the developing human embryo and as such should be an agreed-upon organismal function for both sides of the brain death controversy within the Catholic tradition.

In brief, my argument is the following: If TK had retained his integration after total brain failure, then we would expect that his three organismal functions would be comparable pre- and post-brain death. In contrast, if TK had lost his integration, then we would expect that his three organismal functions, after the tragic destruction of his brain, would be defective or unreliable or faulty in some way.

Blood pressure homeostasis

Homeostasis is the state of equilibrium (balance between opposing pressures) in the

body with respect to various functions and to the chemical compositions of [its] fluids and tissues, and the processes through which such bodily equilibrium is maintained.[3] One paradigmatic example of homeostasis in the human body is the regulation of blood pressure and sodium homeostasis. Blood pressure changes are detected throughout the circulatory system by pressure receptors called baroreceptors. When one's blood pressure moves outside an optimum range, a signal is sent to the brain which responds by secreting hormonal neurotransmitters that can alter the heart rate and the contraction or expansion of blood vessels in order to restrict or to increase blood flow. The kidneys also regulate blood pressure through what is known as the renin-angiotensin system involving other hormones. Renin is an enzyme released by the kidney that triggers the activity of angiotensin and aldosterone. Together these molecules work to raise blood volume, blood pressure, and sodium levels in the blood. Maintaining a physiologically optimum blood pressure is a complex and coordinated process involving numerous integrated body parts. It is an activity of the whole for the whole.

To illustrate the integrative nature of homeostasis, consider this comparison between a human body and a Boeing 777–300ER jetliner. Homeostatic control of the body's blood pressure is analogous to the flying of the Boeing 777–300ER. Both processes require constant monitoring and constant adjusting, in the first case, of blood volume, blood-vessel wall tension, heart rate, and blood and urinesalt concentration, and in the second case, of the aircraft's angles of rotation, its center of mass, its air speed, its altitude, and its direction. Both require complex integrative systems that are able to detect fluctuations in their environment and to make compensatory changes to maintain, in the first case, a steady blood pressure or in the second case, a steady flight path.

Normally, blood pressure is regulated by the medulla oblongata in the brain stem (Colmbari et al. 2011). Not surprisingly, therefore, the loss of the medulla oblongata following total brain destruction results in irregular and erratic blood pressure fluctuations and dramatic shifts in sodium levels in the blood. TK's autopsy report reflects that he experienced this unstable physiological reality soon after total brain failure.

Significantly, however, TK's autopsy report establishes that he was able to recover his blood pressure homeostatic equilibrium several weeks after the traumatic destruction of his brain. As the autopsy report makes clear, once TK had passed through the physiological crisis period that inevitably follows total brain destruction—a crisis period Shewmon attributes to spinal shock (1999)—no pharmacological interventions were needed in the long term to regulate either his blood pressure or his sodium levels. If TK's blood pressure system had lost its integration when he suffered total brain death, then we would expect that TK's blood pressure system would have been permanently crippled. It was not.

It is not clear how TK's body was able to maintain his blood pressure in the absence of the brain stem—this is an instance of new biology that calls out for further scientific investigation—but he was able to do so. With regard to the regulation of blood pressure and of sodium plasma levels, TK was homeostatically as stable after brain death in the long run as he was before total brain failure. In other words, with regard to blood pressure homeostasis, TK was as integrated after his total brain failure as he was before his tragic injury.

Robust immune response

The immune system is the body's self-defense system. It is an army of billions of

cells of different types including T cells, B cells, NK cells, monocytes, macrophages, Langerhans cells, dendritic cells, megakaryocytes, and granulocytes, scattered throughout the body in different lymphoid organs including the adenoids, tonsils, lymph nodes, thymus, spleen, Peyer's patches, bone marrow, and tissue lymphatics. I include this partial list of immune cell types and immune organ types to emphasize the integrative nature of the immune response. Like any military force composed of artillery, infantry, reconnaissance, field engineers, and armor, the body's immune system has to be integrated and coordinated in order for it to mount a successful defense against an infection. Biologically, this integration is mediated by numerous molecules called cytokines, including chemokines, interferons, interleukins, lymphokines, and tumor necrosis factor, which are produced by immune cells in order to communicate to other cells throughout the body.

