PROGRAM

of the

One Hundred Twenty-Sixth Annual Meeting

AMERICAN
OTOLOGICAL SOCIETY, INC.

APRIL 17 - 18
1993

CENTURY PLAZA HOTEL AND TOWER
Los Angeles, California

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JULY 1992 - JUNE 1993

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The American Otological Society is accredited by the Accreditation Council for Continuing Medical Education to sponsor continuing medical education for physicians.

This Continuing Medical Education offering meets the criteria for eight (8) credit hours in Category One (1) of the Physician's Recognition Award of the American Medical Association.

SATURDAY, APRIL 17, 1993

REGISTRATION - 7:00 a.m.

BUSINESS MEETING - 7:00 a.m.
ROOM: The Beverly Hills Room (Restricted to Members)

Minutes of the Previous Annual Meeting

Introduction of New Members

Election of Nominating Committee

Report of the Secretary/Treasurer

Report of Editor/Librarian

SCIENTIFIC PROGRAM - 7:30 a.m.
ROOM: The Beverly Hills Room (Open to Non-Members)

Remarks by the President
Mansfield F. W. Smith, M.D.

Remarks by the Guest of Honor
D. Thane R. Cody, M.D.

Presidential Citation
Helen H. Potter
"Pioneer in Oral Education of the Hearing Impaired"

1. 8:00 a.m. ON GENETIC AND ENVIRONMENTAL FACTORS IN MENIERE'S DISEASE
Mr. Andrew W. Morrison*
Professor James Mowbray
(by invitation)
Professor Robert Williamson
(by invitation)

2. 8:10 a.m. EVALUATION OF TORSIONAL EYE RESPONSES IN DIAGNOSIS OF VESTIBULAR DISORDERS
Walter H. Johnson, Ph.D., F.C.A.S.I.*
Henry G. Kitts *(by invitation)*
J. Wadia, B.Sc. *(by invitation)*
Michael Thornton, B.A.Sc.
(by invitation)

***Speaker**

3. 8:20 a.m. AN ANIMAL MODEL OF TINNITUS: A DECADE OF DEVELOPMENT
P. J. Jastreboff, Ph.D.* *(by invitation)*
Clarence T. Sasaki, M.D.

4. 8:30 a.m. ASSESSMENT OF THE STATUS OF THE PERIPHERAL AUDITORY SYSTEM IN INFANTS AND CHILDREN USING EVOKED OTOACOUSTIC EMISSIONS
Susan J. Norton, Ph.D.* *(by invitation)*

5. 8:40 a.m. THE EFFECT OF PERILYMPHATIC FISTULAE ON DISTORTION PRODUCT EMISSIONS IN THE GUINEA PIG
John Kokesh, M.D.* *(by invitation)*
Susan Norton, Ph.D. *(by invitation*
Larry Duckert, M.D., Ph.D.

6. 8:50 a.m. DISTORTION PRODUCT OTOACOUSTIC EMISSIONS IN THE ELDERLY AND IN PATIENTS WITH SENILE DEMENTIA OF THE ALZHEIMER'S TYPE
Philip Garcia, M.D.* *(by invitation)*
Judy Peterein, MS-CCA *(by invitation)*
Roanne K. Karzon, Ph.D. *(by invitation)*
George A. Gates, M.D.

9:00 a.m. DISCUSSION

9:10 a.m.

ADVANCED VESTIBULAR TESTING AND REHABILITATION
DO THEY MAKE A DIFFERENCE?
PANEL
Moderator - John R. E. Dickens, M.D.
Panelists
David Cyr, Ph.D. *(by invitation)*
Susan Herdman, Ph.D. *(by invitation)*
Charles Luetje, M.D.
Steven A. Telian, M.D. *(by invitation)*
Robert Jackler, M.D.

***Speaker**

10:00 a.m. DISCUSSION

10:10 a.m. INTERMISSION

7. 10:30 a.m. EPINEPHRINE INDUCED CHANGES IN HUMAN COCHLEAR BLOOD FLOW
Josef M. Miller, Ph.D.*
Esa A. Laurikainen, M.D., Ph.D. *(by invitation)*
Reidar Grenman, M.D., Ph.D. *(by invitation)*
Jouko Suonpaa, M.D., Ph.D. *(by invitation)*
Goran Bredberg, M.D., Ph.D. *(by invitation)*

8. 10:40 a.m. CELL DIVISION IN THE GERBIL COCHLEA AFTER ACOUSTIC OVERSTIMULATION
David W. Roberson, M.D.* *(by invitation)*
Edwin W Rubel, Ph.D.

9. 10:50 a.m. CHANGES IN THE CENTRAL AUDITORY PATHWAY IN DEAFNESS
Jean K. Moore, Ph.D.* *(by invitation)*
John K. Niparko, M.D. *(by invitation)*
Fred H. Linthicum, M.D.

10. 11:00 a.m. REPAIR OF CHRONIC TYMPANIC MEMBRANE PERFORATIONS WITH EPIDERMAL GROWTH FACTOR
Robert K. Jackler, M.D.*
Alice J. Lee, B.A. *(by invitation)*
Ninetta M. Scott, B.A. *(by invitation)*
C. Philip Amoils, M.D. *(by invitation)*
Maya Cato, B.A. *(by invitation)*

***Speaker**

11. 11:10 a.m. FUNCTIONAL LOCALIZATION IN EUSTACHIAN TUBE: A HYPOTHESIS
Isamu Sando, M.D., D.M.S.*
Haruo Takahashi, M.D. *(by invitation)*
Shoji Matsune, M.D., D.M.S.
(by invitation)
Hajime Aoki, M.D., D.M.S.
(by invitation)

12. 11:20 a.m. NEW KNOWLEDGE ABOUT THE FUNCTION OF THE HUMAN MIDDLE EAR
Richard L. Goode, M.D.*
Mead Killion, Ph.D. *(by invitation)*

11:30 a.m. DISCUSSION

13. 11:40 a.m. OTOLOGIC ASPECTS OF THE ACOUSTIC ENVIRONMENT IN RESTAURANTS
Charles P. Lebo, M.D.* *(by invitation)*
Ellen R. Mosher, M.S. *(by invitation)*
Susan Jelonek, M.B.A. *(by invitation)*
David R. Schwind, B.S.E. *(by invitation)*
Karen Decker, B.A.E. *(by invitation)*
Harlan Krusemark, B.S. *(by invitation)*
Pamela Kurz, B. Arch. *(by invitation)*

14. 11:50 a.m. TEST FITTING AN IMPLANTABLE HEARING AID ON 3D CT SCAN RECONSTRUCTIONS OF THE TEMPORAL BONE
Greg Esselman, B.S.* *(by invitation)*
Jim Coticchia, M.D.* *(by invitation)*
Michael Vannier, M.D. *(by invitation)*
Gail J. Neely, M.D.
John M. Fredrickson, M.D.

15. 12:00 p.m. CLINICAL APPLICATIONS FOR MULTIPLE FREQUENCY TYMPANOMETRY
David J. Lilly, Ph.D. *(by invitation)*
F. Owen Black, M.D., F.A.C.S.*

***Speaker**

16. 12:10 p.m. MYCOBACTERIUM CHELONAE OTORRHEA
Daniel J. Franklin, M.D.*
Michael G. Stewart, M.D.
(by invitation)
Richard J. Wallace, Jr., M.D.
(by invitation)
Jeffrey R. Starke, M.D. *(by invitation)*

17. 12:20 p.m. FLOW CYTOMETRIC STUDY OF ACOUSTIC NEUROMAS: CORRELATION WITH CLINICAL FINDING
Donald W. Goin, M.D.*
Sheila E. Ryan, M.D. *(by invitation)*
Eleanor B. Sinton, M.D. *(by invitation)*
David C. Kelsall, M.D. *(by invitation)*

12:30 p.m. DISCUSSION

12:40 p.m. PHOTOGRAPH
(All members remain for group photo)

PRESIDENT'S RECEPTION AND DINNER DANCE
Reception 6:30 p.m. - Room: Century Ball Room II
Banquet 7:30 p.m. - Room: Century Ball Room I

For Members, Officially Invited Guests,
their Ladies or Escorts
- Black Tie -

SUNDAY, APRIL 18, 1993

REGISTRATION - 7:00 a.m.

