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**MONOGRAPH**

**“ENCEPHALIC DEATH”**

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### **Gratitude**

I want to express my gratitude towards my family, because all the achievements that I have done and will do are thanks to them. I also want to express my gratitude towards my friends, even the ones who I have lost contact or does not remember me anymore, cause through all the years that I have been living, they have helped me to keep going forward to my future while we were having fun. Finally, I want to express my gratitude to the authors of the books that I am using, because without them this work could never be fulfilled.

## Summary

In the first chapter of the monograph is introduced the concept of what encephalic death truly is and provides some background information about the first known cases that were labelled as brain death after it was proclaimed as a condition. After that it continues to explain about how a correct diagnosis must be done. One cannot just run some test over any patient, the person that is going to be tested must fulfill all the clinical requirements, this is due to the existence of numerous factors that can alter the results of the test. Then it starts to recite the different kinds of test that must be done on the patient to correctly diagnose a case of brain death.

In the second chapter the focus changes into the reasons why the encephalic death is produced and its difference between other neurological disorders. A list of different causes that may lead to brain death is given with its full explanation of how they affect the patient and how they are produced in the body. It is seconded by some other neurological disorders that are like encephalic death and that they may cause confusion in the time when a diagnosis must be given to the patient. The purpose of this section is to make people realize the importance of brain death and not to confuse it with some other serious, but not as deadly, illnesses.

Finally, in the third chapter there is a massive change, because it switches from a purely medical point of view into one more philosophical one. It starts by explaining what a person truly is in a context that we can later use to understand the next point of view about embryos and fetuses. They are put as an example of to discuss the ethics and moral of a

situation and how messy things can turn out to be with such a complicated and fulminant disease as encephalic death.

## Index

Gratitude.....	ii
Summary.....	iii
Index.....	v
Introduction.....	1
Chapter I.....	2
1.1 Definition.....	3
1.2 Background.....	3
1.3 Diagnosis.....	3
1.3.1 Clinical requirements.....	4
1.3.2 Neurological explorations.....	4
Chapter II.....	9
2.1 Energetic encephalon requirements for functional maintenance.....	9
2.1.1 Glial lesions in hypoxic events.....	10
2.1.2 Apoptosis.....	10
2.2 Alterations neuropathology related to brain death.....	11
2.3 Importance of differentiating brain death with other neurological diseases.....	12
2.4 Neurological states that can be mistaken for brain death.....	12
Chapter III.....	14
3.1 Person.....	14
3.1.1 Social context.....	14
3.1.2 Philosophical context.....	14
3.2 Embryos.....	15
3.2.1 Embryo as a person.....	15
3.2.2 Cases of pregnancy and brain death.....	16
Conclusions.....	17
Recommendations.....	18
Referencies.....	19

## **Introduction**

*Encephalic death*, or more commonly known as brain death, is a catastrophic disease that can affect every person no matter the circumstances. The objective of this assignment is not only to inform about the diagnosis of the disease and the nefarious repercussions that will come after developing such a mortal condition, but to open the minds of the people and make them realize how terrible brain death can truly be. Only if when we submerge into the understanding of this topic, then we will finally be able to comprehend the colossal importance that such an illness poses.

People nowadays often hears many medical terms that they do not really know what they mean, and if someone does not know truly something, they cannot comprehend it is importance. It is the objective to share the knowledge that we pose of this kind of topic so that people can understand, what they are dealing with and recognize the importance that it rightfully should have. Brain death is a serious topic that must be treated and inform about with utterly respect and directness because of the repercussions that it will not only have the patients, but also their entire families.

All the information that has been provided in this paper, was gathered by a thoroughly research done to a very large number of books and scientific articles related to the main topic. Even though not all the information gathered was necessary, there were key sections that showed to be very useful in order to complete this assignment. Articles like the ones written by Escudero and Escobar were essential to describe the soul of topic and other

books were also needed when it was time to make it a little more personal and relatable to people in general.

Encephalic death is a topic that unfortunately affects to a very high amount of people around the world because it has no limits nor preferences when it affects an individual. There is not a specific place in the world that we can say that it is where all this disease is coming from. Although is true that some places may be more likely to develop this condition, but there is currently no regional preposition of any kind that would increase the percentage of people developing encephalic death.

Encephalic death is such a serious topic that should be inform to people due to the nefarious repercussions that are caused by this fatal condition. The gravity of the condition is more than an enough reason to realize about the importance of this kind of topics. We need to instruct ourselves in order to know what we are facing and so that we can see conditions like these under a new approach in which we can understand it in a better way.