Significantly, TK's autopsy report establishes that he did not need additional antibiotic interventions whenever he got pneumonia. For most of his life as a disabled patient, he took oral antibiotics whenever he got sick. He was also not prone to more frequent infections. These clinical observations demonstrate that TK was able to mount a robust immune response whenever he experienced an infection. It is evidence of an activity of the whole for the whole. Recent research has revealed that the nervous system and the immune system are coordinated. For example, neurons sense inflammation and interact with immune cells to regulate the immune response (Sundman and Olofsson 2014). However, TK's autopsy report reveals that this neuronal control is not necessary for the integration of the immune system. If his immune system had lost its integration—in Condic's words, it would remain coordinated, but not integrated[4]—then we would expect that TK's immune system would have been crippled. We would expect him to manifest some kind of immunodeficiency that would have manifested itself in either increased infection rates, increased healing time, or increased need for antibiotics during an infection. None of these were observed in TK's autopsy report. Therefore, with regards to his immune response, TK was as integrated after his total brain failure as he was before his tragic injury.

Proportionate growth

Proportionate growth is a hallmark sign of human development—as it is for all organismal development—especially during the fetal period from the ninth gestational week through to birth. The growth of the head, the trunk, and the limbs of the fetal child, along with all of his organs, are coordinated and synchronized in a precise way. At nine weeks of gestation, the head of the fetal child is about half his crown-rump length (CRL), which is the measurement of the length from the top of the head to the bottom of the buttocks. However, by 36 weeks, the head is only a third of the fetal child's CRL. Throughout development, both arms and both legs grow at identical and synchronized rates. This proportionate growth is so tightly coordinated and controlled that the gestational age of the fetal child is routinely assessed by measuring his body proportions.

Crucially, the human organism "does development" in a specifically human kind of way. He does not do it in a dog way or a bird way or a kangaroo way. He does it as an activity of the whole for the whole in a particularly human way. Thus, in my view, human development is the human organism's activity of the whole for the whole *par excellence*. It is an activity that

manifests well the integration of the human organism. Philosophically speaking, it is an activity that manifests the presence of the human soul. Not surprisingly, therefore, the activity of human development has been used by Catholic scholars as a criterion to distinguish bona fide embryos from non-embryos in the debate over "ANT-OAR," a procedure proposed for creating, by manipulating a human ovum, a non-embryonic being from which, it is argued, stem cells could then be ethically derived (Arkes et al. 2005).

But human development does not end at birth! The human organism continues to undergo a transformation as a whole into maturity. Proportionate growth continues in a coordinated and synchronized manner all the way through to adulthood. For instance, it is clear that the growth of a child's head slows around six years of age, while his heart continues to grow in size to match the continued growth of his trunk and limbs. This is why one of the most striking things about human maturation is the change in the relative proportions between his head and the rest of his body. A baby is mostly head, an adult, not so. Again, a child's limbs grow at comparable and synchronized rates. We rarely if ever see someone whose left arm is significantly longer than his right, or vice versa, or whose right foot is three times larger than his left!

Significantly, in revealing that his limbs were symmetric, TK's autopsy report establishes that he was able to undergo proportionate growth while he was brain-dead for nearly two decades. Shewmon has also described other cases of pediatric brain-dead patients who grow proportionately. Children who have lost total brain function still have limbs of comparable length and organs of the expected size! If TK's bodily system had lost its integration, then we would have expected that TK's body would have lost its ability to grow proportionately. It did not. Therefore, with regard to his ability to grow proportionately, TK was as integrated after his total brain failure as he was before his tragic injury.

Responding to an Important Objection: The Probative Value of TK's Case

On February 3–4, 2005, the Pontifical Academy of Sciences, in cooperation with the World Organization for the Family, hosted a conference at the Vatican to discuss the validity of the brain-related criteria for death. In its final report on the proceedings of the meeting, the Pontifical Academy of Sciences raised an important objection to TK's case. Basically, its final statement defending the validity of the neurological criteria for death suggests that TK's case is an outlier, an exception to the rule, that is not relevant to the brain-death debate:

> If [TK] was a valid documented case of brain death, it makes the point that in extraordinarily rare exceptions this kind of case occurs. However, many years have passed since this case, there is a great deal of uncertainty about it, and *one cannot generalise from it to invalidate the criteria for brain death* … The neurological community does not believe that this case disturbs the conceptual validity of brain death as being equivalent to human death. (Battro et al. 2007, 8, emphasis added)

To put it another way, given the exceptionality of TK's case, the Pontifical Academy is proposing that TK's autopsy report is not probative for understanding the state of all/most/more than a few patients diagnosed with total brain failure.

