

Correspondence



Must the entire brain be dead to diagnose brain death?

To the Editor:

The June 2006 issue of the Canadian Journal of Anesthesia contains four excellent articles dealing with brain death.¹⁻⁴ In 1981 the President's Commission for the Study of Ethical Problems in Medicare and Biomedical and Behavioral Research published a landmark report intended to establish a common ground for American law related to brain death.⁵ The commission defined brain death as the "irreversible cessation of all functions of the entire brain, including the brain stem". Since that time, this seminal report has been used as the basis for much of the discourse on brain death, especially in the United States. Similarly, the World Medical Association has written that "it is essential to determine the irreversible cessation of all functions of the entire brain, including the brain stem".⁶

The purpose of this letter is to point out that, while these bodies have defined brain death in terms of "irreversible cessation of *all* functions of the *entire* brain," in the years since this definition has been widely adopted it has become very clear that many (perhaps most) patients diagnosed with brain death do *not* actually meet this requirement. In particular, many patients diagnosed with brain death still synthesize arginine vasopressin (which regulates serum osmolality), implying the presence of residual function in the hypothalamus. Indeed, evaluation of hypothalamic function is not part of any brain death protocol with which I am familiar. It may be time for the World Medical Association and other authorities to reformulate the definition of brain death to reflect current clinical realities.

D. John Doyle MD PhD FRCPC
Cleveland Clinic Foundation, Cleveland, USA
E-mail: doylej@ccf.org
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References

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- 2 Doig CJ, Young K, Teitelbaum J, Shemie SD. Brief survey: Determining brain death in Canadian intensive care units. *Can J Anesth* 2006; 53: 609-12.
- 3 Hornby K, Shemie SD, Teitelbaum J, Doig C. Variability in hospital-based brain death guidelines in Canada. *Can J Anesth* 2006; 53: 613-9.
- 4 Young GB, Shemie SD, Doig CJ, Teitelbaum J. Brief review: The role of ancillary tests in the neurological determination of death. *Can J Anesth* 2006; 53: 620-7.
- 5 President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavior Research: Defining Death: A Report on the Medical, Legal and Ethical Issues in the Determination of Death. Washington, DC, US Government Printing Office, 1981.
- 6 World Medical Association Declaration on Death. Available from URL; <http://www.wma.net/e/policy/d2.htm>.

Reply:

I thank Dr. Doyle for raising important and fundamental issues that are a source of confusion in theory and bedside practice. Does the term "brain death" refer to death of the brain itself, or does it refer to death as determined by the loss of neurological function? The answer depends on which concept of brain death is accepted, and this varies according to jurisdiction. In the United States, a whole brain definition (cerebral hemispheres and brainstem) for brain death is codified based on the irreversible cessation of all functions of the brain, including the brainstem. This is distinct from the United Kingdom where a brainstem-based definition of death is applied.

In brain injury associated with mass effect or generalized edema, loss of whole brain function usually occurs by the sequence of elevated intracranial pressure, rostral-caudal brainstem herniation and cerebrocirculatory arrest. However, complete and irreversible loss of brainstem function may be seen in isolated brainstem injury without the typical herniation sequence (e.g., massive brainstem infarction) which may or may not be accompanied by complete loss of cerebral hemispheric function. The mechanism of loss of consciousness in brainstem death is related to interruption of the ascending reticular activating system.