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Death, diagnosis and event

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Abstract

Life and death are viewed differently in different cultures, religions, and societies; therefore standardizing their meanings in multicultural societies is challenging and complex. Given this reality, this research investigated how death has been understood throughout history and its associated values. An analytic-narrative literature review was conducted, selecting 69 publications to be read in full. Society and medicine have assumed a dualistic perspective in which death of the brain function is viewed as irreversibility of the existence of a psychological self. Faced with the possibility of procuring organs and tissues from a body kept alive and operated on, life support should always aim to benefit, but without causing harm to others. For these advances to be possible, legislation must be clear and up-to-date.

Keywords: Death. Brain death. Tissue and organ procurement. Bioethics.

Resumo

Morte, diagnóstico e evento

Vida e morte são compreendidas de maneiras distintas em diferentes culturas, religiões e sociedades, portanto padronizar o entendimento dos significados desses termos em sociedades multiculturais torna-se desafiador e complexo. Diante dessa realidade, esta pesquisa busca descobrir como a morte foi compreendida na história e quais valores eram associados a ela. Para isso, realizou-se revisão da literatura analítico-narrativa, com seleção de 69 publicações para leitura na íntegra. A sociedade e a medicina adquiriram uma visão dualista que considera a morte da função cerebral como irreversibilidade de existência de um eu psicológico. Diante da possibilidade de coletar órgãos e tecidos a partir de um corpo mantido vivo e operado, o suporte de vida deve sempre visar o benefício, mas sem causar danos a terceiros. Para que esses avanços sejam possíveis, a legislação deve ser clara e atualizada.

Palavras-chave: Morte. Morte encefálica. Doação de órgãos e tecidos. Bioética.

Resumen

Muerte, diagnóstico y evento

La vida y la muerte se entienden de distintos modos en diferentes culturas, religiones y sociedades, por lo que estandarizar la comprensión del significado de estos términos en las sociedades multiculturales se vuelve desafiante y complejo. Ante esta realidad, esta investigación pretende conocer cómo se abordó la muerte en la historia y qué valores se asociaron a ella. Para ello, se realizó una revisión de la literatura analítico-narrativa, con una selección de 69 publicaciones para su lectura completa. La sociedad y la medicina tienen una visión dualista que considera la muerte de la función cerebral como una irreversibilidad de la existencia de un yo psicológico. Frente a la posibilidad de recolectar órganos y tejidos de un cuerpo mantenido vivo y operado, el soporte vital siempre debe estar dirigido al beneficio, sin causar daños a terceros. Para que estos avances sean posibles, la legislación debe ser clara y estar actualizada.

Palabras clave: Muerte. Muerte encefálica. Obtención de tejidos y órganos. Bioética.

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Addressing death only from a biological point of view is insufficient, as human beings are multidimensional and psyche, social relations and spiritual aspects intertwined. Life and death are the themes of this literature review, which presents the historical course of the concepts and values related to these terms.

For Villas-Bôas [1], death can be characterized as biological and clinical, and the latter precedes the biological, which can occur long afterwards. Different cultures and religions understand life and death in their own ways, based on different perspectives, valuing specific bodily organs as a vital place. For example: for the Egyptian culture the heart is the vital place; for the Japanese, the viscera/abdomen; for the Jewish religion, breathing and the heart; and for Christians, the head [2]. African religions and cultures of the Indigenous people of the Americas may consider important other elements.

Thus, how to consensually define which organ and/or bodily function determines whether a person is alive or not, without hurting susceptibilities? It can be realized that conceptualizing death is pretty controversial, especially in multicultural societies.

Literature on the theme was searched using the health sciences descriptors (DeCS): "brain death," "bioethics," "medical ethics," "organ donation," and "medical education," in different combinations. The sample included full studies available on the SciELO, Latin American and Caribbean Health Sciences Literature (LILACS), Virtual Health Library (VHL) databases, and the Thesis Portal of the Coordination for the Improvement of Higher Education Personnel (Capes), published from 1960 to 2020.