## **Chapter I**

### **Brain death**

#### **1.1 Definition**

Encephalic death or brain death is well known as the complete and irreversible ending of the functions of all the neurological structures such as both hemispheres of the brain and the brain stem, which is enable the communication between the own brain, the spinal cord and the peripheral nerves.

#### **1.2 Background**

The first reported cases of what we assume is brain death, were made by French neurologists. In their reports we can see that the brain damage so massive that, even though they were still alive, they did not possess any kind of brain activity and needed mechanical ventilation.

#### **1.3 Diagnosis**

The diagnosis of brain death must be done by doctors who possess experience and expertise in such delicate matters, due of the importance of the results that will be obtained from the research that will be execute on neurocritical patients. Just as Escudero (2009) claimed, “Diagnosis must be done by doctors with expertise in neurocritical patient treatment. This diagnosis is based on a systematic, complete and rigorous clinical examination that confirms a non-reactive coma, absence of brain stem reflex, and absence of spontaneous breathing” (p.185).

### **1.3.1 Clinical requirements.**

Before the doctors immerse themselves into a full neurological examination, they need to be sure that there are not any kind of conditions that will compromise with the results or the research. If there is such a thing that corrupts the clinical conditions that are required for the procedure, then the results will not be admissible.

#### ***1.3.1.1 Absence of metabolic alterations.***

Important metabolic or toxic hydro electrolytic, acidic or endocrine alterations must be rule out, because they can guide to a misdiagnosis

#### ***1.3.1.2 Absence of poisonings.***

Toxic depressants of the central nervous system must be rule by an extensive and very rigorously blood test and urine test, due that the very presence of this substance can alter the results of the diagnosis

#### ***1.3.1.3 Absence of central nervous system depressant drugs.***

In order to have the clinical conditions that are needed to have a proper diagnosis, is required the absence of drugs that affect the central nervous system. Just as Escudero (2009) express, "In the treatment of neocritical patients, benzodiazepines, propanol, opiates and barbiturates are commonly used, which can mask the neurological examination."  
(p.187)

### **1.3.2 Neurological explorations.**

In order to correctly diagnose brain death, it is of extremely importance to be aware of three specific factors: non-reactive coma, absence of brainstem reflexes and apnea.

#### ***1.3.2.1 Non-reactive coma.***

One specific symptom that the patient must have to diagnose brain death is that the patient is immerse in a deep and unreactive coma. Just as Escudero (2009) claimed, “The patient must present generalized muscular hypotonia, deep coma and non-reactive with level 3 on the Glasgow Coma Scale. There can’t be any type of motor or vegetative response, as well as motor attitudes in decerebration or decortication.”

#### ***1.3.2.2 Absence of brainstem reflexes.***

Once the procedure to determine if a patient has indeed brain death, there must be no eye reflexes nor response at any kind.

The absence of photo motor reflection is an indicator of brain death. The pupils in the patient may present different types of forms and sizes, but when brain death is present, it always is non-reactive to light.

The corneal reflexes are also tested to provide information in order to get better results. To determine if there is any response from the patient’s corneal reflexes, the doctor will stimulate the patient’s cornea. The normal response would be palpebral contraction, reddening or shedding tears, however a non-reactive response would indicate an abnormality on the patients.

The encephalic oculum reflexes needs to be tested as well. To test the reflexes, the head of the patient must start to give fast turns in horizontal form. Nonetheless, if the patient were truly suffering from encephalic death, there would be no response at all.

The nauseous reflex will also be tried to stimulate by the doctor, through the veil of the soft palate, the uvula and the oropharynx, but unsuccessfully.

Another reflex that will be taken in consideration will be the dysgenic reflex. In this test, a probe is introduced through the endotracheal tube trying to cause a trachea stimulation, but due to the encephalic death, it will be non-reactive.

Finally, the oculo-vestibular reflex test is a rather short, but complex procedure. This test allows the doctor to know if the previously mentioned reflex is still operating.

With the head at 30 degrees, 50 ml of cold serum is injected into the external ear canal, keeping the patient's eyes open for 1 min and observing under normal conditions a slow component nystagmus towards the irrigated ear and a fast component away from the irrigated conduit. The nystagmus is regular and rhythmic and remains less than 2-3 min.

