VIEWPOINT

The 50-Year Legacy of the Harvard Report on Brain Death

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On August 5, 1968, an ad hoc committee at Harvard Medical School published a landmark report that laid the groundwork for a new definition of death, based on neurological criteria.[1] The authors, under the leadership of anesthesiologist Henry Beecher, stated that their primary purpose was to "define irreversible coma as a new criterion for death." The concept of brain death has guided clinical practice for 50 years even though vigorous debate about its legitimacy has never ceased.

The Committee, Its Contexts, and Its Recommendations

The development of positive pressure ventilators in the 1950s enabled physicians to extend the lives of people who previously would have died. Some of these patients had no discernible cognitive function. Were these lives worth extending? Throughout the 1950s and 1960s, neurologists developed criteria to guide these decisions. Meanwhile, new success with organ transplantation triggered debates about organ donation. Was it appropriate to take organs before the donor's heart stopped or even to remove the beating heart?

In September 1967, Beecher convened a committee to consider the "ethical problems created by the hopelessly unconscious patient." Debate has been substantial ever since about whether the committee's primary motivation was to resolve controversy about withdrawal of life support or to increase access to transplantable organs. The final report named both issues: (1) the burden on patients, families, and hospitals, of a patient "whose brain is irreversibly damaged"; and (2) the concern that "obsolete criteria for the definition of death can lead to controversy in obtaining organs for transplantation."

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The committee was not alone in such deliberations. The first heart transplantation, in December 1967, had heightened interest in the concept of brain death. As Beecher's committee met through the spring and summer of 1968, similar discussions took place in London, England (English and Scottish Health Ministries), Geneva, Switzerland (the World Health Organization's Council for International Organizations of Medical Sciences), Cape Town, South Africa (convened by Christiaan Barnard, MD), and Sydney, Australia (World Medical Association). Each group supported the emerging concept of brain death.

Beecher's committee produced the most specific criteria. Coma could be considered irreversible and a patient declared dead if, over a 24-hour period, the patient did not respond to stimuli, had no spontaneous movement or breathing, and had no reflexes; a flat electroencephalogram provided valuable confirmation of the cessation of brain function. These criteria clarified circumstances under which clinicians could withdraw life support. The criteria also facilitated organ transplants by allowing physicians to declare the donor dead prior to withdrawal of the ventilator and cardiac arrest. This permitted procurement of organs in an optimal condition while removing moral or legal responsibility from the clinicians for having caused the patient's death by organ removal.

Legal Recognition of Brain Death Across the United States

These recommendations had no legal force. Over the next decade, however, the concept of brain death gained traction. Kansas became the first state to adopt a version of the Harvard criteria into law in 1970. Through the 1970s, individual states developed a patchwork of different criteria, making it possible to be legally dead in one state but alive in another.

In 1981, the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research addressed the problem by helping develop a model definition of death for adoption by all the states. The Uniform Determination of Death Act (UDDA)[2] states: "An individual who has sustained either (1) irreversible cessation of circulatory or respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brainstem, is dead." All 50 states have now adopted some version of the UDDA, although some material variability remains. For example, 4 states permit families to assert varying degrees of conscientious objection.[3] Other states vary in the number and qualifications of physicians required to determine death by neurological criteria.[3]

Brain Death and Public Policy

Brain death represents a state of very severe neurological injury with no evidence, to date, that anyone correctly diagnosed will ever regain consciousness or breathe without a ventilator.[4] Under the law, life-sustaining treatments may be withdrawn from these patients without requiring the permission of surrogates. This avoids the emotional and financial toll of providing intensive care to patients with no hope of recovery. The effect of this feature of the UDDA has diminished over the past 50 years, however, as withdrawal of life support from patients with severe neurologi-

cal injury has become increasingly common and accepted, regardless of whether those patients have been diagnosed as brain dead.

The greatest influence of the law has been in making it possible to procure virtually any organ or tissue from a person diagnosed as brain dead. Since death is declared at a time when the body is still being ventilated, oxygenated, and perfused, the organs and tissues may be obtained with minimal ischemic injury. UNOS reports that each year more than 8000 donors are declared dead by neurological criteria, each with the potential to save as many as 8 lives, in addition to composite grafts such as limbs and faces.[5] Both the procurement and allocation of organs have had widespread public admiration and support, with few cases of controversy or dissent.

Bolstering the Conceptual Foundations of Brain Death

Although the UDDA established a solid legal standard, concerns have remained about the lack of a clear conceptual connection between the "irreversible cessation of all functions of the entire brain" and the societal understanding of death. Patients who are brain dead may be permanently unconscious and ventilator dependent, but what criterion about this clinical state makes them dead?