Initially, the abstracts were read and 69 articles were selected to be read in full. Thus, the literature review followed the analytic-narrative method, in which we sought to understand how the theme was historically addressed.

What is death?

In the Paleolithic period, when humans had a natural primitive or instinctive perception, death was regarded as transformation. The rites that allowed the safe passage of the body had an aggregative function in terms of social organization [3]. This is a period of prehistory in which people lived in nomadic groups and, therefore, the interpretations of this period are basically conjectures based on scarce evidence.

While agriculture evolved, the vision of life and death became associated with harvesting. In this context, resurrection myths arose, based on the idea of periodic renewal represented by the observation of the seasons and the sequence of sowing and harvesting. Moreover, this new vision of renewal of agricultural communities became associated with the concepts of both resurrection and rebirth, giving rise to great tombs, which symbolized such belief [3].

In ancient Egypt, the development of society and the increase in the quality of human life gradually replaced the idea of death with a concept of immortality, previously reserved for gods and pharaohs. Death was then considered a transition to an eternal existence, based on morality [3].

In the Old Kingdom of Egypt, only pharaohs were mummified, since the vital energy of the entire kingdom resided in them. Mummification was a way to keep the king—and therefore the kingdom—immortal, that is, a way to circumvent death by preventing putrefaction, because they considered that the preservation of the body was a sine qua non condition for immortality. Thus, for the Egyptian people, in death the person becomes its own body, a philosophical view very close to materialism [4].

In a comparison made between the mourning process of Japanese and English widows in 1969, an important contrast between the predominantly Shinto and Buddhist perspective of death and the English view was noticed. In the Japanese tradition, the deceased subject becomes part of the group of their ancestors, and it is common for people to talk to deceased spouses, take them food and even cigarettes, as contacts with ancestors are encouraged. In the Western tradition, taking food to the grave would be interpreted as an inability to deal with grief, while in the Eastern tradition this would be totally in line with how grief is experienced [5].

The Hopi people, native to Arizona, conceive death as something polluting and try to forget and overcome this event as quickly as possible. This is because the spirit is considered an entity that does not carry the characteristics of the dead and should thus be feared [5].

Judaism defines death as a moment related to breathing. In one passage of the Babylonian Talmud, to determine whether rescued people from a burial under a landslide are alive, their nose must be checked, regardless of how severe their injuries seems to be. Hence, in the Jewish view, neurological evaluation is not sufficient to define death. Although there are groups in Judaism that accept brain death as possible, based on sacred texts about decapitation and spinal injury, the cardiorespiratory criterion is still the most accepted [6].

In the 14th century, the Council of Vienne defined death under the modern Catholic perspective, considering that life ends with the definitive separation of the soul from the body, when all the life that remains in the body is no longer integrated to the individual. According to Pope John Paul II, science cannot define the exact moment of death, but the separation between body and soul generates clear somatic signs that the person has died [6]. In other words, for the Catholic Church, the medical community is the one who defines the criteria to declare someone's death, with no evident disagreement of death by neurological criteria.

In the Islamic tradition, death is universal, predestined, and occurs only with Allah's permission. Its determination by cardiovascular or neurological criteria is accepted by most Muslim countries and scholars, although there is no precise definition of what it represents in Islam [6].

For Aristotle, the soul was the functional form of humans, so that when a body ceases to perform its functions, it also ceases to exist and the body is no longer a person. He tried to deal with death by suggesting a new outlook on life, of a search for happiness [7]

Contrary to what Aristotle claimed, Socrates and Plato believed in the duality between body and soul and in the immortality of the latter. For Socrates, there is no way of knowing whether death is good or bad, whether the soul would be moved to another place, or whether only human beings would sleep a long and deep dreamless sleep. Plato followed Socrates and set out arguments that understood the soul as eternal, and the body as a prison for it [7].

For Heidegger [8], who continued Kierkegaard's existentialist philosophy, death is not a final event, since individuals are always their own death, in the sense of going toward it—in other words, the human being is a being for death. However, the view that death is a gradual and continuous event that accompanies a person throughout life is not a common or even predominant perspective in the history of philosophy. Most philosophers who discuss the subject try to define death as a final moment or process in the individual's life.

