Meeting Summary

IERASG 2011

Thank you George

Thanks to our IERASG Chair– John Durrant

Disclaimer

Scientific Sessions

51 oral presentations
23 posters

Special Presentations:

Hallowell Davis Lecture: Charlie Liberman
ABR amplitudes reveal aspects of pathology not revealed by thresholds

Keynote I: A Roger D Thornton:
The Translational Nature of AEP Research

Keynote II: James Hall III
Hearing Assessment in Infants

Hallowell Davis Lecture: Charlie Liberman

Animal ABR- Amplitude better than threshold, to predict damage to hair cell primary afferent changes- structure to function
Stereocilia and cell body changes- then cell death-
Spiral ganglion cells- very slow to degenerate-years
TTS- mice/g pigs- synaptic complex changes- afferent terminals- glutamate excitotoxicity.
Immunohistochemistry fluorescent dyes
DPOAEs and ABRs- both attenuated in base, where no threshold shift- synaptic changes permanent?
Human temporal bone studies support ganglion cell loss with age in ganglion cells
Afferent losses maybe more to low SR fibers- perhaps implications for processing signals in noise

Roger Thornton: A Translational Life

Simplicity to complexity, Animals to humans
Equipment- first rudimentary to sophisticated
Software- self written, analyses innovative- neurologic applications
PAM
Derived band- traveling wave velocity- differed in MD pts- glycerol
Loudness and ABR
OAEs and MLS- infant hearing screening
OAE rate suppression not see in those w/ SNHL
MLS- OAE temporal nonlinearities- Volterra slices
Relationship between amp and temporal nonlinearities – effects of SNHL
ABR and MLS- changes seen w/age for Volterra slices
SVP- attention effects- due to synchrony changes
Tinnitus and AEPs?

Keynote II: Jay Hall- Newborn hearing testing

A day in the life of a pediatric clinical audiologist
Universal newborn hearing screening
Early intervention makes a difference
Evidence-based practice- Levels of evidence
JCIH Position Statements- guideline for testing
Screeners- OAE/ABR
Cross-check principle- test battery
Impedance, OAEs, AEPs
OAES- led to recognition of auditory neuropathy
ABR: air/bone tonebursts/clicks
Time/accuracy tradeoff
Real ear/coupler- need better standardization
Change should be slow clinically: chirps, ASSR?
EcochG
Goal- suitable amplification

Round Table I: Guy Lightfoot

ABR systems for infant diagnostic hearing testing

Round Table II: James Hall III

Research Advances in AEPs

Advanced Bionics Symposium

Cochlear Symposium

Roundtable: Guy Lightfoot

Specifications of ABR systems:
NO SNR capability, weighted addition, limited sensitivity/rejection, no
Autostop, hard to differentiate superimposed waveforms
Provide input to manufacturers about desirable features, and review
systems and publish comparative data tables
Chirps, connectors
For threshold estimation
Air/bone
Research to support the specifications
ASSR
Calibration
Baysian averaging

Roundtable- AEP Clinical Applications: Jay Hall

History of AEPs
Some used clinically, some not
Need an evidence base for the clinical utility of approach
Good clinical equipment, standards, billing codes,
AEPs: Bone Conduction ABR/ASSR: Susan Small
ASSR: Objective Measures HA fitting: Jose Barajas de Prat
Toneburst ABRs/CAEPs/MMN/P3 and Clinical Research- long time delay, APD: Suzanne Purdy

Advanced Bionics

Mike Sundler, David Decker, Filiep Vanpoucke,

Some discussion about technology driving improvements in human performance, and the future
Current steering, spanning in CI pts, neural response imaging, selectivity, Volume conduction model to drive electrode stimulation, multipole stimulation, new pulse parameters, objective measures, electrical field imaging

Cochlear Symposium

Frank Koall, Jochen Nicolai, Ralf Greisiger, George Tavarkilaze, Ulrich Hoppe

Measurement protocols Z, ECAP, EABR
Relationship between ECAP and ABR, spread of excitation, electrode foldover- risks and identification
Postoperative NRT studies estimate gain and upper level for each electrode from T-NRT and C-NRT, excitation summation, spread of excitation
Telemetry for Research: Nucleus implant communicator
CAEP/psychoacoustics, responses to speech frequency, reduce artifact, perceptual distance

Countries represented by presenters (24)

Australia
Belgium
Brazil
Canada
Cuba
Denmark
Egypt
Georgia
Germany
Iran
Israel
Japan
Korea
Lebanon
Malaysia
New Zealand
Norway
Poland
Russia
Slovenia
The Netherlands
Ukraine
United Kingdom
United States

