

Advancing toward a modern death: the path from severe brain injury to neurological determination of death

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In 1968, the Harvard Ad Hoc Committee established a new, neurologically based definition of death.¹ The neurological determination of death, more commonly known by the term “brain death,” was influenced by 2 major advances in health care, the creation of intensive care units (ICUs) and the development of mechanical ventilators that treated irreversible apnea and interrupted the natural evolution from devastating brain injury to cardiopulmonary death, and was needed to address ethical concerns associated with organ donation arising from the then-new discipline of transplant surgery.

Neurological death is the prerequisite for cadaveric organ donation, and severe brain injury is the prerequisite for developing neurological death. Traditional cardiopulmonary definitions of death (asystole and apnea) are insufficient in the face of advancing technology that may support complete and irreversible loss of heart or lung function, or both. Every solid organ can be supported by technology or replaced by transplantation *except* the brain. If your brain is dead, you are dead. However, if your heart is dead, you may not be dead if your circulation is being supported by a machine.

In recent years, the success of transplantation techniques has increased the demand for organs to a level that far exceeds supply. In the year 2001, 3800 Canadians were on a transplant waiting list, but only 1803 transplants were performed.² As a result of the lack of available organs, 10%–30% of those on a waiting list die before an organ becomes available.² This widening gap between demand for and availability of transplantable organs has generated attention from provincial and federal governments.

Our society and profession must be attentive to the processes of care that start with a patient's severe brain injury and culminate in the neurological determination of death. A key step is the development of national agreements and standardized practices for the management of these patients in order to improve patient care and, when death is inevitable, to focus on offering the opportunity for solid organ donation as part of quality end-of-life care in the ICU. Specialists in intensive care and the Canadian Critical Care Society have recognized the need for their engagement in these aspects of care in their recent position paper.³

A severe brain injury initiates a sequence of events that will culminate in survival or death. Neurological death is

merely the final end point of any form of brain injury that results in uncontrollable intracranial hypertension and the arrest of cerebral blood flow. The most common causes of neurological death are traumatic brain injury, cerebrovascular accidents and hypoxic-ischemic injury after cardiac arrest. The time from injury to diagnosis of neurological death varies from hours to many days, depending on the severity of initial injury and the response to therapy.

The sequence initiated by devastating brain injury may include (1) resuscitation in the field, (2) evaluation and stabilization in the emergency department (ED), (3) referral and access to ICU services, (4) prognostication, (5) ICU-based neuroprotective therapies, (6) withholding or withdrawal of life support, (7) outcomes including survival, death by cardiopulmonary criteria or death by neurological determination and (8) optimal end-of-life care, including tissue and organ donation.

In our experience, many adult patients with severe brain injury and perceived poor prognosis are denied access to an ICU for a trial of therapy, prognostication and/or optimal end-of-life care. Data at St. Michaels Hospital in Toronto suggest that a significant number of patients referred for direct admission to the neurosurgical ICU are denied access.⁴ Although based on poor prognosis, this ED-to-ICU admission triage practice varies from centre to centre and is affected by the availability of ICU beds. Ramifications of this practice include the exclusion of those patients who potentially may benefit from evolving neurological therapies and lost opportunities for potential organ donation for those patients who appear to be neurologically dead (but the nature of whose death has not been diagnosed).

In the ICU, there are a number of evolving forms of neuroprotective strategies that may improve outcomes after severe brain injury and may decrease the number of patients whose condition results in death. These therapies include ventricular drainage for the monitoring and treatment of intracranial hypertension,⁵ improved neurological outcomes after cardiac arrest with the use of hypothermia,⁶ and decompression craniectomy after trauma or stroke.⁷

If prognostic information indicates that there is no hope of meaningful recovery, end-of-life care is advised and provided. Withholding or withdrawal of life support is the universal standard of care and is the most common event that precedes a death in an ICU.⁸ This practice re-

flects the ability to sustain cardiopulmonary function technologically in the face of an underlying disease process that may be incompatible with recovery. Despite the universality of this care, the reliability of the assessment of the likely outcome of a given patient's condition, the clinical threshold for determining futility, and the process, methods and timing of withholding or withdrawing life support may vary significantly from centre to centre and from clinician to clinician.^{9,10}

For those experienced in ICU care, neurological death is distinct, stark and unambiguous. In all Canadian provinces and territories, brain death is legally defined as "according to accepted medical practice." However, nationally and internationally, there is variability and inconsistency in the accepted medical practices for determining neurological death.¹¹ In Canada, procedures associated with neurological death are determined individually by each hospital. Guidelines established by the Canadian Congress Committee on Brain Death in 1988¹² and the Canadian Neurocritical Care Group in 1999¹³ began to clarify the criteria but have not led to uniform practice. Important challenges exist in the Canadian context and include the consistency and standardization of diagnostic criteria, clarification of whole brain versus brain stem death, diagnosis in infants and further defining legal standards for the diagnosis. Clarity, consistency and uniformity should be a minimum prerequisite for something so fundamental and may minimize any variability or deficits in the recognition, diagnosis and documentation of neurological death.

The incidence of neurological death is an absent vital statistic. The Canadian organ donation record is widely perceived to be mediocre in comparison with those of other advanced nations.¹⁴ However, an essential flaw in the crude comparison of organ donation rates is their expression *per million population*. These comparisons do not account for well-known differences in the incidence of severe brain injury (trauma and cerebrovascular injury) that exist over time and between jurisdictions.¹⁵

Currently, any conclusions or inferences about true donor rates are inherently flawed. The most accurate denominator for comparative donor statistics is the incidence of neurological death, and the Canadian incidence of neurological death is unknown. There is no obligation for a mandatory diagnosis when neurological death occurs and no mechanism for reporting its occurrence when it is diagnosed. Medical certificates record death and causation, but they do not distinguish between death by cardiopulmonary criteria versus neurological criteria. Any attempt at advancing organ donation in Canada requires accurate data on the incidence of neurological death, because neurological death must be established for cadaveric organ donation.

These aforementioned processes of care and their variability affect the optimal management of severely brain-injured patients and those whose condition is evolving to

neurological death. In view of these issues, the Canadian Council for Donation and Transplantation is sponsoring a Canadian Forum on Severe Brain Injury to Neurological Determination of Death, on April 9–11, 2003, in Vancouver. The forum is the first of its kind to bring together Canadian experts in emergency medicine, the neurosciences, intensive care medicine, health law and bioethics and members of the public, with the goal of developing national agreements on the optimal care of patients with severe brain injury and of those whose condition evolves to neurological death, incorporating the option of organ donation in the provision of quality end-of-life care.

Participants at the forum will discuss and aim to agree on best practices for emergency physicians, neurologists, neurosurgeons and intensive care specialists in relation to the care of critically injured patients with poor neurological prognoses. They will discuss legislation, policies and practices related to the neurological determination of death in Canada and in other countries. They will be challenged to create a made-in-Canada definition of the neurological determination of death to ensure consistency and reliability in its diagnosis, declaration, documentation and reporting. This forum is an initial step in developing consensus guidelines on the neurological determination of death for children and adults. As such, the forum report will make recommendations, through the Canadian Council for Donation and Transplantation, to relevant organizations on the dissemination of these practice arrangements and definitions across Canada. We hope to engage Canadian physicians in a dialogue about these issues and welcome comments from readers.

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