Death comes to be defined as a transition of the body from a state "with" life to a state "without" life, in which individuals cease to be a person, becoming bodies awaiting decomposition. But are beings just their bodies? Epicurus, and his famous statement *Death is nothing to us, when we are, death is not come and, when death is come, we are not* [9], can be classified as one of the first "terminators," for he was of a philosophical school that claimed that people cannot exist dead. In this perspective, after death, a person is annihilated, and the buried or cremated body would only be a corpse, no longer the person [10].

In a materialist perspective, another philosophical view that conceives of terminality, Feldman [10] explained that death would be a profoundly transforming moment of an object that, once alive, becomes dead, yet it does not cease to exist. It is obvious that the body does not disappear with death, but in the materialistic view death is dissociated from the person, and its properties transform it into someone dead. The body did not arise from the death of the person, as it already existed and continues to exist as a corpse.

Olson, cited by Bradley, Feldman, and Johansson [7], defined human existence as composed of two persons: the physical and the psychological. Basically, after death, the physical body does not materially disappear, although an irreversible process of decay begins; however the psychological being ceases to exist immediately, being obliterated. This way of thinking is defined as pluralism or dualism between the person and the body. From this point of view, the death of the psychological being is the final, irreversible death of the individual—but not of their body.

In his book *Persons and bodies: a constitutional view*, Baker [11] advocates a different form of dualism, in which, although constituting one indivisible being, the human body and the

human person are not identical. In this approach, the human person is *something with the capacity for first-person perspective*, as in saying *I am fast*, *I am strong*, *I am athletic* [12]. Thus, the person characterizes and refers to themselves in the first person and defines themselves by their body. However, the body has no rights and no job, but the person's self does.

Baker [11] states that when someone talks about their own bodies, they refer to the body about which they have first-person perspective. However, one's self and body can exist separate from each other, and one can refer to a body even before it constitutes a person, such as a fetus, and likewise one can speak of a spouse before having met them. The body continues after the person perishes, but there will no longer be something with the capacity of a first person, a person in itself.

Biological concepts of death

Diagnosing death has been a challenge in medical practice and evolves as new technologies and knowledge emerge. Among the initial concepts, from 1787 [13], which conceived the cessation of circulation as death, and the studies of 1994 [14], which considered the permanent suspension of the body's vital functions as a diagnosis of death, there were great advances, especially after the Harvard Committee [15], which included the definition of brain death, thus creating a new field of debate.

Strictly related to biology, death begins when an organism ceases to function and ends with its decomposition [1]. The organism is a successful arrangement of cells in different stages of evolution, with distinct functions and collapse times. Upon deprivation of nutrients, such as glucose and oxygen, previously distributed readily by the blood circulation, cells enter an intracellular chaos that inevitably leads to death, deteriorating an organ, a system, and ultimately the entire body.

Different cells, organs, and tissues have limited viability and lifespan after circulation and respiration stop. From a biological point of view, once the process of death has begun, the whole body follows its natural course to putrefaction [16,17]. Currently, however, artificial ways have been invented to keep the body functioning like a machine, which under natural conditions would not happen.

Thus, biologically, death is also understood not as a single and finite moment, but as a process that includes a sequence—well described in current studies—of gradual phenomena, which consequently makes it even more difficult to know when death occurs. The evolution of organ and tissue transplants made it necessary to better define this process in an attempt to precise the moment of death, thus emerging the concept of brain death. However, it is greatly important to provide a better and deeper understanding of biological death, therefore it is essential to know this process, described by thanatology [18].

From the beginning to the consummation of the death process, abiotic or negative phenomena can be described, cascading from an initial event: an individual's death. However, the knowledge about the human body's decomposition is still poor, which, combined with the variables, makes it impossible to create universal and true constants about this process. Thus, it is only possible to have an idea of the estimated time of the events that follow the death process [19].

