MEDICAL PRACTICE

Contemporary Themes

Diagnosis and management of brain death

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British Medical Journal, 1979, 1, 525-527**Summary and conclusions**

Finland was the first country in which brain death was legally accepted. Since 1975, 37 cases of brain death had been recorded in a university hospital in Finland, and these were reviewed. The cause for brain death was intracranial bleeding in 32 cases, other cerebrovascular disorder in two, and intracranial neoplasm in three. In 21 brain death was diagnosed clinically. In 16 cases confirmatory investigations (electroencephalography, cerebral angiography) were needed. After brain death had been established artificial support was withdrawn in 15 patients and organ transplantation was carried out in 10. In 12 patients, however, diagnosis of brain death did not influence management, though the heart stopped beating on average 25 hours after diagnosis.

The Finnish criteria for brain death seem to be reliable and suitable for routine use.

Introduction

The concept of brain death has been widely discussed in recent years, and several countries have adopted their own criteria and tests for confirming brain death—for example, the Harvard criteria in the United States¹ and the statement issued by the honorary secretary of the Conference of Medical Royal Colleges

and their Faculties in the United Kingdom.² Finland was, however, the first country in which brain death was legally accepted. The diagnostic criteria for establishing brain death were published by the National Board of Health on March 24 1971, and they were as follows.³

The patient is dead when the brain tissue is damaged to such an extent that the vital brain functions have irreversibly stopped, regardless of whether the heart is beating. The basic cause of brain death must be fully established.

(1) If the damage of the brain tissue is caused by increased intracranial pressure (contusion, haemorrhage, tumour, etc) irreversible termination of brain functions must be verified with the following tests: (a) the pupils are permanently dilated and do not respond to light; (b) there is no spontaneous respiration and it cannot be restored with a respirator or other effective artificial respiration after 30 min to 1 h; (c) there are no reactions in the [other] cranial nerves.

(2) In other cases and in cases in which doubt remains about brain death further examinations (electroencephalography, cerebral angiography, etc) must be carried out. Absence of electrical activity in an electroencephalogram is not, as such, a reliable sign of death in children and cases of hypothermia and acute intoxication.

These criteria have been applied at the Meilahti University Hospital in Helsinki since the publication of the circular. The hospital has departments of medicine, surgery, neurology, and lung diseases and 901 beds. It also has an intensive care unit, emergency ward, and a large outpatient department. We report on the application of these criteria and their effects on management of 37 patients in this hospital.

Patients, methods, and results

Because no special register is kept for cases of brain death the files of the department of neurology, intensive care unit, and emergency ward were searched. Since 1975 37 cases of brain death had been recorded and case histories and necropsy records were investigated. There were no cases of acute head injury because such patients are usually taken to another hospital.

Of the 37 patients, 24 were men and 13 women (mean ages 37 and

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44 years respectively; mean age of whole group 40 years). In 21 cases the diagnosis of brain death was based on simple clinical examination (1st criterion), and no confirmatory investigations were carried out (table I). The clinical diagnosis was subarachnoid haemorrhage in all these patients, and this was confirmed in 17 patients at necropsy. The consultant anaesthetist and a senior neurologist confirmed the arrest of spontaneous respiration (as required by the hospital) in 12 cases, but in a further nine the anaesthetist was not consulted. Organs were removed for transplantation from nine patients. Artificial respiration and other support were withdrawn from seven patients, but in five support was maintained even after diagnosis of brain death.

Confirmatory investigations (2nd criterion) were required in 16 patients (table II), subarachnoid haemorrhage again being the most common diagnosis. It was suspected in five patients and confirmed in all of them at necropsy. In one patient subarachnoid haemorrhage was mistakenly diagnosed as subdural haematoma (case 11) because of a misleading case history, though lumbar puncture was not performed. The series also included four cases of intracerebral haemorrhage, two embolic lesions, and three intracerebral tumours, all of which were histologically confirmed by a neuropathologist. In one patient (case 12) intracerebral haemorrhage was mistakenly diagnosed as cerebral abscess, since pleocytosis was the only finding in the cerebrospinal fluid. The most complicated case was that of a 25-year-old man (case 13) whose case history was totally misleading and caused postponement of lumbar puncture until death occurred. Subarachnoid haemorrhage was subsequently diagnosed. The anaesthetist was consulted in 10 out of the 16 cases, and organs were removed for transplantation in only one case. Artificial respiration and other support were withdrawn from eight patients after the diagnosis of brain death, but seven patients were still receiving active support.