BUSINESS MEETING - 12:30 p.m.
ROOM: The Beverly Hills Room (Restricted to Members)

Report of the:

a. Board of Trustees of the Research Fund
b. American National Standards Institute
c. American Board of Otolaryngology
d. Award of Merit Committee
e. American College of Surgeons
f. American Academy of Otolaryngology-Head and Neck Surgery

***Speaker**

Report of the Audit Committee

Report of the Nominating Committee

Reading of Communications

Unfinished Business

New Business

SCIENTIFIC PROGRAM - 1:00 p.m.
ROOM: The Beverly Hills Room (Open to Non-Members)

18. 1:00 p.m. USE OF PROLIFERATING CELL NUCLEAR ANTIGEN IN THE DETERMINATION OF GROWTH RATES IN ACOUSTIC NEUROMAS
Richard J. Wiet, M.D., F.A.C.S.*
Stephen G. Ruby, M.D. *(by invitation)*
George P. Bauer, M.D. *(by invitation)*

19. 1:10 p.m. ANTIDROMIC STIMULATION OF THE GREATER SUPERFICIAL PETROSAL NERVE (GSPN) IN MIDDLE FOSSA SURGERY
Moises A. Arriaga, Major, USAF, M.D.* *(by invitation)*
Regis Haid, M.D. *(by invitation)*
David Masel, M.D. *(by invitation)*

20. 1:20 p.m. FACIAL NERVE TUMORS PRESENTING AS ACOUSTIC NEUROMAS
Sean O. McMenomey, M.D.*
(by invitation)
Michael E. Glasscock, M.D.
Lloyd B. Minor, M.D. *(by invitation)*
Barry Strasnick, M.D. *(by invitation)*
C. Gary Jackson, M.D.

***Speaker**

NOTES

21. 1:30 p.m. TRANSLABYRINTHINE APPROACH TO SKULL BASE TUMORS WITH HEARING PRESERVATION
Barry E. Hirsch, M.D., F.A.C.S.* *(by invitation)*
Stephen P. Cass, M.D. *(by invitation)*
Laligam Sekhar, M.D. *(by invitation)*
Donald C. Wright, M.D. *(by invitation)*

22. 1:40 p.m. VENOUS INFARCTION FOLLOWING TRANSLABYRINTHINE ACCESS TO THE CEREBELLOPONTINE ANGLE
John P. Leonetti, M.D.* *(by invitation)*
O. Howard Reichman, M.D. *(by invitation)*
Seth J. Silberman, M.D. *(by invitation)*

23. 1:50 p.m. EXCISION OF PETROCLIVAL TUMORS BY A TOTAL PETROSECTOMY APPROACH
Stephen P. Cass, M.D.* *(by invitation)*
Laligam N. Sekhar, M.D. *(by invitation)*
Barry E. Hirsch, M.D. *(by invitation)*
Donald C. Wright, M.D. *(by invitation)*
Shlomo Pomeranz, M.D. *(by invitation)*

2:00 p.m. DISCUSSION

2:10 p.m. INTRAOPERATIVE NEURAL MONITORING: WHEN IS IT HELPFUL, WHEN IS IT REQUIRED?
PANEL
Moderator - Robert K. Jackler, M.D.

Panelists
Derald E. Brackmann, M.D.
Barry E. Hirsch, M.D.
Jack M. Kartush, M.D.
John K. Niparko, M.D.
Samuel H. Selesnick, M.D.
Herbert Silverstein, M.D.

***Speaker**

	3:00 p.m.	DISCUSSION
	3:10 p.m.	INTERMISSION
24.	3:30 p.m.	INTRAOPERATIVE MEASURES OF THE ELECTRICALLY EVOKED COMPOUND ACTION POTENTIAL **Bruce J. Gantz, M.D., F.A.C.S.*** **Carolyn J. Brown, Ph.D.** *(by invitation)* **Paul J. Abbas, Ph.D.** *(by invitation)*
25.	3:40 p.m.	JUST NOTICEABLE DIFFERENCES FOR SYNTHESIZED SPEECH STIMULI IN COCHLEAR IMPLANT RECIPIENTS **Alan G. Micco, M.D.*** *(by invitation)* **Tom Carrell, Ph.D.** *(by invitation)* **Nina Kraus, Ph.D.** *(by invitation)* **Dawn B. Koch, Ph.D.** *(by invitation)* **Anu Sharma, M.A.** *(by invitation)* **Richard J. Wiet, M.D.**
26.	3:50 p.m.	COCHLEAR IMPLANT RELATED OSTEONEOGENESIS IN AN ANIMAL MODEL: FLUORESCENT LABELS **James E. Saunders, M.D.*** *(by invitation)* **David W. Molter, M.D.** *(by invitation)* **John T. McElveen, Jr., M.D.** *(by invitation)*
27.	4:00 p.m.	ACOUSTIC REFLEX DECAY IN MULTI-CHANNEL COCHLEAR IMPLANT PATIENTS **Tracey G. Wellendorf, M.D.*** *(by invitation)* **Harold C. Pillsbury, M.D.** **Joseph W. Hall, Ph.D.** *(by invitation)* **John H. Grose, Ph.D.** *(by invitation)* **Tambrey Oettinger, M.Ed.** *(by invitation)*

***Speaker**

28. 4:10 p.m. AN UPDATE OF REPARATIVE GRANULOMA: A SURVEY OF THE AMERICAN OTOLOGICAL SOCIETY AND THE AMERICAN NEUROTOLOGICAL SOCIETY
Michael A. Seicshnaydre, M.D.*
(by invitation)
Aristides Sismanis, M.D., F.A.C.S.
Gordon B. Hughes, M.D., F.A.C.S.

29. 4:20 p.m. FATE OF ALCOHOL PRESERVED HOMOGRAFT OSSICLES
Roger E. Wehrs, M.D.*

4:30 p.m. DISCUSSION

30. 4:40 p.m. ROLE OF AUTOIMMUNITY IN CONTRALATERAL DELAYED ENDOLYMPHATIC HYDROPS
Jeffery P. Harris, M.D., Ph.D.*
David Aframian, M.D. *(by invitation)*

31. 4:50 p.m. NEUROTOLOGIC MANIFESTATIONS OF HIV INFECTION – IMMUNOHISTOCHEMICAL AND EM STUDY
Dennis G. Pappas, Jr., M.D.*
H. K. Chandra Sekhar, M.D.
(by invitation)
Dean E. Hillman, Ph.D. *(by invitation)*
Jin Lim, B.S. *(by invitation)*

5:00 p.m. Installation of New President:
Robert I. Kohut, M.D.

5:10 p.m. ADJOURNMENT

***Speaker**

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ABSTRACTS

of the

ONE HUNDRED TWENTY-SIXTH
ANNUAL MEETING

AMERICAN OTOLOGICAL SOCIETY, INC.

APRIL 17 - 18
1993

CENTURY PLAZA HOTEL & TOWER
LOS ANGELES, CALIFORNIA

ON GENETIC AND ENVIRONMENTAL FACTORS IN MENIERE'S DISEASE

Andrew W. Morrison, Prof. James Mowbray, Prof. Robert Williamson

An association between Meniere's disease (MD) and one of the HLA-C genotypes has been identified. The present research is a progression from association to linkage study in families with more than one living member affected by unequivocal Meniere's disease. The first stage, the identification of a sufficient number of such families, the confirmation of the diagnosis and the collection of blood samples is progressing well. The second stage, the HLA typing within the families, concentrating initially on affected members is producing interesting results.

We have also shown an association between active phases of MD and the presence of circulating immune complexes, and of group specific protein of enteroviruses, VP1, in the serum, bound largely to the IGM antibody identified in the complexes. This investigation continues to confirm these results in cases of MD compared with control. The family studies include these searches since there may be variants of MD where a different genetic background predisposes to viral damage. C6 may be the site of a gene region involved in susceptibility to the disease.

