

# “Brain Death”: A Utilitarian Construct, Not Biological Death-The Reasons the Concept of “Brain Death” Should Be Abandoned

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## Abstract

**Purpose:** To show that the concept of “brain death” is a purely utilitarian construct which does not have adequate medical foundation.

**Methods:** Presentation of known and novel arguments from the medical literature and unknown arguments from the philosophical literature.

**Results:** There are multiple self-evident inconsistencies, contradictions and logical errors inherent in the concept of “brain death” according to which this concept is obviously invalid.

**Conclusion:** It is considered unavoidable that the only honest option is the definitive abandonment of the concept of “brain death”.

**Keywords:** brain death, brainstem death, consciousness, spinal automatisms, transplantation

## 1. Introduction

The establishment of the concept of “Brain Death” (“BD”, hereinafter) came about in 1968 from the Ad Hoc Committee of the Medical School of the US Harvard University. The Harvard report cited no medical studies or any patient data that would validate the clinical tests put forth for establishing “BD” and equating it with death” (Doyen, 2016). Over the last 50 years since the introduction of the term “BD” many serious problems have arisen concerning this concept which makes it unavoidable to abandon this term.

### 1.1 *The Aim of the Invention of “BD” Was Purely Utilitarian*

a)The main purpose of the above Committee was to define the irreversible coma as a new criterion of death in cases of patients who were comatose and apneic and in whom there was not "discernible" activity of their Central Nervous System (CNS, hereinafter). It is noteworthy that the above Committee admitted unequivocally that the purpose of defining a new criterion of death was purely utilitarian; that is, the need of defining a new criterion of death, according to the above Committee, was the fact that the “brain dead patients” (“bdps”, hereinafter) are "burden on their families, on the hospitals and on those in need of hospital beds already occupied by these comatose patients. Obsolete criteria for the definition of death can lead to controversy in obtaining organs for transplantation" (Ad hoc committee of the Harvard Medical School, 1968). It is also supported that "BD" is a social construct (Taylor, 1997), is different from that of the biological concept of death and that it was invented for the harvesting of organs for transplantation (Freeman and Ferry., 1988; Shewmon, 1989; Taylor 1997; Truog, 1997; Evans, 2002). “Some critics expressed concern at the time that, if death could be redefined for utilitarian purposes, it could be redefined again at a later time, possibly threatening more vulnerable groups” (Fost, 1999).

The Ad Hoc Committee of the Harvard University report did not base its neurologic criterion of death on any concept of death (Doig and Burgess, 2003). Another astonishing and brave really confession by the defenders of “BD” was that the above Committee "was primarily concerned with futility of care and finding ways to help physicians with withdrawal of support" (Diringer and Wijdicks, 2001).

Additionally, other important information was given by the representative of the American Academy of Neurology (AAN, hereinafter) who would write that the Harvard Committee knew well that "BD" represents a unique comatose state (Wijdicks, 2003) (but not biological death – the clarification in the parenthesis is of the

writer's). Hence, it is deduced that "bdps", are not cadavers but patients in deep apneic, probably irreversible coma, in whom the maintenance of circulation permits the continued cellular and organ system function, preventing the onset of the process of disintegration (Taylor, 1997).

Furthermore, very elucidating, in the context of "BD", are the comments of the president of the above Harvard Committee, Professor Henry Beecher, who would write that: a) "Death is defined at different levels: mental death, spiritual death and social death" ... At any level we choose to define death, it is an arbitrary decision" (Beecher ad Dorr, 1971). Furthermore, H. Beecher defines life as the ability of man to communicate with others. The position of H. Beecher becomes even clearer when he takes the view that "to live is to function" Beecher, (Beecher, 1968) and b) "The social motivation of saving human life with transplantations is a good and sufficient reason to draw this line (that is to define death) in brain death" (Beecher and Dorr, 1971). When one examines closely the consequences of the arbitrary "social construct" (Taylor, 1997), that of "BD", comes across the existence of additional slippages, as discussed below.

### 1.2 Problems Concerning the Criteria for "BD" Determination

Truog and Robinson would soundly write in 2001 that *in the absence of a world consensus on the definition of human death, it is difficult-really impossible- to be diagnostic patterns* (Truog and Robinson, 2001).