The following phenomena, when analyzed independently, are not specific and do not confirm the proposed diagnosis, which corroborates once again the idea of process and chain of events that culminate in a definitive diagnosis of death [18,20].

The immediate phenomena—initial signs and events, immediate to death, occurring almost simultaneously—start with the loss of consciousness, defined as the absence of responsiveness and contact with the external environment, followed by the loss of senses, tactile, thermal, and painful sensations. At this point, any painful stimulus demonstrates total absence of responsiveness. Consequently, it evolves to loss of muscle tone.

Two tests corroborate the diagnosis of the death: 1) Rebouillat's sign: injection of 1 ml of ether in the lateral face of the thigh (in dead bodies, the liquid extravasates through the orifice and is not absorbed by the muscle); 2) Roger and Beis's sign: application of electric shock and absence of contraction, demonstrating real death [18].

The Hippocratic face (deep eyes, wrinkled forehead, tapered nose, depressed temples) present in dying individuals acquires a new countenance after loss of facial tone, leading to a lack of expression. At first, generalized muscle relaxation appears, leading to pupil dilation, opening of the mouth and eyes, opening of the anal and urinary sphincters, release of feces, urine, and sperm. The cessation of breathing can be evidenced by the absence of vesicular sounds on pulmonary auscultation or, more precisely, by electromyographic recording of the respiratory incursions [20].

Many tests have been described to evaluate cardiocirculatory arrest, some of them being too invasive. Cardiac auscultation with absence of beating (Bouchut's test) and electrocardiogram with or without injection of adrenaline (Guérin and Frache test) are of great importance. The absence of systemic circulation can be evidenced by the Magnus test: a tourniquet is made on the distal end of a finger, and if alive, an area of cyanosis is formed. Nevertheless, it is important to highlight, with cardiopulmonary resuscitation maneuvers and invasive mechanical ventilation, in many cases, cardiac arrest can artificially delay the diagnosis of death [13].

Numerous ocular alterations also occur with the arrest of circulation: emptying of the central retinal artery, discoloration of the choroidal layer, and arrest of circulation of the superficial retinal network in ophthalmoscopy [18]. Evidence for brain function arrest is associated with clinical signs of brain death (apperceptive coma, absence of trunk reflexes) [15] and the absence of electrical activity or cerebral blood flow [18].

The phenomena that initially and immediately occur after death have been described so far. Thereafter, abiotic events take their course consecutively toward the decomposition of the body. It is thus evident that for biology there are two different groups of events: immediate phenomena (loss of functions) [10] and mediate or consecutive phenomena (end of the body).

Consecutive abiotic phenomena:

1. Cadaveric dehydration: the cadaver undergoes a dehydration process, evidenced by weight decrease, dryness of the skin and mucous membranes, eyeball flaccidity, wrinkling (Bouchut's sign), dryness (*taches noire*), and corneal opaqueness [18];
2. Algor mortis: the cessation of the full functioning of the thermoregulatory system determines the gradual cooling of the body. Initially, extremities lose heat progressively. Trunk and internal organs may maintain their temperature for up to 24 hours after death [20,21];
3. Postmortem hypostasis (*livor mortis*): the interruption of blood circulation causes the blood to accumulate and flow to lower regions of the corpse or to regions in contact with surfaces. Lesions are then formed on the skin, such as bluish-purple spots or plaques, which appear in the lower region of the corpse, depending on its position, including internal organs. The hypostases remain until putrefaction and are important to determine both the time of death—because they appear around two to three hours after death—and the position of the individual at the time of death—because they can change place as the corpse is moved, but remain fixed after 12 hours [18,22];
4. Cadaveric stiffness: physical-chemical event related to muscle dehydration and hypoxia, which lead to non-formation of adenosine triphosphate (ATP), maintenance of the actin and myosin bond, alteration of the cell membrane, and accumulation of lactic acid. It consists of muscle contraction and stiffness, usually beginning two to three hours after death, reaching its peak in eight hours, and finally disappearing in 24 hours. Cadaveric rigidity is also considered in the diagnosis of death from a medico-legal point of view [20]; and
5. Cadaveric spasm: sudden muscular rigidity acquired at the moment of death (Kossu's sign).

