THE MIDDLE LATENCY RESPONSES IN GERIATRIC POPULATION

Thesis submitted for partial fulfillment
of M.D. degree in Audiology

Presented by

Ali Abdul Daiem Ali

M.B., B.Ch., M.S.(Audiology)

Supervised by

Prof.Dr. SALAH M. SOLIMAN

Professor and Head of Audiology Unit

Faculty of Medicine

Ain Shams University

Dr. Nabil Rabei

Assistant Professor

Department of Otolaryngology

Faculty of Medicine

Ain Shams University

Dr. Somia Tawfik

Assistant Professor

Department of Otolaryngology

Audiology Unit

Faculty of Medicine

Ain Shams University

Cairo
1992

ACKNOWLEDGMENT

I would Like to express my deepest gratitude to Dr. SALAH SOLIMAN, Professor and Head of the Audiology unit, Faculty of Medicine, Ain Shams University, for his great help and invaluable advice. I appreciate his unlimited support to achieve this work.

I would also like to thank Dr. Nabil Rabei, Assistant Professor of Otolaryngology, Faculty of Medicine, Ain Shams University and Dr. Somia Tawfik, Assistant Professor of Audiology, Faculty of Medicine, Ain Shams University for their helpful supervision.

Support of my colleagues at the Audiology unit, Faculty of Medicine Ain Shams University and at the Hearing and Speech Institute was important in completing this work.

الله

بسم الله الرحمن الرحيم

CONTENTS

INTRODUCTION

AND

RATIONALE

INTRODUCTION AND RATIONALE

Electroencephalic response audiometry (ERA) is one of the most recent electrophysiological tests for evaluation of the function of the auditory system.

When ERA is recorded through surface electrodes placed on the vertex, four entities can be recorded according to their latency, different properties and presumably different anatomical sources. These components are:

1- Early or auditory brainstem response (ABR),

2- Middle latency response (MLR),

3- Late cortical response, and

4- Very late response (Skinner, 1978).

To state that auditory system is intact, ABR and MLR -as a measure of the central auditory function- must be considered. If a child has normal ABR and absent MLR, especially at a higher intensity, doubt has to be cast on the function of the auditory cortex or the auditory fibers in the thalamic area (Keith, 1988).

The middle latency responses (MLRs) are those biphasic potentials recorded at interval of 10-100 msec post-stimulus (Erwin and Buchwald, 1986 b). The MLR components have proved to be frequency specific and therefore, useful in the measurement of the auditory thresholds in non-cooperative subjects (Mc Farland et al., 1977).

Geriatrics is the branch of Medicine that concerns itself with the prevention and diagnosis of problems associated with aging. The term "Geriatrics" was coined in 1909 by an American physician ,Ignaz Leo Vaschers. On the other hand, the science of gerontology is an interdisciplinary activity which encompasses all aspects of aging including the physiologic, sociologic, religious and political aspects (Maurer and Rupp, 1979).

Those who investigate the effect of aging on hearing mechanism or provide services to senior persons handicapped by auditory dysfunction, frequently discover more questions than answers about the causes, contributing conditions and psychological implications of hearing problems.

Geriatric population is considered as one of the audiologically-difficult-to-test groups. This necessitates the use of advanced objective techniques (like ERA) as an aid to the conventional subjective and behavioral observation audiometry. In addition, conventional audiometry -due to the central pathophysiological changes in elderly persons- would be of less value in giving information about the central auditory nervous system. Therefore, MLR as a measure of central auditory function with a frequency-specific clinical value could help in evaluating the auditory system of elderly subjects.

This study was designed to test this assumption and resolve conflicting or inconclusive results regarding the MLR changes as a function of age.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

Anatomy of Central Auditory Nervous System

The fibers of the auditory nerve originate from the hair cells of the cochlea and enter the brainstem in two branches to the dorsal and ventral divisions of the cochlear nuclei. Rose et al. (1960) suggested their tonotopic arrangement, so that the basal turn of the cochlea projects more dorsally and the apical end projects most ventrally. From the cochlear nuclei, the fibers pass to the superior olivary complex (SOC) and to the nuclei of the lateral lemniscus (LL) in three main pathways: the trapezoid body, the intermediate stria and the dorsal acoustic stria. The SOC is innervated tonotopically; the ventral cochlear nucleus project bilaterally to both medial olives, ipsilateral to the lateral olive and contralaterally to the medial nucleus of the trapezoid body and the nucleus of the lateral lemniscus (Figure 1).

The cells of the dorsal nucleus project primarily via the dorsal acoustic stria, to the contralateral nuclei of the lateral