Response Measures:

ABR, including Stacked ABR, CHAMP
(acoustic reflexes)
(Acoustics)
ASSR/EFR
CAEP
(CT)
eCAP
EcochG (AP, CM, SP)
FFR
(fMRI)
MLR
MMN
(MRI)
OAEs (DPOAEs/TEOAEs)
P3/P300
(audiometrics, speech perception in noise)
VEMP (cVEMP/oVEMP)
(Vestibular function)

Subjects

Those w/ auditory processing/ language disorders

Auditory Neuropathy pts
Cochlear implantees
Hearing Impaired
Meniere's Disease pts
Normal Hearing
Newborns: premies, neonates, infants
Older adults
Vestibular schwannoma pts (Neurovascular conflict)
Young adults
Children with PKU
Migraineurs
Tinnitus pts
Aphasic adults

Chinchillas
Gerbils
Guinea pigs
Mice

Stimuli:

Air/bone/electrical
AM signals (noise, SAM, including multiple SAM stimuli)
Noise (signals in noise, tonebursts in noise, speech-weighted noise, speech-enveloped noise, babble, NBN, noisebursts, White, Bob)
Binaural tones (binaural beats)
Chirps
Clicks
Electrical stimuli
Gap stimuli
MLS (and other sequences used for deconvolution)
Multimodal: Speech in noise, plus visual
Speech: Syllables (in quiet and in noise), Vowels, Sentences
Emotional words, stress
Tonebursts (including paired TBs, oddball paradigm)

Some more details, by AEP

EcochG

ECAP in CI: variability due to e.g. age of deafness/implantation, time post activation, electrode
spread of excitation for virtual channels-steering the electrical field, spread of excitation using NRT: perimodiolar electrodes less spread of excitation than lateral electrodes, noise estimation, pulse shifting/shape,

CM (and ABR) threshold in children (NH, HL, AN/AD), OAEs

OAEs

TEOAEs- time/frequency analyses and waveform envelope (window) asymmetry- Gabor and enhanced tone analyses and relationship of analysis approach and presence of SOAEs

Fine structure of TEOAE comprised of smaller number of components that FFT bins- based again on the assumption of response asymmetry

Maturation of DPOAEs in term/preterm infants

OAE and EcochG in pts w/hydrops, and migraine pts

OAE/ABR – in infants who failed newborn hearing screening

ABR

Clinical applications of EABR in CI users

Frequency specificity is not place specificity,
Acoustics (chirps), standard masking techniques, ASSR/ABR

Introduction of a non-linear MLS approach-increases amplitude

Comparison of click/TB/stacked ABR for retrocochlear diagnosis

ABR in children w/ PKU- those w/ diet controlled and not

To speech- in those w/ SLI/APD

ABR simulator to train students

Threshold change over first year of life (NICU, failed screening)

ABR II

Chirps, cochlear dispersion, level effects, upward spread of masking, in MD, chirps vs derived bands, CHAMP, Meniere's vs hydrops

ABR and acoustic neuroma

Algorithms to remove EMG 'artifacts'

ABR/OAE/ HF audiometry in migraine pts

ABR/ASSR chirp rate and detection time

ASSR/EFR

ASSR in CI patients: pre/post surgery, rel to behav thr, Processing/detection strategies- deal w/ stimulus artifacts

ABR/ASSR comparison with a variety of audiometric configurations- similar accuracy for both approaches- ASSR took less time, ASSR and dead regions

ASSR – nearfield/farfield in chinchillas, effects of multiple stimuli

EFR- natural speech, optimal response-detection approaches, chirps in term/preterm infants

ASSR- very low to high MFs, Dyslexia- temp proc def (controls), sleep hemispheric asymmetry

Multiple ASSR automated screening air/bone

MLR

In kids w/ PKU

CAEP

Intracortical telemetry using the extracortical electrodes in CI pts CAEPs/speech perception early in rehab process-plasticity, acoustic change complex, CAEPs/CI/Speech stimuli-stim artifact Speech prosody (noise) in CI pts CAEP (PEPS-C, sp in noise)

CAEP and binaural beats- create a ‘central toneburst’ and alternate phase mid-sweep. Use response subtraction to create a transient response

CAEPs/Deconvolution/fast rates- alternating stimulus mode reduced adaptation

CAEPs/Aging: stim level and noise- neural synchrony? Data trends:N1 latency in quiet longer in older subjects at lower levels, noise increased N1 and P2 latency more in older adults. Older adults larger N1-P2 in quiet, but not in noise