#### a. Criteria of the Ad Hoc Harvard Committee for "BD" determination

The criteria for the determination of "BD" according the Ad Hoc Committee of Harvard were drawn by Professor Raymon Adams and included the permanent state of complete unreceptivity and complete unresponsivity. *By complete unreceptivity was meant all stimulus effects (whether excitatory, reflexive, cognitive, or other functions on the organism. By complete unresponsivity was meant all responses whether brainstem, spinal or cerebral in origin, including respiration* (Adams, 2001). The basic diagnostic clinical criteria for the diagnosis of "BD", according to the above Harvard Committee, were the non responsive coma -even in the most painful stimuli- the lack of spontaneous movements, apnea after disconnection from the ventilator for 3 min and absence of reflexes with emphasis on the reflexes of the brainstem. It should be emphasized that any spontaneous movements and any reflexes, either of the CNS or the spinal cord, should be absent in the state of "BD" (Ad hoc committee of the Harvard Medical School, 1968).

The authors of the largest study that has been conducted in the US for "BD" (NINCDS study) indicate that "BD" *is a concept without precise clinical or pathological basis* and therefore the diagnostic criteria are arbitrary (Walker and Molinari, 1980). The term "BD", according to the authors of NINCDS study *never acquired a precise clinical or pathological basis. As a result, arbitrary standards that were considered essential for the diagnosis of cerebral death were set up... the inadequacies of which became obvious when patients meeting these criteria survived* (Walker and Molinari, 1980).

**Comment 1.** The criteria of the Ad Hoc Harvard Committee for "BD" determination are compatible with total loss of the functions of the whole nervous system (though, without any reliable proof that this loss is definitively irreversible) but not with the biological death of man.

#### b. Criteria of Minnesota and of English School for "BD" determination

According to the criteria of Minnesota (absence of brainstem reflexes), the patient may be pronounced as "brain dead" on the basis of the findings from the clinical bedside examination and the clinical judgment, (Mohandas and Chou, 1971).

The absence of brainstem reflexes were also used as criteria for establishing the diagnosis of "BD" by two successive decisions, in 1976 and 1979, in the UK (Pallis, 1982). It is worth noting to be underlined the following logical error; that is that the same medical tests, which were used for prognostic reasons were lately used as diagnostic, that is, that the patients were already dead (Pallis, 1982).

**Comment 2.** The equation of the alleged total loss of the brainstem functions to the biological death of man is illogical since in the seriously injured brainstem the maintenance of circulation (using the appropriate life-sustaining therapy) *permits the continued cellular and organ system function, preventing the onset of the process of disintegration* (Taylor 1997). More disturbing, unreasonable and clinically dangerous is the logic error of identifying prognosis with diagnosis.

#### c. Criteria of the USA Committee (1981) for "BD" determination

According to the "uniform" definition of death, it may be diagnosed using either the cardio-pulmonary criterion or by using the neurologic criterion (Guidelines for the determination of death, 1981).

The neurologic criterion of the US Committee for the diagnosis of "BD" (1981) differs from that of the Harvard

Committee in the fact *that* according to President's Committee (1981) the activity of the Peripheral Nervous System as well as the reflexes of the spinal cord may persist in the state of "BD" (*Guidelines for the determination of death, 1981*).

The warm supporter of the concept of "BD", Professor of Neurology James Bernat, acknowledges that large areas of the cortex and other anatomical structures of the brain cannot be evaluated with bedside neurologic examination because of the destruction of the ascending reticular formation of the brainstem, (Bernat, 1992).

**Comment 3.** It is deduced that the invention of the reduction of the criteria for "BD" determination occurred when spinal cord reflexes and spontaneous movements were later observed in "bdp<sub>s</sub>".

d. The question of irreversibility of the loss of CNS functions in "brain dead" patients

The great problem concerning the above definition of death according to the neurological criterion is that "*There is insufficient evidence to determine the minimally acceptable observation period to ensure that neurologic functions have ceased irreversibly*" (Wijdicks et al, 2010). It should be reminded that irreversibility is a sine qua non condition for the diagnosis of "BD".

**Comment 4.** The most important prerequisite (for all sets of criteria) for the diagnosis of "BD" –irreversibility– is not met; thus, the diagnosis of "BD" is unfounded.

e. The use of laboratory tests in the diagnosis of "BD"

The representative of AAN argues that *the clinical neurologic examination remains the standard for the determination of brain death* [Wijdicks (a), 2001]. In the same line of reasoning the American Professor of Neurology James Bernat claimed that this diagnosis is safely made by clinical only criteria; however, fourteen years later (2006) he admitted that "BD" *diagnosed according to the clinical criteria established by the American Academy of Neurology is incomplete*. Furthermore, the latter reconsidered his previous view and admitted that, in order to diagnose "BD", it is necessary to use also a laboratory test which is suitable for the demonstration of the definite cessation of all intracranial circulation (Bernat, 2006). However, it is also noteworthy the fact that there have not been criteria developed by the neuroradiological Societies for the diagnosis of "BD" [Wijdicks (b), 2001].