To confirm brain death electroencephalography was carried out 10 times in eight patients and angiography 11 times in 10 patients (six aortic arch and five carotid angiograms) (table II). Two angiograms and one electroencephalogram were carried out in a 19-year-old

man (case 4) who died from an infratentorial tumour. Carotid angiography failed because of subintimal injection of the contrast medium.

Organs were removed only from patients who died from subarachnoid haemorrhage (10 patients; 27% of series). Eight of the 10 had been treated in the emergency ward where patients are kept if death is likely to occur (table III). Kidneys were removed in seven patients and corneas in six. Although the diagnosis of brain death did not influence treatment in 12 patients (tables I and II), the heart stopped beating after an average of 25 hours. Over half of these patients were from the neurological wards.

TABLE III—Management of patients with brain death in different wards of the hospital

	Organ transplantation	Artificial support withdrawn	Treatment unchanged
Neurology department	1	8	7
Emergency ward	8	5	4
Intensive care unit	1	2	1
Total	10	15	12

Discussion

Perhaps the most widely known criteria for the diagnosis of brain death are those of the Harvard Committee on Irreversible Coma,¹ which include an unresponsive, apnoeic patient with isoelectric electroencephalogram. One year later it was suggested in a report from Harvard that electroencephalography was not necessary.⁴ Electroencephalographic silence is not included in the criteria

TABLE I—Clinical details of 21 patients with clinical diagnosis of subarachnoid haemorrhage without confirmatory investigations

Case No	Sex	Age (yrs)	Necropsy diagnosis	Confirmed by consultant anaesthetist	Management
1	M	39	Subarachnoid haemorrhage	—	Unchanged
2	M	42	"	—	"
3	M	46	"	—	"
4	M	43	"	—	"
5	M	58	No necropsy	+	Support withdrawn
6	M	22	Subarachnoid haemorrhage	—	"
7	M	40	"	—	"
8	M	42	"	+	Organ transplantation
9	M	35	"	+	"
10	M	27	"	+	"
11	M	46	"	+	"
12	F	33	No necropsy	—	Unchanged
13	F	55	"	+	Support withdrawn
14	F	50	Subarachnoid haemorrhage	+	"
15	F	43	"	—	"
16	F	58	"	—	"
17	F	49	"	+	Organ transplantation
18	F	48	No necropsy	+	"
19	F	43	Subarachnoid haemorrhage	+	"
20	F	57	"	+	"
21	F	39	"	+	"

TABLE II—Clinical details of 16 patients in whom investigations were performed to confirm brain death

Case No	Sex	Age (yrs)	Clinical diagnosis	Necropsy diagnosis	Confirmed by consultant anaesthetist	Confirmatory investigations	Management
1	M	45	Intracerebral haemorrhage	The same	+	EEG × 2	Unchanged
2	M	38	Vascular lesion of brain stem	"	—	Aortic arch angiography	"
3	M	28	Intracerebral haemorrhage	"	—	Carotid angiography	"
4	M	19	Infratentorial tumour	Colloid cyst, third ventricle	—	EEG, carotid and aortic arch angiography	"
5	M	23	Subarachnoid haemorrhage	The same	—	EEG	"
6	M	64	"	"	—	"	"
7	M	37	"	"	+	Carotid angiography	Support withdrawn
8	M	45	"	"	+	EEG	"
9	M	39	Intracerebral haemorrhage	"	—	"	"
10	M	40	Subarachnoid haemorrhage	"	+	Aortic arch angiography	Organ transplantation
11	M	31	Subdural haematoma	Subarachnoid haemorrhage	+	Carotid angiography	Unchanged
12	M	55	Cerebral abscess	Intracerebral haemorrhage	+	EEG × 2, aortic arch angiography	Support withdrawn
13	M	25	Intoxication	Subarachnoid haemorrhage	+	Aortic arch angiography	"
14	F	17	Infratentorial tumour	Cerebellar haemangioblastoma	+	"	"
15	F	26	"	Tentorial meningioma	+	Carotid angiography	"
16	F	55	Cerebral embolism	The same	+	EEG	"

adopted in the UK. In 1977, however, this criterion was again recommended in the USA,⁵ possibly to protect medical practitioners against litigation.

