

**Complex Auditory Brain Stem Response
in Children with History of Otitis Media
with Effusion**

Thesis

***Submitted for the Partial Fulfillment of Master Degree
in Audiology***

By

Lamiaa Mahmoud Abdel Rahman

(M.B.B.Ch.)

Resident of Audiology, Ain Shams General Hospital

Supervised by

Prof. Dr. Amany A. Shalaby

Professor of Audiology, ENT Department

Faculty of Medicine- Ain Shams University

Prof. Dr. Tamer Ali Youssef

Assistant Professor of Otolaryngology

Faculty of Medicine- Ain Shams University

Dr. Dalia Mohamed Hassan

Assistant Professor of Audiology, ENT Department

Faculty of Medicine- Ain Shams University

**Faculty of Medicine
Ain-Shams University**

2016



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقُلْ زِدْنِي عِلْمًا

صدق الله العظيم

سورة طه (آية ٤١)





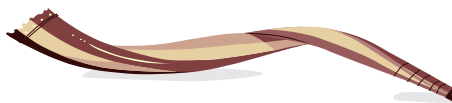
*First of all, I thank **ALLAH** for blessing this work as a part of his generous help throughout my life.*

*I am greatly indebted and grateful to **Prof. Dr. Amany A. Shalaby**, Professor of Audiology, ENT Department, Faculty of Medicine, Ain Shams University, for her continuous guidance, support and constructive criticism through the work. She has generously devoted much of her time and her effort for planning and supervision of this study.*

*I would like to display my indebtedness to **Dr. Tamer Ali Youssef**, Assistant Professor of ENT Department, Faculty of Medicine, Ain Shams University, for his support, faithful advice and meticulous supervision*

*I wish to extend my thanks to **Dr. Dalia Mohamed Hassan**, Assistant Professor of Audiology, ENT Department, Faculty of Medicine, Ain Shams University, for her meticulous supervision, scientific support and judicious guidance throughout this work.*

Finally, my particular appreciation to my family for their generous assistance.



Tamiaa Mahmoud

Contents

List of Abbreviations	I
List of Tables	III
List of Figures	VI
Introduction	1
Aims of the Work	5
Review of Literature	
• <i>Chapter One:</i> Otitis media	6
• <i>Chapter Two:</i> Complex auditory brainstem response... ..	46
Materials & Method	73
Results	81
Discussion	95
Conclusion	106
Recommendations	107
Summary	108
References	112
Appendices	136
Arabic Summary	--

List of Abbreviations

Abb.	Full term
ABR	Auditory brain stem response
AOM	Acute otitis media
ASD	Autism spectrum disorders
CANS	Central auditory nervous system
CAPD	Central auditory processing disorders
CI	Confidence interval
CSOM	Chronic suppurative otitis media
CV	Constant & vowel
db	Decibels
EAC	External auditory canal
EEG	Electroencephalogram
ET	Eustachian tube
ETD	Eustachian tube dysfunction
F0	Fundamental frequency
FFR	Frequency following response
FFR	First formant frequency
HF	High frequency
HPeV1	Human par echovirus 1
IC	Inferior colliculus

List of Abbreviations

Abb.	Full term
IgE	Immunoglobulin E
IL	Intre leukaine
MEE	Middle ear effusion
NICU	Neonatal intensive care unit
OM	Otitis media
OME	Otitis media with effusion
PCR	Polymerase chain reaction
PLS4	Preschool language scale 4j
PTA	Pure tone audiometry
RAST	Radioallergosorbent testing
RSV	Respiratory syncytial virus
S-ABR	Speech ABR
SOM	Secretory otitis media
TM	Tympanic membrane
TW	Tympanogram width
URI	Upper respiratory tract infection

List of Tables

Table	Title	Page
1	Mean, SD, t and P values of the age in control and study group	81
2	Gender distribution in the control and study group	82
3	Distribution of child of the study group accordingly to language development	82
4	Mean, SD and range of percent scores of otitis media questionnaire in study group	83
5	Mean, SD and range of duration of otitis media in months	83
6	Mean, SD and range PTA threshold in right and left ear in control group	83
7	Mean, SD and range PTA threshold in right and left ear in study group	84
8	Mean, SD and t and P value of pure tone audiometry between control and study group in right ear	84
9	Mean, SD and t and P value of pure tone audiometry between control and study group in left ear	85
10	Mean, SD and range of SRT and WDS in study group	85

Table	Title	Page
11	Classification, number and percent (%) with tympanometry in control and study group	86
12	Mean, SD, t and P values in the Arabic CAPD questionnaire scores in control and study group	86
13	The school scores of the children of the control and study group	87
14	Percent identification of complex ABR waves in control and study group	88
15	Mean and SD of waves latency and spectral analysis of control and study group in right ear and results of tests of significance	89
16	Number and percent (%) of Biomark score abnormality in the study group	90
17	Person's correlation coefficient between duration of OM and complex ABR	90
18	Person's correlation coefficient test between the age of study group and complex ABR	81
19	t and P value of CAPD questionnaire scores and complex ABR in study group	92
20	t and P value of school scores and complex ABR in study group	93

Table	Title	Page
21	t and p value of duration of otitis media compared to language age	93
22	Person's correlation coefficient and between duration of otitis media and CAPD questionnaire in study group	94
23	t and p value of duration of otitis media compared to school scores	94

