PROGRAM
of the

One Hundred Twenty-Ninth
Annual Meeting

AMERICAN OTOLOGICAL SOCIETY, INC.

May 4-5,
1996

Hyatt Regency Grand Cypress Resort
Orlando, Florida

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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, MAY 4, 1996

REGISTRATION - 12 NOON

BUSINESS MEETING - 12:30 P.M.
ROOM: BALLROOM GHI

(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 - 1:00 p.m.
ROOM: BALLROOM GHI

(Open to Non-Members)

Remarks by the President
Derald E. Brackmann, M.D.

Remarks by the Guest of Honor
James L. Sheehy, M.D.

Presidential Citation
Joseph C. Farmer, Jr., M.D.

NOTES

1. 1:30 p.m. A Safe and Effective Technique for the Mobilized Footplate in Otosclerosis Surgery
Michael J.Fucci, M.D.* (by invitation)
William H. Lippy, M.D.
Arnold G. Schuring, M.D.
Franklin M. Rizer, M.D.

2. 1:38 p.m. Barotrauma Following Stapes Surgery:A Survey of Recommended Restrictions and Clinical Experiences
Willard Harrill, M.D.* (by invitation)
Herman A. Jenkins, M.D.
Newton J. Coker, M.D.

3. 1:46 p.m. Resident Stapedectomy: Criteria for Success?
Peter J. Catalano, M.D.
Ofer Jacobowitz, Ph.D.* (by invitation)
Sasha Pearl, B.A.

4. 1:54 p.m. A Meta-Analysis Review of Revision Stapes Surgery with Argon Laser: Effectiveness and Safety
Richard J. Wiet, M.D.*
Douglas C. Kubek, D.O.
Paul Lemberg, M.D.

2:02 p.m. Discussion

5. 2:10 p.m. Stapedius Tendon Reconstruction: J.B. Causse Technique and Results
Jean-Bernard Causse, M.D.*
Robert Vincent, M.D.

6. 2:18 p.m. The Efficacy of Hyaluronic Acid Foam as a Middle Ear Packing Agent in Experimental Tympanoplasty
James L.Krupala, M.D.*(by invitation)
Gerard J. Gianoli, M.D

***speaker**

NOTES

7.	2:26 p.m.	Chronic Tympanic Membrane Perforations Repaired with Collagen Membranes **Dennis G. Pappas, Sr., M.D.** **Dennis G. Pappas, Jr., M.D. ***
8.	2:34 p.m.	Medial Canal Fibrosis of the External Auditory Canal **Peyman Saadat*** (by invitation) **William H. Slattery, III, M.D.**
	2:42 p.m.	Discussion
	2:50 p.m.	Intermission
9.	3:10 p.m.	DNA Analysis of Human Cholesteatomas **Rosemary Desloge, M.D.*** (by invitation) **John F. Carew, M.D.** **Connie L. Finstad, Ph.D.** **Jodi Sassoon, M.D.** **Melissa G. Steiner, Ph.D.** **Lisa Staiano-Coico, Ph.D.** **Simon C. Parisier, M.D.** **Anthony P. Albino, Ph.D.**
10.	3:18 p.m.	Retraction Cholesteatoma of the Sinus Tympani **John P. Leonetti, M.D.*** **Richard A. Buckingham, M.D.** **Sam Marzo, M.D.**
11.	3:26 p.m.	Endoscopic Management of Acquired Cholesteatoma **Muaaz Tarabichi, M.D.*** (by invitation)
12.	3:34 p.m.	Refined Mastoid Reconstruction with the Pedicled Auricular Perichondrial Flap **Larry G. Duckert, M.D., Ph.D.*** **Kathleen H. Makielski, M.D.** **Jan Helms, M.D.**
	3:42 p.m.	Discussion

***speaker**

NOTES

13. 3:50 p.m. A New Adhesive Bonding Material for the Cementation of Implantable Devices in Otologic Surgery
Anthony J. Maniglia, M.D.
John W. Werning, M.D., D.M.D.*
(by invitation)

14. 3:58 p.m. A Neurophysiological Approach to Treating Hyperacusis
William C. Gray, M.D.* (by invitation)
Pawel J. Jastreboff, Ph.D.
Susan L. Gold, M.D.

15. 4:06 p.m. MRI Findings in Sudden Hearing Loss
William H. Slattery, III, M.D.*
(by invitation)
William M. Lo, M.D.
James E. Saunders, M.D.

16. 4:14 p.m. Plasmapheresis in Autoimmune Inner Ear Disease:Long-Term Follow Up
Charles M. Luetje, M.D.*

4:22 p.m. Discussion

17. 4:30 p.m. Radiation-Induced Tumors of the Temporal Bone
Lawrence R. Lustig, M.D.*
(by invitation)
Robert K. Jackler, M.D.
Michael J. Lanser, M.D.

18. 4:38 p.m. Introcranial Complications of Temporal Bone Osteoradionecrosis
John P. Leonetti, M.D.*
Thomas Origitano, M.D., Ph.D.
Douglas Anderson, M.D.
Edward Melian, M.D.
Mark A. Severtson, M.D.

***speaker**

19.	4:46 p.m.	Endovascular Occlusion of the Condylar Vein and Inferior Petrosal Sinus in Jugular Foramen Surgery **Moises A. Arriaga, M.D.*** (by invitation) **David Carrier, M.D.**
20.	4:54 p.m.	Management of Complications from Temporal Bone Fractures **Hilary A. Brodie, M.D., Ph.D.*** (by invitation) **Teresa C. Thompson, D.V.M.**
	5:02 p.m.	Discussion
	5:10 p.m.	GROUP PHOTOGRAPH FOR ALL A.O.S. MEMBERS (Location to be announced.)

***speaker**

SUNDAY, MAY 5, 1996

REGISTRATION - 7:00 a.m.

BUSINESS MEETING - 7:00 a.m.
Room: BALLROOM GHI
(Restricted to Members)

Report of the:
a. Board of Trustees of Research Fund
b. American Board of Otolaryngology
c. Award of Merit Committee
d. American College of Surgeons
e. American Academy of OtolaryngologyHNS

Report of the Audit Committee

Report of the Nominating Committee

Reading of Communications

Unfinished Business

New Business

SCIENTIFIC PROGRAM - 7:30 a.m.
ROOM: BALLROOM GHI
(Open to Non-Members)

21. 7:30 a.m. Clinical and Surgical Implications of Recent Data About the Mechanics of the Human Middle Ear
Saumil N. Merchant, M.D.*
(by invitation)
John J. Rosowski, Ph.D.
Michael E. Ravicz, M.D.
Sunil Puria, Ph.D.
Susan E. Voss, M.D.
William T. Peake, Sc.D.

22. 7:38 a.m. The Use of Organotypic Cultures of Corti's Organ to Study the Protective Effects of Anti-Oxidant Molecules on Cisplatin Induced Damage of Auditory Hair Cells.
Thomas R. Van De Water, Ph.D.
Richard D. Kopke, M.D.* (by invitation)
Juan P. Garcia, M.D.
Wei Liu, B.S.
Joseph Feghali, M.D.
David Spray, Ph.D.
Ramin Gabaizadeh
Harold Steinman, Ph.D.
Irving Listowsky, Ph.D.
Bridgitte Malgrange, Ph.D.
Robert J. Ruben, M.D.
Leonard Ryback, M.D.

23. 7:46 a.m. Glycolipid Antigens in the Human Cochleovestibular System
Elias M. Michaelides, M.D.*
(by invitation)
Aristides Sismanis, M.D.

24. 7:54 a.m. Hair Cell Formation in Cultures of Dissociated Cells From the Vestibular Sensory Epithelium of the Bullfrog
Ricardo Cristobal, M. D. *(by invitation)
I. Lopez, Ph.D.
D. Honrubia
A. Espinosa de los Monteros, Ph.D.
Vicente Honrubia, M.D., D.M.Sc.

***speaker**

8:02 a.m. Discussion

25. 8:10 a.m. Predictive Value of Intraoperative Brainstem Auditory Evoked Responses in Surgery for Conductive Hearing Losses
Samuel H. Selesnick, M.D.*
(by invitation)
Jonathan D. Victor, M.D., Ph.D.
Ravi K. Tikoo, M.D.

26. 8:18 a.m. Intraoperative Electrocochleography During Stapedectomy and Ossicular Reconstruction
Jack Wazen, M.D.*
Ronald Emerson, M.D.
David Foyt, M.D.

27. 8:26 a.m. Perspectives on a State Enacted Hearing Screening and Assessment Program in the Newborn Population
Mark J. Abrams, M.D.* (by invitation)
Myles L. Pensak, M.D.
Karen Buhrer, M.D.

28. 8:34 a.m. Allergic Eustachian Tube Dysfunction: Diagnosis and Treatment
M. Jennifer Derebery, M.D.*
(by invitation)
Karen I. Berliner, Ph.D.

8:42 a.m. Discussion

29. 8:50 a.m. Vagal Nerve Monitoring: A Comparison of Techniques in a Canine Model
Mark A. Severtson, M.D. *(by invitation)
John P. Leonetti, M.D.

30. 8:58 a.m. Cognitive Evoked Potentials in Speech Stimuli in Normal Hearing Subjects and Patients with Cochlear Implants
Paul R. Kileny, Ph.D.*
Teresa A. Zwolan, Ph.D.
Angelique Boerst, M.A.

