Box 5 | **Death and the law**

Under the US Uniform Determination of Death Act[151], a person is dead when physicians determine, by applying prevailing clinical criteria, that cardiorespiratory or brain functions are absent and cannot be retrieved[146]. The neurocentric definition is purposefully redundant, requiring a determination that "all functions of the entire brain, including the brain stem" have irreversibly ceased[151]. The American Academy of Neurology guidelines are shown in BOX 2 **. The Canadian guidelines closely mirror these[152]. In 1971, Finland was the first European country to accept brain death criteria. Since then, all EU countries have accepted the concept of brain death. However, although the required clinical signs are uniform, less than half the European countries that have accepted brain death criteria require technical confirmatory tests, and approximately half require more than one physician to be involved[153]. Confirmatory tests are not mandatory in many third-world countries because they are simply not available. In Asia, death based on neurological criteria has not been uniformly accepted and there are major differences in regulation. India follows the UK criteria of brainstem death[154]. China has no legal criteria and there seems to be some hesitation among physicians to disconnect the ventilator in patients with irreversible coma[57]. Japan now officially recognizes brain death, although the public remains reluctant — possibly as a result of the heart surgeon Sura Wada, who was charged with murder in 1968 after removing a heart from a patient who was allegedly not brain dead[155]. Australia and New Zealand have accepted whole brain death criteria[156].**

Some legal scholars have also endorsed the neocortical definition of death[157,158] but they have never convinced legislatures or courts. A physician who believes that a patient who is permanently unconscious but breathing is dead risks criminal prosecution or a civil claim for wrongful death if he or she acted on this belief[146]. A finding that consciousness is irreversibly lost will not, by itself, under any applicable medical practice guidelines or law, justify a diagnosis of death; evidence that brainstem functions are absent is always required. However, withdrawing any treatment that is not considered to be of benefit to the patient is medically and legally accepted, and no doctor has ever been charged with murder for doing this in well-documented cases of patients in an irreversible vegetative state[106]. It should be noted, however, that N. Barber and R. Nejdl were charged with murder in California for withdrawing all treatment, including artificial hydration and nutrition, from a patient, Mr Herbert, who had been comatose for 7 days. However, their case was dismissed before trial and the patient's condition later evolved into an irretrievable vegetative state[159].

Finally, death is a biological phenomenon for which we have constructed pragmatic medical, moral and legal policies on the basis of their social acceptance[129]. The decision of whether a patient should live or die is a value judgment over which physicians can exert no specialized professional claim. The democratic traditions of our pluralistic society should permit personal freedom in patients' decisions to choose to continue or terminate life-sustaining therapy in cases of severe brain damage. Like most ethical issues, there are plausible arguments supporting both sides of the debate. However, these issues can and should be tackled without changes being made to the current neurocentric definition of death. The benefits of using living humans in a vegetative state as organ donors do not justify the harm to society that could ensue from sacrificing the dead donor principle[129].

Many of the controversial issues relating to the death and end of life in patients with brain damage who have no hope of recovery result from confusion or ignorance on the part of the public or policy makers about the medical reality of brain death and the vegetative state. Therefore, the medical community should improve educational and public awareness programmes on the neurocentric criteria and testing of death; stimulate the creation of advance directives as a form of advance medical care planning; continue to develop clinical practice guidelines; and more actively encourage research on physiological effects and therapeutic benefit of treatment options in patients with severe brain damage.

What is the future of death? Improving technologies for brain repair and prosthetic support for brain functions (for example, stem cells, neurogenesis, neural computer prostheses, cryonic suspension and nano-neurological repair) might one day change our current ideas of irreversibility and force medicine and society to once again revise its definition of death.

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doi:1038/nrn1789

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Acknowledgments

The author is Research Associate at the Belgian 'Fonds National de la Recherche Scientifique'.

Competing interests statement

The authors declare no competing financial interests.

Online links

FURTHER INFORMATION

Steven Laureys' homepage: http://www.ulg.ac.be/crc/en/slaureys.html
US National Institute of Neurological Disorders and Stroke: http://www.ninds.nih.gov/disorders/coma/coma.htm
American Academy of Neurology: http://aan.com/professionals/practice/pdfs/pdf_1995_thru_1998/1995.45.1012.pdf
American Medical Association: www.ama-assn.org/ama/pub/category/8457.html
British Medical Association: www.bma.org.uk/ap.nsf/Content/pvs?OpenDocument&Highlight=2,vegetative,state
World Medical Association: http://www.wma.net/e/policy/p11.htm
World Federation of Catholic Medical Associations and Pontifical Academy for Life: http://www.vegetativestate.org
United Network for Organ Sharing: http://www.unos.org/
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Steven Laureys' homepage: http://www.ulg.ac.be/crc/en/slaureys.html
US National Institute of Neurological Disorders and Stroke:
http://www.ninds.nih.gov/disorders/coma/coma.htm
American Academy of Neurology:
http://aan.com/professionals/practice/pdfs/pdf_1995_thru_1998/1995.45.1012.pdf
American Medical Association:
www.ama-assn.org/ama/pub/category/8457.html
British Medical Association:
www.bma.org.uk/ap.nsf/Content/pvs?OpenDocument&Highlight=2,vegetative,state
World Medical Association:
http://www.wma.net/e/policy/p11.htm
World Federation of Catholic Medical Associations and Pontifical Academy for Life: http://www.vegetativestate.org
United Network for Organ Sharing: http://www.unos.org/

Biography

Steven Laureys graduated with an M.D. from Vrije Universiteit Brussel, Belgium, in 1993. While specialising in Neurology he entered a research career and obtained his M.Sc. in Pharmaceutical Medicine working on pain and stroke using *in vivo* microdialysis and diffusion MRI in the rat. Drawn by functional neuroimaging, he moved to the Cyclotron Research Centre at the University of Liège, Belgium, where he obtained his Ph.D. studying residual brain function in the vegetative state. He is board-certified in neurology and in palliative and end-of-life medicine. A recipient of the William James Prize from the Association for the Scientific Study of Consciousness, he recently published "The Boundaries of Consciousness". His current post is at the Belgian National Fund of Scientific Research and the Liège University Hospital.