Unlike cadaveric stiffness, which settles progressively throughout the first hours [18], in the destructive transformative phenomena, the body continues its process of progressive destruction, autolysis, putrefaction, and maceration:

1. Autolysis: occurs at the cellular level. The presence of anaerobic phenomena at this point leads to cellular destruction promoted by enzymes that act intensely, without the aid of bacteria, making the pH of the medium

increasingly acid. Two phases can be identified: the first is the latent phase, in which the cytoplasm is destroyed; the second is the necrotic phase, when the nucleus is destroyed. As the acidity of the environment becomes incompatible with life, this process also helps diagnosing death, and it is possible to measure the pH of the corpse by several methods: Labord's sign, Brissemoret and Ambard's test [23];

2. Putrefaction: it consists of the decomposition of the body from the action of aerobic, anaerobic and facultative bacteria. In adults, it starts in the intestine, leading to the formation of greenish spots in the abdomen, which is the first sign of putrefaction. It is greatly influenced by the physical-chemical conditions of the environment (temperature, humidity, acidity of the medium, etc.)—at temperatures below 0°C this process does not begin. This stage goes through four subsequent phases, namely: the chromatic period, the gaseous or emphysematous period, the liquefaction period, until it culminates in the skeletonization period [18,20,23].
3. Maceration: it corresponds to a transformation process in which the body loses consistency, flattens the belly and detaches the bones and skin flaps [20].

Thus, when death is analyzed, two distinct events occur from the biological point of view. The first is immediate and consists of the loss of consciousness and senses and the cessation of breathing and circulation, leading to the cessation of brain functioning and culminating in brain death. If there is no artificial respiratory and circulatory support, this picture will evolve into the second event, composed of progressive phenomena that begin with stiffness and cooling and end with the putrefaction of the body. The further the decomposition process progresses, the more sensitive the diagnosis of death becomes.

Lungs, heart, brain death

Parameters of death in history

Until a significant part of the 19th century, individuals died at home, assisted by family members and loved ones [24]. In this context, the physician was charged only with the role of spectator, as they understood death as a natural and inherent element to the existential experience [25].

The biotechnicist and hospital-centric model of the 20th century made death begin to occur in hospital environments more frequently, where there is usually excessive therapeutic obstinacy aimed at maintaining life at any cost in detriment of the patients' well-being, and physicians started to regulate the moment in which death would occur [26]. Hospitalization, intensive care units, and transplants characterize new trends of this century, increasing the possibility of delaying death as much as possible, which directly implies the responsibility of defining the moment in which death becomes inevitable.

However, regardless of the technological advances of the last century, the brain and its functions cannot be replaced by any means. Thus, death does not inevitably affect the organism as a whole, but may be restricted to the central nervous system. This unique characteristic drives discussions about what is death by medical and legal communities worldwide.

Hence, scientists and thinkers from different fields of knowledge, and even bureaucrats and managers started participating in debates on what characterizes death. The motivation of these spheres regarding the subject may be related to the costs of advanced life-prolonging therapies, the possibility of organ and tissue donation, and prolonged family suffering due to the extension of the period of evolution towards death.

In this context, the concept and diagnosis of death have evolved, so that the exclusive understanding of this event due to cardiac or respiratory arrest is replaced by the idea of encephalon, cerebral, or cortical death, which means the end of the relationship life, that is, the existence of the individual. According to Luciana Kind [27], this discussion arose in the 1960s, after the technological development that extended the process of death. Thus, the creation of life support machines and new medical procedures preceded the discussion and production of arguments on the definition of brain death [27].

From a moral and legal standpoint, it is important to have an objective definition of

death and the understanding regarding the irreversibility of the clinical situation of patients. The *Universal Declaration on Bioethics and Human Rights* (DUBDH), when discussing the modern redefinition of death, stated that *decisions regarding ethical issues in medicine, life sciences and associated technologies may have an impact on individuals, families, groups or communities and humankind as a whole* [28], considering that all human beings, without distinction, should benefit from the same high ethical standards in medicine and scientific research.