**Comment 5.** Since it is not feasible to be examined most of the parts of the brain by clinical bedside examination, the diagnosis of "BD" is unfounded.

f. Are the established criteria for the diagnosis of "BD" properly used?

The representative of the AAN conducted two research studies with his colleagues in order to ascertain whether the established clinical criteria by the AAN for the diagnosis of "BD" were used. The results of both researches were so disappointing as to conclude that *the precision for the assessment of brain death is potentially contentious* (Wijdicks, 2002; Greer et al, 2008).

A most interesting information which was given by the above representative of the AAN is extremely important: In 22% (total 93) of "BD" pediatric patients in the US *the harvesting of organs was cancelled, although it had been requested from the parents of these patients, because after meticulous neurological examination it was found out that the diagnosis was fault!* (Wijdicks et al, 1999).

### 1.3 Contradictions and Inconsistencies Concerning the Concept of "BD"

a) The representative of the AAN in an article of his, in 1995, would write: *normal blood pressure and absence of diabetes insipidus without pharmacologic support are compatible with brain death* (Wijdicks, 1995); nevertheless, six years later, the same researcher, would write the opposite: *One should doubt a clinical diagnosis of brain death in a patient whose condition remains stable* [Wijdicks (c), 2001]. However, we argue that when the brainstem is clinically dead, it is impossible for the patient to be hemodynamically stable (at least in the acute phase).

b) The content of the "White Paper", which was submitted by the Council for Bioethics of the President of the United States, in 2008, is noteworthy. According to this Council, *the UK standard follows Pallis in accepting 'death of the brainstem' rather than total brain failure, as a sufficient criterion for declaring a patient dead. Such a reduction, in addition to being conceptually suspect, is clinically dangerous* (Controversies in the Determination of Death, A White Paper by the President's Council on Bioethics, 2008).

c) Interesting and disturbing for those who accept the concept of "BD", are the following pathological findings: 1) two of the twenty-five "bdp<sub>s</sub>" diagnosed on the basis of the Minnesota criteria, did not have any abnormal findings in the brainstem in the post-mortem gross and microscopic pathological examination (Mohandas and

Chou, 1971) 2) The majority (~60%) of cases of "bdp<sub>s</sub>" the brainstem was almost normal or, more precisely, only 0-5% of the neurons of the examined brainstems showed ischemic changes (Wijdicks and Pfeifer, 2008). It is evident that it is impossible to coexist clinically "dead brainstem" with almost normal neurons.

d) Veatch argues *that pediatric organs can be procured after the application of either brain or heart-based criteria for pronouncing death. If someone is pronounced dead on the basis of irreversible loss of heart function, after all, it would be not possible for heart function to be restored in another body...However, one cannot say a heart is irreversibly stopped if, in fact, it will be restarted...It is impossible to transplant a heart successfully after irreversible stoppage...Removing organs from a patient whose heart not only can be restarted, but also has been or will be restarted in another body, is ending a life by organ removal* (Veatch, 2008).

e) In two cases of infants the supportive treatment of life was withdrawn, resulting in the cessation of cardiocirculatory activity after an average of 18 minutes. For these infants 75 seconds was permitted to elapse before removal of the heart for transplantation was begun! (Curfman et al, 2008). This fact and other similar *demonstrate how ironically is being applied and violated the "dead donor rule"!*

Furthermore, the multiple contradictions and inconsistencies concerning the concept of "BD" were eloquently shown by Shewmon [Shewmon 1997, Shewmon (a), 1998, Shewmon (b) 1998, Shewmon 2009, Shewmon , 2010] and Truog (Truog, 1992, Truog, 1997).

#### 1.4 Problems Concerning Especially the Apnea Test

The safety of apnea test was called into question by the wise investigators of the largest study on this topic, the NINCDS study, and the test was considered potentially dangerous for an already seriously damaged brain (Allen et al., 1980).

The most important problem for the assessment of the apnea test is that the threshold of maximal stimulation of the respiratory centers in the medulla oblongata has been *arbitrarily* set in the United States at a partial pressure of arterial carbon dioxide of 60 mm Hg [Wijdicks (a), 2001].

#### 1.5 Movements in "Brain Dead" Patients ("bdp<sub>s</sub>", Hereinafter)

It should be noted that in the NINCDS Collaborative Study for "BD", in 1980, many of the aforementioned spontaneous movements, which occurred in 5-10% of the "bdp<sub>s</sub>", could not be identified by the examiners as recognized reflex patterns (Allen et al., 1980).

