Auditory Temporal Processing in Tinnitus Patients with Normal Hearing

Thesis
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By

Ahmed Abdullah Yousry Gamal Eldeen
M.B.B.Ch.

Supervised by

Prof. Dr. Adel I. Abdel-Maksoud Nassar
Professor of Audiology, ENT Department
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
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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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List of Abbreviations

Abb.	Full term
ABR	Auditory brainstem response
AFT	Auditory fusion test
ASHA	American speech language association
c-ABR	Speech ABR
CANS	Central auditory nervous system
CBC	Complete blood count
CT	Computed topography
CV	Consonant-vowel
CVC	Consonant-vowel-consonant
dB	Decibel
dB SL	Decibel sensation level
DCN	Dorsal cochlear nucleus
DPOAEs	Distortion product otoacoustic emissions
DPT	Duration pattern test
EMEA	European Medicines Agency
Fo	Fundamental frequency
F1	First formant
FDA	Food and Drug Administration
FFR	Frequency following response
F-MRI	Functional magnetic resonance imaging
GIN	Gaps in noise
GPIAS	Gap pre-pulse inhibition of the acoustic startle reflex
HF	Higher formants

Abb.	Full term
IC	Inferior Colliculus
IHCs	Inner hair cells
IPI	Interpulse interval
ISI	Interstimulus interval
LLLT	Low level laser therapy
MCL	Most comfortable loudness
MGB	Medial geniculate body
MML	Minimal masking level
MMN	Mismatch negativity
MRI	Magnetic resonance imaging
Msec	Millisecond
MSN	Medullary somatosensory nuclei
NBN	Narrow band noise
NIHL	Noise induced hearing loss
NU-6	Northwestern university auditory test number 6 word lists
OAEs	Otoacoustic emissions
OHCs	Outer hair cells
PET	Positron emission tomography
PMF	Pitch match frequency
PPI	Pre-pulse inhibition
PTA	Pure tone audiometry
RGDT	Random gap detection test
RI	Residual inhibition
RISB	Rotter incomplete sentences blank
rTMS	Repetitive transcranial magnetic stimulation
SOAE	Spontaneous otoacoustic emissions
SPL	Sound pressure level

Abb.	Full term
SRT	Speech reception threshold
SSRIs	Selective serotonin reuptake inhibitors
STSS	Subjective tinnitus severity scale
T.C.S.T	Time compressed speech test
TCA	Tricyclic antidepressants
TCQ	Tinnitus cognitions questionnaire
TEOAEs	Transient evoked otoacoustic emissions
THI	Tinnitus handicap inventory
THQ	Tinnitus handicap questionnaire
TMAS	Taylor manifest anxiety scale
TRQ	Tinnitus reaction questionnaire
TRT	Tinnitus retraining therapy
TSS	Tinnitus severity scale
UCL	Uncomfortable loudness level
VCN	Ventral cochlear nucleus
VOT	Voice onset time
WDS	Word discrimination score

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INTRODUCTION

Tinnitus is defined as the perception of a sound that results exclusively from within the nervous system without any corresponding mechanical, vibratory activity within the cochlea, and is not related to external stimulation of any kind **(Jastreboff, 1995)**. Tinnitus represents a symptom of diverse pathologies and all levels of the nervous system, to varying degrees, are proposed to be involved in tinnitus manifestation **(Jastreboff, 1990)**.

The study of tinnitus mechanisms has increased tenfold in the last decade. The common denominator for all of these studies is the goal of elucidating the underlying neural mechanisms of tinnitus with the ultimate purpose of finding a cure. It is increasingly clear that tinnitus is a pathology involving neuroplastic changes in central auditory structures that take place when the brain is deprived of its normal input by pathology in the cochlea. Cochlear pathology is not always expressed in the audiogram but may be detected by more sensitive measures **(Henry et al., 2014)**.

Auditory temporal processing is one of the important auditory skills that are necessary for complex higher level auditory processing **(Gilani et al., 2013)**. There is compelling evidence that temporal processing plays an important role in speech perception**.** Recently, the role of auditory temporal processing in tinnitus has been studied. Patients with tinnitus experience difficulty understanding degraded speech **(Hass et al., 2012)**.

Studies on temporal processing in tinnitus patients involved mainly the psychophysical tests including Gap in Noise 'GIN' and Duration Pattern Tests 'DPT'. **Hass et al. (2012) and Gilani et al. (2013)** reported abnormal gaps in noise (GIN) test results reflecting auditory temporal resolution difficulties in patients with tinnitus. The hypothesis is that deficits that are demonstrated behaviorally in the temporal processing ability will also be seen in results of electrophysiological tests **(Musiek and Gollegly's, 1988)**. A neurophysiological correlate of temporal processing deficit has been proposed in the speech-evoked auditory brainstem response **(Nuttall et al., 2014)**.

Speech-evoked brainstem responses faithfully represent many acoustic elements of the stimulus, including stimulus timing, fine structure (harmonics), and the fundamental frequency **(Hornickel and Kraus, 2011)**. It is widely considered to provide an index of the quality of neural temporal encoding in the central auditory pathway and offers a quantitative evaluation of the auditory pathways at the rostral part of the brainstem. They are probably the most reliable of brainstem timing measures at this level **(Tahaei et al., 2014).**

To the authors' best knowledge, no published studies focused on the relationship between c-ABR and tinnitus. The present study was designed to evaluate auditory temporal processing ability in tinnitus patients objectively using c-ABR, and subjectively using the psychophysical auditory temporal processing tests. This might represent a step in understanding some of the underlying tinnitus mechanisms and their adverse effect on speech perception.

AIMS OF THE WORK

1- To study the psychophysical auditory temporal processing tests in tinnitus patients with normal hearing.

2- To explore the c-ABR measures in tinnitus patients with normal hearing.