In response to clicks of high intensity, a vestibular evoked potential defined as a short latency electromyogram and called “click evoked myogenic potential” (CEMP), can be recorded from surface electrodes over the tonically contracted sternocleidomastoid muscle. Today, it is well established that, in normal subjects, the earliest response, p13-n20, is dependent upon vestibular activation, specifically sacculo-fundulus. During EEG recordings, potentials with this latency are called vestibulomyogenic potentials, or VEMP, the short latency response to 1 or 2 kHz clicks. We investigated whether a CEMP could be recorded in classical brainstem and middle latency auditory evoked potentials (BAEP, MASTP) by using A1-Cz, A2-Cz and early endolymphatic potentials (4 subjects). We studied the effect of the CEMP in a multichannel cognitive auditory evoked potentials (3 channels, auditory and visual tasks). Interest is focused on (1) CEMP potential should not be confused with a neural response, and (2) it would allow us to understand how different brainstem tracts are in brainstem auditory pathways and on release mediated through the vestibular nerve and the soma. Moreover, the p13-n20 CEMP was found to be elicited in the sitting, but not in the supine, position. Implications of these findings will be discussed.

Abstract:

Myogenic activity and cognitive auditory evoked potential, risk of confusion?

Introduction:

The main finding of the present presentation consists in showing that a CEMP p13-n20 component can be evidenced in the sitting position, but not always in the supine position.

This myogenic artifact (CEMP) may pollute numerous studies, using joint A1-A2 auricular references.

Indeed this potential can modify the responses obtained during the acquisition of cognitive evoked potential when the subject is sitting. The complex was absent if the stimulation was done in a lying position and in each of the nine subjects, that the typical AEPs were present in all nine subjects while recording from the ipsilateral cortical references (A1-Cz) (see Figure 2) using a 32 channel evoked potential setup at A1-Cz, the ear electrode being inserted in the lobule. The other ear electrode was placed on the contralateral mastoid (see Figure 1 for illustration). The complex was absent if the stimulation was done in a lying position.

Material and methods

The main goal of the present study is to show that the p13-n20 component, classically described in BAEPs, can be further evidenced in a middle latency reference CEMP (A1-Cz, A2-Cz). The CEMP can be used as a simple and non-invasive method for evaluating the integrity of the vestibular nerve. Interactions with other evoked potentials (i.e., BAEPs, VEMP and CEMP) are recorded using a 32-channel amplifier system. The signals were digitized and stored for further analysis offline using a multi-channel data acquisition and analysis system. A total of 250 clicks were presented over each ear. Trains of 500 clicks with an intensity of 90 dB were delivered in random order. Stimulus onset asynchrony was 100 ms. The duration of the stimulation of the right ear was 2.5 s, 100 ms before the stimulation of the left ear. The inter-click interval was 1 s. Two sets of 200 (100 msec) averaged responses were obtained for each ear. The first set was obtained in the sitting position and the second set in the supine position. The SNR (signal-to-noise ratio) was calculated from the first set of responses. The SNR was calculated from the difference between the mean amplitudes of the p13 and n20 components. The statistical significance was determined by the paired t-test. The threshold of significance was set at p < 0.05.

Results:

In the first group of subjects, latencies and amplitudes of the p13-n20 component were statistically similar in the sitting and supine positions. In the second group, the latency and amplitude of the p13-n20 component were statistically similar in the sitting and supine positions. In the second group, the latency of the p34-p44 complex reflected a bilateral response to unilateral stimulation. Further works have also shown that the p13-n20 complex is only present at cortical references if an acoustic stimulation of the sacculae gives rise to inhibitory post synaptic potentials in the cochlear nerve and auditory brainstem nuclei (see Biacabe et al., 2001 for review). Moreover, the utility of CEMP was, for example, proved to be useful for detecting dysfunction of inferior vestibular nerve in patients with multiple sclerosis (Murofushi et al., 2001). Due to its clinical potentialities, there has been an increasing interest in the use of CEMP for detecting dysfunction of the inner ear. The p13-n20 complex was present with a latency of 13 ms in the sitting position and 16 ms in the supine position.

Discussion:

The CEMP is the result of an interplay between auditory and vestibular inputs. In response to clicks of high intensity, a vestibular evoked potential defined as a short latency electromyogram and called “click evoked myogenic potential” (CEMP) can be recorded from surface electrodes over the tonically contracted sternocleidomastoid muscle. Today, it is well established that, in normal subjects, the earliest response, p13-n20, is dependent upon vestibular activation, specifically sacculo-fundulus. During EEG recordings, potentials with this latency are called vestibulomyogenic potentials, or VEMP, the short latency response to 1 or 2 kHz clicks. We investigated whether a CEMP could be recorded in classical brainstem and middle latency auditory evoked potentials (BAEP, MASTP) by using A1-Cz, A2-Cz and early endolymphatic potentials (4 subjects). We studied the effect of the CEMP in a multichannel cognitive auditory evoked potentials (3 channels, auditory and visual tasks). Interest is focused on (1) CEMP potential should not be confused with a neural response, and (2) it would allow us to understand how different brainstem tracts are in brainstem auditory pathways and on release mediated through the vestibular nerve and the soma. Moreover, the p13-n20 CEMP was found to be elicited in the sitting, but not in the supine, position. Implications of these findings will be discussed.

Conclusion:

The main finding of the present presentation consists in showing that a CEMP p13-n20 component can be evidenced in the sitting position, but not always in the supine position.

This myogenic artifact (CEMP) may pollute numerous studies, using joint A1-A2 auricular references.

Indeed this potential can modify the responses obtained during the acquisition of cognitive evoked potential when the subject is sitting.

Due to the amplitude and the latency of the different components of the CEMP associated with the filters used for the visualisation of the cognitive EP; new artefactual components are created close to the P50 classically used in clinical psychiatric neurophysiology that should not be confused with neuronal response.

Myogenic auditory (evoked) potentials (MAEP) during BAEP

P300 auditory evoked potentials (CEP) in 32 channels with head « unsupported »

Fig.1: Total recording for myogenic (MAEP) / P300 eliciting stimulus - head unsupported during auditory stimuli. We can see a « normal and meaningful » result. The complex was slightly delayed in the sitting subject compared to the supine subject. The latency of the p13-n20 component was 13 ms in the sitting subject and 16 ms in the supine subject.

Fig.3: Total recording for myogenic (MAEP) / P300 eliciting stimulus - head unsupported during auditory stimuli. We can see a « normal and meaningful » result. The complex was slightly delayed in the sitting subject compared to the supine subject. The latency of the p13-n20 component was 13 ms in the sitting subject and 16 ms in the supine subject.

Fig.2: Total recording for myogenic (MAEP) / P300 eliciting stimulus - head unsupported during auditory stimuli. We can see a « normal and meaningful » result. The complex was slightly delayed in the sitting subject compared to the supine subject. The latency of the p13-n20 component was 13 ms in the sitting subject and 16 ms in the supine subject.

Fig.4: Focus on the normal middle electrodes before convolution filtering for the P300 auditory evoked potentials. We can see a symmetrical strong deflection of the P300 component just after the « P50 » components.

Fig.5: Focus on the central middle electrodes after convolution filtering for the P300 auditory evoked potentials. We can see a symmetrical strong deflection of the P300 component just after the « P50 » components.

Fig.6: Focus on the central middle electrodes after convolution filtering for the P300 auditory evoked potentials. We can see a symmetrical strong deflection of the P300 component just after the « P50 » components.