***speaker**

31. 9:06 a.m. Electrophysiological Methods in Cochlear Implant Assessment
Tucker G. Stevens, M.Ed.*
(by invitation)
M. Suzanne Hasenstab, Ph.D.
Claudia D. Mason, M.Ed.
Michael W. LeMay, M.A.
George H. Williams, M.D.

32. 9:14 a.m. Promontory Electrical Stimulation in Patients with Hearing Loss After Middle Cranial Fossa Acoustic Tumor Removal
Rick A. Friedman, M.D., Ph.D.*
(by invitation)
Derald E. Brackmann, M.D.
Dawna Mills, M.A.

33. 9:30 a.m. Communication Outcomes Related to Early Cochlear Implantation
Diane Brackett, Ph.D.* (by invitation)
Carol V. Zara, M.A.
Susan B. Waltzman, Ph.D.
Noel L. Cohen, M.D.

34. 9:38 a.m. Educational Needs and Cost-Benefit Considerations in Children With Cochlear Implants
John K. Niparko, M.D.
Howard W. Francis, M.D.* (by invitation)
Mary Eager Koch, M.A.
J. Robert Wyatt, M.D., M.B.A.

35. 9:46 a.m. Cochlear Implants in Young Children: A Longitudinal Study of Speech Perception
Susan B. Waltzman, Ph.D.* (by invitation)
Noel L. Cohen, M.D.
Janet E. Green, M.D.

36. 9:54 a.m. Facial Nerve Stimulation Following Nucleus 22 Channel Cochlear Implantation
David C. Kelsall, M.D.* (by invitation)
Jon K. Shallop, Ph.D.
Erin Prenger, D.O.

***speaker**

10.02 a.m. Discussion

10:10 a.m. Intermission

37. 10:30 a.m. Some Anatomic Observations on Otolith Repositioning for BPPV
Richard A. Buckingham, M.D.

38. 10:38 a.m. Transtympanic Gentamicin Therapy: University of Pittsburgh Experience
Barry E. Hirsch, M.D.* (by invitation)
Donald B. Kamerer, M.D.

39. 10:46 a.m. A Comparison of LongTerm Hearing Results After Middle Fossa Vestibular Neurectomy, Endolymphatic Mastoid Shunt and Medical Regime
Salvatore Iurato, M.D.*
Antonio Quaranta, M.D.
Marina Onofri, M.D.
Vicenzo Sallustio, M.D.

40. 10:54 a.m. Long-Term Effects of Meniere's Disease On Hearing and Quality of Life
Sam Kinney, M.D.*
Sharon A. Sandridge, Ph.D.
Craig W. Newman, Ph.D.

11:02 a.m. Discussion

41. 11:10 a.m. Management of Acoustic Neuroma in the Elderly Patient
Michael E. Glasscock, III, M.D.
Dennis G. Pappas, Jr., M.D., *
Spiros Manolidis, M.D.
Peter G. Von Doersten, M.D.
C. Gary Jackson, M.D.

42. 11:18 a.m. Acoustic Neuroma Surgery: Outcome Analysis of Patient Perceived Disability
Saurabh B. Shah, M.D.* (by invitation)
Peter L. Rigby, M.D.
Jeannie H. Chung, B.S.
Darren D. Cooke, B.S.
Robert K. Jackler, M.D.

***speaker**

43. 11:26 a.m. Endoscopically Assisted Prevention of Cerebrospinal Fluid Leak in Suboccipital Acoustic Neuroma Surgery
Hannu J. Valtonen, M.D., Ph.D.*
(by invitation)
Dennis S. Poe, M.D.
Carl B. Heilman, M.D.
Edward C. Tarlov,M.D.

44. 11:34 a.m. Focal Infarction of the Cerebella Peduncle as a Cause of Persistent Cerebellar Dysfunction Following Acoustic Neuroma Surgery: A Report of 8 Cases
Peter L. Rigby, M.D.* (by invitation)
Steven W. Cheung, M.D.
David W. Sim FRCS Ed (ORI)
Robert K. Jackler, M.D.
Lawrence H. Pitts, M.D.

45. 11:42 a.m. Cochlear Implantation in Pediatric Patients with Mondini Deformities
Ronald A. Hoffman, M.D.
L. Downey, M.D.* (by invitation)

45. 11:50 a.m. Discussion

12 NOON Introduction of New President
Joseph C. Farmer, Jr., M.D.

ADJOURNMENT

***speaker**

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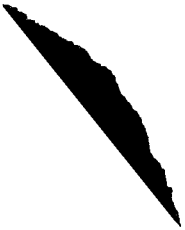

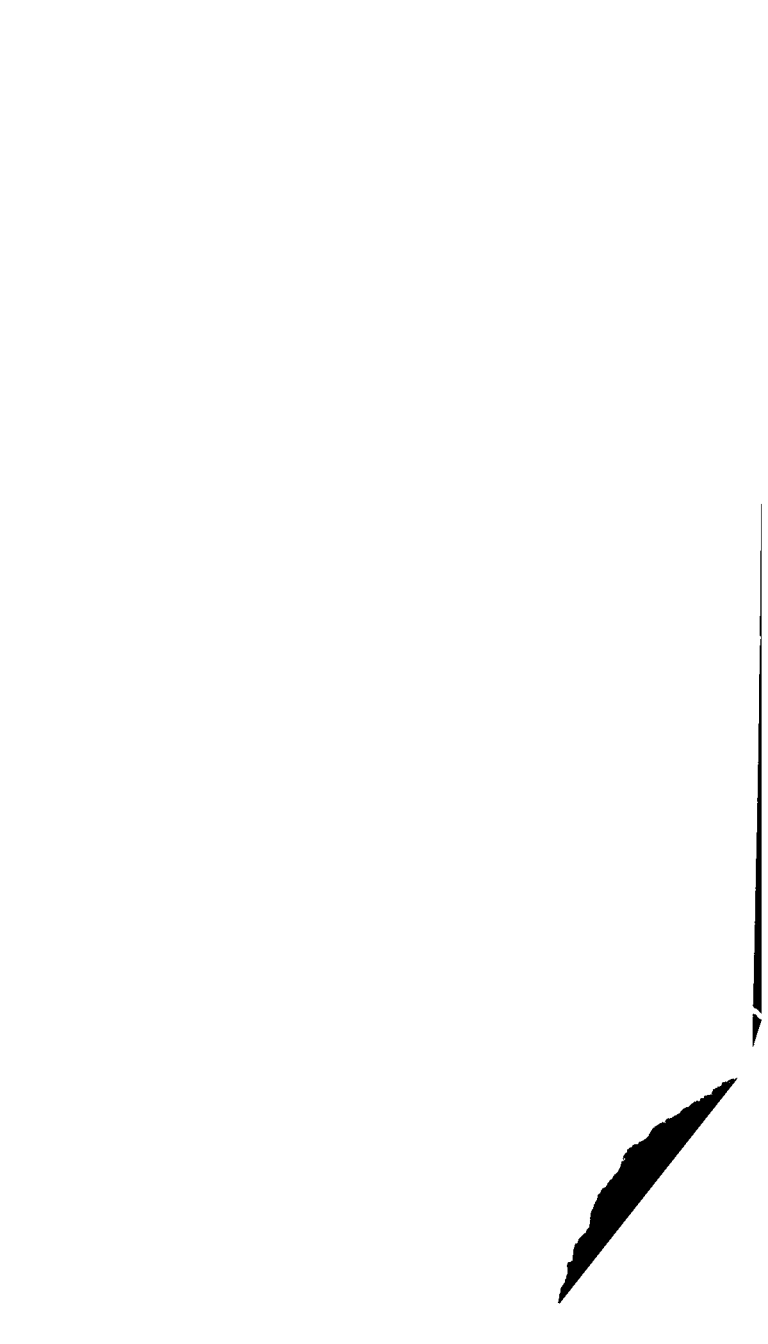

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1.

A SAFE AND EFFECTIVE TECHNIQUE FOR THE MOBILIZED FOOTPLATE IN OTOSCHLEROSIS SURGERY

Michael J. Fucci, M.D., William H. Lippy, M.D.
Arnold G. Schuring, M.D., Franklin M. Rizer, M.D.

There are several ways to manage a mobilized footplate in stapedectomy surgery. We review an alternate technique of placing a vein graft and a Robinson prosthesis on the mobilized footplate. Between 1962 and 1991, 145 footplates were inadvertently mobilized during over 10,000 stapedectomies for otosclerosis. There were 73 thin and blue footplates mobilized and 72 thick and white footplates mobilized. All ears had a vein graft and a 4.0 mm. Robinson prosthesis placed on the footplate and were followed for at least three years. In the thin and blue group, hearing results were successful and satisfactory in 97% and 100% of ears, respectively. In the thick and white group, hearing results were successful and satisfactory in 60% and 72% of ears, respectively. Revision was performed on 22 thick and white footplates. Footplate re fixation was found in all but one case. After revision, the thick and white footplate group had successful and satisfactory hearing in 79% and 89% respectively. The hearing results for all mobilizations, including revisions, was 85% successful, 95% satisfactory, and 5% unsatisfactory.

We conclude that placing a vein graft and Robinson prosthesis is a safe and effective technique in handling a mobilized footplate in stapedectomy surgery .

