HOSTED BY
ELSEVIER
Available online at www.sciencedirect.com
ScienceDirect
Journal of Otology 11 (2016) 63–72
www.journals.elsevier.com/journal-of-otology/

Review

Enhanced auditory evoked potentials in musicians: A review of recent findings

Himanshu Kumar Sanju [a,*], Prawin Kumar [b,1]

[a] All India Institute of Speech and Hearing, Mysore, Karnataka, India
[b] Department of Audiology, All India Institute of Speech and Hearing, Mysore, Karnataka, India

Received 3 March 2016; revised 25 April 2016; accepted 25 April 2016

Abstract

Auditory evoked potentials serve as an objective mode for assessment to check the functioning of the auditory system and neuroplasticity. Literature has reported enhanced electrophysiological responses in musicians, which shows neuroplasticity in musicians. Various databases including PubMed, Google, Google Scholar and Medline were searched for references related to auditory evoked potentials in musicians from 1994 till date. Different auditory evoked potentials in musicians have been summarized in the present article. The findings of various studies may support as evidences for music-induced neuroplasticity which can be used for the treatment of various clinical disorders. The search results showed enhanced auditory evoked potentials in musicians compared to non-musicians from brainstem to cortical levels. Also, the present review showed enhanced attentive and pre-attentive skills in musicians compared to non-musicians.

Keywords: Neuroplasticity; Auditory evoked potential; Review; Musicians; Electrophysiological

Contents

* Corresponding author. Tel.: +91 7406093279 (mobile).
E-mail addresses: himanshusanjuaiish@gmail.com (H.K. Sanju), prawinaudio@gmail.com (P. Kumar).
Peer review under responsibility of PLA General Hospital Department of Otolaryngology Head and Neck Surgery.
[1] Tel.: +91 9886833741.

http://dx.doi.org/10.1016/j.joto.2016.04.002

1. Introduction

Electrophysiological testing is one of the objective modes of assessment to check the integrity of the auditory function and neuroplasticity (Starr et al., 1977; Golding et al., 2007). These measures complement the information provided by behavioral measures (Bruneau et al., 2003; McArthur and Bishop, 2005; Golding et al., 2007). Auditory evoked potentials are one of the electrophysiological measures which describe a series of electrical changes occurring in the peripheral and central nervous systems, usually related to the sensory pathways (Kraus and Nicol, 2008). Auditory evoked potentials can be further classified as endogenous and exogenous potentials. The exogenous potentials are primarily evoked by some external event related dimensions of the stimulus (Kraus and Nicol, 2008). The endogenous potentials are responses which are due to internal events such as cognition or perception (Sams et al., 1985; Novak et al., 1990; Čeponien et al., 2002; Chang et al., 2014). Recently, researchers showed a great interest in using auditory evoked potentials as an objective tool to assess neuroplastic changes in different populations including musicians (Bidelman and Alain, 2015; Pantev et al., 2015) and dancers (Karpati et al., 2015; Sinha et al., 2013). In the present review, auditory evoked potentials in musicians are summarized under different headings and the findings of various studies can act as an evidence for music-induced neuroplasticity and enhanced auditory evoked potentials which can be used for the treatment of various clinical disorders, i.e. dyslexia, central auditory processing disorder, schizophrenia, development language disorder, Parkinson disease, Alzheimer's disease, etc.

Music training contributes to the development of cognitive and linguistic abilities with increment in neuroplasticity along cortical and sub-cortical pathways of the auditory system as revealed by various electrophysiological studies (Bidelman and Krishnan, 2010; Musacchia et al., 2008; Okhrei et al., 2012; Nikjeh et al., 2009; Polat and Ataş, 2014). Music requires a wide range of processing mechanism which consists of encoding of sounds at a higher cognitive level involving memory, sequencing and learning. These higher cognitive skills, enhanced by music training, ultimately help improving speech and language processing.

2. Methodology

Various databases, such as PubMed, Google, Google Scholar and Medline, were searched for references related to auditory evoked potentials across musicians from 1994 to 2016.

3. Roadmap of review

1. Brainstem auditory evoked potentials in musicians
2. Cortical auditory evoked potentials in musicians
3. P300 in musicians
4. Mismatch negativity in musicians
5. Neuroplasticity in musicians
6. Clinical implication

All the above electrophysiological tests were conducted across different types of musicians by several schools of researchers.

3.1. Brainstem auditory evoked potentials in musicians

Wong et al. (2007) recorded brainstem encoding of linguistic pitch. The results showed that the musicians reflected more enhanced and better encoding of linguistic pitch compared to non-musicians. A similar study was done by Lee et al. (2009) which assessed auditory brainstem responses in 10 adult musicians and 11 non-musicians. The musicians were six pianists, two vocalists and two violinists with 10 or more years of musical training. The stimuli used were two musical intervals, the minor seventh and major sixth respectively. The results revealed that there were significant differences in the spectral analysis of the frequency following response. Musicians had significantly greater amplitudes for the harmonics compared to non-musicians. The other major finding for this study was that the number of years of musical exposure and training was well correlated with the amplitude of each of the frequency. It can be inferred that musicians have a better encoding of linguistic pitch and harmonics compared to non-musicians.

Parbery-Clark et al. (2009) recorded subcortical neurophysiological responses to speech in noise and quiet situations for experienced musicians and non-musicians. The stimuli taken were CV speech syllable /da/ of 170 ms in quiet and background noise which consisted of multi-talker babble. The results indicated that musicians were having higher similarities between brainstem responses of speech in quiet and noisy situations thereby indicating to us that incorporating background noise was not degrading brainstem responses in musicians. However, poor brainstem responses were seen in non-musicians when speech stimuli were presented in noise. This indicates that addition of background noise deteriorates brainstem responses in non-musicians when performance was compared to quiet condition. These outcomes showed that musical training and experience curb the adverse effects of background noise, showing perceptual benefits in speech in noise conditions for musicians compared to non-musicians.

Bidelman and Krishnan (2010) investigated brainstem frequency-following responses across adult musicians and age-matched non-musicians in response to the vowel /i/ at a different level of reverberation. The outcome of the study showed that the effect of reverberation had a slight impact on neural encoding of the pitch, but at the same time the neural encoding of the formant related harmonics were significantly vulgarized. In another study, Bidelman et al. (2011b) recorded brainstem frequency-following responses for both musicians and non-musicians. The stimuli taken were tuned and detuned chordal arpeggios which were differing only in pitch. The results revealed that musicians showed faster and enhanced neural synchronization and brainstem encoding for defining characteristics of musical sequences regardless if they were in