To ensure that the bioethical standard of decisions is as appropriate as possible, objective data that promote understanding of this diagnosis and concept are fundamental to guide the disbursement of resources for organ and tissue donation policies and programs and/or the limitation of expenditures by the system (due to the shortage of resources intended for brain death patients). These data can be used to reduce the suffering of families at the time of diagnosis and increase the percentage of family members who accept organ and tissue donation procedures. They can also increase the confidence of professionals in the area by accelerating diagnoses and conducts, as well as reducing costs due to interruption of hospital resources committed, as in the case of withholding life support.

It is possible to infer that, with the medical and legal acceptance of brain death, society has adopted a dualistic perspective on death, as previously exposed. Thus, with the death of the brain function, it is no longer possible for a psychological self to exist, and it is allowed to keep a body alive and operated on for organ harvesting. It is no longer the individual who once lived—for they are dead, only their body lives—and, therefore, organs and tissues can be harvested without harming a living person.

Cristina Lima [29] considers the variability of the concept of death an academic issue, but this cannot be stated regarding criteria and tests, which must be very well defined. No matter how much the moment of death may be discussed, the methods, signs, and symptoms accepted to give this diagnosis from the medicine-legal point of view must be assertive, regardless of the philosophical basis from which it is evaluated. If the brain death criterion is used, the clinical characterization of brain death syndrome must be clearly defined and, if there is cardiovascular arrest, the evaluation must present precise parameters in order to avoid diagnostic variability.

In the 1930s, in Boston, Drinker and Shaw [27] developed the iron lung, later applied and disseminated by Lassen and Ibsen. This technology made it possible to transiently interrupt the dynamic process involving loss of brainstem function, respiratory arrest, and subsequent cardiac arrest. Moreover, other resources—such as vasoactive drugs—have allowed physicians to keep patients alive for treatment of brain injuries that previously would have led to death [30].

Therefore, the criteria for brain death diagnosis started to be discussed mainly after the work of Mollaret and Goulon [31], in 1959, in their description of the "*coma dépassé*" (literally a "state beyond coma"), based on 23 clinical cases. It described loss of the rapport pathways, including trunk reflexes, and vegetative functions such as respiration, thermal dysregulation, and collapse of the circulatory system, in addition to alterations in electroencephalogram (EEG) that are now typically related to brain death. This is a landmark article, but it should be noted that the authors did not consider this definition as equivalent to death [31].

Schawb, Potts, and Bonazzi [32] published the first set of rules and symptoms for the diagnosis of brain death. The authors suggested that physicians would be authorized to withhold life support and declare patients dead if these conditions are met:

1. Spontaneous respiration must be absent for 30 minutes;
2. There should be no tendon reflexes of any kind;
3. There should be no pupillary reflexes and pupils will be dilated;
4. Pressure on the eyeball should not alter heart rate;
5. EEG should have flat lines with no rhythm in all captures for 30 minutes;
6. A loud noise should not cause detectable discharge in the EEG; and
7. Resistance between electrodes is usually above 50,000 ohms [32].

In the same article, they argue that maintaining artificial cardiopulmonary bypass generates high costs, stress to family members, and professional

and hospital equipment demands [32]. The discussion continued in several symposia and scientific articles.

In 1968, there was an important advance with the publication of the Harvard Committee criteria [15], which established the term "irreversible" as a new criterion for death and described that, for the diagnosis, the brain-dead patient must be unresponsive and not receptible to stimuli such as pain, touch, sound, or light. Furthermore, there should be no spontaneous movements or breathing—it is suggested to tun off the life support for three minutes for testing—no trunk or tendon reflexes, and have a flat EEG.

The final suggestion is repeating the tests in 24 hours to confirm the irreversibility of the condition, and it is necessary that the patient be in an adequate condition, with no factors that can interfere with the results. Thus, both central nervous system depressants and hypothermia (<32°C) should be avoided, so that the diagnosis of brain death is accurate and reliable [15].