OBJECTIVES:

1. **To discuss the incidence and surgical options regarding a mobilized footplate in otosclerosis surgery.**
2. **To discuss an alternate technique for treating an inadvertently mobilized footplate in otosclerosis surgery.**
3. **To discuss the hearing results and revision findings of this alternate technique.**

BAROTRAUMA FOLLOWING STAPES SURGERY: A SURVEY OF RECOMMENDED RESTRICTIONS AND CLINICAL EXPERIENCES

Willard C. Harrill, M.D., Herman A. Jenkins, M.D., Newton J. Coker, M.D.

We surveyed 419 members of the American Otological Society and American Neurotology Society to investigate current recommendations advised to minimize barotrauma following stapes surgery. The survey design allowed for analysis of factors potentially influencing recommendations given by physicians, and permitted the responding physicians to describe in detail their clinical experience with barotrauma following stapes surgery. Of the 284 surveys returned, 231 (55%) were adequately completed for statistical analysis.

The results demonstrate substantial agreement in the recommended restrictions for a specific activity for both stapedectomy and stapedotomy. Post-operative recommendations for air travel varied from no restriction to a maximum restriction of 4 to 6 months, with 60% (n=226) of physicians recommending at least a 2 week abstinence. Twenty percent of physicians recommended a restriction of no more than 2 days. Snorkeling recommendations varied from no post-operative restriction (5%; n=222) to permanent avoidance (12%), with a majority (56%) recommending 1 to 3 months restriction. Permanent SCUBA diving restrictions were recommended by over 50% of physicians (120/221). Of note, 35% of physicians advised restrictions between 1 and 6 months.

Variables thought to affect these recommendations were statistically analyzed. Air travel restriction was significantly related to the lifetime total stapedotomies performed by the physician and to the percentage of patients using air travel to acquire surgery. Snorkeling restriction was associated with the number of stapedotomies performed over the past twelve months and the referral pattern of the physician's practice. SCUBA diving recommendation was related to stapedotomy experience and referral pattern. The age of the physician, number of years in practice, experience with barotrauma, and the number of stapedectomies performed either lifetime or over the past 12 months proved to be statistically insignificant variables affecting the post-operative recommendations.

Of the 270 cases of barotrauma reported, detailed information was provided for 114. Barotrauma was most commonly associated with air travel (57%), with 27 cases reporting a median postoperative occurrence at 12 months. Diving-related barotrauma occurred in 26 cases, with an event occurring at a median of 18 months post-operatively (n=7). Twenty-two cases of barotrauma were associated with other etiologies. Of the 135 complications reported, perilymphatic fistula was most common (59%), followed by prosthesis dislocation (37%), and tympanic membrane perforation (4%). Of note, 38% (19/50) of patients reported to have a prosthesis dislocation were found to also have a perilymphatic fistula. The most common prosthesis type associated with barotrauma was the piston (48%; n=101), followed by wire (34%), and Robinson (19%). The prosthesis type was related to the type of barotrauma, the procedure performed, and the type of graft material used. In absolute numbers, wire and piston prostheses were more common with barotrauma, regardless of whether a stapedectomy or stapedotomy was performed and whether or not a tissue seal was used.

OBJECTIVES:

1) To investigate post-stapes surgery restrictions advised to minimize barotrauma.
2) To analyze factors influencing the recommended restrictions.
3) To examine clinical experiences with post-operative barotrauma.

RESIDENT STAPEDECTOMY: CRITERIA FOR SUCCESS?

Peter J. Catalano, M.D., Ofer Jacobowitz, Ph.D., Sasha Pearl, B.A.

"Successful" stapes surgery is defined as closure of the air-bone gap to 10dB or less while maintaining good speech discrimination. The literature is replete with series of resident performed stapedectomies with "success" rates between 60 and 80%, well below what is acceptable to most otologists.

We recently reviewed our series of 50 consecutive resident performed stapedectomies over a 5 year period. Fourteen procedures were performed without the supervision of an attending otologist (Group I) while 36 procedures were closely supervised and used a single stapedectomy technique (Group II). "Success" was achieved in 3 patients from Group I (21.4%) and 22 patients from Group II (61.1%). There was one profound SNHL in a Group II patient due to a purulent postoperative middle ear infection. Our results emphasize the resident's need for close intraoperative supervision, simplicity in surgical technique, and experience in middle ear surgery.

These results, combined with 15 other published series, highlight the fact that resident performed stapedectomy, under the best of circumstances and with close attending supervision continues to fall short of the "success" rates reported by senior otologists. The combined data also raises the question of whether current criteria for "success" are appropriate for those procedures performed by resident surgeons. In this paper, new criteria for "success" following resident performed stapedectomy are proposed, the impact that such a change might have on residency training in otology is discussed, and our current patient series is reviewed.

OBJECTIVES:

1. To emphasize the need for close attending supervision during middle ear surgery.
2. To question whether current criteria for "success" in stapedectomy is appropriate at the resident level.
3. To propose new criteria for "success" in resident performed stapedectomy and how this might impact on residency training in otology.

A META-ANALYSIS REVIEW OF REVISION STAPES SURGERY WITH ARGON LASER: EFFECTIVENESS AND SAFETY

Richard J. Wiet, M.D., Douglas C. Kubek, D.O., Paul Lemberg, M.D.

A review of the current literature (1970-1995) on revision stapes surgery for otosclerosis has produced a myriad of studies. Unfortunately, the published surgical outcomes have been less than desirable considering the success with primary stapedotomy. Even in the most experienced otologic surgeon's hands, successful results, i.e., <10 dB postoperative pure tone average (PTA) air-bone gap, ranged from 16% to 80%. 1-14 The outcomes included two distinctly different techniques used to correct the pathological process visualized intraoperatively: conventional dissection without laser and laser assisted dissection. The most common causes of failure included displaced prosthesis, adhesions, bony fixation of the footplate and necrosis of the incus. 1-14 A retrospective review and categorical meta-analysis using a log-linear model was carried out. Eleven studies without the use of the laser, n=1147, and 4 studies with the use of the laser, n=197, including our own patients, n=23, were entered into the model. The results demonstrate an advantage in safety and efficacy in the group using laser assistance for revision stapes surgery. Sixty-three percent of the group using a laser in the revision procedure had a successful result, while only 51% of the patients had a successful result in the group that did not employ the use of a laser. (p=0.5).

OBJECTIVES:

1. **To review by meta-analysis the surgical outcomes of revision stapes surgery for otosclerosis.**
2. **To demonstrate that the use of argon laser in revision stapes surgery yields safe postoperative audiologic outcomes compared to conventional surgical instruments.**
3. **To illustrate surgical techniques to amend specific pathological finding with the argon laser in revision stapes surgery.**

STAPEDIUS TENDON RECONSTRUCTION : J.B. CAUSSE TECHNIQUE AND RESULTS

Jean-Bernard Causse, M.D., Robert Vincent, M.D.

The function of the stapedius tendon is to protect the inner ear from excessive sound. In stapes surgery, the majority of otologic surgeons transect the stapedius tendon without reconstructing it. However, its reconstruction can be an added benefit.

This study will show the method, results, and conclusion of stapedius tendon reconstruction.

Initially, the stapedius tendon is severed as close to the stapes head as possible. The tendon is then lowered, allowing the distal tip to be attached to a Polycel ring and to the shaft of the piston. The space between the tendon and the Polycel ring is then bridged with loose periveinous connective tissue taken from the adventitial side of a piece of vein graft. The ring is placed so that the tendon will be perpendicular to the shaft of the piston. This technique allows traction of the piston parallel to the footplate in order to fix the piston onto the edge of the stapedotomy. In addition, penetration of the piston into the vestibule by pulling of the tendon is thus prevented.

To date, one-year postoperative results have been 73% positive stapes reflexes (687 stapes) indicating that reconstruction of the stapedius tendon is possible in the majority of cases.

OBJECTIVES:

1. **To summarize the usefulness of the stapedial reflex.**
2. **To present a new technique of rebuilding the stapedial tendon during stapes surgery.**
3. **To present the results of that technique.**

THE EFFICACY OF HYALURONIC ACID FOAM AS A MIDDLE EAR PACKING AGENT IN EXPERIMENTAL TYMPANOPLASTY

James L. Krupala, M.D. , Gerard J. Gianoli, M.D.

The efficacy of Hyaluronic acid (HA) foam in the prevention of middle ear adhesions and other structural abnormalities in guinea pigs undergoing experimental tympanoplasty was investigated. Postoperative changes in the middle ear were evaluated by light microscopy after six weeks. The presence of adhesions, diminution of airspace, new bone formation, tympanic membrane formation, and mucosa inflammation were characterized by an objective grading system. Results were compared to absorbable gelatin sponge and a control group (no middle ear packing). HA foam, as compared to gelatin sponge, demonstrated a trend toward increased airspace preservation, decreased mucosal inflammation, and decreased new bone formation. Further experimental trials are warranted.

OBJECTIVES:

1. **To demonstrate efficacy of hyaluronic acid foam as middle ear packing agent.**
2. **To compare hyaluronic acid foam to Gelfoam and control with regards to middle ear reactivity (inflammation, scarring tympanic membrane formation.)**

CHRONIC TYMPANIC MEMBRANE PERFORATIONS REPAIRED WITH COLLAGEN MEMBRANES

Dennis G. Pappas, Sr., M.D. , Dennis G. Pappas, Jr., M.D.

