

Brain Death

I. A Status Report of Medical and Ethical Considerations

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• Use of neurologic criteria to pronounce death, although accepted by many, has caused controversy among physicians, lawyers, legislators, philosophers, and theologians. The present work attempts to resolve this by accomplishing four objectives. (1) It summarizes scientific information that establishes the ability to determine the state of brain death with certainty on the basis of presently available clinical and laboratory criteria. (2) It shows that the concept of brain death is in accord with secular philosophy and the three major Western religions. (3) It documents the need for legislative recognition that death may be pronounced on the basis of neurologic criteria. (4) It reviews the present status of judicial and statutory law relating to the determination of death in the United States.

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BRAIN DEATH is a term commonly used to describe a condition in which the brain is completely destroyed and in which cessation of function of all other organs is imminent and inevitable. The concept of brain death is important to consider, since advances in medical technology have resulted in the artificial prolongation of the overall process of dying. In the past, cessation of heartbeat and spontaneous respiration always produced prompt death of the brain, and, similarly, destruction of the brain resulted in prompt cessation of respira-

tion and circulation. In this context, it was reasonable that absence of pulse and respiration became the traditional criteria for pronouncement of death. Recently, however, technological advances have made it possible to sustain brain function in the absence of spontaneous respiratory and cardiac function, so that the death of a person can no longer be equated with the loss of these latter two natural vital functions. Furthermore, it is now possible that a person's brain may be completely destroyed even though his circulation and respiration are being artificially maintained by mechanical devices.

A number of authors have argued persuasively that a person whose brain is totally destroyed is in fact dead,¹⁻⁴ and this premise has gained considerable acceptance throughout the world from the public and from professionals in various relevant

fields. Accordingly, the pronouncement of death on the basis of irreversible cessation of all brain function has become common. Nevertheless, this use of the concept of brain death has caused considerable controversy among physicians, lawyers, legislators, philosophers, and theologians. This controversy is founded partly on the failure of some to accept the concept that death may be pronounced on brain-related criteria,⁵ and partly on the contention that statutory recognition of such pronouncements is neither necessary nor desirable.^{6,7} Groups subscribing to either one or both of these positions actively oppose passage of statutory definitions of death and render enactment of such legislation difficult in the 32 states presently without such laws.

The purposes of this communication are to contribute to a resolution of the controversy and thereby to facilitate passage of statutes recognizing brain death by accomplishing several objectives. First, it will summarize information that establishes the ability to determine the state of complete destruction of the brain with certainty on the basis of available clinical and laboratory criteria. Second, it will demonstrate that total destruction of the brain constitutes a determinant of death that is not in conflict with sound secular philosophic considerations, Orthodox Judaic law,

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traditional Catholic ethics, or the mainstream of Protestant theology. Third, it will document the need for legislative recognition that death may be pronounced on the basis of complete and irreversible destruction of the brain. And fourth, it will review the present status of judicial and statutory law relating to the determination of death in the United States (in a later issue).

VALIDITY OF CRITERIA FOR DETERMINING COMPLETE DESTRUCTION OF THE BRAIN

Any ethical or legal considerations concerning pronouncements of death on a neurologic basis must be founded on the certainty that a person who meets the clinical and laboratory criteria has had actual complete destruction of the brain. In 1968, guidelines were formulated by an Ad Hoc Committee of the Harvard Medical School to permit the determination of irreversible coma.⁸ These Harvard criteria require that neurologic examinations disclose unresponsiveness, absence of spontaneous movements and breathing, absent reflexes, fixed dilated pupils, and persistence of all these findings over a 24-hour period in the absence of intoxicants or hypothermia. A persistently isoelectric EEG over the same period is also required to confirm the clinical examination. Since 1968, the validity of these widely used criteria has been established in several ways.

These validations include the substantial morphologic evidence that, when the criteria have been fulfilled, there is widespread destruction of the brain. Richardson has found that the brains of 128 patients meeting the Harvard criteria showed extensive destructive changes (oral communication, March 1976).⁹ In a larger series of autopsy studies, however, the exact nature and distribution of these fatal morphologic lesions in the brain were also shown to be dependent on the etiology and on the interval between fulfillment of the Harvard criteria and pathologic examination.¹⁰ The latter observation is consistent with the well-known finding in other organs that time must often elapse before morphologic evidence of cellular destruction can be detected.