It is worth mentioning the points and arguments against this clinical definition of brain death, understood as death of the individual. Hans Jonas [33], in his article "Against the stream: comments on the definition and redefinition of death," published in response to the brain death criteria defined by the committee, started from a purely philosophical point of view. The author was concerned that the redefinition of death as death of the encephalon reinforced a dichotomy between brain and body in which, after the death of the former, the latter would pass into the "realm of things," when in fact body and brain compose a unique whole.

Jonas's objection [33] arises from the fact that he does not consider the separation of the individual from his body, so that, for him, withholding life support devices in irreversible cases should only be performed when the interest is to avoid prolonging the individual's suffering, regardless of other possible benefits (donations, beds, family suffering). The author believes that organ harvesting is a destructive activity, which should only be done after death in its classical definition.

Later, Jonas [34] revised his original text and regretted the increasingly flexible criteria for brain death. Despite this objection, medicine moved on in an attempt to find more objective criteria to define brain death, probably based on the distinction then perceived, by medical circles, between the body and the person.

In the same year of Harvard's publication [15], Law 5,479/1968 [35] was enacted in Brazil, which provides for the permission to remove organs for donation. At that first moment, no specific criteria were mentioned to define brain death or its concept according to the Brazilian legislation [35].

In 1971, as Mohandas and Chou [36] point out, a new refinement of criteria emerged from the publication of the *Minnesota Code of Brain Death Criteria*, which included the need for diagnosis of intracranial lesion, exclusion of metabolic causes, standardization of apnea test, and areflexia of only the trunk for diagnosis.

Finally, in 1980, the Uniform Determination of Death Act was published, which defined cessation of brain functions and irreversible cardiorespiratory arrest as death of the individual in the United States [37]. These criteria were revised and expanded in 1981 by the publication of the *Medical consultants on the diagnosis of death to the president's commission for the study of ethical problems in medicine and biomedical and behavioral research*, which addressed both brain and cardiorespiratory death. The last revision was made by the American Academy of Neurology, in 1995 [38,39].

In Brazil, after Law 5,479/1968 [35], it was only in 1991 that the Federal Council of Medicine (CFM) passed Resolution 1,346, establishing the first single criteria for determining brain death:

1) The criteria, at present, for the characterization of total and irreversible arrest of encephalic functions in people aged over 2 years are, as a whole:
a) Clinical: apperceptive coma with nonspecific painful, and vegetative lack of response, of a defined cause. Absence of corneal, encephalic eye, vestibular eye, and vomit reflexes. Positive apnea test. Excluded from the above criteria are cases of metabolic intoxication, drug intoxication, or hypothermia.
b) Complementary: absence of bioelectrical or metabolic cerebral activities or of encephalic perfusion.
2) The observation period of this clinical state must be of at least 6 (six) hours.
3) The total and irreversible stop of the encephalic functions will be verified by observing these criteria registered in a protocol duly approved by the Ethics Committee of the Medical Facility.

4) Once a total and irreversible stopping of the patient's brain functions is confirmed, the physician must immediately communicate such fact to the patient's legal guardians before taking any additional measures [40].

In 1997, Law 9,434 was enacted [41], establishing that the CFM is responsible for defining brain death criteria, as well as requiring the test by two physicians not participating in the transplant team. In the same year, the CFM passed Resolution 1,480/1997 [42], which, in addition to detailing the physical examination, establishes criteria for brain death in children aged under 2 years.

Article 4. The clinical parameters to be observed to confirm brain death are: apperceptive coma with absence of supraspinal motor activity and apnea.
Article 5. The minimum intervals between the two clinical evaluations necessary for the characterization of brain death will be defined by age group, as specified below
a) from 7 days to 2 incomplete months – 48 hours
b) from 2 months to 1 incomplete year – 24 hours
c) from 1 year to 2 incomplete years – 12 hours
d) over 2 years – 6 hours
Article 6. The complementary tests to be observed to confirm brain death should unequivocally demonstrate: absence of brain electrical activity, absence of brain metabolic activity, or absence of cerebral blood perfusion [42].