An attempt has been made to develop a simple outpatient method of healing chronic tympanic membrane perforations. Large perforations were created in the chinchilla. Using an experimental protocol, a large segment of collagen membrane was placed over the chronic perforation in contact with the residual TM. A series of control ears did not receive a membrane implant, to assure us that the created perforation did not spontaneously heal. In a group of chinchillas, the collagen membranes were lined with epithelium in 80% of treated ears. Clinical trials utilizing collagen membranes in chronic tympanic membrane perforation is being initiated.

OBJECTIVES:

1. **To develop and maintain a perforation in an experimental model (animal).**
2. **To determine by pathological means tissue reaction to collagen membrane**
3. **To test in the laboratory a procedure that can be applied in the clinic to humans.**

MEDIAL CANAL FIBROSIS OF THE EXTERNAL AUDITORY CANAL

Peyman Saadat, William H. Slattery III, M.D

Medial canal fibrosis is a rare cause of conductive hearing loss. This entity is an acquired atresia of the external auditory canal caused by various etiologies including chronic otitis externa, chronic otitis media, chronic dermatitis, fibrous dysphasia, and trauma.

In this study a chart review was performed on 26 patients from the House Ear Clinic with a clinical diagnosis of medial canal fibrosis. Patients frequently presented with bilateral disease. Nine patients had surgical correction of the medial canal fibrosis. Cholesteatoma was responsible for the fibrosis in one case. Follow-up ranged from 1-10 years (average five years). Long-term surgical results will be presented. Treatment options will be presented.

OBJECTIVES:

1. **To describe the clinical characteristics of postinflammatory medial canal fibrosis.**
2. **To discuss the treatment option for the postinflammatory medial canal fibrosis.**
3. **To present the long-term follow-up of patients treated surgically with medial canal fibrosis.**

DNA ANALYSIS OF HUMAN CHOLESTEATOMAS

Rosemary B. Desloge, M.D., John F. Carew, M.D., Connie L. Finstad, Ph.D., Jodi Sassoon, M.D., Melissa G. Steiner, Ph.D., Lisa Staiano-Coico, Ph.D., Simon C. Parisier, M.D., Anthony P. Albino, Ph.D.

Cholesteatoma is a destructive lesion of the middle ear and/or mastoid process which produces complications by erosion of the temporal bone. The clinical hallmarks of cholesteatomas, namely invasion, migration, uncoordinated proliferation, altered differentiation, aggressiveness, and recidivism are traits typically associated with the neoplastic cell. However, there is little evidence to support or refute the speculation that cholesteatomas are a low -grade squamous cell neoplasm. The existence of defects in the genetic complement of the major cellular constituents comprising a cholesteatoma, fibroblasts and keratinocytes, would support the speculation that cholesteatomas are a neoplasm, since cancers commonly manifest quantitative and qualitative alterations in the normal euploid complement of genetic information, resulting in a cell that has an abnormal or aneuploid amount of DNA. Measurement of the DNA content (ploidy) by flow cytometry is useful in identifying alterations in the DNA within cells and tissues. In this report, we analyzed the DNA content of 11 human cholesteatomas and 9 postauricular specimens using flow cytometry and determined that cholesteatomas have a normal euploid DNA content.

OBJECTIVES:

1. **To present new research data on the DNA content of cholesteatoma.**
2. **To propose future investigations aimed at developing a better understanding of cholesteatoma.**
3. **To uncover the molecular pathology responsible for cholesteatoma.**

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RETRACTION CHOLESTEATOMA OF THE SINUS TYMPANI

John P. Leonetti, M.D., Richard A. Buckingham, M.D.,
Sam Marzo, M.D.

Posteromedial retraction of the tympanic membrane, between the oval window superiorly and the round window niche inferiorly results in the formation of an epithelial-lined pocket within the sinus tympanic recess. Failure to recognize posterior invagination of the tympanic membrane intraoperatively will lead to inadvertent tearing of the tympanomeatal flap at the level of the annulus with epithelial seeding of the middle ear and probable cholesteatoma recurrence.

This paper will focus on the clinical manifestations and radiographic findings suggestive of sinus tympanic epithelial retraction of the pars tensa and will provide direct correlation between human cross-sectional temporal bone anatomy and otomicroscopy. The surgical management of these challenging lesions includes initial endaural access, external meatal bone removal posteromedial to the tympanic annulus and anterior to the vertical portion of the facial nerve, and middle ear ventilation following marsupialization of the epithelial retraction.

While early tympanic membrane retraction can be treated with a ventilation tube, deep epithelial pockets may require additional surgical treatment. A method for the management of sinus tympanic cholesteatomas will be demonstrated through selected case presentations.

OBJECTIVES:

1. To define the entity of sinus tympanic retraction cholesteatoma.
2. To provide temporal bone cross sectional anatomic correlation with otomicroscopic examples of sinus tympanic cholesteatomas.
3. To discuss the surgical management of sinus tympanic cholesteatomas.

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ENDOSCOPIC MANAGEMENT OF ACQUIRED CHOLESTEATOMA

Muaaz Tarabichi, M.D.

There is an increased awareness of the advantages of the endoscope when evaluating old mastoid cavities for recurrent disease; the same advantages could be applied in the initial surgical management of acquired cholesteatoma.

38 patients with acquired cholesteatoma were examined under the microscope. All patients had severe retraction with bony erosion and complete removal of the dermal debris could not be accomplished under the microscope. None of the patients had any previous surgery on the involved ear. Office based endoscopy showed a large pocket that was emptied in 21 patients. CT examination showed extensive involvement of almost all the mastoid air cells in two patients who ultimately underwent postauricular mastoidectomy. 36 patients underwent transcanal exploration of the middle ear using the endoscope instead of the microscope. Local anesthesia was used in 19 patients. There were two distinct groups of patients:

-25 patients had endoscopically accessible disease. Wide transcanal atticotomy was performed and the sac was completely removed. The defect was then reconstructed with composite tragal graft. 22 patients had one year follow-up which showed no recurrent disease. Two years follow-up was obtained in 14 patients (including six patients who had pre-planned exploration) with recurrent disease identified in three patients.

-11 patients had extensive disease involving the mastoid cavity proper. Transcanal atticotomy was performed and the bony defect was extended posteriorly into the antrum and was packed and left open. The tympanic membrane defect inferior to the horizontal segment of the facial nerve was reconstructed using composite tragal graft. Follow-up was obtained for 8 patients at one year and office based endoscopic examination showed substantial closing of the attic defect in one patient who ultimately underwent canal wall down postauricular mastoidectomy. Five patients had two years follow-up with two patients undergoing office based removal of recurrent cholesteatoma pearls from the open antrum.

There was no evidence of any facial nerve injury in both groups and bone conduction thresholds were stable except in one patient who had lateral canal fistula and severe preoperative sensorineural hearing loss and dizziness.

The Endoscope offers less invasive alternatives in the surgical management and the continuous surveillance of acquired cholesteatoma.

OBJECTIVES:

1. To describe the role of the endoscope in the management of cholesteatoma.
2. To describe the surgical technique.
3. To discuss the outcome of endoscopic management of cholesteatoma.

REFINED MASTOID RECONSTRUCTION WITH THE PEDICLED AURICULAR PERICHONDRIAL FLAP

Larry Duckert, M.D.,Ph.D., Kathleen H. Makielski, M.D.
Jan Helms, M.D.

While exteriorizing and eliminating disease, the open cavity surgical technique, including radical mastoidectomy and canal down tympanomastoidectomy, is associated with an avoidable incidence of recurrent drainage and patient inconvenience. Required routine maintenance, problems inherent to water contamination and less than optimal reconstructive potential have resulted in a number of surgical approaches designed to eliminate the postoperative mastoid cavity. One such option, the cavity obliteration, may be suitable under some conditions but canal wall reconstruction may yield a more attractive anatomical and physiological result. Unfortunately, canal wall reconstruction is not entirely free of problems, which may be both immediate (graft dehiscence and infection) or delayed (graft retraction, absorption and extrusion).

A number of surgical techniques have been promoted to avoid these pitfalls but no single technique would appear to have clear advantage. There is a consensus however that many of the early healing problems following canal wall reconstruction are related to graft exposure and poor blood supply. The utility of autograft cartilage has long been recognized for reconstruction of the posterior canal and attic wall. However, it has been the author's past experience that when large postoperative defects required large grafts results were too often compromised by dehiscence and delayed healing, presumably related to incomplete soft tissue coverage and limited blood supply.

Two years ago, we reported our combined experience using large cartilage-perichondrial autograft "shields" to reconstruct remnant tympanic membranes. The closure rate of greater than 90% in less than favorable conditions, we believe, was in part related to the rapid re-vascularization of the graft and mechanical support provided by the perichondrium. Encouraged by the early results achieved in the middle ear with the cartilage-perichondrial graft, we modified our method of mastoid reconstruction in cases where graft viability was challenged by inadequate canal or bowl skin coverage and questionable nutritional source. Under these conditions we complimented the single sheet conchal bowl cartilage graft with a broad based perichondrial flap developed from the posterior surface of the auricle. The tissue is easily elevated at the time of cartilage harvest and is rotated to cover the canal surface of the graft.