To test the hypothesis that there maybe a genetic predisposition to MD, which may interact with other factors eg environmental such as viruses or immunogen, DNA samples from our family members will be studied with suitable probes or DNA markers utilizing clinical clues to study candidate regions of the human genome. The project will then be assessed prior to the final stage, the total genome search.

Objectives:

1. To ascertain families with more than one member suffering from Meniere's disease.

2. To identify a possible genetic predisposition to Meniere's disease.

3. To identify possible environmental triggers.

EVALUATION OF TORSIONAL EYE RESPONSES IN DIAGNOSIS OF VESTIBULAR DISORDERS

Walter H. Johnson, Ph.D., F.C.A.S.I., Henry G. Kitts,
J. Wadia, B.Sc., Michael Thornton, B.A.Sc.

A technique has been developed which involves measurement of eye torsion in response to body tilt at a rate which is sub-threshold for semicircular canal stimulation but which activates (by change in body position relative to the gravity vector) responses specifically involving the otolith receptors of the Inner Ear. Resulting counter-rolling compensatory responses can be accurately measured and the results compared from different directions of body tilt. Measurement of the degree of eye torsion responses is accomplished by the use of miniature video cameras coupled to a T.V. monitor and associated computer digitizing equipment which produces a print-out in analogue form of the patient's responses. It is emphasized that the procedure involves the recording of each eye separately and simultaneously thus facilitating the determination of possible CNS involvement as compared to the responses of patients with peripheral lesions. The average range of normal healthy responses can be superimposed on the patient's responses to facilitate a pictorial comparison.

The presentation will include a brief review of the status of our knowledge concerning the related physiology of otolith function.

AN ANIMAL MODEL OF TINNITUS: A DECADE OF DEVELOPMENT.

Pawel J. Jastreboff, Ph.D. and Clarence T. Sasaki, M.D.

Although tinnitus affects approximately 9 million people in the U.S.A., a cure remains elusive and the mechanisms of its origin are still speculative. The crucial obstacle in tinnitus research has been the lack of an animal model, thus limiting investigations to human subjects with all apparent restrictions. Creating an animal model of tinnitus seemed to be impossible since tinnitus, being an auditory phantom perception, does not have any measurable physical correlate. Over the last decade we have been creating an animal model of tinnitus by combining a variety of methodologies including a behavioral component to allow for the detection of tinnitus perception.

The development of a model had been started using 2-deoxyglucose to map changes in the metabolic activity of the auditory pathways as a function of time after unilateral destruction of cochlea, the surgical procedure which induces tinnitus in humans in about 50% of cases. It has been found that after seven days the initial decrease of the metabolic rate in the cochlear nucleus and the inferior colliculus, corresponding to the side of the lesion, recovered to preoperative values. Such a restoration of the metabolism could be due to the development of tinnitus.

Spontaneous activity of single units recorded from the inferior colliculus before and after salicylate administration was investigated to reveal possible changes in neuronal activity related to tinnitus. Salicylate administration resulted in an increase of the most probable frequency of discharges of units recorded from the inferior colliculus. The observation that salicylate was without effect for units recorded from the cerebellum argued against the explanation of the results as reflecting nonspecific to auditory system action of the drug. The observation was, however, consistent with the interpretation that the results reflect the presence of salicylate-induced tinnitus. Furthermore, the data suggested the emergence of abnormal temporal patterns of neuronal activity. Our recent data have confirmed and further elaborated this observation, indicating involvement of extralemniscal pathways and certain subclasses of units in tinnitus.

Although both 2-deoxyglucose and single unit recordings indicated the possibility of tinnitus presence in animals, the final proof could only be achieved by evaluating modifications of animal behavior presumably induced by tinnitus. We developed a behavioral model based on the conditioned suppression paradigm and tested it extensively. The basic idea was to create a situation in which any kind of auditory signal is associated with safety, whereas silence would indicate danger and induce fear, which could also be measured. Inducing tinnitus in rats that were trained to be afraid of silence provided them with a safety signal and facilitated the extinction process of the trained fear of silence. Further refining of this basic paradigm allowed us to measure tinnitus pitch and loudness. Every experimental manipulation aimed at inducing tinnitus or its alleviation is first evaluated in the behavioral paradigm to determine if tinnitus is present and if it changes due to experimental manipulation. The model is presently used for investigating the hypotheses for the mechanisms of tinnitus, including the involvement of calcium homeostasis, the role of calcium channels and the possibility of utilizing calcium channel modulators in dealing with tinnitus. Presently we are expanding the model to include immunocytochemistry and patch clamp recordings.

OBJECTIVES:

1. An objective animal model of tinnitus has been developed. This model includes the evaluation of: i) perception of pharmacologically-induced tinnitus in rats, including its pitch and loudness; ii) tinnitus-related electrical activity of single neurons in the auditory pathway; iii) potentials, micromechanics, and ion homeostasis of the cochlea.
2. Electrophysiological recordings performed under conditions in which animals exhibited behavioral manifestation of tinnitus revealed the presence of abnormal, epileptic-like activity at the level of inferior colliculus.
3. This model is presently used to evaluate the effectiveness of potential treatments as well as to investigate the mechanisms of tinnitus: Specifically, the involvement of cochlear calcium homeostasis, classes of neurotransmitters, and the central processing of the tinnitus signal in tinnitus perception.

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ASSESSMENT OF THE STATUS OF THE PERIPHERAL AUDITORY SYSTEM IN INFANTS AND CHILDREN USING EVOKED OTOACOUSTIC EMISSIONS

Susan J.Norton, Ph.D.

Evoked otoacoustic emissions (EOAE) represent energy generated within the cochlea during or following presentation of an external acoustic stimulus. Because they can be measured in the external ear canal EOAE are a powerful non-invasive tool for assessing cochlear status. Other advantages of EOAE are (1) they are frequency-specific; (2) they can be recorded across a broad range of frequencies (e.g. at least 500-6000 Hz); and (3) they are pre-neural. In a study of children 4 to 13 years of age (mean age 7.4 years) we found a systematic relationship between EOAE amplitude and pure tone average (PTA). EOAE amplitude decreased as PTA increased. In ears with a PTA ≥ 40 dB HL EOAE were generally not observed. Using decision criteria based on signal detection theory we found that click- and tone-burst evoked emission amplitude predicted PTA ≥ 30 dB HL with 95-100% accuracy. These results in children can be extended to infants. Normal-hearing infants have very robust EOAE. We have found the EOAE can be used to (1) screen for hearing loss in neonates; and (2) when combined with auditory brainstem responses (ABR) can help separate peripheral and central auditory pathology in neurologically compromised infants.

Objectives:

1. The practitioner should be familiar with evoked otoacoustic emissions as a tool for screening for hearing impairment in infants.

2. The practitioner should be familiar with the relationship between EOAEs and ABR in infants.

3. The practitioner should be familiar with the concept of universal neonatal screening for hearing impairment using EOAEs.

THE EFFECT OF PERILYMPHATIC FISTULAE ON DISTORTION PRODUCT EMISSIONS IN THE GUINEA PIG

John Kokesh, M.D., Susan Norton, Ph.D.,
Larry Duckert, M.D., Ph.D.

Unilateral round window perilymphatic fistulae were surgically created in 20 guinea pigs. Distortion product otoacoustic emissions at 2f1-f2 were recorded prior to and immediately following laceration of the round window. The stimuli were two equal level pure tones, f1 and f2 ($f1 < f2$), ranging from 20 dB to 80 dB SPL. f2 frequencies ranged from 2,000 Hz to 10,000 Hz with a fixed f2/f1 ratio of 1.25. Animals with opened bullae but without fistulae served as controls. Immediately after an acute fistula there was a statistically significant reduction in emission amplitude across all stimulus levels in the experimental ears compared to the controls ($p < 0.05$). This is in contrast to pathologies such as hydrops or ototoxic drug administration which effect emissions in response to low-to-moderate level stimuli, but not to high-level stimuli. After an 18 day survival period emission measurements were repeated, and fluorescein was infused into the cochlea to verify patency or healing of the fistula. Nine animals demonstrated patent fistulae while eleven healed their fistulae. At 18-days emission amplitudes in animals with healed fistulae could not be differentiated from controls while emission amplitudes in animals with patent fistulae were statistically different from controls ($p < 0.05$). The results suggest that otoacoustic emissions may be useful in detecting perilymphatic fistulae and in monitoring their healing.