In addition, patients who fulfill the Harvard criteria have been shown by

isotopic techniques to have no significant intracranial blood flow,¹¹ and absent intracranial blood flow over a 10-to 15-minute interval is uniformly associated with subsequent necrosis and liquefaction of the brain.¹² The latter finding is based on autopsy studies from several Scandinavian hospitals of more than 120 patients who had nonvisualization of intracranial arteries after cerebral angiography with contrast injections repeated over a 10- to 15-minute interval. In related studies from several centers, clinical and EEG evidence of complete brain destruction was almost always associated with angiographic evidence of cessation of intracranial blood flow.¹³⁻¹⁶

Another validation of the Harvard criteria derives from cooperative studies of the value of EEG and neurologic examination in the determination of complete brain destruction.^{17,18} In these studies, members of the American Electroencephalographic Society and of EEG societies in Europe were questioned. Of the 2,642 cases under study, there was no instance of recovery in a patient who fulfilled the Harvard criteria. Furthermore, since 1970, there have been no adequately documented examples in which the Harvard criteria could be considered invalid.¹⁹ Moreover, many authorities presently consider these criteria too strict in at least two regards.¹⁹⁻²⁴ First, it has been shown that spinal reflexes including withdrawal movements may persist after complete destruction of the brain. Second, it is believed that certain determination that the brain is totally destroyed can be made even when the period of clinical and EEG evidence of absent brain function is reduced to less than 24 hours. The latter is consistent with the opinion that methods for measuring intracranial blood flow will allow a sure determination of complete brain destruction to be made with periods of observation less than the 24 hours proposed in the original Harvard criteria.^{11-16,22} In this regard, it should be noted that the immature brain is more resistant to all forms of insult. Therefore, altered, less restrictive criteria for determining total brain destruction in patients under 14 years of age may differ from those in adults.

Further support for the use of less

restrictive criteria is provided by the recently completed Collaborative Study on Cerebral Survival, which was based on an analysis of 503 unresponsive apneic patients. From this experience it was concluded that, if all appropriate diagnostic and therapeutic procedures had been performed to exclude reversible conditions, brain destruction was always present if certain criteria were observed for at least 30 minutes six hours or more after the cerebral insult had occurred. The specified criteria were unresponsiveness, apnea, dilated pupils and absent cephalic reflexes, electrocerebral (EEG) silence, and confirmation of absent cerebral blood flow by angiography, isotopic bolus techniques, or echoencephalography.^{23,25,26} The confirmatory test for absent cerebral blood flow was not deemed necessary in cases where the obvious etiologic factor was known to be a nontreatable condition, such as massive brain trauma.

Although some groups have indicated that EEG is not required to determine that brain death has occurred,^{21,27} and although many neurologists and neurosurgeons would agree that brain death can safely be pronounced in the absence of electrocerebral silence in the occasional patient, the recommendation that EEG criteria be met before brain death is pronounced is probably best for general usage.^{22-25,28} This recommendation appears advisable at present in light of a report that a patient who ultimately recovered had met the clinical criteria of brain death but never had electrocerebral silence,²⁹ and in view of the current trend toward increasingly frequent medical malpractice suits.

A final validation of the criteria for measuring total destruction of the brain has been an attempt on our part to explore purported anecdotal exceptions. In every instance where recovery of brain function was claimed, the criteria had not been fulfilled. Thus, the validity of the criteria must be considered to have been established with as much certainty as is possible in biology or medicine.

PHILOSOPHICAL AND RELIGIOUS ACCEPTABILITY

It is one thing to know that we now

possess the technical capacity to determine accurately that a human brain has been completely and irreversibly destroyed. It is quite another matter to make the social policy judgment that it is acceptable to use complete and irreversible destruction of the human brain as a basis for treating the person as a whole as if he or she were dead. We are convinced that society now has sufficient philosophical certainty, based on the main stands of secular philosophical thought and the major Western religious traditions, to use destruction of the brain as an indicator that the person has died.

It has been suggested that one reason for changing society's concept of death to one oriented to brain function is that it would provide desperately needed organs for transplantation and other useful medical purposes. However, the fact that someone would be useful to others if pronounced dead should not alone be a sufficient reason for considering that person dead and cannot be the sole basis for changing to the use of brain-oriented criteria. Rather, there must be sound reasons independent of that if society is going to alter its definition of death.

The principal reason for deciding that a person is dead should be based on a fundamental understanding of the nature of man. Our present conceptualization of man almost reflexively draws a distinction between a person whose organs are under nervous system influence and the remnant of a person or his corpse in which residual and nonhomeostatic functions may or may not have completely ceased. Without a brain, the body becomes the convenient medium in which the energy-requiring states of organs run down and the organs decay. These residual activities do not confer an iota of humanity or personality. Thus, in the circumstance of brain death, neither a human being nor a person any longer exists.