In relation to these movements, we argue that the (putative) complex spinal reflexes and automatisms, which are elicited in some "bdp<sub>s</sub>", are very similar with some stereotyped body movements which are conducted through the brainstem; these are rotational movements of the head-controlled by the interstitial nucleus-raising and flexion movements of the head and body which are controlled by the prethalamic and the recommissuralis nuclei correspondingly (Guyton and Hall, 1996).

The above described stereotyped body movements are feasible only when the aforementioned nuclei of the midbrain and the lower diencephalon are functional (condition that does not exist in "bdp<sub>s</sub>"). Furthermore, a) the elicitation of any movements in "bdp<sub>s</sub>" is not concordant with the initial criteria of the Ad Hoc Harvard Committee and b) some of these (putative) spinal reflexes have never been observed in patients with high lesions of the cervical spine (Awada, 1995).

Additionally, according to the supporters of the concept of "brain death", the brief attempt of the body to sit up to 40 to 60 degrees, the crossing of the arms above the chest and other similar movements (Jordan et al, 1985) is possible to be feasible by dead!

**Comment 6.** However, we argue that the first days after the manifestation of spinal shock, flaccid paralysis should be present; thus, it is not possible to be elicited many of these "reflexes".

#### 2.1 The Inaccuracy of Identifying the Content of Consciousness With Arousal

Consciousness, according to classical Neurology, is distinguished in *arousal* (wakefulness or alertness) and in *content of consciousness or awareness*. *Arousal is the physical and psychological state that allows a being to react to stimuli. It is considered that a being can experience arousal without awareness, but awareness cannot be achieved without arousal to allow for reactions to sensory input* (Shutter, 2014).

In conjunction with the issue of "BD," we understand why certain neuroscientists believe that it is impossible to exist the content of consciousness when the brain is severely damaged. Their view is explained by the fact that they identify "consciousness" with arousal without examining what happens to the content of consciousness or awareness. In this way we can also explain the fact that according to them the evaluation of "consciousness" is

possible using Position Emission Tomography and functional MRI; the above methods make it possible to trace the region of the brain which is being activated upon the perception of a given stimulus; however, no information is obtained about thoughts or the remaining content of consciousness since we do not know the neural mechanisms of thought (Guyton & Hall, 1996).

It is also considered that the necessary prerequisite for the presence of the *content of consciousness* is the interaction of the brain cortex with the ascending reticular activation system (Bleck, 1999). However, our own aspect is that it is possible the creation and existence of the *content of consciousness* without *arousal* (vide infra the paragraph: *The operation of soul (and nous) considered "in itself"*).

In any case, it is not elucidated what happens with the “*performed content of consciousness*” (this term is of the writer’s and includes the performed private self-conscious experiences, memories, thoughts, future plans, feelings and acquired knowledge which may remain latent in memory but inactivated) in comatose patients.

For the time being, there are not any established criteria for the diagnosis of the loss of the *content of consciousness*, because consciousness is a subjective experience (Truog and Fackler, 1992), the content of which is not susceptible to evaluation and measurement because there are no clinical methods available for assessing self-awareness (Giacino, 1997); thus, the diagnosis of “BD”-which is based on the putative absence of “consciousness”- is based on an unproved hypothesis! Furthermore, the decreased -and especially the abolished in comatose states- wakefulness prevents the evaluation of the *content of consciousness*; (Plum and Posner, 1987) thus, in these states it is not possible to evaluate the *content of consciousness*.

Additionally, the irreversibility of consciousness loss, for the time being, is not possible to be diagnosed with certainty (Youngner and Bartlett, 1983; Arts et al, 1985; Steinbock, 1989; Childs and Mercer, 1996). The clinical state of “BD” is certainly different from that of the persistent vegetative state; nevertheless, they have one common characteristic, that is the (putative) loss of the content of consciousness; however, there are indications that the performed content of consciousness had not been lost during the time the patients were in persistent vegetative state (Arts et al, 1985; Child and Mercer, 1996); thus, by analogy, one can conclude that is unfounded the view that in “bdps” there is irreversible loss of the content of consciousness.

In a previous article (Karakatsanis, 2016) we had suggested the potential application of Positron Emission Tomography and the Deep Brain Stimulation in an initial cross section of “bdps” without massive brain edema - given a prior informed consent at an unsuspected time- in order to uncover the potential inward consciousness of these patients; however, we do not know whether such a study has already been carried out.