DISTORTION PRODUCT OTOACOUSTIC EMISSIONS IN THE ELDERLY AND IN PATIENTS WITH SENILE DEMENTIA OF THE ALZHEIMER'S TYPE.

Philip Garcia, M.D., Judy Peterein, MS-CCA,
Roanne K. Karzon, Ph.D., George A. Gates, M.D.

Prior studies have indicated that elderly patients with senile dementia of the Alzheimer's type (SDAT) have poorer behavior pure-tone thresholds than would be expected by age alone. To investigate whether hearing loss, as opposed to poor performance on auditory tasks, is part of the SDAT syndrome we studied a group of patients with early SDAT by subjective (behavioral) and objective audiometry (auditory brainstem responses (ABR) and distortion product otoacoustic emissions (DPOE)). DPOE provide an objective assessment of peripheral cochlear function through the generation of a cochlear emission in response to stimulation of the cochlea by two tones. The healthy cochlea produces an acoustic response in proportion to the stimulus intensity at a frequency that is closely related to the frequencies of the test tones (2f1-f2). By varying the frequency and intensity of the input stimuli, a DPOE map of cochlear function may be obtained. Interpretation of the results of DPOE audiometry are still under study.

Pure-tone audiometric thresholds, DPOE, selective ABR, and measures of central auditory function (SSI-CCM, SSI-ICM) were prospectively measured in 77 elderly adults (mean age 77 years), including 42 patients with a Clinical Dementia Rating (CDR) of 0.5 or 1.0 (indicating early SDAT). Ten normal hearing adults (age 18-29) served as normal controls. The data were collected with the audiologist and investigators blinded to the CDR status of the subjects.

The magnitude of DPOE at 75 dB SPL and I/O detection thresholds at 1, 2, 3, and 4 kHz were examined as a function of CDR and severity of hearing loss. The DPOE varied significantly with the pure-tone thresholds, but there were no significant differences were found as a function of CDR score.

DPOE are useful adjuncts for assessment of peripheral hearing loss in the elderly and in patients unable to respond objectively. We conclude that patients with early SDAT do not exhibit hearing loss to any greater extent than age matched controls. Based on these subjects it does not appear that involvement of the auditory system is an early sign of SDAT.

Objectives:

1. To examine and assess the clinical utility of distortion product otoacoustic emissions in the elderly and compare them in patients with SDAT.

2. To evaluate and compare audiometric tests in the elderly and inpatients with SDAT.

EPINEPHRINE INDUCED CHANGES IN HUMAN COCHLEAR BLOOD FLOW

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Reidar Grenman, M.D., Ph.D., Jouko Suonpaa, M.D., Ph.D.,
Goran Bredberg, M.D. Ph.D.

Recently it has been reported that human cochlear blood flow (CBF) can be measured noninvasively via a laser Doppler flowmeter (LDF). Increases in CBF were reported in anesthetized and non-anesthetized human volunteers with electrical stimulation applied to the round window (RW) at levels comparable to those used in cochlear in prostheses. Little or no change was reported with CO2 respiration. In anesthetized subjects, marked CBF increases were found with warm water irrigation of the ear canal. The current study extends these findings on human CBF by investigating the effect of topical sympathetic drugs. Patients of this study were operated upon for the condition of excessive salivation by sectioning the tympanic plexus through a middle ear approach. During this procedure CBF was monitored over the stria vascularis of the basal turn of the cochlea using the needle probe of a Perimed Laser Doppler Flowmeter. To facilitate the operative procedure the surgery was carried out under hypotensive anesthesia, and at the termination of the surgery, blood pressure (BP) was normalized by the means of systemic administration of epinephrine. This procedure results in a transient overshoot in blood pressure during epinephrine infusion. Furthermore, occasional bleeding in the middle ear was controlled by topical application of epinephrine 1:1000. The drug was also applied directly to the RW to examine its effect on CBF.

Systemic epinephrine caused a 40-77 mmHg (± 70%) increase in the mean BP. The initial BP increase was associated with a small 14 ± 5% (M±SD) initial increase in skin blood flow (SBF) and CBF (beta effect). This was followed by a marked reduction in SBF (48±26%)(alpha effect) and further increase in CBF (52±21%). The 1:1000 epinephrine applied to the RW resulted in a consistent dramatic decrease in CBF (61±31%) below the resting baseline value while BP and SBF were unaffected. CBF began a slow recovery after 2 minutes. At this time the drug was removed the RW and CBF recovered to predrug baseline over 9-14 minutes. These changes in CBF were larger than those observed in guinea pigs with comparable manipulations, suggesting a relatively more pronounced importance of adrenergic control of cochlear blood flow in humans than in rodents. We note that these changes with topical epinephrine application utilized the same concentration as that routinely used in middle ear surgery. Such changes, if prolonged, could account for the occasional unexplained sensory neural hearing loss or tinnitus associated with some middle ear procedures. This may be a particular concern in the metabolically compromised cochlea, e.g. in older patients or in patients with a prior history of noise exposure.

Objectives:

1. To evaluate the responsiveness of cochlear blood flow to transient systemic blood pressure changes and a locally applied adrenergic agent.
2. To assess the permeability of the round window membrane to a vasoactive drug which may offer a therapeutic advantage and/or demonstrate a risk to negatively affect blood flow.
3. To validate the utility of the laser Doppler to study the dynamic properties of inner ear blood flow in humans.

This work was supported in part by the Alan Gornick Tinnitus Fund.

CELL DIVISION IN THE GERBIL COCHLEA AFTER ACOUSTIC OVERSTIMULATION

David W. Roberson, M.D., Edwin W. Rubel, Ph.D.

Recent studies have shown that regeneration of cochlear hair cells occurs in avian species after acoustic and ototoxic insult. It has not been unequivocally determined whether the mammalian inner ear has similar regenerative potential. This study was undertaken to determine if hair cells or other cells of the mammalian cochlea would proliferate following acoustic trauma.

Four, 21 day old gerbil pups were subjected to an acoustic insult consisting of a two octave (1460-5650) band of white noise at 130 dB SPL for 13 hours. Beginning immediately following the noise exposure, the pups were injected intramuscularly with 0.2 mCi of tritiated thymidine every twelve hours for five days (total dose, 2.0 mCi, approximately 130 mCi/kg body weight). Twelve days after the noise exposure, the pups were over-anesthetized and their labyrinths infused with 2% paraformaldehyde and 2% glutaraldehyde fixative in 0.2 N cacodylate buffer with 10 mg/l CaCl. The animals were sacrificed and the cochleas kept in fixative overnight at 4°C. Two age-matched control pups did not undergo noise exposure but were otherwise treated similarly.

The cochleas were embedded in Polybed media (Polysciences, Warren, PA) and cut into four quadrants with two axial, mid-modiolar cuts using a jeweler's diamond saw. The cochlear faces, including the organ of Corti, were sectioned at 3 μm. Sections were placed on acid-washed, chrome-alum subbed slides, dipped in Kodak NTB2 Nuclear Track emulsion (1:1 dilution) and exposed at 4°C for periods ranging from two to twenty-eight months. The sections were developed, fixed, counterstained with toluidine blue and coverslipped with DPX.

The noise-damaged cochleas showed progressively more severe damage from apical to basal turns. In the apical turn, there was little or no visible damage; in the middle turn, there was some loss of the cellular organization of the organ of Corti; in the basal turn, there was more severe damage, extending in some cases to complete destruction of the organ of Corti and the ingrowth of a new epithelial layer on the basilar membrane.