Both the American and British codes recommend that the decision to withhold artificial respiration should be made by two doctors, and we follow the same procedure at our hospital. A further advantage of the British code is the detailed recommendation on how the arrest of spontaneous respiration should be verified. The most complete procedure, however, is that recommended by the Swedish Medical Society.⁶ These criteria include unresponsive coma, apnoea, isoelectric electroencephalogram, and non-filling of the cerebral vasculature after two aortocranial injections of contrast medium 25 minutes apart. Although this procedure is the most accurate, technical limitations may prevent it from being widely used.⁷

After seven years of use the Finnish code seems to be suitable for general application. Nevertheless, the consultant anaesthetist was asked to confirm the diagnosis in fewer than two-thirds of the cases. We believe that if the code gives no instructions on how the arrest of spontaneous respiration should be verified an anaesthetist should be consulted in all cases of suspected brain death. Furthermore, in a third of our patients the diagnosis of brain death did not influence management. These patients died within a day, and the relatives might have been spared from further emotional distress if support had been withdrawn when the diagnosis was established. As soon as it is obvious that the patient cannot recover life-supporting measures should perhaps be withdrawn, since continued support may increase reluctance to embark on resuscitative measures generally.⁸ Moreover, the hospital's capacity to give active treatment to

patients with a better prognosis is reduced, especially when only a few beds are available for intensive care.

The diagnosis of brain death should be based on a reliable clinical examination. Incorrect identification of the basic cause may still occur, as it did in three cases in the present series—one case of subarachnoid haemorrhage was diagnosed as subdural haematoma and another as intoxication, while in the third case intracerebral haemorrhage was incorrectly identified as cerebral abscess. The greatest risk seems to be in differentiating between intoxication and brain death. Intoxicated patients are often seen at our hospital, but the question of brain death is seldom raised. We have found that the criteria included in the Finnish code are sufficiently accurate to distinguish between patients who have a chance of even partial recovery and those who have not.

References

- ¹ Committee of Harvard Medical School, *Journal of the American Medical Association*, 1968, **205**, 337.
- ² Conference of Medical Royal Colleges and their Faculties, *British Medical Journal*, 1976, **2**, 1187.
- ³ National Board of Health, Circular No 1508. Finland, 24 March 1971.
- ⁴ Beecher, H K, *New England Journal of Medicine*, 1969, **281**, 1070.
- ⁵ Collaborative Study. *Journal of the American Medical Association*, 1977, **237**, 982.
- ⁶ Ingvar, D H, and Widén, L, *Läkartidningen*, 1972, **69**, 3804.
- ⁷ Walker, A E, and Molinari, G F, *Transactions of the American Neurological Association*, 1975, **100**, 29.
- ⁸ Jennet, B, *Resuscitation*, 1976, **5**, 49.

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Prescription for a better British diet

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Summary and conclusions

A new approach to establishing an upper or prescriptive level of recommended intakes of nutrients was devised for use in Britain. It was based on present food supplies in the UK, and the following measures were proposed to improve the national diet: moderate reductions in intakes of fat, sugar, meat, and alcohol; increased intakes of cereals, potatoes, and other vegetables and fruit; while intakes of milk and eggs and fish, pulses, and nuts were to remain unchanged. The proportions of food energy derived from protein would be increased, despite reduced meat consumption. Nutrient content of the diet may be expressed in terms of food groups or as nutrient concentrations per energy unit, which is particularly applicable

to planning or prescribing diets for individuals or small groups.

The suggested changes in the national diet are large enough to be meaningful, yet would not disrupt agricultural or trade policies if implemented over the next decade. Furthermore, the methods used to assess the recommended intakes of nutrients are flexible enough to be used both for planning and prescribing diets and for evaluating results of dietary surveys or histories.

Introduction

Nutritionists and dietitians often assess the adequacy of a diet by comparing the nutrients that it contains against tables of recommended intakes. In Britain the standards used were formerly those recommended by the Committee on Nutrition of the British Medical Association.¹ These have now been superseded by the *Recommended Intakes of Nutrients for the United Kingdom*, published by the Department of Health and Social Security in 1969.² This report states that "The recommendations may be used as guides for caterers and dietitians when planning diets for groups of healthy individuals. They may also be used in the evaluation of surveys of food consumption, and so in the identification of potential nutritional problems which merit further investigation."

In our opinion, a single set of recommendations cannot fulfil both these purposes adequately. We present an alternative approach to prescribing nutritionally acceptable diets.

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