Brain death does not produce any kind of eye movement. (Escudero, 2009, p.188)

#### **1.3.2.3 Apnea test.**

When it comes to an apnea test, it must be done a hyperoxygenation and the parameters of the respirator to get a norm ventilation. Just as Escudero (2009) express:

It should draw an arterial blood gas to document the PaCO<sub>2</sub> and disconnect the patient from the respirator, introducing a cannula to the trachea with oxygen at 6 l / min to achieve oxygenation adequate and avoid hypoxia that may cause asystole. (p.188)

#### **1.3.2.4 Atropine test.**

It is nonetheless the pharmacological exploration of the vague nerve and its connections to the brain stem. The doctor will give the patient a dose of 0.04 mg/kg intravenous atropine sulfate to check the heart rate before and after the dose. In case of encephalic death heart rate should not exceed 10% of baseline heart rate.

### **1.3.3 Instrumental diagnostic tests.**

#### **1.3.3.1 Electroencephalogram**

The electroencephalogram is a fast, not invasive and easy test, so it makes it the most common between all the instrumental tests. Escudero (2009) explains that the Electroencephalogram studies only the bioelectrical activity of the cerebral cortex in the convexity of the cerebral hemispheres. However, it has its limitations, because it is interfered by the depressant drugs of the central nervous system.

#### ***1.3.3.2 Evoked potentials***

The evoked potentials are the responses to external stimulates towards the central nervous system. Depending of the kind of stimulates it will be a very low electrical response depending of what kind of response the stimulate provoke. In the case of encephalic death there will be no response at all any kind of stimulates.

#### ***1.3.3.3 Transcranial Doppler***

When the intracranial pressure of the patient rises due to an injury, parallel to the intracranial pressure the cerebral perfusion pressure starts to decrease, causing the progressive loss and eventually the stop of the cerebral blood flow and cerebral circulatory arrest. During this process, we can distinguish four different stages.

The first stage is when the intracranial pressure beats the diastolic blood pressure preventing its normal flow, but the flow during systole remains intact.

In the second stage, the reversed diastolic flow pattern appears when the intracranial pressure produces the cessation of cerebral perfusion. It is characterized by the presence of antegrade flow in systole.

The third stage correspond the systolic spikes, which receive a rather short and pointed antegrade systolic waves, however there is not blood flow on the systole

nor in the diastole.

The fourth and final stage would be the absence of sonogram. In very evolved cases of encephalic death there would be no response and the brain death will be accepted as the diagnose if the explorer has previously observed the brain's blood flow.

## **Chapter II**

### **Causes of brain death and differences between other neurologic diseases**

#### **2.1 Energetic encephalon requirements for functional maintenance**

The brain needs the appropriate and constant flow of oxygen and glucose in order to achieve a high enough level of energy that is required to complete all brain functions as the transmission of nerve impulses and more. As the nerve tissue does not have the ability to store the previously mentioned molecules, it is not uncommon for them to become in deficit and later cause struggles.

Reaching that restricting access to these molecules would have a dire effect on the brain. It has come to be known that in this is a principle called selective vulnerability which causes certain areas of the brain not to receive a constant flow, they come to die. Just as Escobar (2005) claimed: "The peculiar tendency of neural lesions caused by oxygen deficit to affect, preferably, certain areas of the cerebral parenchyma, led to the development of the theory of the selective tissue vulnerability "to pistic" by the Vogt, in 1922" (p.329)

Global brain death occurs when oxygen and/or glucose levels have reached zero, just like in the cases of a cardiac arrest or an episode of hypotension. The most common cause of the cadence of these molecules could occur would be hypoxic/anoxic damage. It is usually due to the blockage of the respiratory pathways, respiratory arrest, oxygen deficit in the air being breathed or even carbon monoxide poisoning.

### **2.1.1 Glial lesions in hypoxic events.**

Not long after suffering a hypoxic/ischemic event, an astrocyte glial reaction occurs. This reaction tends to be progressive and is strongly linked to the period in which brain death has developed, constituting the scar of the injury. Oligodendroglia reacts with tumefaction even though it appears to be caused by demyelination caused by the degeneration of destroyed neurons.

### **2.1.2 Apoptosis.**

Apoptosis is a subtle process in which the cell is destroyed by an internal program that they possess. This mechanism exists to remove cells that are unnecessary during several physiological phenomena. This is constituted by rinsing, condensation, and fragmentation with extrusion of the entire cellular structure in apoptotic bodies. These would explain how the changes that result in programmed cell death from apoptosis' fragments, which occur quickly and without leaving a record of inflammation (Escobar,2005). Contrary to necrosis that makes histologic identification difficult in some cases.