In over 200 sections examined from the undamaged cochleas, there was no evidence of any cell division in the organ of Corti or in other cochlear structures. In over 300 sections examined from the noise-damaged cochleas, there was no evidence of hair cell regeneration, or of any cell division within the organ of Corti. Labeled nuclei were seen in several other locations in the noise-damaged cochleas. Labeled nuclei were frequently seen among the VIII nerve fibers coursing towards the modiolus; presumably these represented glial division after deafferentation. In addition, labeled nuclei were frequently seen in the cells of the stria vascularis, Reissner's membrane, the tympanic border cells and the inner sulcus supporting cells. Finally, in those sections in which the normal organ of Corti was completely obliterated there were labeled nuclei in the new epithelial layer covering the basilar membrane.

We conclude that there is a reactive gliosis and diffuse epithelial cell proliferation in the gerbil cochlea following acoustic trauma. Cell proliferation was not seen, however, within the organ of Corti proper. There was no evidence of hair cell regeneration.

OBJECTIVES:

1. To determine if hair cell regeneration occurs following acoustic trauma in a mammalian species.
2. To determine patterns of cell division in the gerbil cochlea following acoustic trauma.

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CHANGES IN THE CENTRAL AUDITORY PATHWAY IN DEAFNESS

Jean K. Moore, Ph.D., John K. Niparko, M.D.,
Fred H. Linthicum, M.D.

Postmortem brainstems obtained through the House Ear Institute donor program and collaborative donations are enabling us to evaluate changes resulting from profound hearing loss in central auditory centers. This information is relevant to estimation of the prognosis in rehabilitation of sensorineural impairment. Morphometric and immunohistochemical investigations are being carried out on the cochlear nuclei of the pontomedullary brainstem in five cases of profound deafness (chronic otitis, n=1; genetic etiologies, n=2; surgical ablation, n=2). Cumulatively, these five cases allow us to assess the influence of age of onset, duration of hearing loss and degree of ganglion cell survival on neural degeneration in the central auditory pathway.

REPAIR OF CHRONIC TYMPANIC MEMBRANE PERFORATIONS WITH EPIDERMAL GROWTH FACTOR

Robert K. Jackler, M.D., Alice J. Lee, B.A.,
Ninetta M. Scott, B.A., C. Philip Amoils, M.D., Maya Cato, B.A.

It has long been known that a few chronic tympanic membrane (TM) perforations can be induced to heal by placing a paper patch over the residual TM. The paper patch presumably acts as a scaffold for the regenerating epithelium. Unfortunately, paper patching is only suitable for small TM perforations and is successful in only a minority of cases. While current paper patch technique is of only limited value, there is reason to believe that the principle involved is sound. We have undertaken an effort to investigate novel methods of TM repair utilizing growth factors and biomembranes which might prove more conducive to epithelial regeneration. An animal model of chronic TM perforation has been developed in the chinchilla for this purpose.

Epidermal Growth Factor (EGF) is a potent mitogen for epidermal cells which has been shown to promote healing of injuries to the cornea, skin, and other tissues in both animal and human studies. In initial studies, topical applications of EGF in saline solution (25μL of 1 mg/ml concentration) were utilized in combination with a paper patch in an attempt to promote healing of chronic subtotal TM perforations. In each animal the contralateral ear served as a control, receiving a paper patch impregnated with 25μL of saline. Following 3 applications of EGF over a period of 1 week, perforation closure typically took several weeks. Complete closure of the TM perforation was achieved in 81% of treated ears and in 25% of controls ($P=0.0014$). Histological evaluation of the healed TMs showed them to have trilaminar structure which included a middle fibrous layer of nearly normal thickness.

Subsequently, dose ranging studies were undertaken which demonstrated that concentrations of 0.25, 0.5, and 1 mg/ml all possessed equivalent efficacy. Additional experiments, designed to explore simplification of the procedure, revealed that both the paper scaffold as well as rimming of the perforation's epithelial edge may be eliminated without impairing EGF's effectiveness. Closure of even large perforations has been achieved following application of EGF to a gelfoam pledget within the perforation. Remarkably, limited success has even been achieved in total perforations which lack any residual TM margin. We hope that this line of research will ultimately lead to the development of a simple and inexpensive method of closing chronic TM perforations in the outpatient setting, without the need for sophisticated equipment or specialized surgical skills. Human trials are planned in the near future.

Objectives:

1. To report on the success of epidermal growth factor in inducing chronic tympanic membrane perforations to heal in an animal model.

2. To suggest that the future of tympanic membrane reconstruction may lie in the use of mitotic growth factors which promote epithelial regeneration and synthetic biomembranes which foster epithelial growth.

FUNCTIONAL LOCALIZATION IN EUSTACHIAN TUBE: A HYPOTHESIS

Isamu Sando, M.D., D.M.S., Haruo Takahashi, M.D.,
Shoji Matsune, M.D., D.M.S., Hajime Aoki, M.D., D.M.S.

A hypothesis is presented regarding localization of the ventilatory, clearance and protective functions of the eustachian tube: the superior (roof) portion of the eustachian tube as viewed in cross-section may be mainly involved with ventilation of the middle ear, while the inferior (floor) portion is mainly involved with middle ear clearance. Factors providing a mechanical advantage to, and thus pointing to superior localization of, the ventilation function include the well-developed lateral lamina of the eustachian tube cartilage, the C-shape of the eustachian tube lumen in cross-section, and insertion of the tensor veli palatini muscle at a right angle to the tip of the lateral lamina. Dense populations of goblet cells and glands and much mucosal folding in the floor portion of the eustachian tube point to localization of the clearance function inferiorly in the tube. Factors to protect the middle ear are present in all areas of the eustachian tube in cross-section: 1) the well-developed lateral lamina and rich distribution of elastin on the luminal side of the portion of the tube between the medial and lateral lamina (hinge portion) provide a mechanical advantage in closing the roof portion of the eustachian tube, and 2) mucosal folding and Ostmann's fat tissue may help to close the floor portion of the tube. Rich distributions of mucosa-associated lymphoid tissue (MALT), glands, and goblet cells in the floor portion of the eustachian tube may also help protect the tube.

Objectives:

1. Review the major functions of the eustachian tube.
2. Present a hypothesis that identifies the structural base for these functions and their localization in the eustachian tube.
3. Review the implications of this hypothesis in our understanding of mechanical and functional factors in eustachian tube physiology.

This study was supported by research grants DC00158 and DC00123, National Institutes of Health

NEW KNOWLEDGE ABOUT THE FUNCTION OF THE HUMAN MIDDLE EAR

Richard L. Goode, M.D., Mead Killion, Ph.D.

Conventional teaching of the acoustic function of the human middle ear is that it serves as an impedance matching system to offset the loss that occurs when sound passes from the low impedance air of the external ear canal to the high impedance cochlear fluid. A transformer analogy is often used and the increase in pressure produced by the effect of the eardrum: footplate area ratio and the lever ratio is considered to be approximately 27 dB. Recent data on middle ear function has shown this teaching to be incorrect. A transformer analogy is not appropriate since the pressure gain of the human middle ear varies with frequency. At low frequencies the gain is high, approximately 40 dB. At higher frequencies, above 1000 Hz, it decreases so at 4000 Hz it is approximately 20 dB. This occurs because the eardrum is much more efficient below the 1000 Hz resonant frequency of the middle ear than above, where it rolls off at approximately 9 dB per octave. In addition, the ossicular lever system has increasing slippage with frequency in many ears and this produces an additional 3-4 dB decrease per octave. The end result is that the middle ear at 4000 Hz is approximately 20 dB less efficient than it is at 1000 Hz. This inefficiency is offset by the resonance of the external ear canal so that the hearing threshold in the 1000-4000 Hz range is relatively flat. This information is of use to the otologist since it would be expected that a middle ear prosthesis would produce a more successful result above 1000 Hz than below since the gain of the normal middle ear is greater at lower frequencies. In addition, such prosthesis would bypass the slippage already in the ossicles which would produce the high frequency improvement as compared to the lower frequencies.

Objective:

1. This paper will discuss modern middle ear physiology with emphasis on how this information can help the practicing otologist.