Within a period of three years, the flap was used in 36 cases of canal wall reconstruction in conjunction with conchal cartilage grafts without failure. In this manner, we were consistently able to achieve better soft tissue coverage of the graft, eliminate laterial graft dehiscence and encourage rapid re-epithelization of the canal. By implication, we feel this flap provides a source of nutritional support for the free cartilage graft as well as the overlying skin. This flap innovation can be applied independently or used with other more conventional muscle-periosteal flap designs to enhance the success of mastoid cavity rehabilitation.

OBJECTIVES:

1. To introduce a surgical procedure designed to facilitate mastoid cavity canal wall reconstruction.
2. To present the advantages of this technique and favorable outcome data.
3. To provide a detailed instructional description of the technique using artist's drawings and video tape demonstration.

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A NEW ADHESIVE BONDING MATERIAL FOR THE CEMENTATION OF IMPLANTABLE DEVICES IN OTOLOGIC SURGERY

Anthony J. Maniglia, M.D., John W. Werning, M.D., D.M.D.

Presently, there are no FDA-approved adhesive bone cements for the surgical fixation of prosthetic materials in the middle ear. The development and future application of implantable hearing devices for sensorineural hearing loss mandates the need to develop an adhesive bone cement. A promising new cement, 4-META/MMA-TBB opaque resin, has shown remarkable adhesive properties as a bone cement in vivo. The cement is composed of 4-methacryloyloxyethyl trimellitate anhydride (4-META) and methyl methacrylate (MMA) as monomers and tri-n-butyl borane (TBB) as an initiator. An electromagnetic implantable hearing device presently under development was implanted into the middle ear of five cats using 4-META/MMA-TBB resin to cement a titanium-encased magnet to the incus. Gross microscopic examination prior to animal sacrifice (Mean=9.6 months) demonstrated maintenance of middle ear anatomic integrity without evidence of ongoing inflammation. The cemented magnets remained firmly adherent to the incudi in all subjects. Serial auditory brainstem response audiometry revealed no evidence of ototoxicity from long-term implantation. Light and transmission electron microscopy of the incus and temporal bone showed no evidence of toxicity or inflammation and the presence of a unique "hybrid layer" at the bone-cement interface. Our investigation highlights the special biomechanical properties and the biocompatibility of 4-META/MMA-TBB resin that make it an attractive bone-bonding agent for use in otologic surgery, including its potential usefulness during ossicular reconstruction.

This research is supported by NIH grant ROl-DC01953-03.

OBJECTIVES:

1. To introduce a new adhesive bone cement with properties that are unique for otologic surgery.
2. To discuss the results of extensive in vivo biocompatibility testing of the cement.
3. To demonstrate its usefulness for the cementation of implantable hearing devices as well as its potential application during ossicular reconstruction.

A NEUROPHYSIOLOGICAL APPROACH TO TREATING HYPERACUSIS

William C. Gray, M.D., Pawell J. Jastreboff, Ph.D., Susan L. Gold, M.A.

Twenty six patients whose chief complaint was hyperacusis were seen in the University of Maryland Tinnitus and Hyperacusis Center and treated using the neurophysiological approach developed by Jastreboff. Mean duration of hyperacusis prior to being seen was 45 months, range 2 to 240 months. Twelve of the 26 experienced physical pain in response to loud sounds. Fifteen of 26 cited an incident of noise exposure as the precipitating event. Other precipitating factors were surgery, emotional trauma, head injury, and drug side effects. Five of 26 had a history of major depression or panic attacks prior to the onset of their hyperacusis. Thirteen of 26 had been on benzodiazepines or antidepressants. Most of the patients had mild high frequency sensorineural hearing loss. One had unilateral profound sensorineural hearing loss and one had unilateral Meniere's disease. Audiometric data is presented. Twenty-five of the 26 were treated with binaural Viennatone AMTi broad frequency noise generators following a specific protocol for hyperacusis. This protocol involves wearing the noise generators with the noise at a barely perceptible level initially. The intensity level is gradually increased over a period of weeks but always is maintained at a low level so as not to interefere with perception of environmental sounds. Patients receive intensive counseling on the probable mechanism and significance of their hyperacusis and receive close followup and psychological support. Twelve patients were signficantly improved by this therapy, 8 were unchanged but continuing therapy. None were worse. In patients who also had tinnitus, improvement in hyperacusis frequently preceeded improvement in tinnitus. Many whose lives had been severely disrupted by their hyperacusis were able to resume normal activities.

OBJECTIVES:

1. To present demographic, clinical and audiometric data on a series of patients with severe life-disrupting hyperacusis.
2. To describe a successful method for treating this condition.
3. To present outcome data on this group of patients.

MRI FINDINGS IN SUDDEN HEARING LOSS

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James E. Saunders M.D.

Sudden sensorineural hearing loss presents the clinician with a two-fold diagnostic dilemma; exactly when is the diagnostic work-up complete and have exhaustive tests determined the etiology of this disease? Viral inflammation, vascular occlusion, neuropathy and tumors have all been proposed as possible etiologies of sudden sensorineural hearing loss. The obligation of the clinician to order an MRI with gadolinium is controversial in some centers since the incidence of the acoustic neuroma presenting as sudden sensorineural hearing loss is thought to be low. To address these two issues, all studies from patients that had an MRI scan with gadolinium performed within one month after the onset of their sudden sensorineural hearing loss were reviewed. Fifty-one patients met this criteria. These studies were re-reviewed by a neuroradiologist (W.M.L.) to determine if subtle abnormalities existed within the MRI. Audiometric studies and treatment results were compared with MRI findings. MRI abnormalities were divided into the respective locations; middle ear, cochlea, eighth nerve complex, brainstem or cerebrum. The results are presented with examples of each abnormality.

We believe that MRI with gadolinium performed shortly after sudden sensorineural hearing loss is required to rule out treatable causes of the hearing loss. Properly performed, these tests provide vital information regarding the etiology of sudden sensorineural hearing loss.

OBJECTIVES:

1. To describe MRI findings in patients who experience sudden sensorineural hearing loss.
2. To present possible etiologies of sudden sensorineural hearing loss based on MRI findings.
3. To emphasize the need for MRI to complete the diagnostic work-up of sudden sensorineural hearing loss.

PLASMAPHERESIS IN AUTOIMMUNE INNER EAR DISEASE LONG -TERM FOLLOWUP

Charles M. Luetje, M.D.

Eight patients who underwent plasmapheresis (PMP) during treatment for autoimmune inner ear disease (AIED) were reported in 1989. Followup at that time ranged from 10 to 44 months. Most (6/8) showed some improvement and stability of hearing. Followup was obtained six years later. Of the 16 ears, hearing was improved and stable in 3, same and stable in 6, worse but fluctuant in 2, worse but stable in 1 and not usable in 4, one of whom developed an acoustic tumor. An additional 13 patients underwent PMP. Six of these had PMP elsewhere which made accurate assessment difficult. Of the remaining 7, followup for over two years was obtained in 4; hearing was the same and stable in 3. Followup was too short in the others, but clearly 1 obtained no benefit. In 16 patients with accurate followup, 12 were not taking steroids or cytotoxic drugs. PMP appears beneficial in some patients as adjunctive therapy in AIED.

OBJECTIVES:

1. **To review long term results of plasmapheresis in autoimmune inner ear disease.**
2. **To establish efficacy of plasmapheresis in some patients as part of treatment for autoimmune inner ear disease.**
3. **To propose earlier use of plasmapheresis in treatment of autoimmune inner ear disease.**

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RADIATION-INDUCED TUMORS OF THE TEMPORAL BONE

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Michael J. Lanser, M.D.

Radiation therapy (RT) is a valuable, life-saving adjunct in the treatment of head and neck malignancies. With refinements in its application, radiation therapy involving the temporal bone is becoming increasingly widespread for a variety of otologic conditions, including meningioma, schwannoma, glomus tumors, and other central nervous system tumors. To date, little attention has been given to one of the most worrisome long-term complications of this therapeutic modality, radiation-induced tumors (RIT) of the temporal bone. We present 5 cases of RIT of the temporal bone: 2 osteosarcomas, 2 fibrosarcomas, and one squamous cell carcinoma. All 5 temporal bone tumors occurred in individuals that had previously received 50 cGy or more of radiation. The initial histologic diagnoses included 2 astrocytomas, a glomus jugulare, a malignant schwannoma, and a vestibular schwannoma. There was an average latency period of 17 years (range 7-23 years) between completion of radiation and diagnosis of the RIT. Four patients were treated with resection plus chemotherapy and 1 decided against therapy. The prognosis was poor, with survival time ranging from 7-13 months after diagnosis was made. Though RIT of the temporal bone occurs with a very low incidence, its possibility should be factored in when deciding upon the most appropriate therapeutic modality.

OBJECTIVES:

1. **To discuss the rare but devastating complication of radiation-induced tumors of the temporal bone.**
2. **To present 5 cases of radiation induced tumors of the temporal bone, identifying characteristics, presentation, etc.....**
3. **To discuss the outcome of these tumors and the implications for choosing radiation versus surgery for otologic conditions or tumors.**

INTRACRANIAL COMPLICATIONS OF TEMPORAL BONE OSTEORADIONECROSIS

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Douglas Anderson, M.D., Edward Melian, M.D.,
Mark A. Severtson, M.D.

