ASSESSMENT OF BRAIN DEATH IN PEDIATRIC INTENSIVE CARE UNIT

Thesis

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Investigator

Waleed Abd El-Menaim Saied

M.B.B.Ch - M.Sc.

Supervisors

Mohammed El-Naggar

Professor of Pediatrics and Pediatric Intensive Care – Cairo University

Ahmed El-Beleidy

Professor of Pediatrics and Pediatric Intensive Care – Cairo University

Omneya Afifi

Professor of Pediatrics and Pediatric Neurology – Cairo University

Department of Pediatrics
Faculty of Medicine
Cairo University

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DEDICATION

This study is dedicated to the souls of our dear colleagues we lost:

Doctor Mohamed Badawi *and* ***Doctor Haitham Hosni****.*

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List of Abbreviations

BAER: Brain stem auditory response

CBF: Cerebral blood flow

CNS: Central nervous system

CO_2: Carbon dioxide

CPR: Cardiopulmonary resuscitation

CT: Computed tomography

ECG: Electrocardiogram

ECS: Electrocerebral silence

EEG: Electroencephalogram

ICP: Intracranial pressure

ICU: Intensive care unit

MESOT: Middle East Society for Organ Transplantation

MOSF: Multiple organ system failure

O_2: Oxygen

$PaCO_2$: Pressure of arterial carbon dioxide

PaO_2: Pressure of arterial oxygen

PICU: Pediatric intensive care unit

PVS: Persistent vegetative state

SPSS: Statistical package for social science

ABSTRACT

Brain death is defined as the complete and irreversible absence of all brain function including profound coma, apnea, and absence of all brain stem reflexes. It is diagnosed by means of rigorous testing at the bedside, in addition to confirmatory tests such as electroencephalogram which vary from country to country. As technological complexity and advancements in critical care continued to explode during the past several decades, brain death as a new concept of death emerged and evolved as a necessary measure for determining death. Before the development of these neurological criteria, death was classically described as the cessation of circulation and respiration. The major reason for medical, community, and legal acceptance of brain death is the need for organ donation from “beating heart” donors. A declaration of brain death is only used for this purpose, and not for withdrawal of life support measure which are useless once brain death is declared.

The present study aimed to assess brain death as regarding the common causes, patients’ age, clinical criteria and different durations of progression to coma, brain death and cardiovascular death.

Key Words: Brain death, Brain stem, Apnea.

Introduction
and
Aim of the Work

Brain death is defined as complete and irreversible absence of all brain functions demonstrated by profound coma, apnea and absence of all brain stem reflexes. [1,2]

It is a particular type of death unique to mechanically ventilated patients in the intensive care unit. The patient is ventilator dependant and if the ventilator is switched off; cardiac arrest will occur in 5 to 10 minutes. [3]

Brain death can occur in critically ill patients due to irreversible damage of cortical and brain stem functions secondary to severe system failure (respiratory, cardiovascular, metabolic and hematological failure). Seizures, head trauma, central nervous system infections, and hypoxic or metabolic encephalopathy are the common causes of acute neurological dysfunction in the pediatric intensive care unit. [4]

With the progress in intensive care medicine, the concept of brain death has been emerging. Modern technology of organ system support allows clinicians to maintain cardiopulmonary function indefinitely, even after brain function has permanently ceased, this necessitated a reassessment of definition of death. [4]

The concept of brain death continues to be a topic of international debate among medical clinicians, anthropologists, philosophers, and ethicists. [5]

All patients who are declared brain dead are comatose and apneic, and they lack brain stem reflexes. It is essential to ensure that reversible conditions associated with altered metabolic states, exposure to toxic agents, fluid and electrolyte abnormalities, hypothermia, hypotension, or medication effects are treated. Hypothermia occurs in about 50% of children who are comatose after catastrophic brain injury. Thus, patients should be rewarmed

before the neurological examination and neurodiagnostic tests are completed. [6]

Apnea test is essential to document the diagnosis of brain death. It depends on idea that rising $PaCO_2$ above 60 mmHg has a strong stimulatory effect on respiration, and spontaneous breathing effort reappears except in brain dead patients. [7]

EEG documentation of electrocerebral silence (ECS) and measurements indicating the absence of cerebral blood flow (CBF) remain the most widely available and useful methods for confirming the clinical diagnosis of brain death. However, during the past decade, reliance on confirmatory testing has decreased and reliance on repeated clinical examinations that indicate coma, apnea, and lack of brain stem function has increased. [6]

When the criteria of brain death are fulfilled, the child should be considered legally dead. This determination is crucial to the process of organ transplantation that requires the harvested heart, lung, liver or bowel to be obtained from a donor whose heart is beating. Several thousand potential organ recipients die each year while awaiting transplantation. [8]

The Qur'anic affirmation of bodily resurrection has determined many religious and moral decisions regarding cadavers. Many Muslim scholars have permitted cadaveric organ donation. [9,10,11,12,13,14]

Aim of the Study

- Assessment of incidence and distribution of different causes and factors leading to brain death in our country.

- Assessment of validity of clinical and laboratory criteria for diagnosis as an indicator for permanent and irreversible brain damage.
- Assessment of durations from admission to onset of coma to diagnosis of brain death and from brain death diagnosis to cardiovascular death.
- Assessment of the validity of electroencephalogram (EEG) for the diagnosis of brain death below and after one year of age.

Review of Literature

Life and Death

Life is the state of being which begins with generation, birth, or germination, and ends with death. **(15)**

The difficulties encountered in medicine in utilizing concepts relating to life and death in the human organism are related to inappropriate fundamental definitions. Mutually exclusive sequential stages of the life cycle, as well as incrementally inclusive (nested) phases of the life cycle in the human organism are both explicitly defined. **(16)**

A brain centered approach requires emphasis on the ontogenesis of the structure and function of the brain. Operational definitions lead to a characterization of the different developmental periods of the human organism including phases designated as the "human being" and the "person". The brain centered concept is use to define the onset (brain life) and termination (brain death) of this critical system of the human being. The onset and termination of the human being occurs respectively with the beginning of the operation of the entire critical system (brain life), and with the end of the operation of the entire critical system (brain death). The onset is related to completion of the structural brain and the beginning of its function, while the termination is related to the destruction or irreversible dysfunction of the entire brain. **(17)**

These concepts contain a fundamental asymmetry. A self-consistent, practical, biologically based approach may provide a logical foundation for a large variety of medical, legal, ethical and social issues. **(16)**