IERASG: USING EVOKED POTENTIALS TO SOLVE CLINICAL PROBLEMS

Chair:

Suzanne Purdy

Speakers:

Andy Beynon

Mridula Sharma

Bob Burkard

Barbara Cone

John Durrant

Abstracts:

Andy Beynon

"Audio-vestibular assessment in Cochlear Implants"

In contrast to more peripheral auditory evoked potentials (EP), cortical EPs covers sound processing of the complete auditory neural pathway. Besides determining thresholds (bottom-up processing), cortical potentials are also useful to gain insight in the neural plasticity and top-down processing in children and adults. Compared to peripheral EPs (cochlear, brainstem), later latency potentials might reflect auditory cortical discrimination (cognitive P300, MMN) or detection of changes in tonal and speech stimuli (ACC). In CI recipients, similar experiments can be performed electrically using conventional or customized CI interfaces to present the electrical stimuli.

An overview of our present electrophysiological CI research and clinical assessment for auditory detection and discrimination at the cortical level will be addressed, including direct and indirect electrical CI stimulation, main differences between acoustic and electrical EP recordings, and future applications for speech processor fitting. Since the CI candidate profile has been changed the last decade, an increased number of patients with residual hearing receive CIs. Consequently, besides auditory, the importance of pre- and postop vestibular assessment has been significantly increased too. Use of simple clinical vestibular tests that improve preop counseling and postop follow up of CI candidates will be addressed.

Learning Objectives:

1. Participant will know which electrically-evoked auditory evoked potentials can be used for clinical application to assess auditory cortical detection and discrimination of sounds
2. Participant will have insight in the state-of-art how evoked potentials can be used for clinical fitting of cochlear implant patients
3. Participant is able to apply simple tests to assess the vestibular function in young CI candidates or users

Mridula Sharma

"Auditory selective attention and P300"

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Selective auditory attention is of interest and regarded as necessary when understanding speech in the presence of noise. The underlying processes of this skill are not that well understood. The purpose of this study was therefore to investigate the underlying markers of this skill using adult participants in bilingual (Mandarin-English) and monolingual (English) speakers. Two groups of ten normal-hearing monolingual and ten bilingual (English-Mandarin) young adults participated in this study. Each participant was presented 2 blocks of stimuli trains at 10dB SNR. One block referred to as discrimination paradigm had /da/ interspersed with /ba/ such that the presentation was /da, ba, ba/ with 60% probability of /da/ occurring in first position. The remaining two trains had /da/ occurring in either second or third position with 10% probability. CAEP data was collected from 25 electrodes. P1-N1-P2 and P300 are evaluated for /da/ when presented in different temporal positions. Wavelet time-frequency analysis is performed to analyse the epoched frequency band power information and cluster permutation statistics is used to test the differences across the groups and conditions. The presentation aims to discuss the ERP as well as time-frequency results as a measure of selective auditory attention in young adults.

Learning Objectives:

1. Define selective attention
2. Describe the methodology for P300
3. Describe the differences between time and frequency domain analyses

Bob Burkard

"From bench to bedside in ERA: s faster always better?"

Digital signal processing has been used to enhance the collection and analysis of auditory evoked potentials (AEPs), which in many instances improves their clinical applications. In this presentation, we will describe two processing approaches that hold promise to make the collection of AEPs for efficient. First, we will talk about using various signal processing strategies which allows collecting AEPs at much faster rates than allowed by conventional averaging. Faster rates saves in obtaining an average to a constant number of stimuli. However, the amplitude change with increasing rate combined with other changes that might degrade the signal-to-noise ratio (such as jitter in the interstimulus interval) must be considered when estimating the relative efficiency of these approaches. We will present advantages these approaches offer in terms of more fully assessing adaptation of the response. In our second approach, we will discuss the advantages and potential disadvantages of using chirp stimuli, rather than clicks (or tonebursts), for hearing screening and threshold estimation. Issues such as the need to change optimal chirp duration with level, limited data in hearing-impaired subjects and infants, and exactly where along the cochlear partition that the auditory brainstem response arises (based on stacked ABR data) will be discussed.

Learning Objectives:

1. The attendee will be able to describe the effects of increasing rate on the auditory brainstem response
2. The attendee will be able to describe both the advantages and disadvantages of MLS versus CLAD approaches to obtaining ABRs at high stimulation rates
3. The attendee will be able to describe where along the cochlear partition broadband transient stimuli are predominantly evoked, based on the Stacked ABR approach

Barbara Cone

"What can we learn about infant speech detection and discrimination from cortical auditory evoked potentials? "

In the first study, infants with normal hearing were tested using tonal and speech stimuli. All CAEP tests were completed while the infants were awake and engaged in quiet play. CAEP latency-intensity input output functions were steeper in infants compared to adults. CAEP amplitude growth functions with respect to stimulus SPL were adult-like at this age, particularly for the earliest component, P1–N1. Infant perceptual thresholds were higher, on average, than levels at which CAEPs could be obtained.

In the second study CAEPs were obtained for vowel tokens presented in an oddball stimulus paradigm. CAEP component amplitudes and latencies were measured in response the change in vowel type. CAEP amplitudes for vowel change were statistically significant when presented at a rate of 2/s. The CAEP amplitude differences for vowel contrasts could be used as an indicator of the underlying neural capacity to encode spectro-temporal differences in vowel sounds.

Learning Objectives:

1. List the stimulus and recording parameters needed to obtain CAEPs in infants.
2. Compare the differences in CAEP latency and amplitude that exist between infant and adult responses.
3. Critique the findings from perceptual and electrophysiologic methods of estimating speech feature detection and discrimination.

John Durrant

"Low-rate, longer-latency equivalent steady-state responses and removing the time-frequency barrier",

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Objective audiological tests of today emerged from over a half-century of research of electric response audiometry (ERA), effectively following two methodological streams--transient-evoked versus steady-state response (SSR) testing. Although transient-evoked potentials have enjoyed the wider-spread use clinically, particularly the auditory brainstem responses (ABRs), there has been underuse of (transient) long-latency responses (LLRs: cortical auditory evoked potentials [CAEPs]) in subjects unlikely to be testable in awake/alert states, including very young children. The aim of this presentation is to clarify the perceived difference in transient versus SSR tests and show that LLR/CAEP using steady-state methodologies has efficacy for use in infants and young children. Recent advances include frequency-domain approaches collectively, not only to short- (ABR) and middle-latency transient responses, but also to LLRs/CAEPs, namely ASSRs at repetition/modulation rates of 80Hz, 40Hz, and 20-5Hz respectively--even down to 0.75 Hz--without sacrificing time-domain analyses. The near future of research and development thus promises the clinician options for information desired rather than choices that compromise one “view” (frequency-domain) for the other (time-domain). The authors of this presentation have been principle innovators in these areas of advance and contributed relevant publications as career-long workers in ERA and related areas of evoked response testing.

Learning Objectives:

After this presentation, participants will be able to:

1. Describe why only pragmatic issues make differences in time- versus frequency-domain tests of auditory evoked potentials (AEPs), namely that these views derive form a “two-way street”.
2. Summarize recent evidence that steady-state analyses are applicable a low rates of stimulus repetition (modulation frequencies) and identify test advantages of such/related approaches to even long-latency-equivalent responses, particularly promising for testing late/cortical responses in young children.
3. Identify issues of research and development of steady-state-response approaches that promise ultimately to permit analyses in either domain without compromising choices, that is either time and/or frequency views from the same recordings.