Radiation induced osteonecrosis of the temporal bone contributed to the development of life-threatening intracranial complications in 4 patients seen between 1987 and 1994. The primary tumor site for which radiotherapy was delivered included the brain, the nasopharynx, the external auditory canal, and the parotid gland. The period between the completion of radiotherapy and the observed complications ranged from 12 to 26 years and the radiation dosage ranged from 60 to 72 Gy.

One patient presented with a brain abscess and an ipsilateral carotid artery aneurysm, another patient developed sigmoid sinus thrombosis with meningitis, and 2 patients had meningitis with epidural abscesses. All 4 patients had long-standing otorrhea as a preceding symptom and all patients developed otalgia with headache.

This paper will discuss the pathophysiology of intracranial complications associated with temporal bone osteoradionecrosis. The prevention, diagnosis, and treatment options will be addressed through these case presentations.

OBJECTIVES:

1. To review the pathophysiology of osteoradionecrosis of the temporal bone.
2. To present 4 cases of intracranial complications related to temporal bone osteoradionecrosis.
3. To discuss the management of intracranial complications associated with osteoradionecrosis of the temporal bone.

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ENDOVASCULAR OCCLUSION OF THE CONDYLAR VEIN AND INFERIOR PETROSAL SINUS IN JUGULAR FORAMEN SURGERY

Moises A. Arriaga, M.D., David Carrier, M.D.

Surgery of the jugular bulb requires adequate vascular control of the sigmoid sinus, jugular vein, inferior petrosal sinus (IPS) and condylar vein (CV). The IPS and CV are not addressed by maneuvers which occlude the sigmoid sinus and jugular vein prior to opening the jugular bulb. Bleeding from the IPS and CV requires packing these structures after opening the jugular bulb. Although packing is effective, the packing often must be repositioned to accurately occlude the bleeding ostia without interfering with tumor removal or causing pressure on the lower cranial nerves. This report describes a technique of preoperative embolization of the IPS and CV to minimize bleeding upon opening of the jugular bulb.

During preoperative angiography, detachable metal coils are positioned in the lumens of the IPS and CV. Surgery proceeds within 48 hours of embolization. The jugular bulb is approached in the usual fashion with occlusion of the jugular vein and sigmoid sinus prior to opening the lumen of the bulb. Our initial cases with this technique have resulted in substantially decreased bleeding upon opening the bulb compared with cases in which the IPS and CV were not occluded with endovascular coils.

Preoperative occlusion of the IPS and CV should be considered if surgery requires opening the lumen of the jugular bulb. Our preliminary experience with detachable coils is encouraging, additional experience and long-term follow-up is necessary before this technique can be recommended routinely for jugular bulb surgery.

OBJECTIVES:

1. To describe the technique of endovascular occlusion of the condylar vein and inferior petrosal sinus.
2. To describe the clinical applications of endovascular occlusion in jugular foramen surgery.
3. To outline clinical studies necessary before routine application of this technique in jugular foramen surgery.

MANAGEMENT OF COMPLICATIONS FROM TEMPORAL BONE FRACTURES

Hilary A. Brodie, M.D., Ph.D., Teresa C. Thompson, D.V.M.

A retrospective review of 708 patients with temporal bone fractures admitted to the University of California, Davis, Medical Center, during the period January 1987 to October 1992 was conducted. The incidence and outcomes of cerebrospinal fluid fistula, meningitis, facial nerve trauma, and hearing loss were analyzed. One hundred-forty-two patients developed cerebrospinal fluid fistula, of which 95 percent closed spontaneously, or with the use of lumbar drains. The remaining seven patients required surgical closure. Surgical closure is recommended for cerebrospinal fluid leaks persisting for greater than ten days. The incidence of bacterial meningitis was less than two percent. Prophylactic antibiotics are not indicated in uncomplicated temporal bone fractures, but do have a role in the management of cerebrospinal fluid fistula. Controversies regarding prophylactic antibiotics in this patient population are reviewed. Immediate complete facial paralysis required surgical intervention, whereas delayed onset, or incomplete facial palsies resolved spontaneously. Early assessment in the emergency room is of the utmost importance in predicting outcome and consequently guiding management recommendations. Cholesteatomas occurred infrequently and were generally a result of epithelial migration through a defect in the scutum, or as a result of canal stenosis, trapping epithelium medially. Current management strategies for the complications of temporal bone fractures are presented.

OBJECTIVES:

1. To describe the characterization of morbidity of temporal bone fractures.
2. To describe the management of facial nerve injuries.
3. To describe the management of cerebral spinal fluid fistulae.

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CLINICAL AND SURGICAL IMPLICATIONS OF RECENT DATA ABOUT THE MECHANICS OF THE HUMAN MIDDLE EAR

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It is commonly believed that the middle ear gain is about 30 dB, and that it is determined by the area ratio and ossicular lever. Investigations into the mechanics of the human middle ear in our laboratory and those of others (e.g., Richard Goode, M.D.) over the last several years have shown that this simple concept is not entirely accurate. These investigations have shown that: 1) The middle ear acts as a frequency selective amplifier with a maximum gain of 20-25 dB at 1-2 kHz, and a gain of only 10-20 dB at higher and lower frequencies. 2) The frequency distribution and size of this gain is the result of constraints imposed by the mechanical properties (i.e. impedance) of the tympanic membrane (TM), ossicles and cochlea. 3) The amount of middle ear gain varies by as much as 10 dB in normal ears. 4) An important concept in middle ear transmission is that the difference of acoustic pressures acting on the oval and round windows (called acoustic coupling) adds to the ossicular chain pressure (called ossicular coupling) to produce cochlear input. In normal ears, acoustic coupling is negligibly small, but it can play a significant role in ears with lesions of the TM and/or ossicles.

These data have implications with regards to our way of thinking about *sound conduction in the diseased middle ear*: 1) The finding of surprisingly small air-bone gaps despite alterations of the TM such as extensive atelectasis, tympanosclerosis, etc might be explained on the basis of reduced ossicular coupling occurring in combination with optimal acoustic coupling. 2) Residual hearing in cases of total loss of the TM and ossicles, or in cases of ossicular chain discontinuity with an intact TM can be explained on the basis of acoustic coupling, without invoking bone conduction. 3) It is possible for identical lesions of the middle ear to lead to differing sizes of air-bone gaps, depending on the impedance of the cochlea.

The data also have important implications with respect to *surgical techniques of middle ear reconstruction*: 1) The difference in *magnitude* of sound pressure between the oval and round windows is much more important than *phase* difference in determining the hearing result. 2) A good hearing result is dependent not only on the efficiency of the reconstructed TM-ossicular chain but also on the adequacy of acoustic coupling. For example, a TM-TORP reconstruction that provides 0 dB ossicular gain might still result in an air-bone gap of $\leq$ 20 dB if there is adequate aeration and protection of the round window. 3) It is possible for identical reconstructions to lead to differing amounts of air-bone gaps.

OBJECTIVES:

1. To describe recent data about the mechanics of the human middle ear.
2. To discuss the clinical implications of these data with respect to sound conduction in the diseased and reconstructed ear.
3. To demonstrate how interaction between clinicians and basic scientists can be fruitful and lead to a better understanding of the acoustics of the diseased and reconstructed middle ear.

THE USE OF ORGANOTYPIC CULTURES OF CORTI'S ORGAN TO STUDY THE PROTECTIVE EFFECTS OF ANTI-OXIDANT MOLECULES ON CISPLATIN INDUCED DAMAGE OF AUDITORY HAIR CELLS

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Cisplatin is an effective chemotherapeutic agent for a variety of malignancies. Ototoxicity, eripheral neuropathy, and nephropathy increase with cumulative cisplatin dosage limiting the usefulness of this drug. A large percentage of children and adults receiving high dose cisplatin therapy develop significant sensorineural hearing loss. Nephrotoxicity has been reduced througth the use of hydration and diuretics, and treatment with neurotrophic molecules has been shown to reduce the incidence of peripheral neuropathy. However, little progress has been made clinically in reducing ototoxicity. Despite the well-known association between cisplatin therapy and hearing loss much remains to be learned about the biochemical mechanism of cisplatin ototoxicity.

We have developed an in vitro model using rat organ of Corti explants to study the mechanisms underlying toxicity of cisplatin for auditory hair cells. In vitro data from this model suggests that cisplatin may interfere with the cochlear anti-oxidant defense system. Reduced glutathione is an important intermediate in the cochlear anti-oxidant defense system. Organ of Corti explants exposed to cisplatin in vitro demonstrate: 1) a sharp rise in the formation of reactive oxygen species; 2) a reduction in intracellular glutathione levels; and 3) alteration in the activity levels of several important anti-oxidant enzymes, e.g., glutathione-s-transferase, glutathione reductase and catalase.

In the organ of Corti explants a number of thiol containing and anti-oxidant compounds limit the amount of cisplatin induced auditory hair cell destruction. Diethyldithiocarbamate (DDTC), methylthiobenzoic acid (MTBA), sodium thiolsulfate, reduced glutathione, rutin, trolox and ascorbate all cause reduction in cisplatin induced hair cell damage when used either as individual treatment agents or in some cases as a combined treatment. These agents protect against cisplatin induced damage through a variety of mechanisms. DDTC may chelate cisplatin and reverse the inactivation of anti-oxidant enzymes. MTBA appears to intracellulary inactivate cisplatin by binding to it. Glutathione is an important intracellular free radical scavenger and protects key protein sulfhydryl groups from oxidation. Rutin, trolox, and ascorbate limit free radical damage to cell membranes. The in vitro protective effects of these agents correlate with evidence of in vivo otoprotection and underscore the importance of the anti-oxidant system as a target for cisplatin.