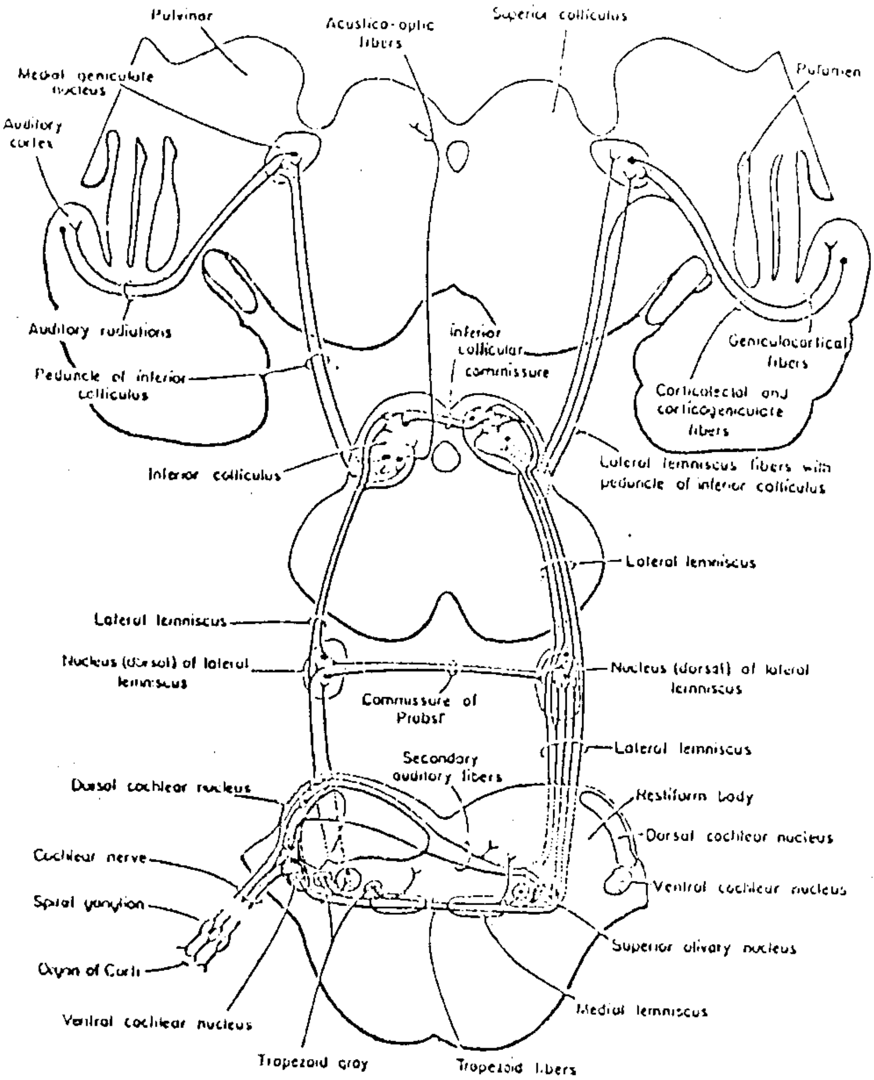

Figure (1): Central Auditory pathway (quoted from Luxon, 1981) lemniscus. The ascending fibers from the SOC run tonotopically in the lateral lemniscus to the central nucleus of the inferior colliculus. The medial SOC projects upon the ipsilateral colliculus while the lateral superior olive projects bilaterally to both colliculi. Fibers from the inferior colliculi project via the brachium to the ipsilateral medial geniculate body (MGB), although a few may cross to the opposite inferior colliculus (Jungert, 1958).

The auditory thalamus is composed of all divisions of the MGB, (dorsal, ventral and medial) together with the supraventricular nucleus. The ventral division is considered to be an exclusively auditory structure and the principal auditory thalamic nucleus. The dorsal and medial nuclei of the MGB as well as the suprageniculate nucleus receive projections from both acoustic afferents and afferents from other modalities (Luxon, 1981). From the thalamus, the afferent pathways project to the auditory cortex. Fisch (1983) considered that the most critical stages of the development of the auditory system, that is when the thalamocortical auditory connection is normally established. He also found that the conduction time between thalamus and cortex is 20 times longer in the newborn than adult of the same species.

The thalamocortical fibers terminate in the transverse (Heschl's) gyri that lie across the upper buried surfaces of the temporal lobes (Brodal, 1957). The cytoarchitecture of the primary auditory cortex (Brodmann's area 41 and 42) is distinctive but histologically resembles other primary cortical sensory areas. Tonotopic organization of the auditory cortex is suggested by Romani et al. (1982) through the neuromagnetic measurements of the response to auditory stimuli. Data about timing and frequency of sound are converted into information about the location of the sound source. Much of the processing takes place in various centers along the pathway and when impulse eventually reach the nuclei in the midbrain they are directed to a network of neurons that respond to sounds from specific areas. The distribution of this area form a two-dimensional map of the space in front of the individual. Each cell responds to sound from specific region of space. Information about sounds' localization then passes to higher centers or the cortex (Knudsen, 1981). For such information, processing is essential because the individual who heard the sound and was able to localize it must be still able to judge its precise location even when the sound has ceased to exist.

MLR WAVEFORM

MLR is a biphasic potential formed of a fast wave (5 - 100 Hz) relative to the slower wave of the cortical response. It is preceded by the early brainstem response and followed by the late cortical response (Skinner, 1978). Early studies used a 50 msec time base to record MLR. The MLR components identified on that time base were Po, 12 msec latency; Na, 16 msec latency; Pa, 25 msec latency and Nb with 36 msec latency (Picton et al., 1974). Ozdamar and Kraus (1983) described three categories of the MLR waveform; first, the separate peaks Pa, Nb, Pb; secondly, absent Pb with single Pa peak. The third waveform was defined as a broad Pa composed of Pa and Pb potentials with absence of Nb. Musiek et al. (1984) analyzed the MLR waveform from 8 msec to 90 msec. When using this time domain, it may be possible to recognize four positive peaks (Po, Pa, Pb and Pc) and three negative waves (Na, Nb and Nc). Waves Na, Pa, Nb and Pb were reported to comprise greater amplitude than the other waves and Pa wave appeared to be the most robust and consistent wave of all MLR components.