In response, there are two reasons why TK's case *is* relevant to the brain-death debate. First, it is proof-of-principle that

the human organism does *not* need a brain to maintain its organismal integration. For decades, the integration rationale has been used to defend the neurological criteria: Loss of the brain means loss of bodily integration because the brain *necessarily* integrates the body. Notice that this is an empirically verifiable claim. There is no *a priori* reason to think that the body must need a single integrating organ—why not two coordinated, redundant integrating organs or no organ at all?—or that the brain must be this central integrating organ. TK's case dismantles the grounds for thinking that the brain is necessary for bodily integration. The President's Council has acknowledged this fact:

> If being alive as a biological organism requires being a whole that is more than the mere sum of its parts, then it would be difficult to deny that the body of a patient with total brain failure can still be alive, at least in some cases. (President's Council on Bioethics 2008, 57)

It is not clear if the "wholeness" of the brain-dead patient is caused by a single organ. Shewmon, for instance, has speculated that the spinal cord may assume many of the brain's integrating functions after death (Shewmon 2001, 469–71). In my view, this may be true but it is less important. As I explained above, for the Catholic moral tradition, organismal integration remains the preeminent sign of organismal life regardless of how this integration is maintained. Since he retains his organismal integration, TK is proof-of-principle that a brain-dead individual can still be and is alive.

Second, TK's case is not as rare as some may make it out to be. Admittedly, cases of long-term survival of brain-dead patients are not common. However, it is difficult to assess the significance of this statistical fact because the claim that TBD patients are dead is a self-fulfilling prophecy: Physicians would be less likely to give a TBD patient the extensive medical interventions needed to sustain him through the period of crisis after tragic brain failure because they already consider him dead. Thus, it is impossible to determine the percentage of TBD patients who would have survived as TK did, had they been given the aggressive medical treatment that TK had received. Nonetheless, Shewmon has identified 175 cases of long-term survival after brain death (Shewmon 1998, Supplemental Tables). In a recent review, Esmaeilzadeh et al. (2010) have chronicled the medical management of 30 pregnant women diagnosed with brain death who were kept on life support for weeks or even for months so that their fetal child could mature. Notably, some of these long-lived TBD survivors retained their ability to maintain their blood pressure homeostasis; others retained robust immune response; and others grew proportionately. TK is not as exceptional as he may seem. He is simply the longest-living survivor of many long-lived survivors. He is also a long-lived survivor whose cranial autopsy confirmed an earlier brain-death diagnosis, rebutting the claim made by some that he and others like him are not truly brain-dead.

Finally, I would like to address the last claim of the Pontifical Academy of Sciences statement cited above, i.e., the neurological community does not believe that this case disturbs the conceptual validity of brain death as being equivalent to human death. This has been contradicted by subsequent developments in the brain-death debate, particularly the President's Council's rejection of the integration rationale for brain death that had been used by the neurological community to justify the neurological criteria for decades. As even prominent brain-death advocate James Bernat acknowledges, the President's Council was persuaded primarily by

Shewmon's analysis (Bernat 2014, 5). TK's case *did* disturb the conceptual validity of the BD debate.[5] And it should have!

Conclusion

During debates over the ontological status of human embryo-like entities at the beginning of life within the Catholic tradition, it is assumed that these entities are human organisms and thus human persons until this is proven otherwise.[6] The same assumption should hold at the end-of-life. In both scenarios, we need to hold ourselves and others who wish to label human persons as "non-persons," to a high moral bar. Thus, Catholic physicians and bioethicists who still think that TK is dead would need to provide an explanation for how he lost his bodily integration without experiencing any empirically verifiable deficits in his ability to maintain his blood pressure, to mount a robust immune response, and to grow proportionately for 20 years. To claim that TK is clearly a non-integrated aggregation of organ systems that is being externally coordinated in some way by the mechanical ventilator, because the brain is needed for bodily integration, is to already beg the question. Anyone who claimed this would have to explain away the results of TK's autopsy report that point to his being integrated and thus to his being alive. A human being made in the image and likeness of God deserves no less than this.

APPENDIX: What Is the Soul?

The debate over the metaphysics of death in the Catholic tradition necessarily involves discussions that appeal to the soul. Thus, I think that it is important that I provide an explanation of the soul for healthcare professionals not familiar with the Aristotelian philosophical tradition. Please note that this summary explanation does not and cannot include explanations for all the complexities that can arise in creation.

