

UPDATE ON BRAIN DEATH FOR PHYSICIAN AND SURGEONS

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[Cenni sulla morte cerebrale per medici e chirurghi]

ABSTRACT

Since the definition of brain death by the Harvard Medical School in 1968, numerous steps forward have been made. In this brief review we describe the current diagnostic criteria of brain death and the main ethical guidelines on the subject.

Key words: Brain death, neurologic criteria, ECG, bioelectric cerebral silence.

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In recent decades, modern resuscitation techniques, supported by technologically advanced equipment, make it possible to keep alive those who cannot breathe independently and have severely impaired cardiac function. Therefore, it became necessary in medicine to reformulate the concept of death and assimilate it, in recent years, to the concept of brain death⁽¹⁻¹⁴⁾.

The neurological standard of death established in 1968 by a Harvard Commission⁽¹⁾ was based on clinical and EEG criteria.

“Brain death” is the complete and irreversible cessation of all brain functions.

Brain death in Italy is regulated by legislation, which, first with the Law dated December 29, 1993 and Ministerial Decree No. 582 of August 22, 1994 and later with Decree No. 136 of June 12, 2008, both published in the Official Gazette of the Italian Republic, allow physicians to make a diagnosis that is also based on the concept of “irreversibility”, which must be correlated with a primary brain pathology supported by a prior loss of consciousness.

The neurological criteria that support the diagnosis of death may concern patients in a coma, without normal functions of the brain stem due to primary brain diseases such as head trauma, acute brain events (ischemia or hemorrhage), cerebral anoxia due to cardiac arrest following 24 hours after arrest, and primary and secondary brain tumors⁽¹⁵⁾. Of course, other conditions may also progress to states of coma and then death, such as metabolic and vascular encephalopathies, dementia, multiple sclerosis, and amyotrophic lateral sclerosis⁽¹⁶⁻²³⁾.

In Italy, the “Commission” responsible for ascertaining the irreversibility of brain death is made up of a medical examiner or Healthcare Management physician, or by a pathologist, an anesthetist-resuscitator, a neurologist or neurosurgeon, both with valid and documented professional experience of electroencephalography.

The Commission takes office after a report made by those responsible for an intensive care unit to the Healthcare Director, following a clinical condition that correlates with a diagnosis of brain

death, after electroencephalographic evidence of “electrical silence”.

In Italy, the investigation concerning children was reformulated in 2008 by a law abolishing the previous policy of 1994, which, however, had established an observation period of 12 hours for children under the age of 5 and 24 hours for those under one year, while it reconfirmed the legal requirement of proof of cerebral blood flow in infants under one year.

The Commission is required to have an EEG recording performed, evaluate also the reflexes of the trunk and perform the apnea test.

Any organ harvest can only be done after a thorough assessment of brain death.

The neurological criteria for declaring death are now essential for physicians in Italy in the light of modern minimally invasive surgical techniques and multidisciplinary clinical decisions^(24,25,26).

Obviously, further knowledge on the processes involved in the transition from coma to death is a modern challenge for scientific research.

An individual may be declared clinically dead, even in the presence of breathing and heartbeat temporarily supported from the outside with the aid of equipment.

In the case of brain death, the electroencephalogram (EEG) shows no electrical activity, called “flat” EEG.

The neurological examination does not show responses to pain, the pupils appear fixed and oculo-cephalic, and corneal reflexes are absent.

Brain death is not to be confused with other clinical conditions due to poisoning by barbiturates, sedative overdose, hypothermia, hypoglycemia, coma or chronic vegetative state. Some define brain death as death of the neocortex, but the most correct and accepted definition concerns the cessation of the functions of the neocortex and underlying brain stem. As regards cerebral bioelectric activity, its recording may present a pattern of complete arrest, with consequent flat EEG, even during very deep anesthesia or following events that cause cardiac arrest, lasting up to a few seconds.

The diagnosis of brain death requires rigorous investigation, with criteria defined by law, at times different from one country to another⁽¹⁻¹⁴⁾, and must be confirmed by a neurological report and two flat isoelectric EEGs at least 6 hours apart from one another.

Most donations for organ transplantation are performed on persons in a state of brain death.

Death is characterized by the irreversible cessation of circulatory, respiratory and nervous function. In accordance with Article 2, paragraph 1, of the Law No. 578/1993 already mentioned above, the ascertainment of death due to cardiac arrest can be performed by a physician with continuous ECG recording for no less than 20 minutes on paper or in digital format.

The clinical and instrumental requirements for the ascertainment of death in patients with brain injury who underwent resuscitation are:

- Lack of wakefulness and consciousness, no brainstem reflexes and No spontaneous breathing;
- Absence of brain electrical activity;
- No blood flow to the brain.

The diagnostic process must include the formulation of a definite etiopathogenic diagnosis related to the brain lesion. The absence of alterations in thermal, cardiovascular, respiratory, and endocrine-metabolic homeostasis must also be documented as elements of possible interference with the overall clinical-instrumental picture.

In the event that cerebral blood flow is absent, the physician of the hospital where he works has the legal obligation to immediately inform the healthcare director, pursuant to article 3 of Law No. 578 of December 29, 1993.

In the ascertainment of death in patients with brain injury who received resuscitation for the period of observation required by law, the following conditions must be met:

lack of wakefulness and consciousness, absence of brainstem reflexes (photomotor reflex, corneal reflex), absence of reactions to painful stimuli in the territory of innervation of the trigeminal nerve, absence of motor response in the territory of the facial nerve after a painful stimulus, absence of oculo-buccal, pharyngeal, and cough reflex, absence of spontaneous breathing and values of arterial CO₂ no less than 60 mmHg, blood pH no greater than 7.40, in the absence of artificial ventilation, absence of brain electrical activity, documented by EEG performed according to the specified technical procedures, lack of blood flow to the brain.

The ascertainment of death requires an observation period of at least 6 hours.

In cases of anoxic brain damage, the observation period must begin no earlier than 24 hours before the anoxic event, except for those cases in which there is no blood flow to the brain.

In the latter case, the observation period may also begin before 24 hours from the time of the anoxic insult.

The investigation carried out by the medical team must be completed at least twice, at the beginning and end of the observation period.

The execution of EEG investigations must be carried out by neurophysiopathology technicians, always under medical supervision.

In Decree No. 136 of June 12, 2008 the instrumental parameter specified with the clinical parameters set forth by the law is the EEG.

It must document the absence of electrical activity in the origin, both spontaneous and induced, of amplitude greater than 2 microvolts, in any region of the scalp, for a continuous time of thirty minutes.

EEG recordings must be made on paper and in digital form, at the time of determination of the condition of irreversible cessation of all brain functions, and repeated at the end of the observation period.

The diagnosis of brain death cannot be carried out on any patient, but only on those in a coma and with complete loss of brainstem functions, as a result of brain damage (e.g., head trauma resulting in extended intracerebral hemorrhage, cerebral anoxia due to cardiac arrest, brain tumors).

In children under one year of age, in case of unreliability of the electroencephalogram, the law requires an assessment of cerebral blood flow (by Doppler ultrasound or arteriography, or transcranial Doppler, angio-scintigraphy, CT scan with contrast medium).

Normal cerebral blood flow is equal to 55mL/min. for 100 g of brain mass and below 15-20mL/min there is cortical electrical silence.

The law on the determination of brain death, in force in Italy, is a good law, among those in many Western countries⁽¹⁻¹⁴⁾, because it excludes arbitrary and fallacious forms of assessment of death.

The concept of death was seen in the past from a perspective different from today's.

The very term still used today, namely "to breathe one's last breath", was correlated to the belief that a person died when he or she stopped breathing.

The use of resuscitation techniques in support of cardio-respiratory functions has shifted the center of gravity of the definition of the time of the ascertainment of the death of an individual, from "pulmonary and cardiac death" to brain death⁽¹⁻¹⁴⁾.

Brain death based on medical grounds is not only an event but also a process, which, by definition, is correlated with the state of knowledge in medicine, and this can be a parameter when discussing the issue of euthanasia.

Current scientific knowledge defines brain death as the true death of an individual, emphasizing its diversity from coma.

Brain death is never reversible, whereas coma can be.

Medical science aims, as always, to save life, without yielding to the hypothesis of early death.

From an ethical point of view, the modern debate on death and euthanasia focuses on two visions:

- Ethical vision;
- Utilitarian vision.

The ethical vision states that an action is a morally wrong as such, regardless of the consequences it causes.

The utilitarian view⁽²⁷⁾, however, argues that an act can be considered lawful if it determines, in cases of violation of a rule, greater benefits of the violated rule.

In the utilitarian view⁽²⁸⁾, human life does not have an absolute value in itself.

Singer and Rachels⁽²⁷⁻²⁹⁾ are two of the first major supporters of the death by euthanasia.

Peter Albert David Singer, the philosopher of anti-speciesism, assimilates "Speciesism" to racism and sexism, supporting the thesis by which "killing, sometimes, is not wrong," and that "the lives of human beings do not always have the same value," since life itself has no absolute value.

Singer^(28,29) argues that the idea of death by euthanasia may be lawful for the terminally ill and for infants with severe birth defects, based on the concept of quality of life, which requires that the ethics of the sacredness of life may be replaced by the ethics of the quality of life.

James Rachels⁽²⁷⁾ promotes the utilitarian ethic according to which the moral sustainability of euthanasia cannot be hindered by any cultural or religious tradition.

Medical ethics is based on the respect for the individual and his or her life, since the Hippocratic tradition, and reaffirmed by the Christian tradition.

The Declaration of Geneva (1948), ratified by the World Medical Association, already made it mandatory for physicians to have "the utmost respect for human life from the moment of conception."

Physicians must always safeguard the life of others, both through therapeutic intervention and prevention.

Beyond any ethical, philosophical, or religious references, it is up to physicians to codify, according to law, the parameters that certify the diagnosis of brain death.

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