In 2001, in response to Consultation 8,563/2000 PC/CFM/42/2001 [43], the CFM established the time of death as the closure of the brain death protocol (two clinical exams and one complementary exam). In addition, it authorized the withhold of life support in non-donor patients and the performance of the complementary exam between clinical exams, but never as the first measure [43].

In 2007, the CFM passed Resolution 1,826 [44], reinforcing that it is ethically correct and legal to suspend support to brain-dead patients, organ and tissue donors or not—as long as the action is preceded by discussion and has the family's consent. Finally, Resolution 2,172/2017 [45], in addition to detailing clinical, diagnostic, and complementary examinations for brain death by age group, presented new features. The main updates were the requirement of specific training of a physician to perform the brain death protocol examination—but no longer necessarily having a neurologist or neurosurgeon—and the reduction of the time among clinical examinations to one hour in patients older than 2 years [45].

Another issue that has gained prominence in Brazil is the advance directives and the living will. Thus, individuals, by identifying and expressing their will for the end of their lives, become responsible for part of the decision-making process regarding the determination of advanced life support procedures and possible organ donation. Under this context, the advance directives are created through the CFM Resolution 1,995/2012 [46].

This resolution brought up rules with criteria about treatments considered invasive or painful in cases of low possibility of recovery for patients aged over 18 years, conscious of their mental capacities and responsible before the law [47]. The discussion about the autonomy of patients in relation to their own decision began in 1967, with the institution of the living will in the United States, where patients were allowed to decide on the medical procedures they would be subjected to in case of vegetative state, enacted as law in 1976 and being revised with the Patient Self-Determination Act, in 1991. The measure has been internationalized, with versions in Argentina (2001), Italy (2006), Portugal (2008), among others [47].

The living will is based on the concept of patient autonomy, not only to avoid self-sufficiency, possibly imposed on them by actions of artificial prolongation of life, but to maintain the dignity of the individual in relation to their death process [47]. There is also the rejection of a paternalistic relationship between doctor and patient, allowing the latter to have a voice in the discussion about their clinical evolution [47].

So far in this paper, we have discussed not only the philosophical point of view of brain death and the death of the individual, but also the medical-legal understanding. However, it is important to emphasize that, whenever possible, the view not only of the relatives, but of the patients should be considered, even if they are no longer conscious at the time of diagnosis. This individual mandate can come either from advance directives of will, contained in medical records before the worsening of the patient's mental faculties, or from the patient's legal representative.

As previously mentioned, currently Brazil has specific legislation for brain death and organ and tissue donation. Thus, a class council is defined to elaborate diagnostic criteria (the CFM), there is a requirement for clinical examination determined in a pre-established protocol, which must be confirmed by two professionals, and a complementary examination is mandatory.

Even so, despite the current brain death criteria being very well defined in protocol and law, many physicians have difficulty in determining the moment of death as the instant of diagnosis of brain death. In many cases, doctors think of anesthetizing patients to remove their organs [1]. There should be no doubts about the diagnosis and concept of brain death, as it would be unacceptable to remove organs and/or tissues from someone if there were uncertainty about their death.

As explained in the DUBDH, direct and indirect benefits to patients, research subjects, and other affected individuals should be maximized and any possible harm minimized when it comes to the application and advancement of scientific knowledge, medical practices, and associated technologies [48].

Final considerations

Regardless of technological advances in the field, the emergence of new practices and technologies—in this case, life support and organ and tissue donation—should always aim to benefit without causing harm to others. Then, health professionals must dominate technique and ethics in the procedures performed, and legislation needs to be updated to allow advances in the area to be really applied and supervision possible.

The Brazilian and the world legislation have evolved and changed a lot since the subject started to be considered. It is expected that it will continue to change and adapt as knowledge on the subject advances. Thus, the conception of death is influenced by technical advances, and it is necessary to take into account the techno-scientific evolution, but without disregarding the dignity and respect for people in final stage of life.

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