OTOLOGIC ASPECTS OF THE ACOUSTIC ENVIRONMENT IN RESTAURANTS

Charles P. Lebo, M.D., Ellen R. Mosher, M.S., Susan Jelonek, M.B.A., David R. Schwind, B.S., Karen Decker, B.A., Harlan Krusemark, B.S., Pamela Kurz, B.A.

Noise data was obtained by a multidisciplinary team (one otologist, two audiologists, two acoustical engineers and two architects) in 27 San Francisco Bay Area restaurants. The measured parameters included sound pressure levels (SPL) in dBA and dBC and averaging SPLs. This data was supplemented by digital tape recordings, subjective noise ratings, and multiple configuration hearing aid user speech discrimination scores. The latter were consistent with test scores obtained in comparable simulated environmental conditions in a sound booth.

The background noise levels in most of these establishments made optimal communication difficult for persons with normal hearing and more so for those with impaired hearing. Most of the environments measured were very unpleasant for persons afflicted with high frequency sensorineural hearing losses, which are the most prevalent hearing problem in middle-aged and senior restaurant patrons.

The results of our study suggest, in a preliminary way subject to confirmation by use of multiple subjects and by other investigators, that speech discrimination in noise in persons afflicted with high frequency sensorineural hearing losses varies with the electronic and acoustical properties of hearing aids and that the currently most common hearing aid configuration (linear ITE aids) does not significantly enhance speech discrimination (and often reduces the latter) in background noise of the types which were encountered in most of the restaurants we investigated. Notably better discrimination scores were obtained under identical conditions with nonlinear BTE aids equipped with mutlisignal processing, compression, and deep, open earmolds.

OBJECTIVES:

1. To measure a designated interior design and noise parameters in restaurants of various types.
2. To explore the extent to which hearing aid configurators mitigate the conversational problems encountered in restaurant environments by sensorineural hearing-impaired persons.
3. To produce digital tape recordings of restaurant noise for use in clinical evaluation of unaided and aided speech discrimination in noise.
4. To compare (in a preliminary manner) in-field and clinical speech discrimination scores obtained with specific hearing aid configurators.

Test Fitting an Implantable Hearing Aid on 3D CT Scan Reconstructions of the Temporal Bone

Greg Esselman, B.S., Jim Coticchia MD, Michael Vannier, M.D.,
J. Gail Neely, M.D., John M. Fredickson, M.D.

Despite detailed CT imaging techniques, visualization of 3D anatomic structures of the temporal bone is difficult. We sought to facilitate evaluation of temporal bone anatomy in candidates for an electromagnetic implantable hearing aid by utilizing new and exciting 3D CT scan reconstruction techniques to "test fit" a middle ear transducer model on high resolution 3D temporal bone images.

The hearing aid in this study is designed to mount in the mastoid region of the temporal bone and extend to the middle ear where it attaches to the incus. The device was modeled as a cone seated on a cylindrical base using NIH Image software on a Macintosh™ computer. Human temporal bone CT scans were obtained using a Siemens Somatom Plus S spiral CT scanner capable of producing slice thicknesses of less than one millimeter, with resolution of less than 0.5mm. A program was written to superimpose the 3D hearing aid model onto the CT scan slices of the temporal bone, showing the hearing aid transducer "implanted" in the temporal bone. Preliminary results have shown that current transducer dimensions are easily compatible with the dimensions of the mastoid region of the temporal bone, permitting implantation without violation of surrounding structures such as the external auditory meatus, mastoid tegmen, dura, or sigmoid sinus. Verification of these results using cadaver specimens will follow. Resulting data will be used to determine optimum orientation and size limitations for the human implantable device.

This methodology for high resolution 3D imaging of the temporal bone may have multiple clinical applications, such as improved diagnostic imaging for temporal bone fractures and conductive hearing loss, and precise preoperative assessment of optimal types and sizes of total or partial ossicular replacement prostheses.

Clinical Applications for Multiple Frequency Tympanometry

David J. Lilly, PhD and F. Owen Black

Tympanometric data obtained with a low-frequency probe tone can provide useful clinical information for patients with disorders of the tympanum, the tympanic membrane and the eustachian tube. Low-frequency, single-component tympanometry, however is relatively insensitive to many lesions that affect the middle ear and especially the ossicular chain. This study was designed to explore clinical applications for multiple-frequency and multiple-component tympanometry. A review of major theoretical underpinnings and historical antecedents will be followed by a discussion of requisite instrumentation, experimental findings, clinical applications and by patient case reports. Primary focus will be upon those common middle-ear disorders that do not always yield abnormalities or pathognomonic patterns with conventional tympanometry.

Brief case reports will include findings from patients with: 1) profound mixed hearing loss due to otosclerosis; 2) disruption of the ossicular chain with and without fibrous union; 3) congenital ossicular fixation; and 4) complications following stapes surgery. Results of this study are of special interest to otologic surgeons.

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Mycobacterium Chelonae Otorrhea

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Richard J. Wallace, Jr. M.D., Jeffrey R. Starke, M.D.

Infections with non-tuberculous mycobacteria (NTM) are being identified with increasing frequency but the otologic manifestations of NTM infection are not well defined. Mycobacterium chelonae is an ubiquitous saprophyte known to cause disease by inoculation after trauma. Though reported following open heart and breast augmentation surgery, it is not well recognized as a cause of post tympanostomy tube otorrhea. Five cases from varying geographical locations have recently been isolated. Each exhibited high grade resistance to many antibiotics, including aminoglycosides and antituberculous agents. Therapy consisted of debridement and prolonged erythromycin therapy. M. chelonae is a problematic infection requiring specific diagnosis and treatment, and should be recognized in refractory cases of tympanotomy tube otorrhea.

Flow Cytometric Study of Acoustic Neuromas: Correlation with Clinical Finding

Donald W. Goin, M.D., Sheila E. Ryan, M.D.,
Eleanor B. Sinton, M.D., David C. Kelsall, M.D.

Behavior of acoustic neuromas is difficult to forecast. With other solid tumors, flow cytometry has become an accepted method for assessing true biologic potential. Aneuploidy (abnormal DNA) is generally considered strong evidence for more aggressive neoplasia than diploid (normal) DNA content. High S-phase is accepted as a potent promotor of tumorigenesis with increased potential for aggressive behavior.

In this study, we retrospectively correlated flow cytometry in thirty-five cerebellopontine angle tumors with clinical history, audiometry, and radiographic findings. Flow studies demonstrated three distinct categories of DNA content and two distinct categories of S-phase. Combining ploidy and S-phase, we defined three groupings. Our thesis was that these groups would correlate with clinical patterns and might influence post-operative management. No such correlation was confirmed. However, high aneuploidy did correlate with multiple operations.

Use of Proliferating Cell Nuclear Antigen in the Determination of Growth Rates in Acoustic Neuromas

Richard J. Wiet, M.D., Stephen G. Ruby M.D., George P. Bauer M.D.

The growth rate of acoustic neuromas is difficult to predict clinically; however, it would be of benefit for the clinician and for patient prognostication. Laboratory studies utilizing flow cytometry and immunologic methods have been used to investigate growth rates of acoustic neuromas.

We preformed a pilot immunohistochemical study using proliferating cell nuclear antigen (PCNA) on twenty randomly selected vestibular schwannomas to compare the growth factors, determined immunohistochemically, to the clinical growth rate in this class of lesions. PCNA is an antibody against DNA polymerase delta, which is expressed in late G1 through S phase of the cell cycle. Representative five micron sections from formalin fixed, paraffin embedded tissues were stained for PCNA (Triton Biochemical) utilizing a peroxidase-antiperoxidase methodology. The representative sections were analyzed on a CAS 200 image analyzer, with the positive staining expressed as a percentage of total nuclear area.

Proliferation rate ranged from 0.00% to 8.87% with a mean of 2.54% and a median of 1.91%. Ninety-five percent of our pilot stu dy cases had a growth rate between 0% and 6.8% (2 S.D.). The advantage of using PCNA is that standard archival formalin fixed, paraffin embedded tissues may be analyzed, and that PCNA detects cells in G1 through S phase, allowing relative comparison to studies utilizing S-phase fractions, determined by flow cytometry.