This in vitro model of cisplatin auditory hair cell toxicity has provide further clarification of our understanding of cisplatin induced auditory hair cell toxicity. These in vitro studies suggest that cisplatin interference with the anti-oxidant defense system of the cochlea plays a role in the genesis of hair cell damage by this agent. In support of this hypothesis a variety of thiol compounds and anti-oxidants were shown to limit auditory hair cell damage by cisplatin. These agents or related compounds may prove to be clinically relevant in limiting cisplatin ototoxicity in the future.

OBJECTIVES:

1. To establish the validity of organotypic cultures of the juvenile rat organ of Corti as a model system for the study of cisplatin ototoxicity.
2. To characterize the effects of cisplatin exposure on the anti-oxidant system in organ of Corti explants.
3. To discuss screening and identification of molecules that affect the inner ear's anti-oxidant system

GLYCOLIPID ANTIGENS IN THE HUMAN COCHLEOVESTIBULAR SYSTEM

Elias M. Michaelides, M.D., Aristides Sismanis, M.D.

Glycolipids are molecules located on the surface of normal nerve cells. Recently, antibodies against sulfated glucoronyl glycolipids (SGGL) antigens have been implicated in the pathogenesis of immune mediated peripheral neuropathies such as Guillain-Barre Syndrome and demyelinative polyneuropathy. SGGLs have been reported to be present in peripheral nerves, optic nerve, sympathetic ganglia, and cerebellar cortex. Antibodies to SGGL antigens in the sera of patients with immune-mediated cochleovestibular disorders have also been identified. The presence of SGGL's in inner ear structures and cochleovestibular nerve has not been previously reported.

In this study, we examined vestibular neuroepithelia, cochleovestibular nerves, and endolymphatic duct and sac tissues for the presence of sulfated glucoronyl paragloboside (SGPG), a common SGGL. These tissues were obtained from patients undergoing neurotologic procedures for acoustic neuromas or intractable Meniere's disease. All twelve specimens, except endolymphatic duct were found to contain SGPG. We speculate that SGGLs may plan an important role as antigens in immune-mediated processes affecting not only inner ear structures but also the cochleovestibular nerve.

OBJECTIVES:

1. To establish the presence of sulfated glucoronyl glycolipids (SGGLs) in inner ear structures and cochleovestibular nerve.
2. To discuss the role of glycolipid antigens in autoimmune neuropathies.
3. To suggest that SGGLs may play a role in immune-mediated cochleovestibular disorders.

HAIR CELL FORMATION IN CULTURES OF DISSOCIATED CELLS FROM THE VESTIBULAR SENSORY EPITHELIUM OF THE BULLFROG.

R. Cristobal*,M.D., I. Lopez, Ph.D. D. Honrubia, C. Zamora, A. Espinosa de los Monteros[1], Ph.D., Vincente Honrubia, M.D.

A culture of dissociated cells from the vestibular epithelium of the bullfrog was developed. In this system, the in vitro production of hair cells (HCs) from isolated precursors was demonstrated for the first time. Vestibular end organs were treated with collagenase, and further dissociated mechanically. Cells were plated into 4 wells and maintained in Medium 199 supplemented with 10% bovine serum. New HCs were consistently observed after 3 days, and for as long as 7 days of culture with time-lapse photography. The criteria for defining new HCs were as follows: identification of the nucleus, cylindrical or pear morphology, and the presence of stereocilia and/or kinocilium. In order to confirm the identity of new HCs, cultures were processed by immunocytochemistry for the detection of calmodulin. This protein is present in the sensory cells but not in any other cells of the inner ear (1). In our cultures, calmodulin was only found in elements that meet the above criteria for HCs. Histological verification was also obtained with phalloidin-rhodamine staining of the actin filament in the HC cytoskeleton including the kinocilium. Finally, in order to demonstrate in vitro post-mitotic HC formation, four experiments were conducted. In each experiment, one culture was given a 3 hour BrdU pulse on day 3 post-plating, another culture was pulsed on day 4, and the third culture on day 5. Cells were allowed to survive for two additional days and then processed for BrdU immunocytochemistry. The total number of cells in the culture, as well as the numbers of BrdU positive and BrdU negative HCs, was assessed. Results (mean cell number $\pm$ standard error) are shown in the following table:

Time of BrdU Application/ Fixation	Mean Cell Number	Mean BrdU$^+$ Cell Number	Mean HC Number	Mean BrdU$^+$ HC Number
Days 3/5	1676.33$\pm$342.83	159.00$\pm$43.90	29$\pm$ 6.03	8.66$\pm$1.33
Days 4/6	1013.66$\pm$200.20	86.75$\pm$37.09	24$\pm$ 4.51	8.66$\pm$1.67
Days 5/7	1068.66$\pm$148.84	131.50$\pm$29.62	12$\pm$ 3.46	3$\pm$1.00

Statistical analysis revealed that the percentage of HCs in the cultures surviving 6 days (2.4%) was the greatest, and significantly different from the other two cultures. The percentage of BrdU labelled cells was not significantly different among cultures using an unpaired t-test ($p<0.05$). These findings indicate that the rate of precursor proliferation (i.e. BrdU incorporation) remains constant.

In conclusion, evidence of in vitro HC formation has been obtained. BrdU immunoreactivity demonstrated that 2 days are sufficient for the completion of the process of cell division and differentiation into HCs that meet the above criteria The development this new method to culture isolated new hair cells provides new opportunities to study the molecular biology and cell biology of hair cells (Supported by NIDCD grant DC 01404).

(1) Calcium Binding Proteins in the Inner Ear of Xenopus laevis. H. Kerschbaum and A. Hermann. Brain Research 617 (1993) 43-49.

OBJECTIVES:

1. A new method for the dissociation and culture of hair cells and their precursors was developed.
2. The newly created system was utilized to demonstrate the formation of new hair cells in culture from disociated precursors.
3. The mitotic mechanism of hair cell formation was documented.

PREDICTIVE VALUE OF INTRAOPERATIVE BRAINSTEM AUDITORY EVOKED RESPONSES IN SURGERY FOR CONDUCTIVE HEARING LOSS

Samuel H. Selesnick, M.D., Jonathan D. Victor, M.D., Ph.D., Ravi K. Tikoo, M.D.

Surgical repair of conductive hearing loss can be performed under local or general anesthesia. Local anesthesia is simple and requires neither the cost nor the time spent recovering from general anesthetic agents. In addition, subjective assessment of the quality of hearing and the presence of tinnitus or vertigo can be performed under local anesthesia. There are, however, limitations that have led some otologic surgeons to general anesthesia. Under general anesthesia, there is no time limit for surgery, so that unanticipated surgical findings can be dealt with in an unhurried manner. This is particularly important at institutions involved with residency education. The greatest advantage of general anesthesia, however, is not excellent analgesia, but rather, that the patient will remain totally immobile throughout the surgery. Patient motion can lead to disaster in the form of deafness, vertigo and facial paralysis. The use of intravenous sedation with local anesthesia can be helpful, but, if sufficient does not address the problem of restlessness. If sedation is too deep, the result can be a restless, and incoherent patient who cannot be reasoned with. Despite its advantages, general anesthesia for otologic surgery eliminates intraoperative communication with the patient, so that questions regarding improvement in hearing, tinnitus and vertigo can only be answered post operatively.

The use of BAER for intraoperative monitoring of hearing during cerebellopontine angle surgery has been well documented in the literature. The brainstem auditory evoked response (BAER) required no conscious patient participation, and remains unchanged under general anesthesia.

The goal of the present study was to assess the use of BAER under general anesthesia during otologic surgeries for conductive hearing loss, and to assess its predictive value for post operative hearing. Thirty patients met criteria for inclusion into the study protocol. All were operated on by the senior author (SHS) at the New York Hospital-Cornell Medical Center between September of 1993 and July of 1995 . Surgeries were performed to correct a conductive hearing loss and included canalplasty, tympanoplasty, ossiculoplasty and stapedotomy. BAERs were performed after induction of general anesthesia and then again once reconstruction had been performed. At least two tracings were performed at each time interval. If no discernable tracing was found after 3 attempts, the trial was concluded, otherwise at least two similar tracings were averaged to obtain introoperative data. Puretone and speech audiometry were performed preoperatively and approximately three months post operatively.

Using a chi square analysis , a statistically significant correlation between a decrease in the wave V latency and a 25 dB postoperative improvement in relative air conduction thresholds and speech reception thresholds was found. In addition, there was a statistically significant relationship between a decrease in the wave V latency and a 25 dB relative decrease in the postoperative air-bone gap.

Just as intraoperative facial nerve monitoring during acoustic neuroma surgery has given the otologic surgeon the ability to predict long term facial outcome, so, too, does intraoperative BAER allow prediction of postoperative hearing in patients requiring general anesthesia for surgery of conductive hearing loss.

OBJECTIVES:

1. To review use of intraoperative BAER.
2. To review surgical anesthesia requirements for surgery for conductive hearing losses.
3. To assess role of BAER in predictive hearings outcomes in surgery for conductive hearing loss.