For Catholics, the fifteenth ecumenical council, the Council of Vienne (1311), defined the rational or intellectual soul as the *form* of the human body and proposed this definition as an article of Catholic faith when it declared the following: "In order that the truth of the pure faith may be known to all and the path to error barred, We define that from now on whoever presumes to assert, defend, or obstinately hold that the rational and intellectual soul is not of itself and essentially the form of the human body is to be censured as heretic" (Denzinger, §902). That is why it is important to understand the term, "soul."

The soul is the explanation for life in the same way that gravity is the explanation for the behavior of apples falling to the ground. If one asks an Aristotelian to explain the difference between a living thing like an oak tree and a non-living thing like a brick, he would say that the oak tree has soul while the brick does not. The soul is the explanation for life. Or to be more technical, it is the substantial form of a living thing. Anything that is alive, whether it is a yeast cell, a pineapple plant, or an elephant is alive, because it has soul. Soul explains organism.

The soul is also the explanation for the unity, identity, and end-directness seen in a living organism. Unity: Why is my body one body and not two? Because it has one soul. Why are conjoined twins two different organisms rather than one? Because there are two souls that inform the distinct bodies that are incidentally conjoined. Identity: Why is my ear mine and not yours? Because it has my soul and not yours. Why does your body reject my kidney when it is transplanted into you? I propose, because your body has your soul, and my transplanted kidney does not. End-directness: Why does a human embryo develop into a human infant and not a puppy? Because it has a human soul that directs its development in a human-specific manner.

Notice that these philosophical explanations do not negate the importance of biological explanations. Why does your body reject the transplanted kidney? Biological reason: Because the MHC on the kidney are incompatible with your immune system. Philosophical reason: I propose that it is because the kidney has a soul that is different from your own soul. These two

reasons are compatible. They are both true: The MHC on the kidney are different from the MHC on your own cells because both have different souls. Or to take another example: Why does my body have my DNA and not yours? Because my body is informed by my soul, which specifies my DNA as mine, while yours is informed by yours, which specifies yours as yours. Since soul determines identity, the underlying philosophical reason for the differences between individual genomes is that they are informed by different souls.

Death is the separation of the soul from the body. Thus, it is important that Catholic healthcare professionals who are thinking about death consider death not only from a biological perspective, but also from a philosophical one. Though one cannot directly perceive or sense the soul, one can discern its presence or absence by discerning the presence or absence of its effects. If a human body is decomposing, i.e., becoming many parts rather than one integral body, then one must conclude that it is not informed by a soul. However, if a human body is one, integrated, and continuing to develop along a particular human-species trajectory, then one must conclude that it must still be informed by a human soul.

Given this background, it should be clear that the debate among Catholic philosophers and moral theologians over the legitimacy of the brain death criteria must first focus on whether the brain-dead patient is one, integrated, and continuing to develop along the particular human developmental pathway. If so, then he is not dead. If not, then he is.

Notes

1. Sociologist Richardson (2000, 15) described decomposition as follows: "The physicality of a human corpse is undeniable. It is a carcass with a predisposition to decay, become noisome, obnoxious to the senses, and harrowing to the emotions. Disposal of such perishable remains is imperative."
2. Cf. *Catechism of the Catholic Church*, no. 997: "In death, the separation of the soul from the body, the human body decays and the soul goes to meet God, while awaiting its reunion with its glorified body." For further discussion on the nature of the soul, see the appendix of this essay.
3. *Stedman's Medical Dictionary*, 28th ed. (Baltimore: Lippincott Williams & Wilkins, 2006), s.v. "homeostasis."
4. In my view, the distinction proposed by Maureen Condic (2014) between an integrated and a coordinated system is unclear and in need of further clarification. However, what is certain is that the healthy human being is integrated. His being integrated is what makes him an organism. Therefore, I claim that we can conclude that a patient with total brain failure is integrated if we can show that the functioning of his biological systems—in this case, TK's immune system—is comparable to the functioning of those same systems in a healthy individual with an intact and robust brain.
5. In his testimony in front of the President's Council, Shewmon used TK as one of three instructive cases to demonstrate the validity of his arguments. His testimony is available at the following: https://bioethicsarchive.georgetown.edu/pcbe/transcripts/nov07/session5.html.
6. This was clear during the debates over the ontological status of ANT-OAR entities. For representative analysis, see the essays in *Communio* in the collection, "Critiques of Altered Nuclear Transfer (ANT) and Oocyte Assisted Reprogramming (OAR)." Available at http://www.communio-icr.com/collections/view/ant-oar.

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