We conclude that PCNA immunohistochemical analysis may potentially offer prognostic information for individual patients with vestibular schwannomas, relating to the growth potential of each tumor. Further study with an expanded patient population is planned to explore this potential.

Objectives:

1. To describe a newer molecular technique, the use of proliferating cell nuclear antigen coupled with immunohistochemical techniques, to determine cellular proliferation of vestibular schwannomas.

2. To report on the results of our pilot study utilizing this technique as applied to randomly selected vestibular schwannomas.

3. To discuss the advantages of this technique as compared to flow cytometry and Ki 67 labeling.

Antidromic Stimulation of the Greater Superficial Petrosal Nerve (GSPN) in Middle Fossa Surgery

Moises A. Arriaga, M.D., Regis Haid, M.D., David Masel, M.D.

Accurate identification of the GSPN is essential in middle fossa surgery (MF). This landmark may be obscured by fibrous bands paralleling the course of the GSPN, a prominent lesser superficial petrosal nerve and bone overlying the GSPN.

Antidromic stimulation of the GSPN with EMG facial nerve monitoring reliably maps the course of this nerve prior to drilling on the floor of the middle cranial fossa. The specific advantages of electrical confirmation of the position of the GSPN include precise identification of a middle fossa landmark, reduced dural elevation necessary for surgical orientation, and limiting dissection prior to identification of reliable landmarks.

The technique will be illustrated with case examples of the full range of middle fossa surgery including MF vestibular nerve section, MF acoustic neuroma surgery, and extended MF resection of upper brainstem and cavernous sinus lesions.

Objectives:

1. To review the use of electrical stimulation of the GSPN to confirm surgical landmarks in middle fossa surgery.

2. To discuss the application of antidromic GSPN stimulation in all three techniques for identification of the IAC in middle fossa surgery.

Facial Nerve Tumors Presenting as Acoustic Neuromas

Sean O. McMenomey, M.D., Michael E. Glasscock, M.D., Lloyd B. Minor, M.D., Barry Strasnick, M.D., C. Gary Jackson, M.D.

Facial nerve tumors can present as masses in the internal auditory canal or cerebellopontine angle and may mimic an acoustic neuroma. These tumors can occur in any segment of the nerve from the brain stem to the neuromuscular junction.

Prior to the advent of CT scanning and magnetic resonance imaging with gadolinium, facial nerve tumors were often difficult to diagnose. Even with these modalities it may be difficult to distinguish between an acoustic neuroma and a facial schwannoma preoperatively.

Particular attention to the signs and symptoms associated with facial nerve tumors (in the absence of a motor deficit) include taste disturbances, spasms, and a dry eye. These symptoms, combined with modern radiologic studies, should allow for more accurate diagnosis, patient counseling, and treatment.

We present a series of thirty-one facial nerve tumors diagnosed and treated at The Otology Group from 1975 to 1992. Of the lesions, 11 (32%) were thought to be acoustic neuromas.

Translabyrinthine Approach to Skull Base Tumors with Hearing Preservation

Barry E. Hirsch, M.D., Stephen P. Cass, M.D., Laligam Sekhar, M.D., Donald C. Wright, M.D.

The improvement in surgical techniques and experience gained in management of skull base tumors has confirmed that these lesions can be efficiently and safely excised. Patients presenting with limited preoperative deficits have challenged the surgeon to design the surgical approach so as to minimize postoperative morbidity and preserve function. At the University of Pittsburgh Medical Center, tumors of the middle fossa and clivus with extension into the posterior fossa are usually approached by a combined subtemporal, transtentorial, transpetrous approach. In patients with preoperative hearing the surgical exposure is often limited by the labyrinthine portion of the otic capsule. The technique of partial labyrinthectomy, removing the posterior and/or superior semicircular canals, maximizes exposure with preservation of hearing. Preliminary reports by Molony et al, MCElveen, and Hakuba have demonstrated hearing preservation despite sacrifice of a semicircular canal. This report details our experience with partial labyrinthectomy approach for large skull base neoplasms. The indications, benefits, techniques and hearing results of this approach are reviewed.

Venous Infarction Following Translabyrinthine Access to the Cerebellopontine Angle

John P. Leonetti, M.D., O. Howard Reichman, M.D.,
Seth J. Silberman, M.D., Gregory Gruener, M.D.

Between July of 1988 and August of 1992, 141 tumors of the cerebellopontine angle were surgically removed through a variety of transtemporal approaches. Superior petrosal sinus (SPS) resection was performed in 44 of these patients with either large tumors in the vertical dimension or contracted mastoid anatomy in an effort to enhance intradural tumor exposure and facial nerve identification.

Three patients who underwent SPS resection developed early postoperative temporoparietal venous infarction with transient expressive aphasia. The ipsilateral cavernous sinus was entered and packed during tumor dissection in all 3 cases and one patient had sacrifice of the petrosal vein.

This paper will review the cortical venous drainage as it relates to transtemporal access to the cerebellopontine angle. Three cases of postoperative venous infarction will be presented in order to emphasize the importance of the cavernous sinus collateral venous return in patients having undergone superior petrosal sinus resection.

Objectives:

1. To review intracranial venous anatomy as it relates to translabyrinthine surgery.

2. To present three cases of expressive aphasia occurring after translabyrinthine removal of acoustic neuromas with planned resection of the superior petrosal sinus and inadvertent entry of the ipsilateral cavernous sinus.

3. To discuss management of postoperative venous infarction following translabyrinthine tumor removal.

Excision of Petroclival Tumors by a Total Petrosectomy Approach

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Benign intradural petroclival tumors have the potential to be cured surgically. However, the operative resection remains challenging due to the restricted surgical exposure and anatomical relationships of the tumor to the brain stem, vertebrobasilar artery and branches and cranial nerves.

This report details the use of a total petrosectomy approach to remove 17 large and giant size petroclival tumors (meningioma, cordoma, hemangiopericytoma, paraganglioma, schwannoma, granuloma). The approach involves sacrifice of any residual hearing, complete mobilization of the facial nerve, anterior mobilization of the carotid artery and extensive drilling of the petrous apex and clivus medial to the carotid artery.

The facial nerve remained anatomically intact in 7 patients (House grade 1-3 in 6/7 patients), required grafting or resuturing in 7 patients (House grade 4-6) and was not present due to prior surgery in 3 patients. The carotid artery was preserved in 16/17 patients and resected in one patient. Six patients manifested significant postoperative complications (3 permanent hemiparesis, three transient hemiparesis, one patient died of pulmonary embolism). Total tumor resection was accomplished in 10/17 patients. Tumor residual was related to cavernous sinus involvement, vascular encasement, or brainstem invasion.

Total resection of the petrous bone is an extension of the transcochlear approach that can provide a significantly improved exposure that allows for safer removal of some otherwise "unresectable" tumors.

Intraoperative Measures of the Electrically Evoked Compound Action Potential

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Predicting cochlear implant performance prior to placement of the device continues to be problematic. Preoperative round window electrophysiologic measures and psychophysical tests have provided conflicting results. We have developed an electrophysiologic paradigm to measure the electrically evoked compound action potential (EAP) at the time of surgery. Measures of EAP amplitude and rate of growth of the response with increasing stimulus level are indicative of the number of surviving auditory nerve fibers. Measures of rate of recovery from the refractory state are an index of how accurately fine temporal information is coded at the level of the auditory nerve. We have measured EAP growth and recovery data in 12 children and 7 adults implanted with the Nucleus cochlear implant system to date. Results show a range of EAP growth and recovery rates across patients. Preliminary performance data from four children recorded at one year postimplant shows a tendency for patients with good performance on word recognition tests to have steeper EAP growth functions and faster rates of recovery from the refractory state. Additionally, preliminary data suggests patients deafened by meningitis to have somewhat shallower EAP growth functions and presumably poorer neural survival than congenitally deaf children.