Although all members of society will not be able to agree precisely on an acceptable formulation of man's nature, fortunately all that is necessary to establish a public policy is agreement on some widely acceptable, general statements about the nature of man. Almost all segments of society will agree that some capac-

ity to think, to perceive, to respond, and to regulate and integrate bodily functions is essential to human nature. Thus, if none of these brain functions are present and will ever return, it is no longer appropriate to consider a person as a whole as being alive.

If there were no offense, no moral or social costs in treating dead persons as if they were alive, then the safer course would be to continue to do so. Quite clearly, however, this is not the case. In addition to reflecting an inadequate understanding of the nature of man, it is an affront to the individual person or that person's memory to treat a human being who has irreversibly lost all brain function as if he were alive. It confuses the person with his corpse and is morally wrong.

Furthermore, maintenance of a dead person on life support systems for no reason is an irresponsible squandering of our economic and social resources. Such a practice places an unnecessary financial burden on society and an additional emotional burden on the person's family and is thereby also morally wrong. Thus, even without consideration of the use of the body or its organs for transplantation or other altruistic purposes, there are sound moral and social reasons for treating a body that has lost significant thinking, perceiving, responding, regulating, and integrating capacities as dead. Of course, it is a waste of human resources and a further wrong to continue treating a corpse as if it were alive when such treatment may deprive other living persons of needed organs. Thus, from a moral and ethical perspective, persons who have lost all brain function and who are certainly dead should be treated accordingly. Before adopting this conclusion as a public policy, however, it is important to examine how such a position accords with the major religious traditions of our society.

The Orthodox Jewish response to the premise that death may be pronounced on brain-related criteria is, like much of the moral conscience of Western civilization, based on biblical and talmudic ethical imperatives. According to these, it is axiomatic that human life is of infinite worth. A corollary of this is that a fleeting moment of life is of inestimable worth

because a piece of infinity is also infinite. The taking or shortening of a human life is, therefore, ethically wrong, and premature termination of life or euthanasia is no less murder for the good intentions that were the motivation for the immoral act.

The indices of life are many. Which of them can be viewed, in ethical or religious terms, as the definition or sine qua non of the living state rather than a mere confirmation that the patient is still living? It is first important to point out that absent heartbeat or pulse was *not* considered a significant factor in ascertaining death in any early religious sources.³⁰ Furthermore, the scientific fact that cellular death does not occur at the same time as the death of the human being is well recognized in the earliest biblical sources. The twitching of a lizard's amputated tail or the death throes of a decapitated man were never considered residual life but simply manifestations of cellular life that continued after death of the entire organism had occurred.³¹ In the situation of decapitation, death can be defined or determined by the decapitated state itself as recognized in the Talmud and the Code of Laws.³¹⁻³³ Complete destruction of the brain, which includes loss of all integrative, regulatory, and other functions of the brain, can be considered physiological decapitation and thus a determinant *per se* of death of the person.

Loss of the ability to breathe spontaneously is a crucial criterion for determining whether complete destruction of the brain has occurred. Earliest biblical sources recognized the ability to breathe independently as a prime index of life.^{30,34} The biblical verse in Genesis records: "And the Lord had fashioned man of dust of the earth and instilled in his nostrils the breath of life and man became a living creature."³⁴ Spontaneous respiration is thus an indicator of the living state. However, it cannot be considered its definition, since a respirator patient whose sole defect is paralysis of the motor neurons to the muscles of respiration due to neurologic disease is surely fully alive despite his inability to breathe spontaneously. Therefore, to define death in biblical terms, loss of respiration must be combined with other more obvious evidence of the nonliving

state. Such evidence would be provided by the clinical and laboratory criteria that allow a physician to determine that complete and irreversible destruction of the brain or physiological decapitation has occurred.

The higher integrative functions of the brain are carried out by portions of the brain other than the brainstem. Irreversible loss of these functions, signifying destruction of corresponding parts of the brain, does not alone constitute a determinant of death in biblical terms. Coincident loss of vegetative functions, represented by loss of spontaneous respiration and indicating destruction of the brainstem, is also a requisite. Thus, destruction of the entire brain or brain death, and only that, is consonant with biblical pronouncements on what constitutes an acceptable definition of death, ie, a patient who has all the appearances of lifelessness and who is no longer breathing spontaneously. Patients with irreversible total destruction of the brain fulfill this definition even if heart action and circulation are artificially maintained. This definition is also fulfilled in patients who die with or from irreversible cessation of heart action, because this results in a failure to perfuse the brain, which produces total brain destruction. Thus, cessation of heart action is a cause of death rather than a component of its definition. In the light of these considerations, the Harvard criteria or other neurologic criteria for determining death can be viewed as the scientific expression of those observations that, until recently, were the actual way a patient was known to be dead.