#### ***2.1.2.1 Apoptosis regulatory mechanisms.***

The apoptosis is constituted by events triggered by a series of stimuli that consist of four defined stages but interconnect with each other.

The first phase consists of apoptotic stimuli that generate signals that can become both intracellular and through the cell membrane. On the contrary, the lack of these signals produces a failure in cell death programs, which leads to apoptosis. Then the control and integration occur through proteins responsible for connecting the death signals with cellular

programs to carry out or eliminate signals that could be harmful or lethal. Finally, the death program is executed in which the cells self-destruct themselves so that their remains can later be eliminated by phagocytosis.

## **2.2 Alterations neuropathology related to brain death**

In the 1970s there was an increase in the relation with the studies of brain death that led to a great contribution to be able to reach what is now referred to as brain death. This study was able to determine that all patients had brain death in effect. Studies later showed that from a neurologic point of view they had manifested having extensive brain necrosis and brain stem, severe brain edema, morphological changes of the so-called "respirator brain", among others.

During autopsies, patients were found to have both macroscopic and microscopic damaged. Encephalon ischemia is a characteristic finding in 94% of cases, infarction or encephalon edema 85%, distortion, compression, and stem ischemia 84%, pituitary tumor with focal hemorrhage, 49% and in cases of more than ten days, cerebellar tonsils disintegrate by 80%. The microscopic study shows absence or scarce inflammatory congestive red capillary reaction with endothelial edema and abundant extravagated hematite that make up multiple petechial, nucleophilic pyknosis and eosinophil cytoplasm of the entire neurons, total necrosis of the granular layer and cells of the brain.

It should be noted that the increase in intracranial pressure secondary to massive brain tumefaction is considered the possible determining mechanism of encephalic death, as it causes obstruction of cerebral circulation. Since 1953, this physiological phenomenon of

encephalic circulatory obstruction had been described in cases of increased intracranial pressure. (Escobar, 2005, p.330)

### **2.3 Importance of differentiating brain death with other neurological diseases**

Brain death is a fatal condition that can be considered as a climate point of life. It is even come to be considered by Escobar (2005) as the irreversible destruction of the brain, with loss of respiratory automatism and persistence of cardiac activity. However, this does not return to brain death an easy condition to identify, due to the existence of neurological diseases with the same symptomatology. These other diseases can be caused by different origins and even become effectively treated, unlike brain death.

### **2.4 Neurological states that can be mistaken for brain death**

Although brain death to be diagnosed must go through many tests, it is not very difficult to confuse with other neurological diseases that are extremely similar to this. Clogging syndrome secondary to bridge destruction in basilar artery thrombosis; are cases where the patient cannot move the limbs, gesture and swallow, but they maintain voluntary flickering, vertical eye movements and state of consciousness is not affected. Guillain-Barré-Strohl syndrome, with progressive paralysis of the entire peripheral nervous system and thus brain death. Accidental hypothermia, at levels of 28 to 32 degrees, leads to pupil paralysis and loss of stem reflexes, these cases, with good clinical management, are likely to be reversible. In cases of alcohol poisoning due to excessive intake, blood alcohol level determination should be made. Finally, in cases of cranioencephalic trauma, caution should

be exercised before making the diagnosis of brain death and as soon as possible specify the causes of unconsciousness and loss of stem reflexes.

## **Chapter III**

### **Embryos and brain death from a philosophical point of view**

#### **3.1 Person**

The concept of a person is one that is mainly formed in a philosophical way, since he tries to explain the uniqueness of everyone that may come to exist. This is because it seeks to contrast with the concept of human nature that seeks the generalization of the individual, looking for the common factors of each one, so that we can supposedly reach what defines us as human beings.

##### **3.1.1 Social context**

From a sociological point of view, it can be said that it is a sociable being who lives and develops in what we call society, without detracting from the importance that each individual possesses a unique character that accentuates him as a person.

##### **3.1.2 Philosophical context**

individual substance of a rational nature is the definition informed by Boethius, which is characterized by three parts: substantiality, individuality and rationality. By considering this, we conclude that being a person is not something ordinary, since we now become a who instead of a who and that we are not part of a group or a nature, but a unique individual with an inner universe.

In modernity, for Locke the person is no longer part of an ethereal and unavailable concept because it is not a way of being or what this should be. This would become the state in which we find ourselves, feel and think.

### **3.2 Embryos**

A human embryo is an organism that is formed by copulation between a man and a woman when it is in the early stages of its formation. This is even considered by many minds as the start of the human live, due to all the characteristics which it has in common with all grown human beings. Just as Arango (2016) claimed: “Genetics says that the human species is the only one with 46 chromosomes and any scientist who examines that embryo will be able to scientifically say that it is - without a doubt - of the human species.” (p.312).

#### **3.2.1 Embryo as a person**

It has already been explained before that the human embryo is a living being and belongs to the human species. This is irrefutable, from a scientific point of view. The new being is not a simple sum of the genetic codes of the parents. This is a new being, which did not exist until then, nor will it be repeated. From the very moment of its conception the zygote begins the personal deployment, multiplying its cells by a process known as mitosis.

The above statement can be affirmed by the simple fact that the embryo possesses three qualities that prove it. It has a cellular coordination that makes it more than a group of different cells, but an individual. Apart has a continuity, since it does not stay like a zygote, it develops limbs until it becomes a different being to the one it once was. It also has a gradualism that allows it to change its appearance as time passes just as humans go by as

they age. Even Arango (2006) is based on the character of the human embryo as a person that he has the same rights to life as his peers.

### **3.2.2 Cases of pregnancy and brain death.**

Brain death can occur in any class of people regardless of what qualities or lifestyle this possesses, which does not prevent the case of a pregnant woman developing this fatal disease. However, this does not mean that the development of the fetus is coming to an end. If a fetus is able to survive outside its mother's uterus, doctors immediately perform a cesarean. In the event that the fetus is not in the condition for its birth, there have been cases in which doctors have put the mother on life support until the fetus is eligible for cesarean is.

Although high-risk, the fetus that is not in the right condition of childbirth should be kept in the mother's uterus in order of its complete development.

This one is ordained, in the first days, with wonderful logistics, the embryo forms the structures that will allow it to survive because it allows it to adhere to the mother and nourish itself - external cell mass that gives rise to the placenta -. Then the internal cell mass with its body structures that are developed slowly, progressively, and always neatly (Arango, 2016,p.78).

It is an Ethical question to have a person under life support but considering that the life of the fetus is at stake this is the most correct option that can be taken. It is the sacred duty of doctors to protect life at all costs and even by taking the Hippocratic oath they are careful to use their medical knowledge to help in this area.

## Conclusions

At the conclusion of this monographic work, it is concluded that:

- Encephalic death is the complete and irreversible ending of the functions of all the neurological structures. There is no existent cure and it is also recognized as a kind of death of the human being.
- It is of great importance to know how to differentiate encephalic death from other neurological diseases. There are a variety of different conditions and diseases that may look like encephalic death.
- Due to the severity of this condition, only a professional in the assigned field of the medicine should make the diagnosis. This is because of the large range of diseases and conditions that may mimic the ones of brain death.
- Brain death is a condition that does not discriminate, because it can affect any kind of people at any point of their lives. It does not matter how healthy or wealthy someone may be, brain death can develop under the right circumstances.
- There currently exist a large amount of methods that are able to diagnose if a person is truly suffering from brain death. Though these methods often come with a group of different tests that all must be taken in order to make a correct diagnosis.
- Even if the patient may seem able to take one of the tests to determine if he has brain death, there are some clinical requirements that must follow in order to take them. This is to ensure there are no abnormal conditions that may interfere in the patient's diagnosis.

## **Recommendations**

At the end of this monographic work it is recommended that:

1. May young people be encouraged to learn about these kinds of conditions so that they can understand the importance and severity of these types of diseases because of the terrible consequences that can lead to the patient and the rest of his family.
2. Learn to differentiate between encephalic death and other diseases and/or neurological disorders that have similar characteristics but, in the end, do not turn out to be as fatal as the brain death itself.
3. In the event that a member of your family or a person close to you develop such a mortal condition, inform yourself in order to know what to expect about this kind of experiences that will follow.
4. Acknowledge that brain death is a condition that can develop to any person independently from any kind of feature that the person in question may present at the time the condition starts to manifest.
5. In the case of somebody that you know may present similar symptoms of the ones which were detail in this paper, bring them into the nearest medical center. It is very important to try to preserve the health and try to prevent any kind of brain damage.
6. Do not try to self-medicate in the case that some of these symptoms appears. You may be causing more damage to yourself than the one that you are aware of and you might even be masking a very dangerous disease.

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