## 2.2 The Brain and Mental Phenomena

The brain is the *necessary organ for the expression and manifestation of mental phenomena, but does not constitute the cause and source of the spiritual phenomena of the mind (nous, in Greek philosophy)*, such as will, thought, judgment, emotion etc. It was a well-known fact in antiquity that, if the mind (*nous*) does not focus its attention on the stimuli and information which reaches the sense organs, no sensation whatsoever can be produced since the mind (*nous*) is the cause and source of sensation. If we take the view of St. John of Damascus that the mind (*nous*) is “the most pure part of the soul” and the “eye of the soul,” (Joannis Damasceni) it is explained the ancient known saying: “*nous sees and nous hears*” (Epiharmus). Sensation depends on the attention and will of mind (*nous*). In the case of brain damage, the rational powers of the mind [continue to] exist but are unable to manifest themselves sensibly.

## 2.3 The Operation of Soul (and Nous) Considered “in Itself”

However, when the brain is damaged even though the rest of the body continues to function, it is impossible for certain functions of the soul (e.g. as that of the inherent *nous*) to make themselves manifest by means of the brain. This lack of outward manifestation however *is not proof that the soul cannot continue to function “in itself”*. In Plato’s *Phaedo* the following view is expressed: “*And indeed the soul reasons best when none of these senses troubles it, neither hearing, nor sight, nor pain nor pleasure, but when it is most by itself, taking leave of the body and as far as possible having no contact or association with it in its search for reality*” (Plato’s *Faedo*).

Particularly worthy of note is St. Maximus the Confessor’s explanation of how the soul functions both “in itself” and with the body (Maximi Confessoris). One of the characteristic properties of the soul, “its function in itself,” is its capacity to carry out complex logical and abstract operations in a most perfect way, when it takes no heed to the stimuli coming in from the external world. In a mysterious and incomprehensible way, *the function of the soul with the body consists* in the activation of the brain by which it renders communication with the outside world through the senses possible but it also understands the changes in the “internal environment” of the body.

However, when the brain is damaged even though the rest of the body continues to function-it is impossible for

certain functions of the soul to make themselves manifest by means of the brain. This lack of outward manifestation however *is not proof that the soul cannot continue to function "in itself"*.

Thus, the identification of the absence of the expression of the human soul's manifestations with the absence of consciousness-as certain scientists maintain-cannot be supported neither by the Greek philosophy nor by the Tradition and Theology of the Eastern Orthodox Church. Therefore, the absence of *arousal* can not serve as an evidence of lack of the *content of consciousness* and thus as a criterion for the diagnosis of "BD".

#### 2.4 Other Positions of Ancient Philosophers Concerning the Brain-Soul (and Brain-Nous) Relationship

Heraclitus, the great pre-Socratic philosopher, contends through obscured and *seminal* reason that man is not rational by nature, but rather that man is "by nature irrational"; "only what encompasses him (the soul) is rational and *echefron* (has understanding)." Furthermore, he contends that the inherent with the soul mind (*nous*) "dresses up" from it (the soul) its rational power (Heraclitus, fragment in Sextus Empiricus). We argue that, considering the above, we can conclude, according to Heraclitus, that it is not the "according to nature" construction of the brain which is the cause of mental phenomena but rather the rational soul with its inherent nous.

Additionally, Aristotle argues that the soul: 1) is the cause and origin of the living body (Aristotle, De Anima, 415b), 2) seems rather to hold the body together; at all events, when the soul has departed, the body disperses in air and rots away (Aristotle, De Anima, 411b), and 3) imparts motion to animals (Aristotle, De Anima, 404a).

Galen criticizing Praxagoras and Herophilus contends that the cause of motion in the body is the soul and that the muscles and nerves are simply its organs or instruments. Thus all motion is lost only with the loss of the soul; "*I reproach Praxagoras and Herophilus ...in the case of the dead neither the nerves nor the muscles are in the state of suffering all the affections which Herophilus and Praxagoras think they do: all motion has deserted then instantly with the soul, for muscles and nerves are just the instruments of the soul*" (Heinrich Von Staden, 1989, 1994).

In conclusion, it is deduced that it is unfounded the allegation that in the state of "BD" have irreversibly been lost both, the content of the consciousness and the vegetative functions of the body; so, *they can not be substantiated and accepted as criteria of "BD"*. As demonstrated above, the utilitarian invention of the concept of "BD" is plagued by so many problems, inconsistencies and contradictions, so that the only honest option is its definitive abandonment.