List of Figures

Figure	Title	Page
1	Diagnosis of perforation of the right tympanic membrane resulting from a previous severe acute otitis media	16
2	Acute otitis media	18
3	Chronic otitis media	19
4	Otitis media chronica mesotympanalis	19
5	Otitis media chronica mesotympanalis	20
6	Otitis media chronica mesotympanalis	20
7	Otitis media with effusion	21
8	Auditory brainstem response to stimuli (da)	49
9	Stimuli used in complex in ABR	56
10	Normal cABR in study group at child 10 years old	78
11	Speech ABR recorded from the right ear of 8 years old child in the present study	79
12	Language age assessment	82
13	Distribution of school scores in study and control group	87

Complex Auditory Brain Stem Response in Children with History of Otitis Media with Effusion

Abstract

Background: Otitis media with effusion (OM) refers to inflammation of the middle ear. It occurs in the area between the ear drum (the end of the outer ear) & the inner ear, including the eustachian tube. It is very common in childhood, with the average toddler having two to three episodes a year. **The aim:** To study c-ABR in children having history of otitis media with effusion & To correlate c-ABR with language development & scholastic achievement in children with history of otitis media with effusion, if any. **Method & Material:** control group: comprised fifteen normal hearing children ranged from 6 years to 12 years. They should have normal middle ear functions, No past history of repeated attack of otitis media with effusion, Absence of neurological deficits, Average or above average intelligent quotient (IQ), negative prenatal, natal and postnatal and with normal developmental history (walking, teething, toilet training and normal language development). Study group: Twenty two children with age matched to control group were included in the present study. **Results:** Result of the study pointed to statistically significant difference in Arabic CAPD questionnaire scores and scholastic achievement scores between control and study group. Complex ABR showed significant statistical difference in the VA slope, C,D,E,O latency and FFR between the two study groups. Positive statistical correlation was found between duration of otitis media and complex ABR at VA slope and O latency, language age and listening, language in central questionnaire and scholastic achievement. Also, positive statistical correlation was found between complex ABR and CAPD questionnaire and scholastic achievement. **Conclusions:** children with a history of chronic otitis media with effusion had deficient neural timing in response to the onset and offset of the transient speech stimuli. This might resulting in impairment of speech encoding at the brain stem. That in turn affect on language development, scholastic achievement and auditory processing abilities.

Keywords: CAPD: central auditory processing disorders, c-ABR: complex auditory brain stem response.

Introduction

Otitis media with effusion (OM) refers to inflammation of the middle ear. It occurs in the area between the ear drum (the end of the outer ear) & the inner ear, including the eustachian tube **(Lieberthal et al., 2013)**. It is very common in childhood, with the average toddler having two to three episodes a year **(Scott, 2006)**.

The rapid onset of signs & symptoms of inflammation in the middle ear is termed acute otitis media with effusion. A middle ear effusion occurs if this effusion last less than 3 weeks it is acute otitis media with effusion, an effusion that last 3 weeks to two to 3 months is called subacute otitis media with effusion. While chronic otitis media with effusion last longer than two to 3 months **(Paparella et al., 1993)**.

The presence of OM with effusion may result in many sequelae on hearing, language development, auditory processing & scholastic achievement **(Berman, 2001)**. Many cases of chronic otitis media with effusion have the fluctuating nature of hearing loss (which may alternate with periods of normal hearing) leads to an inconsistent sound stimulus to the auditory central nervous system, making it difficult for the child to perceive the sounds of speech

(**Santos et al., 2001**). Furthermore, fluid in the middle ear can produce noise at the cochlea, distorting the perception of sounds (**Santos et al., 2001**). Language development begins very early, even during its prenatal phase the child is capable of recognizing voices & the sounds of speech. Children with hearing loss resulting from OM with effusion have greater difficulty in acquiring language, less perception of those sounds of speech which contain silent consonants or fricatives such as /s/ & /z/ (**Petinou et al., 2001**) & frequently make phonetic errors in the pronunciation of /l/ & /r/ (**Borg et al., 2002**).

Moreover, **Santos et al. (2001)** reported that Otitis media with effusion might have effect on auditory processing in long-term unilateral conductive hypoacusia leads to binaural auditory processing deficiencies. **Luotonen et al. (2002)** noticed that children with a history of repeated AOM during the first three years of life were making unsatisfactory progress at school in reading, comprehension of texts & verbal & written expression.

The speech- evoked auditory brainstem response offers a unique vantage point for assessing auditory function due to its remarkably faithful representation of the stimulus acoustics (**Skoe & Kraus, 2010**). It can be divided into: transient & sustained portions, onset response

components (stimulus onset), & frequency-following response (FFR) (**Kraus & Nicol, 2003**).

Auditory deficits contributing to impaired language & listening abilities in children are likely due to a complex interaction between sensory function & cognition. Once thought to be simply a sensory relay to the cortex, the auditory brainstem has been shown to be vastly malleable through meaningful interaction with sound (**Chandrasekaran et al., 2009**). Due to the complex interaction between sensory & cognitive functions that likely occurs in impaired auditory processing, that might be manifested in children with OM with effusion auditory brainstem measures may be particularly useful in revealing the biological correlates of communication (**Kraus et al., 2010**).

Several researches **Wible et al. (2005)**, **Maruthy & Mannarukrishnaiah (2008)** studied speech ABR in children having otitis media with effusion that revealed abnormal development of brain stem encoding. However, effect of chronic otitis media and complex ABR and so forth CAP and scholastics achievement were not addressed before.

Accordingly, this study will investigate the auditory processing patterns objectively using complex ABR in children with history of otitis media with effusion.