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Just Noticeable Differences for Synthesized Speech Stimuli in Cochlear Implant Recipients

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Just noticeable difference (jnds) for synthesized speech stimuli were evaluated in multichannel implant recipients along three acoustic continua where a single acoustic dimension was varied. (A jnd is the smallest acoustic difference that a listener can detect.) The purpose of the experiment was to determine if the implant transmitted those acoustic dimensions and whether the implant recipient could use that information to discriminate speech stimuli. The stimuli were generated along a /ta/-/da/ continuum where voice onset time was varied systematically, a /da/-/ga/ continuum where the frequency of the second and third formats were varied, and along a /ba/-/wa/ continuum where the slope of the formats was varied systematically. Stimuli were presented through a loudspeaker at comfortable listening levels (65-70 dB SPL). A psychophysical adaptive testing procedure (PEST) was used to determine the jnd for each continuum. The data are related to other measures of speech discrimination and phonetic categorization in implant recipients and normal listeners.

Objectives:

1. To review the speech-processing capabilities of the 22-channel cochlear implant.
2. To review the basic signal acoustics fundamental to speech perception.
3. To familiarize the practitioner with selected speech discrimination abilities of implant recipients.

Cochlear Implant Related Osteoneogenesis in an Animal Model: Fluorescent Labels

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The relationship of cochlear implantation to cochlear osteoneogenesis is not known. Cochlear implant related osteoneogenesis has been demonstrated in laboratory animals, but there have been no studies to determine the specific cause, extent, or time course of this process. In this preliminary study, in three experimental categories: surgical trauma to the cochlea, chronic non-stimulated cochlear implantation, and intrascalar neomycin infusion, computer image analysis was used to measure the area of labeled bone on representative mid-modiolar histological sections. The amount of bone deposition was greatest in ears treated with intracochlear neomycin (mean = 4.893 mm^2, SD = 3.688) and chronic implantation (mean = 3.021 mm^2 SD = 1.534). Surgical trauma alone did not produce substantial bone growth (mean = 1.113 mm^2, SD = 0.164) when compared to contralateral control ears (mean = 0.807 mm^2, SD = 0.413). These results suggest that intracochlear neomycin in animal studies of cochlear implantation may contribute to osteoneogenesis and that surgical trauma alone does not induce intracochlear bone growth. This study supports the use of fluorescent bone labeling in the study of cochlear osteoneogenesis.

Acoustic Reflex Decay in Multi-Channel Cochlear Implant Patients

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The purpose of the present study was to measure acoustic reflex decay in response to electrical stimulation in patients fitted with multi-channel (Nucleus) cochlear implants. In patients without cochlear implants, the rate of decay of the reflex in response to continuous acoustic stimulation is an informative diagnostic test in differentiating cochlear from retrocochlear dysfunction. In addition, frequency-specific acoustic reflex decay is evident in normal-hearing ears, indicating a frequency-dependent adaptation in the reflex arc. By testing cochlear-implanted ears, where direct stimulation of the eighth nerve is feasible (bypassing the tuning properties of basilar membrane and haircells), the parameters of place of stimulation and rate of stimulation can be independently manipulated. By varying the parameters of rate of stimulation (at a particular electrode location) and location of stimulated electrode (for a fixed rate of stimulation), it was anticipated that some insight would be gleaned into the role of tonotopicity in the normal reflex arc. Ten cochlear implant patients were tested at stimulus rates of 125, 250 and 500 Hz at both a basal electrode site and an apical electrode site. No demonstrable difference was noted in reflex decay based on location or frequency of stimulus. Results will be discussed in terms of the frequency-dependence of the reflex arc, including consideration of sensory vs neural elements.

An Update of Reparative Granuloma: A Survey of the American Otological Society and The American Neurotological Society

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Members of the American Otologic Society and The American Neurotologic Society were polled regarding stapes surgery and reparative granuloma. One hundred seventy-six questionnaires (38%) were returned and 319,410 stapes cases were statistically analyzed. Three-hundred and twenty-nine reparative granulomas were reported after stapedectomy for an incidence of 0.1%. Twenty-nine reparative granulomas were reported after stapedectomy for an incidence of 0.07%. Seventy-seven surgeons polled reported having encountered at least one reparative granuloma. Fifty surgeons related the occurrence of a reparative granuloma to a specific graft material. Gelfoam was the most common graft material used when a reparative granuloma was encountered, followed by fat. Vertigo was the most frequent reported presenting symptom. The respondents' operative techniques as well as the diagnosis, management and outcome of reparative granuloma cases are discussed.

Fate of Alcohol Preserved Homograft Ossicles

Roger E. Wehrs, M.D.

Homograft ossicles have been utilized in tympanoplasty for 28 years. The majority of these have stood the test of time and continue to function well. However, recently there have been several cases which initially obtained good hearing, but after 8-10 years began exhibiting a progressive conductive hearing loss.

Revision surgery of these ears has demonstrated a resorption of the homograft incus prosthesis with only a shell of bone remaining. It is assumed that these ossicles failed to be invaded by the host's blood vessels and remained inert dead bone which has undergone slow absorption.

Revision of these cases consisted of removal of the homograft ossicle and its replacement with a similar prosthesis of hydroxylapatite. This procedure usually resulted in restoration of good hearing.

These artificial prostheses are made of dense hydroxylapatite are biocompatible and may be coated with living bone. They should survive long term.

Objectives:

1. Review of the use of homograft ossicles in tympanoplasty and introduction of hydroxylapatite prostheses.

2. The practitioner should be aware of causes of failure and long term changes of implanted ossicles.

3. The practitioner should be aware of substitute methods and materials to prevent future failures in middle ear reconstruction.

Role of Autoimmunity in Contralateral Delayed Endolymphatic Hydrops

Jeffrey P. Harris, M.D., Ph.D., David Aframian, M.D.

Contralateral delayed endolymphatic hydrops (e. hydrops) are described as the development of fluctuating hearing loss and episodic vertigo years following sensorineural hearing loss (SNHL) in the opposite good ear. This condition is a variant of delayed endolymphatic hydrops in which new symptoms of severe episodic vertigo develop years later in an ear which has lost most or all of its hearing. In this study, six patients with the contralateral form of this disease are presented and their sera analyzed by western blotting against bovine inner ear antigen. The etiology of the original hearing loss was believed to be either congenital or infectious with the onset of contralateral e. hydrops delayed twenty to thirty years. All patients (6/6) demonstrated reactivity against a 68 kd(kilodalton) molecular weight antigen while sera of normal individuals were negative. The significance of this antigen has previously been reported for autoimmune inner ear disease. These results suggest that the contralateral form of this disorder may have an autoimmune basis. Recognition of this etiology is important so that prompt institution of immunosuppressive agents can be considered in an attempt to preserve function in an only hearing ear.

OBJECTIVES:

1. The practitioner should be familiar with the onset of delayed endolymphatic hydrops many years following primary insult and hearing loss in the contralateral ear.

2. To recognize a possible role for autoimmunity in the onset of contralateral endolymphatic hydrops.

3. To identify this disorder at an early stage for institution of therapy and prevention of contralateral symptoms.

Neurotologic Manifestations of HIV Infection- Immunohistochemical and EM Study

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Neurotologic manifestations of acquired immunodeficiency syndrome (AIDS) are now apparent. The incidence of reported sensorineural hearing loss, vertigo and tinnitus in individuals infected with the human immunodeficiency virus (HIV) has increased dramatically in recent years. These findings could be the sequelae of primary or secondary pathological processes occurring at the auditory and vestibular end organ levels. Ten sets of AIDS post mortem temporal bones have been harvested and evaluated using a multidisciplinary approach. One temporal bone from each cadaver was subjected to histological and immunohistochemical analysis for localization of viral or opportunistic organisms and their pathological effects. The contralateral otic capsule was processed for transmission and scanning electron microscopy (EM). Anatomical components and spaces were evaluated for characteristic signs of focal injury. Virus like particles have been found in addition to inflammatory cells on the endolymphatic surface on preliminary EM study. In addition, clinical data using audiological and vestibular records will be correlated with immunohistochemical and ultrastructural findings. Future identification and clinical management of HIV related neurotologic manifestations rely on such basic research.

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