The tumult that has greeted the suggestion that brain death be given legal recognition is partly the reaction of an uninformed public who envisions the possibility that a man who can move, feel, and think or can possibly recover these functions could be declared dead. The realization that brain death is only professional jargon to describe a patient who exhibits a permanent loss of signs of life, such as spontaneous movement and responsiveness, and has permanently lost the ability to breathe spontaneously would facilitate society's acceptance of the concept of brain death and would help to gain public support for

legislation recognizing that death may be pronounced on the basis of total and irreversible destruction of the brain.

Since the distinction between cellular and organismal death is valid, once death of the person has occurred and can be determined, there is no biblical obligation to maintain treatment or artificial support of the corpse. Thus, according to M. Feinstein, there is no religious imperative to continue to use a respirator to inflate and deflate the lungs and thus maintain the cellular viability of other organs in an otherwise dead patient (written communication, May 5, 1976).

This Orthodox Jewish position is not alone among major Western religious traditions in supporting a concept of death based on irreversible loss of brain function. In the Roman Catholic Church, there is no definitive, authoritative pronouncement, but Catholic theologians interested in moral questions associated with the definition of death issue have generally accepted a concept of death based on brain function. The traditional Roman Catholic understanding of the moment of real death has been based on the time of departure of the soul from the body. Since this separation is not an observable phenomenon, it must be related to physically measurable signs defining apparent death. Because the only certain signs have been the appearance of rigor mortis and the beginning of bodily decomposition, it has been recognized that real death may not coincide with apparent death. Use of such signs as cessation of heartbeat and breathing places the moment of apparent death in greater proximity to the time of true theological death. For practical reasons, theologians have accepted these signs of apparent death as reasonably accurate indicators of irreversible cessation of all vital bodily functions adequate for allowing such processes as embalming and autopsy. When artificial life support systems are used to maintain heart and lung function and when the brain is irreversibly destroyed, there is also no reasonable hope of restoring vital bodily functions to a person. Accordingly, "It would seem that death is more certain under these conditions than it was at the [time of] cessation

of spontaneous heart and lung function. If theologians were willing to accept the latter as signs of apparent death, they should be more willing to accept the irreversible cessation of brain function."³⁵

A similar position has been reached by the Catholic theologian, Rev Bernard Haring,³ who after analysis of the theological arguments concludes, "I feel that the arguments for the equation of the total death of the person with brain death are fully valid." In the same vein, the prominent author on Roman Catholic interpretations of medical ethics, Charles J. McFadden, argues that "once the fact of brain death has been established, *the person is dead*, even though heartbeat and respiration are continued by mechanical means."³⁶ These statements are consistent with the discourse of Pope Pius XII who, in discussing patients who are terminally unconscious, said

one can refer to the usual concept of separation . . . of the soul from the body; but on the practical level, one needs to be mindful of the connotation of the terms "body" and "separation". . . . As to the pronouncement of death in certain particular cases, the answer cannot be inferred from religious and moral principles, and consequently, it is an aspect lying outside the competence of the Church.³⁷

We understand the papal point to be that determination of the criteria for deciding the moment of death requires technical measures that can only be established by those with the appropriate medical expertise.

Among Protestant theologians, there are no consistent positions on questions of medical ethics including the definition of death. However, leading spokesmen of widely diverging traditions accept brain-related criteria for pronouncing death.^{2,38-42} The body is an essential element of the person according to Christian theology; but, as many of these authors emphasize, mere cellular and organ system activity alone is not sufficient to treat a human body as if it were alive. Even more conservative thinkers such as Paul Ramsey accept the use of brain-oriented criteria for pronouncement of death. He recognizes proposals for updating the definition of death as, in reality,

proposals for updating our procedures for determining that death has occurred, for

rebutting the belief that machines or treatments are the patient, for withdrawing the notion that artificially sustained signs of life are in themselves signs of life, for telling when we should stop ventilating and circulating the blood of an unburied corpse because there are no longer any vital functions really alive or recoverable in the patient.²

Thus, the complete and permanent absence of any brain-related vital bodily function is recognized as death by Jewish, Roman Catholic, and Protestant scholars even if they may disagree among themselves on the precise theoretical foundations of this judgment. (This is Part I of a two-part article. Part II will appear next week.)

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