INTRAOPERATIVE ELECTROCOCHLEOGRAPHY DURING STAPEDECTOMY AND OSSICULAR RECONSTRUCTION

Jack Wazen, M.D., Ronald Emerson, M.D., David Foyt, M.D.

Transtympanic electrocochleography (ECOG) was performed on 22 patients undergoing a stapedectomy or an ossicular reconstruction under general anesthesia. In each patient, the N1 threshold to click stimulation was measured before and after the reconstruction. Post - reconstruction ECOG's demonstrated improvement of the N1 threshold in 18 cases, and were unchanged in one. Technical failures occured in 3 cases with uninterpretable results. Improvement in the intraoperative N1 threshold corresponded with improvement in the speech reception threshold and the pure tone average in all but one patient.

Intraoperative ECOG appears to be an effective tool for verifying the functional integrity of ossicular reconstructions. We speculate that intraoperative ECOG may allow the surgeon to "fine tune" the reconstruction and optimize the hearing results under general anesthesia.

OBJECTIVES:

1. To present the results of intraoperative electrocochlegraphy in stapedectomy and ossicular reconstruction.
2. To describe the technique used.
3. To suggest the use of intraoperative ECOG as a predictor of post-operative hearing improvement.

PERSPECTIVES ON A STATE ENACTED HEARING SCREENING AND ASSESSMENT PROGRAM IN THE NEWBORN POPULATION

Mark J. Abrams, M.D., Myles L. Pensak, M.D., Karen Buhrer, M.A.

On a nationwide basis interest in the early identification of the hearing impaired infant has grown significantly over the last quarter century. In March of 1988, a law was enacted in the State of Ohio which required hearing screening and, under certain circumstances, assessment of newborn children. While the value of such a program engendered little early public debate, the institution of such a program represented a significant challenge, from a public health perspective.

This report examines the problems encountered in the implementation of a state mandated screening program. Included as part of the analysis are data gleaned from the index group of 160,000 live births reflecting perspectives on resources, regulations, medical and socioeconomic guidelines; as well as, the implications of this type of legislation upon the clinician.

OBJECTIVES:

1. To present background and progress information on the State Infant Hearing Screening and Assessment Program.
2. To review the pragmatic problems for clinicians involved in the screening process.
3. To assess the future direction and needs of the Program that should be addressed.

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ALLERGIC EUSTACHIAN TUBE DYSFUNCTION: DIAGNOSIS AND TREATMENT

M. Jennifer Derebery, MD, Karen I. Berliner, Ph.D.

While the role of allergy in the production of chronic serous otitis media has long been recognized, allergic factors influencing other forms of eustachian tube dysfunction may be less obvious. An allergic etiology may found for symptoms as diverse as the patulous eustachian tube and the "full ear" seen in eustachian tube dysfunction without a serous effusion.

A retrospective study was done of 120 patients presenting to the House Ear Clinic Allergy Department from 1986 through 1995 with a diagnosis of eustachian tube dysfunction. Otoscopic findings and allergic test results will be discussed, as well as treatment outcome.

The posterior nasopharynx is most likely the physiologic site serving as the target organ of the allergic reaction. Allergic edema of this area can result in the unique effect of either producing a eustachian tube that is "too congested" or, by affecting muscle contraction of the Tensor Veli Palatini, produce a patulous eustachian tube. Either problem can result in "a full ear" with little to distinguish between them on physicial examination. As the decongestent treatments commonly employed for eustachian tube dysfunction may actually increase the symptoms of a patulous eustachian tube, specific historical factors suggesting an underlying allergic cause will be emphasized, as well as treatment options by specific immunotherapy.

OBJECTIVES:

1. **To review and differentiate the clinical presentations of eustachian tube dysfunction that may be caused by allergic disease.**
2. **To present the results of inhalant and food allergy testing on patients suspected of allergic eustachian tube dysfunction.**
3. **To retrospectively present an outcome analysis of the results of allergic management on the symptom of eustachian tube dysfunction by both patient questionnaire and chart review.**

VAGAL NERVE MONITORING: A COMPARISON OF TECHNIQUES IN A CANINE MODEL

Mark A. Severtson, M.D., John P. Leonetti, M.D.

Recent advances in intraoperative cranial nerve monitoring have decreased the probability of iatrogenic neural injury during head, neck, and skull base surgery. Vagal nerve monitoring may be useful during tumor removal from the parapharyngeal space, infratemporal fossa, and the jugular foramen. This information may diminish the risk of iatrogenic denervation of the laryngeal musculature and the pharyngeal plexus which results in abnormalities of speech, swallowing and airway protection. The purpose of this study was to compare a variety of techniques used to intraoperatively monitor the vagus nerve.

Four techniques of vagal nerve monitoring were evaluated. Three techniques directly monitor the thyroarytenoid muscle which is innervated by the recurrent laryngeal nerve. Bipolar electrodes were inserted directly into the vocalis muscle in the first two methods and the mode of insertion distinguishes these methods. One electrode was introduced transcutaneously through the cricothyroid membrane while the other was place via direct laryngoscopy. The third method of monitoring the vocalis muscle utilizes a surface electrode incorporated in a specialized endotracheal tube which straddles the true vocal cords. The fourth vagal monitoring technique also utilizes a laryngeal surface electrode. here, it abuts the extrinsic laryngeal musculature in the postcricoid space of the hypopharynx.

The sensitivities of each technique were measured in a canine larynx because it is comparable in size and histology to the human larynx. After placing each monitoring device, the vagus nerve was identified in the neck. The nerve was sequentially stimulated at a constant current of 4.1 Hz with increasing intensity (starting at 0.05 mAmps) to determine the techniques minimum threshold. A positive response at the vocal cord was defined as a train of four contractions of 50 mVolts or greater. The optimal method of intraoperative vagal nerve monitoring was thereby identified.

OBJECTIVES:

1. To educate the audience as to the development and usefulness of intraoperative vagal nerve monitoring during the resection of parapharyngeal space tumors.
2. To educate the audience as to the specific techniques currently available for intraoperative vagal nerve monitoring.
3. To present data (canine model) identifying the most efficient technique of intraoperative vagal nerve monitoring.

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COGNITIVE EVOKED POTENTIALS IN SPEECH STIMULI IN NORMAL HEARING SUBJECTS AND PATIENTS WITH COCHLEAR IMPLANTS

Paul R. Kileny, Ph.D., Teresa A. Swolan, Ph.D., Angelique Boerst, M.A.

The electrophysiological testing of cochlear implant patients has several clinical goals: 1) to determine detection thresholds; 2) to assist in cochlear implant programming and adjustment; and 3) to determine or predict speech recognition abilities. The electric ABR and MLR have proven to be appropriate measures to determine thresholds of electrical excitability. These evoked potentials, however, are not effective in predicting speech recognition or other discrimination abilities with the cochlear implant. The present study, therefore, was conceived in an attempt to investigate the relationship between cognitive evoked potentials and speech recognition abilities in patients with cochlear implants. The study involves P300 and Mismatched Negativity (MMN) responses to three contrasts involving speech stimuli: 1) a CVC contrast (heed vs. who'd); 2) a VCV contrast (ama vs. asa); and 3) a spondee word contrast (baseball vs. armshair). Eleven normal hearing and 11 implanted subjects participated in this study. In order to eliminate loudness cues the stimuli were delivered using a roving loudness paradigm. This involved randomly varying the intensity of both the frequent and rare stimuli over a 10 dB range. This is advantageous especially in cochlear implant patients who may respond to a loudness difference rather than a phonemic or phonetic difference. This paradigm was compared to a constant loudness using the same stimuli in all subjects. Results indicated a statistically significant different between cognitive evoked potential latencies in the normal hearing and implanted group. The cochlear implant patients were divided based on speech recognition abilities into a "better" and "poorer" groups. When comparing these two groups there was a trend for latencies of responses from the "poorer" group to have longer MMN and P300 latencies. Furthermore, for several of the stimuli used in this study there were relatively high negative correlations between speech recognition scores (CID Sentences, NU6) and MMN (or possibly N2B) latencies. These results are encouraging and indicate that speech evoked cognitive evoked potentials may be used in patients with cochlear implants effectively.

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OBJECTIVES:

1. To provide fundamental information on P300 and MMN.
2. To provide information regarding differences between normal hearing and cochlear implant subjects in P300 and MMN parameters.
3. To provide information regarding the relationship of P300 and MMN measures and speech recognition in cochlear implant patients.

ELECTROPHYSIOLOGICAL METHODS IN COCHLEAR IMPLANT ASSESSMENT

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With the advent of cochlear implant technology many psychoacoustic and behavioral te sts have been developed to determine the interface between device integrity and patient function. Electrophysiological tests also have been applied and found to provide important and useful information in determining the functional benefit of electrical stimulation of the cochlea. With the 1990 FDA approval of the Nucleus 22-channel cochlear implant in children, the task of assessing benefit became much more challenging. Fortunately, electrophysiological techniques can be readily applied to pediatric cochlear implant users for a variety of purposes within the scope of a cochlear implant program.

Electrophysiological techniques in children with cochlear implants have the potential to trace cochlear implant function from the device to the high level processing centers of the brain, without the structured cooperation of the child. Such measures may also overcome the child's inability to perform behavioral tasks due to limits in language sophistication or maturity in understanding the task.

Electrophysiological measures are an integral part of both the Pediatric and Adult Cochlear Implant Programs at the Medical College of Virginia. