ABC of Brain Stem Death

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THE POSITION IN THE USA AND ELSEWHERE

The United States is a more heterogeneous society than ours, and laws and practices differ among States. A person could be considered dead in one State and not dead in another.

In the early 1970s an American Collaborative Study was set up under the sponsorship of the National Institute of Neurological and Communicative Disorders and Stroke. Nine centres took part. The study was designed to "formulate a set of criteria that would identify a dead brain in an otherwise living body."¹ The results emerged piecemeal over the next decade in a series of publications dealing with the clinical, pathological, toxicological, and electroencephalographic findings. The wide scatter of the most relevant data makes access difficult. Further difficulties arise because different centres in the collaborative study did not use words in the same way. This is shown most clearly in relation to "cerebral death." One participant urged that these words be used to describe "irreversible destruction of the (intracranial) components above the tentorium."² Such a definition would clearly exclude a dead brain stem and suggests a vegetative state. But the co-ordinator of the study (and author of its main publications) used the words "cerebral death" to denote something quite different and more general—namely, the irreversible cessation of all nervous activity "within the intracranial cavity."³ This second definition clearly includes a dead brain stem. It describes what most people mean by "whole brain death." A summary statement¹ of the collaborative study's findings was published in 1977. If any document can be said to have reflected a substantial segment of US opinion about brain death (before July 1981) it is this. (Since 1981 there have been radical developments in the USA. A presidential commission has reported on brain death. An associated group of consultants has drawn up guidelines which resemble those prevailing in the UK. Leading medical and legal bodies have endorsed a statute—the Uniform Determination of Death Act—which has already been adopted by 11 States. The statute is discussed critically in the fuller version of this text.)

The main difference between the UK and American approaches to brain death is summarised in the diagram. In the UK we emphasise strictly defined preconditions of irremediable, structural brain damage. In the American Collaborative Study the common clinical causes of brain death were listed as including "drug intoxication or overdose, and metabolic coma."⁴ These are potentially reversible causes of neurological disturbance and although they may well cause brain death, the UK code specifically warns against considering the diagnosis in patients with such conditions. In this area of selection we do not always practise what we preach, and this has left us open to justified criticism from the USA.⁵

Clinical testing is similar in the UK and in the USA. Both practices demand that the patient be in unresponsive coma and without brain stem reflexes. Both demand apnoea, although until very recently this was much more strictly

defined in the UK than in the USA. But in many institutions in the USA (partly as a result of the lack of specification of strict preconditions) there was a demand for other "objective" tests to establish that the brain had ceased to function. The first and most widely used was, of course, the electroencephalogram (discussed in the next article). Other techniques sought to establish that there was no significant cerebral blood flow. Angiography did not really catch on, but various techniques using intravenous bolus injections of radioactive isotopes were explored.⁶ Predictably, problems arose in differentiating internal from external carotid flow, which may be greatly increased in cases of brain death. Rheoencephalography using intracerebral electrodes has also been advocated. The use of somatosensory and auditory evoked responses has been widely investigated.⁷ These second-generation attempts at instrumental diagnosis are meeting a new range of technical problems. In studying evoked potentials, for instance, there may be contamination of the averages by potentials that are time locked to the stimulus but generated by extracranial sources.⁷ The estimation of cerebrospinal lactate concentrations has

Two approaches to brain death

also been proposed. Meanwhile simple bedside clinical testing has held its own. No adequately documented report of any patient fulfilling the UK criteria and failing to develop asystole has been published.

Other countries

Several different developments were meanwhile taking place in other countries. At the end of 1979 the renal transplant organisations in 40 countries were circularised by the departments of surgery of the University of Chicago and of the Albert Einstein College of Medicine, New York, and by the department of neurology at the Hennepin County Medical Center, Minneapolis.⁸ The tables summarise the state of affairs shown in relation (a) to the concept of brain death and (b) to the tests required to establish its presence. The situation is evolving rapidly and some of the reported facts may already be out of date.

Brain death 1979

Explicit legal recognition that brain death is death	Brain death accepted medically as death (but no legal statute)	Brain death either (a) not recognised or (b) not recognised in practice as synonymous with death
Argentina	Belgium	(a) Denmark
Australia	Germany	(a) Israel
Austria	Great Britain	(a) Japan
Canada	India	
Czechoslovakia	Ireland	(b) Poland†
Finland	The Netherlands	(b) Sweden†
France	New Zealand	
Greece	South Africa	
Italy	South Korea	
Norway	Switzerland	
Puerto Rico	Thailand	
Spain	USA (remaining States, although position unclear in some)	
USA (33 States)*		

*Position in USA in September 1982.

†Ventilatory support is withdrawn but heart must stop before organs are removed.

All the countries responding to the questionnaire demanded apnoeic coma and absent brain stem reflexes as integral components of the definition of brain death. Most countries which specified preconditions of structural brain disease did not require additional tests. Countries which did not specify preconditions—that is, where brain death could be diagnosed in patients suffering from severe drug intoxication, metabolic coma, and so on—required either one or two electroencephalograms, separated by variable periods of time, or one or more angiograms (to show that intracranial pressure was so high that cerebral blood flow was impossible), or both encephalograms and angiograms.

The position in Sweden and Poland was unusual. Although brain death was accepted, its logical extension (the concept of what I have called a "beating-heart cadaver") was not. Brain death was not unequivocally equated with death. Brain death warranted withdrawal of ventilatory support, but organs could not be removed while the heart was still beating. In Denmark brain death has not been specifically recognised by any official medical or legal body. This does not seem to inhibit doctors with special experience from diagnosing the condition. A patient is accepted as dead when so declared by a physician

Basis for diagnosis of brain death

	Clinical tests	Electro-encephalogram required	Angiogram required
Australia	+		
Belgium	+		
Canada	+		
Finland	+		
Germany	+		
Great Britain	+		
India	+		
Ireland	+		
New Zealand	+		
Puerto Rico	+		
South Africa	+		
South Korea	+		
Spain	+		
Argentina	+	+	
Austria	+	+	
Czechoslovakia	+	+	or +
France	+	+	
Greece	+	+	
Italy	+	+	
Norway	+		+
Switzerland	+	+	or +
Thailand	+	+	

but there are no formal recommendations on the criteria to be used (E O Jørgensen, personal communication).

A questionnaire sent to the neurosurgical societies of the world³ in 1977 elicited further information. Brain death was legally recognised in Mexico and medically recognised in Bolivia, Brazil, Chile, Colombia, Peru, Turkey, Uruguay, and Venezuela. Brain death is not medically or legally recognised in any Islamic country. Little information can be obtained about practice in the USSR or China.

The position in the UK is often misunderstood. Although our code carries considerable moral authority (in the light of its sponsorship, in 1974, by the Chief Medical Officer of the Department of Health and Social Security, and of its endorsement in 1976 by the Conference of Medical Royal Colleges and their Faculties) it has no legal—or even quasi-legal—status. The DHSS assists its distribution, but Parliament (which alone makes laws) has not addressed the matter. Indeed, the advice of the committees concerned, which included coroners and lawyers, was that legislation was not needed. The precise status of the code has never been tested in a court of law.

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¹ Anonymous. An appraisal of the criteria of cerebral death—a summary statement: a collaborative study. *JAMA* 1977;237:982-6.

² Korein J. Neurology and cerebral death—definitions and differential diagnosis. *Trans Am Neurol Assoc* 1975;100:210-2.

³ Walker AE. *Cerebral death*. 2nd ed. Baltimore: Urban and Schwarzenberg, 1981.

⁴ Smith AJK, Walker AE. Cerebral blood flow and brain metabolism as indicators of cerebral death. A review. *Johns Hopkins Med J* 1973;133:107-19.

⁵ Hughes JR. Guidelines for determination of death. *Neurology* 1982;32:682-3.

⁶ Korein J, Braunstein P, Kricheff I, et al. Radioisotopic bolus technique as a test to detect circulatory deficit associated with cerebral death. *Circulation* 1975;51:924-39.

⁷ Chatrian GE. Electrophysiological evaluation of brain death: a critical appraisal. In: Aminoff MJ, ed. *Electrodiagnosis in clinical neurology*. Chap 7. Edinburgh: Churchill Livingstone, 1980.

⁸ Stuart FP, Veith FJ, Cranford RE. Brain death laws and patterns of consent to remove organs for transplantation from cadavers in the United States and 28 other countries. *Transplantation* 1981;31:238-44.