### 3. Addendum

Sister nurses are a major part of nursing staff, which offers valuable services with sacrificial love, especially to seriously ill patients. Their duty is to relieve the patients from the mental and physical pain; our view is that in any circumstances, they should not be involved in actions that could be harmful to patients.

In accordance with the mentioned arguments in the main text, the "brain dead" patients are not biologically dead and thus the removal of their vital organs for transplantation signifies the subtraction of their life. This practice is obviously contrary to the Hippocratic oath and the laws of humanity.

Furthermore, the concept of "BD" is an invention for purely utilitarian purposes, a fact which is being acknowledged even by the Ad Hoc Committee of the Harvard University; on the basis of the above, we have tried to make the nursing staff think whether the participation in the practices of harvesting of vital organs from "brain dead" patients is ethically permissible.

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### References

- A definition of irreversible coma. (1968). Report of the ad hoc committee of the Harvard Medical School to examine the definition of death. *JAMA*, 205, 337-340.
- Adams, R.D. (2001). Foreword. In Wijdsicks, E.F.M. (Ed.), *Brain Death*. Philadelphia, Williams Lippincott & Wilkins.
- Allen, N., Burkholder, J.D., Molinari, G.F., & Comiscioni, G. (1980). Clinical criteria of brain death. *In The NINCDS Collaborative study of brain death* (pp. 77-147, p. 80, p. 99). NINCDS Monograph No 24, NIH Publication No 81-2286, Bethesda, Maryland.

- Aristotle a) De Anima, Book II, Ch. 4, 415b, p 64. Translation, introduction and notes by R.D. Hicks, M.A. Trinity College, Cambridge, At the University Press, Printed by John Clay, MA, 1907. Retrieved December 11, 2016, from <https://ia802609.us.archive.org/17/items/aristotledeanima005947mbp/aristotledeanima005947mbp.pdf>
- Aristotle b). De Anima, Book I, 411b, Ch. 5, p 45. Translation, introduction and notes by R.D. Hicks, M.A. Trinity College, Cambridge, At the University Press, Printed by John Clay, MA, 1907. Retrieved December 11, 2016, from <https://ia802609.us.archive.org/17/items/aristotledeanima005947mbp/aristotledeanima005947mbp.pdf>
- Aristotle c) De Anima, Book I, 404a, Ch. 2, p 11. Translation, introduction and notes by R.D. Hicks, M.A. Trinity College, Cambridge, At the University Press, Printed by John Clay, MA, 1907. Retrieved December 11, 2016, from <https://ia802609.us.archive.org/17/items/aristotledeanima005947mbp/aristotledeanima005947mbp.pdf>
- Arts, W.F.M., Van Dongen, H.R., Van-Hof-Van Duin, J., & Lamens, E. (1985). Unexpected improvement after prolonged post-traumatic vegetative state. *J Neurol Neurosurg Psych*, 48, 1300-1303.
- Awada, A. (1995). Uncommon reflex automatism after brain death. *Rev Neurol (Paris)*, 150, 586-588.
- Beecher H.K. (1968). Ethical problems created by the hopelessly unconscious patient. *N Engl J Med*, 278(26), 1425-1430.
- Beecher, H.K., & Dorr, H.I. (1971). The new definition of death. Some opposing views. *Int. J. clin. Pharmacol.*, 120-124.
- Bernat, J.L. (1992). How much of the brain must die in brain death?. *The Journal of Clinical Ethics*, 3, 21-26.
- Bernat, J.L. (2006). The whole-brain concept of death remains optimum public policy. *Journal of Law, Medicine and Ethics*, Spring, 35-43. <https://doi.org/10.1111/j.1748-720X.2006.00006.x>
- Bleck, T.P. (1999). Levels of Consciousness and attention. In Goetz, C.G., & Pappert, E.J. (Eds.), *Textbook of Clinical Neurology* (pp. 3-4). W.B. Saunders Co, Philadelphia.
- Childs, N.L., & Mercer, W.N. (1996). Brief report: Late improvement in consciousness after post-traumatic vegetative state. *N Engl J Med*, 334(1), 24-25. <https://doi.org/10.1056/NEJM199601043340105>
- Controversies in the Determination of Death. (2008). *A White Paper by the President's Council on Bioethics*. Washington, DC.
- Curfman, G.D., Morrissey, S., & Drazen, J.M. (2008). Cardiac Transplantation in Infants. *New Engl J Med*, 359, 749-750. <https://doi.org/10.1056/NEJMe0805480>
- Diringer, M.N., & Wijdicks, E.F.M. (2001). Brain death in historical perspective. In Wijdicks, E.F.M. (Ed.), *Brain death* (pp. 5-27). Philadelphia, Lippincott Williams & Wilkins.
- Doig, J., & Burgess, E. (2003). Brain death. Resolving inconsistencies in the ethical declaration of death. *Canadian J of Anesthesia*, 50(7), 725-731.
- Doyen, N. (2016). *Brain Death and the true patient care*. Pontifical University of St. Thomas Aquinas, Rome, Italy. Retrieved 10 December, 2017, from <http://www.tandfonline.com/eprint/BfQht9sNBqqgiySRNkya/full>
- Epiharmus, in Plutarch's *Moralia*, 336b.
- Evans, D. (2002, September). Brain death is a recent invention. *BMJ*, 325-598.
- Fost, N. (1999). The Unimportance of death. In Youngner, S.J., Arnold, R.M., & Schapiro, R. (Eds.), *The definition of Death, Contemporary Controversies* (pp.161-178). Baltimore & London, The John's Hopkins University Press.
- Freeman, J.M., & Ferry, P.C. (1988). New brain death guidelines in children. Further confusion, *Pediatrics*, 81, 301-303.
- Giacino, J.T. (1997). Disorders of consciousness: Differential diagnosis and neuropathologic features. *Seminars in Neurology*, 17(2), 105-111.
- Greer, D.M., Haque, S., & Wijdicks, E.F.M. (2008). Variability of brain death determination guidelines in leading US neurologic institutions. *Neurology*, 70, 284-289.
- Guidelines for the determination of death. (1981). Report of the medical consultants on the diagnosis of death to

- the Presidents Commission for the study of ethical problems in medicine and biomedical and behavioral research, 246, 2184-2186.
- Guyton and Hall. (1996). *Textbook of Medical Physiology* (9th ed.). Philadelphia: W.B. Saunders Co., p. 712, p. 742.
- Heinrich Von Staden 1989. (1994). *The Art of Medicine in Early Alexandria*, Cambridge University Press. Reprinted 1994, 141, Galenus, De tremor, palpitatione, convulsion et rigore 5 (vii, pp. 605-6K), pp 318-319. <https://doi.org/10.1212/WNL.35.7.1082>
- Joannis Damasceni, De Fide Orthodoxa, Lib II, An Exposition of the Orthodox Faith. (Book II). Migne's PG 94, 924b.
- Jordan, J.E., Dyess, E., & Cliett, J. (1985). Unusual spontaneous movements in brain dead patients. *Neurology*, 35, 1082.
- Karakatsanis, K.G. (2016). "Brain dead" Patients: Critically ill or dead? A Potential Answer to the Problem. *Journal of Intensive and Critical Care*, 2(2), 1-4. <https://doi.org/10.21767/2471-8505.100032>
- Maximi Confessoris, Epistolae, Ad Joannem Presbyterum. Migne's, P.G. 91, 436d-437a.
- Mohandas, A., & Chou, S.N. (1971). Brain Death: A clinical and pathological study. *J Neurosurg*, 35, 211-218.
- Pallis, C. (1982). ABC of brainstem death. From brain death to brainstem death. *British Medical J.*, 285, 1487-1490.
- Plato, Plato's Phaedo, transl. G.M.A. Grube (Indianapolis: Hackett Publishing, 1977), pp 13-16 (65a- 67e). Retrieved May 11, 2016, from [http://puffin.creighton.edu/eselk/intro-phil\\_on-linecourse/plato\\_republic/plato\\_republic\\_pg13.htm](http://puffin.creighton.edu/eselk/intro-phil_on-linecourse/plato_republic/plato_republic_pg13.htm)
- Plum, F., & Posner J.B. (1987). *The diagnosis of stupor and coma* (3rd ed.). Ch. 1, F.A. Davis Company, Philadelphia, pp. 3-4.
- Sextus Empiricus, Heraclitus, Against the Mathematicians, 38.
- Shewmon, D.A. (1989, September). The semantic confusion surrounding «brain death». *Arch Neurol* 46: 603. Letter to the Editor; Editor's choice., 2002. Deep Fears. *BMJ* 324(8 June).
- Shewmon (a), D.A. (1998). "Brainstem Death", "Brain Death" and Death: A critical re-evaluation of the purported equivalence. *Issues Law Med*, 14, 125-145.
- Shewmon (b), D.A. (1998). Chronic "brain death". *Neurology*, 51, 1538-1545. <https://doi.org/10.1212/WNL.51.6.1538>
- Shewmon, D.A. (1997). Recovery from "brain death": A neurologist's apologia. *Linacre Q*, 64, 31-96. <https://doi.org/10.1080/20508549.1999.11878373>
- Shewmon, D.A. (1999). Letter to the Editor. *Neurology*, 53, 1371-1372.
- Shewmon, D.A. (2009). Brain Death: Can it be resuscitated?. *Hastings Cent Rep*, 39, 18-34. <https://doi.org/10.1353/hcr.0.0122>
- Shewmon, D.A. (2010). Constructing the death elephant: A synthetic paradigm shift for the definition, criteria, and tests for death. *J Med Philos*, 35, 256-298. <https://doi.org/10.1093/jmp/jhq022>
- Shutter, L. (2014). Pathophysiology of brain death. What does the brain do and what is lost in brain death. *J Crit Care*, 29(4), 683-686. <https://doi.org/10.1016/j.jcrc.2014.04.016>
- Steinbock, B. (1989). Recovery from persistent vegetative state? The case of Carrie Coons. *Hast Cent Rep* 194: 414. In Civetta, J.M., Taylor, R.W., & Kirby, R.R., (Eds.), *Critical Care* (1997, 3rd ed., p. 74). Lippincott-Raven, Philadelphia chapt 5.
- Taylor, R.M. (1997). Reexamining the definition and criteria of death. *Sem Neurol*, 17, 265-270.
- Truog, R., & Robinson, W. (2003). Role of brain death and the dead-donor rule in the ethics of organ transplantation. *Critical Care Medicine*, 31(9), 2391-2396.
- Truog, R.D. (1997). Is it time to abandon brain death? *Hastings Cent Rep (United States)*, 27, 29-37.
- Truog, R.D., & Fackler, J.C. (1992). Rethinking brain death. *Crit Care Med*, 20, 1705-1713.
- Truog, R.D., & Robinson, W.M. (2001). The diagnosis of brain death. *NEJM*, 345(8), 617.
- Veatch, R.M. (2008). Donating Hearts after Cardiac Death. Reversing the Irreversible. *N Engl J Med.*, 359, 7.

