

Sleep and consciousness



Please answer the following questions based on the assigned readings. If you use additional sources, please cite these Laureys: Death, unconsciousness and the brain. This article reviews the how definitions of death have changed with medical progress and understanding of the critical role of the brain in meaningful life.

a) What are different biological definitions of death? What criteria have been used to define death?

There have been many definitions proposed for the term death with most of them centered upon the functioning of the brain like irreversible absence of brain function or irreversible coma, complete irreversible loss of brain stem function, irreversible loss of the capacity for consciousness and interaction also referred to as being in a vegetative state. Some scientist and philosophers have defined death based on the functioning of the circulatory system as a state when there is irreversible cessation of circulation. Since different definitions have been given to explain death, there are several criteria's that are used to determine death. In case of whole brain damage complete cessation of all clinical functions is a major criterion which could be demonstrated as coma. Similarly irreversible cessation of brainstem functions with absence of brainstem reflexes. Other criteria include absence of any other confounding factors, absence of motor responses, and apnoea. Neurological and cardiopulmonary tests are done to ascertain the death of an individual. In the neurological tests irretrievable brain stem function is determined, while in the cardiopulmonary test irretrievable absence of heart beat and breathing are determined. However, after much debate it has been decided that the cardiopulmonary criteria of death which declares that the heart will not auto-resuscitate and which occurs first is a sufficient enough

criterion to declare that a person is dead as it might take some time for the neurological criteria to occur.

b) How do brain death and vegetative state differ? Consider a) behavioral, respiratory (“apnoea” means lack of breathing), b) damage to specific brain structures, and c) brain activity (e. g. EEG, fMRI, PET).

The major criterion for a person to be declared brain dead is presence of coma characterized by irreversible brain damage, while in the case of vegetative state; a person is awake but totally unaware of the surroundings. Such a vegetative state can be partially or totally reversed. However persistent vegetative state cannot be reversed. Brain death can be diagnosed more quickly than irreversible vegetative state as it may take anywhere between 3 to 12 months depending on the extent of injury to the brain to ascertain vegetative state. Brain dead patients require artificial ventilation but those in the vegetative state require the same only in acute stages and otherwise they can breathe without any assistance. The brainstem and hypothalamus are well preserved in the vegetative state and hence these patients show significant motor activity with movement of specific parts such as the trunks, limbs and head but they are not well coordinated or might happen without any purpose. These movements are highly instinctive and might be in response to any external stimuli. They also exhibit facial expressions. In case of brain dead patients, due to damage of the brain stem the body movements are restricted and occur only as a result of any residual activity in the spine or other areas and are not in response to any external stimuli. They also do not show any kind of facial expression. Various imaging studies such as Doppler sonography and positron emission tomography can be used to show the absence of cerebral blood flow and

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neuronal activities in the brain of brain dead individuals. There is also a complete absence in EEG activities and a total lack of conduction through the brain which is determined by somatosensory potentials given to the individuals. However in the vegetative state there is no complete absence of the above activities as there is considerable amount of cerebral blood flow and metabolism. The EEG in this case is slow and mostly of very low voltage. Presence of cortical potentials can be observed in the vegetative state.

c) If a person is in a vegetative state, how long should medical treatment be maintained before a person can be removed from life support? Or, should person never be removed from life support without prior consent?

Patients in the vegetative state generally do not require artificial ventilation or cardiac support unless they are in acute condition. They need to be provided with adequate hydration and nutrition. Stopping the nutrition supply to the individual should be based on established studies carried out on the patient that declares the patient is in an irreversible vegetative state. This has a lot of ethical considerations and only when there is adequate proof that the patient will no longer benefit from medical treatment administered should life support systems be removed. According to research that has been conducted the chances of recovery after 3 months and 12 months for non-traumatic and traumatic injuries are very less. If the individual does not show any signs of improvement the immediate relatives should be consulted to decide upon the future course of action. After obtaining their consent the hydration and nutritive support can be stopped which can lead to death anywhere between 10 to 14 days. Patients who previously express their desire to undergo euthanasia can be subjected to the same as this has been legalized in some countries.

d) Who should pay for maintaining people in a vegetative state?

Since the decision to maintain the individual in life support systems is done by the relatives they must bear the expenses for prolonging of the medical treatment.

2. Mahowald & Schenck: Insights from human sleep disorders.

The authors describe four categories of sleep disorders: hypersomnia, insomnia, circadian rhythm disorders, and parasomnias. In a brief essay:

a) Define each category of sleep disorder;

While there are about 100 disorders related to sleep or wake, most of them fall under four broad categories: hypersomnia, insomnia, circadian rhythm disorders and parasomnias. Hypersomnia is characterized by excessive sleep during daytime which could be due to either social or economic reasons or sleep disorders such as obstructive sleep apnoea and narcolepsy. Insomnia could be defined as the inability to get a sound and sufficient sleep which in most cases is due to the presence of an underlying medical or psychological problem. In the case of circadian rhythm disorders, humans have a routine pattern of activity often referred to as the biological clock and rest based on the light and dark cycle, but when this routine pattern is interrupted due to medical or environmental factors it results in abnormal timing of sleeping pattern. However these people do not experience any disturbance once they fall asleep. Parasomnia is a sleep disorder characterized by unpleasant and unnatural behavior while asleep mostly due to the presence of any psychological problems.

b) Give a specific example (e. g. narcolepsy as an example of hypersomnia) and describe the 1) clinical characteristics, 2) prevalence and risk factors, 3) biological mechanisms and causes (if known) and 4) treatment.

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The major clinical characteristics associated with narcolepsy include: tendency to fall asleep during a period of no activity in the day, experience of sudden muscular weakness while emotional, feeling drowsy before onset of sleep and tendency to remain in a semiconscious state while awakening, hallucinating, sleep paralysis and inability to have a sound sleep during the night. The occurrence of narcolepsy is rare affecting 1 in 2000 individuals. While the initial causative factors for narcolepsy was considered to be psychiatric continued research have revealed that narcolepsy occurs due to disorders in the nervous system of the individual. The genetic components associated with the disease have been identified to be HLA DR2/DQ1 and DQ6. However scientists have maintained that inheriting the genetic component alone cannot cause the disease given its rare occurrence rate. Another significant factor that has been identified is the absence of secretion of a neuropeptide, Hypocretin-1, by cells in the hypothalamus. The non-secretion of this neuropeptide does not occur in any other condition thus ascertaining its link with this disorder. There are medications available for the treatment of this disorder and since the discovery of its association hypocretin-1 injections have been tested in animals which have caused significant reduction in the occurrence of cataplexy and have normalized the sleep/wake behavior in these animals.

References

1. Laureys, Steven. "Death, unconsciousness and the brain." *Nature Reviews Neuroscience* 6 (2005): 899-909.
2. Mahowald M. W and C. H. Schenck. "Insights from studying Human Sleep Disorders." *Nature* 437 (2005): 1279-1285.