Electrophysiological and Psychometric Assessment of Cognitive Functions in Normal Aging

A Thesis submitted for fulfillment of MD in Clinical Neurophysiology

Investigated by

Alshaimaa Sobhi Khalil

M.Sc.

Supervised by

Prof. Dr. Ann Ali Abdel Kader

Professor & Head of Clinical Neurophysiology

Cairo University

Prof. Dr. Ebtesam Mohammad Fahmy

Professor of Neurology

Cairo University

Prof. Dr. Ayatullah Farouk Ahmad

Professor of Clinical Neurophysiology

Cairo University

Dr. Amira Ahmad Labib

Lecturer of Clinical Neurophysiology

Cairo University

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بسم الله الرحمن الرحيم

﴿قالوا سبحانك لا علم لنا إلا ما علمتنا

إنك أنت العليم الحكيم﴾

صدق الله العظيم

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ABSTRACT

Aging and Age-related Changes (ARCs) refer to the declines in component biologic processes occurring with senescence that result in impaired brain structure, cognitive performance and behavior. In the present study we aimed to assess cognitive functions in normal elderly subjects using psychometric cognitive assessment scales and electrophysiological studies including power of brain activity and late cortical responses.

Method: Forty seven healthy elderly subjects were assessed with electrophysiological studies and psychometric scales. Electrophysiological studies include P300 and CNV studies and QEEG recording.

Results: The results of P300 showed a significant positive correlation was found between age and reaction time. A significant negative correlation was found between reaction time and the total score of the performance scale. The results of CNV revealed a significant negative correlation was noted between latency of N2 and total score of the verbal scale. Regarding relative power of EEG frequencies, a significant positive correlation was found between relative power alpha frequency and the total score of performance scale. No significant correlation was revealed between P300, CNV parameters and relative power of EEG frequencies and scores of WMS subtests and parameters of WCST.

Conclusion: Results suggest that the psychiatric scales do not provide a substitute for electro-physiological tests in evaluating the cognitive changes which occur with normal aging. Also, it revealed that P300 parameters are more sensitive than CNV parameters in detecting such changes.

Key words: cognitive, electrophysiological, psychometric, aging.

CONTENTS

List of ABBREVIATIONS

AD Alzheimer's disease

ADHD Attention deficit hyperactivity disorder

ADLs Activities of daily living

AIDS Auto-Immune Deficiency Syndrome

AP Absolute power

ARCs Age-related Changes

ATP Adenosine triphosphate

BOLD Blood oxygenation level–dependent

CLOX Clock Drawing Task

CNV Contingent negative variation

Cr Creatine

CT Computed tomography

dB Decibel

DLPFC Dorsolateral prefrontal cortex

DNA Deoxyribonucleic acid

EEG Electroencephalogram

E-wave Expectancy wave

EXIT-25 Executive Interview

fMRI Functional magnetic resonance imaging

Gln Glutamine

Glu Glutamate

List of ABBREVIATIONS (continued)

HPA Hypothalamic-pituitary-adrenal

5-HT 5-hydroxytryptamine

Hz Hertz

IQ Intelligence Quotient

ISIs Inter-stimulus intervals

Khz Kilo-Hertz

LC Locus coeruleus

MEG Magnetoencephalography

mm Millimeter

MMN Mismatch Negativity

MMSE Mini-Mental State Examination

MRI Magnetic resonance imaging

msec Milliseconds

mtDNA Mitochondrial DNA

µV Microvolts

NAA N-acetyl aspartate

NBM Nucleus Basalis of Meynert

NE Norepinephrine

O-wave Orienting wave

OXPHOS Oxidative phosphorylation

PET Positron emission tomography

PFC Prefrontal cortex

List of ABBREVIATIONS (continued)

PLEDs Periodic lateralized epileptiform discharges

QEEG Quantitative Electroencephalography

RMS Root-mean-square

RP Relative power

SD Standard deviation

sLORETA Standardized Low Resolution Electromagnetic Tomography

VTA Ventral tegmental area

WAIS Wechsler Adult Intelligence Scale

WCST Wisconsin Card Sorting Test

WMS Wechsler Memory Scale

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INTRODUCTION

The aging of the world's population has profound implications for medical care and health care systems. Aging spares no organ or system, and in due course affects everything, from cell to thought **(Raz and Rodrigue, 2006)**.

There is a generalized, proportional decline in mental processing speed among elderly adults that affects all elements of mentation equally **(Bashore *et al.*, 1989)**. Numerous investigators have reported changes in the pattern of brain electrical activity (electroencephalogram, EEG) associated with aging and noted a relationship between specific changes in the EEG and clinical deterioration **(Prichep *et al.*, 2006)**.

The P300 event-related potential (ERP) is thought to reflect neuroelectric activity related to cognitive processes such as attention allocation and activation of immediate memory. However, studies have provided evidence that the P300 also is influenced by biological processes such as fluctuations in the arousal state of subjects **(Polich and Kok, 1995)**.

The contingent negative variation (CNV) can be recorded in the serial conditions of habituation—reinforcement—motor extinction (free attention)—reinforcement—motor extinction (forced attention). The mean CNV amplitude under the reinforcement and motor extinction (free attention) conditions decreases prominently with aging **(Verleger *et al.*, 1999)**.

AIM OF WORK

To assess cognitive functions in normal elderly subjects using psychometric cognitive assessment scales and electrophysiological studies including power of brain activity and late cortical responses.

REVIEW

OF

LITERATURE

Chapter 1

Theories of Normal Aging