In 1981, Bernat and colleagues addressed this issue by suggesting that death should be defined as "the permanent cessation of functioning of the organism as a whole."[6] Further, they argued that brain death is death because "the brain is necessary for the functioning of the organism as a whole. It integrates, generates, interrelates, and controls complex bodily activities." In other words, Bernat et al saw the brain as the master integrator of the body, such that without the brain, the body undergoes rapid disintegration leading to cardiac arrest.

Challenges to the Link Between Brain Death and Integrated Functioning

Although the rationale for defining death as the loss of integrated functioning has stood the test of time, the claim that the brain is responsible for maintaining this integrated functioning has not. Shewmon has shown that patients who are brain dead may maintain virtually every integrative function present in healthy bodies, including digestion, elimination, immunological function, wound healing, growth, sexual maturation, and successful gestation of fetuses in female patients.[7]

Most definitively, Shewmon has shown that brain death does not lead inevitably to disintegration of the body and cardiac arrest.[7] In the rare cases in which nutrition and ventilator support continue to be provided to patients diagnosed as brain dead, prolonged survival is not uncommon. The recent case of Jahi McMath involves a 17-year-old girl who continues to be sustained in New Jersey with a ventilator and tube feedings more than 4 years after her death certificate was issued in California. In the longest known case, a patient was biologically maintained for more than 20 years following the diagnosis of brain death.[4]

Given this growing uncertainty about whether brain death is conceptually coherent, in 2008, the President's Council on Bioethics addressed these issues in its white paper, "Controversies in the Determination of Death."[8] The council's analysis affirmed the view that some patients diagnosed as brain dead could maintain long-term integrated functioning. Recognizing the effect that this claim could have on the current approach to organ procurement, the council proposed yet another biological rationale for why patients with brain death should be considered dead, arguing that these patients are no longer alive because they have ceased to perform "the fundamental vital work of a living organism." Yet even the chair of the council expressed skepticism about whether this definition could distinguish dead patients from those who simply needed an assist device, such as a ventilator, to accomplish this vital work. He concluded by stating, "Until an empirically sound criterion for death is found, the lack of a conjunction between concept and reality remains a problem."[8]

Brain Death: Well Settled, Yet Still Unresolved

History is full of ironies, and the 50-year legacy of the Harvard report is no exception. From one perspective, the report laid the foundation for laws that have both saved and improved the lives of hundreds of thousands of patients through organ and tissue donation. Conversely, decades of attempts to find a conceptual justification for linking this diagnosis to the death of the patient remain incomplete.

The significance of brain death may diminish in the near future. If new genetic technologies render xenotransplantation safe, there could be a supply of transplantable organs without resorting to human donors (although the approach would raise its own ethical concerns). Tissue engineering and 3-dimensional printing might yield synthetic organs. Such developments would make the diagnosis of brain death irrelevant for organ procurement. Until then, however, one warning remains apt—Capron, one of the architects of the UDDA, summarized the situation well in 2001 when he described efforts to determine when death has occurred as both "well settled, yet still unresolved."[9]

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REFERENCES

1. Ad Hoc Committee of the Harvard Medical School. A definition of irreversible coma. *JAMA*. 1968;205(6):337-340. doi:10.1001/jama.1968.03140320031009

2. Uniform Law Commission. Uniform Determination of Death Act, 12A uniform laws annotated 777 (2008). http://www.uniformlaws.org/Act.aspx?title=Determination%20of%20Death%20Act. June 1, 2018.

3. Pope TM. Brain death forsaken: growing conflict and new legal challenges. *J Leg Med*. 2017;37(3-4):265-324. doi:10.1080/01947648.2017.1385041

4. Truog RD. Defining death—making sense of the case of Jahi McMath. *JAMA*. 2018;319(18):1859-1860. doi:10.1001/jama.2018.3441

5. Organ Procurement and Transplantation Network. Donor:donation after circulatory death (DCD) by donation year. Donors recovered: January 1, 1988-March 31, 2018. https://optn.transplant.hrsa.gov/data/view-data-reports/build-advanced/. June 1, 2018.

6. Bernat JL, Culver CM, Gert B. On the definition and criterion of death. *Ann Intern Med*. 1981;94(3):389-394. doi:10.7326/0003-4819-94-3-389

7. Shewmon DA. Chronic "brain death": meta-analysis and conceptual consequences. *Neurology*. 1998;51(6):1538-1545. doi:10.1212/WNL.51.6.1538

8. The President's Council on Bioethics. Controversies in the determination of death: a white paper by the President's Council on Bioethics. 2008. https://bioethicsarchive.georgetown.edu/pcbe/reports/death/. June 1, 2018.

9. Capron AM. Brain death—well settled yet still unresolved. *N Engl J Med*. 2001;344(16):1244-1246. doi:10.1056/NEJM200104193441611