CAEP II

CAEPs to RW floating mass transducer, Type of signal and nose affects CAEP- continuous noise more effective masker than noiseburst, temporal processing w/ Aging and CAEPs, sources of error in multichannel CAEP recordings

CAEP: Speech perception-CAEP to speech vs tones in infants, speech detection in infants, Auditory/visual interaction in speech in noise in school-aged kids

CAEP to emotional words in aphasic subjects: amplitudes decreased in aphasic group to neutral terms, not emotional words. Trained with emotional words- both emotional words and neutral terms (electrode dependent)

VOT in quiet and in noise, consonant position, initial, medial, vowel alone, scalp distribution/source localization; N100 dominated by responses to the vowel: Discrimination versus detection

Spatial release from masking- head related transfer functions (CAEP and FFR)

CAEP III

Decision strategy for searching for CAEP threshold
Use of CAEP (and ABR) with BAHA

CAEP- in kids w/ ANAD

ERPs

P300 SNR time post implantation- P3 reflects listening effort

MMN –in CI pts w/ good and poor speech performance- source localization using min-norm, MMN correlated w/ working memory
Good performers larger left prefrontal activity for easy condition, More late activity in good performers

P300/MMN/behavioral- speech and non-speech stimuli: acoustic vs phonetic cues

Non-AEPs

Acoustics/Instrumentation/perceptual
Acoustic calibration of transients/feature of AEP instruments, perceptual, including audiometrics

EEG
Reaction time and Gamma band coherence- auditory/visual integration, redundant signals effect (attention)- get rid of post-auricular response- parse out single modality responses from bimodal responses- polysensory pathways

Imaging
Active frequency discrimination using simultaneous ERPs and fMRI- good time and spatial resolution when combined, CT of Temp bone/ MRI of 8^{th} n size (& AEPs) in children (good/poor performers with AN/AD w/ implants)

Vestibular Studies

VEMPs:

Spectrum of cVEMP/oVEMP
Steady state VEMP
Manipulating muscle contraction magnitude and the cVEMP

Other
Vestibular changes in CI

Emphases:

New Zealand/Australia

Suzanne Purdy/Harvey Dillon

CAEPs

Cochlear implant pts

Speech Stimuli

ABR-chirps

The Future of AEPs?

But first, the last 30 years:

When I first was involved in AEPs- in the later 1970s:

ABR being studied intensively: animals, humans: normals, infants, those with peripheral/central lesions, hearing impaired

No universal newborn hearing screening
No MRI, fMRI, PET

AEP instruments just a few channels, and mostly Nicolet products

No ASSR, No OAEs

No true multichannel EP systems, no source localization software

Many countries now have newborn hearing screening programs
Now focus on what we do post-screening- with a focus on threshold estimation (and hence the roundtable discussion here), and on habilitation (hearing aids, cochlear implants etc)

In some cases, site of lesion testing now uses imaging modalities. Stacked ABR, CHAMP have been developed for niche applications.

Imaging have replaced AEPs for some site of lesion uses. However. some disorders (e.g., ANAD, CAPD, MS, Meniere's disease) do not necessarily reveal structural lesions, and AEPs (and other sensory modalities) will remain critical for diagnosis and understanding of these disorders

Functional imaging does have good spatial resolution, but temporal resolution remains poor. Source localization procedures have multiple solutions, and often constraints placed on the models are arbitrary. Co-localization using, e.g., fMRI and multichannel AEPs are promising, but lots of work is left to be done, including controlling for artifacts.

For some AEPs (perhaps especially the ABR) we have had reasonable success in using for site of lesion, but we have not really been successful in developing a nosology of these results, to separate out e.g., a space occupying tumor, from MS

Need a true measure of neural synchrony- this important for AN/AD, CAPD,site of lesion testing, and the effects of learning disability/disorders and learning/plasticity on AEPs

Unimodal study of the auditory system overlooks the many sensory interactions known from basic auditory neuroscience studies, and from behavioral observations. We must parse out attentional issues from true sensory interactions in our EP studies.

We need to look at true vestibular evoked potentials in humans. cVEMP and oVEMP are helping us with site of lesion work in audiology, but true sensory VsEPs (as in the work of Tim and Sherri Jones in birds and rodents) needs to be expanded to human studies, so we can isolate the sensory aspect of the response.

We must remain vigilant in developing the required evidence base for our various AEP measures before commercializing these products. It is important that we understand the underlying response measures, how they affected by various pathologies, their strengths and their limitations before going to market with them.

We now wear multiple professional hats

Manny Don, Einar Laukli and Roger Thornton

IERASG Scientific/social, multinational, young/old.

Spasiba