<https://doi.org/10.1056/NEJMp0805451>

- Walker, A.E., & Molinari, G.F. (1980, December). Criteria for cerebral Death. A critique. In *The NINCDS Collaborative STUDY of brain death* (pp. 181-199). NINCDS Monograph No 24, NIH Publication No 81-2286, Bethesda, Maryland.
- Wijdicks, E.F.M. (1995). Determining brain death in adults. *Neurology*, *45*, 1003-1011.
- Wijdicks, E.F.M. (2001 b). Clinical diagnosis and confirmatory testing of brain death in adults. In Wijdicks, E.F.M. (Ed.), *Brain Death* (p. 79). Lippincott Williams & Wilkins, Philadelphia.
- Wijdicks, E.F.M. (2001 a). Current Concepts: The Diagnosis of Brain Death. *NEJM*, *344*(16). <https://doi.org/10.1056/NEJM200104193441606>
- Wijdicks, E.F.M. (2001 c). *NEJM*, *345*, 616-618, No 8 (August 23, 2001).
- Wijdicks, E.F.M. (2001, April). Current Concepts: The Diagnosis of Brain Death. *The New England Journal of Medicine*, *344*(16).
- Wijdicks, E.F.M. (2002). Brain death worldwide. *Neurology*, *58*, 20-25. <https://doi.org/10.1212/WNL.58.1.20>
- Wijdicks, E.F.M. (2003). The neurologist and the Harvard criteria of brain death. *Neurology*, *61*, 970-976.
- Wijdicks, E.F.M., & Pfeifer E.A. (2008). Neuropathology of brain death in modern transplant era. *Neurology* *70*(15), 1234-1237. <https://doi.org/10.1212/01.wnl.0000289762.50376.b6>
- Wijdicks, E.F.M., & Pfeifer, E.A. (2008). *Neuropathology of brain death in the modern transplant era*, *70*, 1234-1238.
- Wijdicks, E.F.M., Rochester, M.N., Bernat, J.L., & Lebanon, N.H. (1999). Letter to the Editor. *Neurology*, *53*, 1369-1370.
- Wijdicks, E.F.M., Varelas, P.N., Gronseth, G.S., & Greer, D.M. (2010). Evidence-based guideline update: Determining brain death in adults. *Neurology*, *74*, 1911-1918. Delimiting Death, 2009. *Nature* *461*, 570, 1 October.
- Youngner, S.J., & Bartlett, E.T. (1983). Human death and high technology: The failure of the whole-brain formulations. *Ann Int Med*, *99*, 252-258.

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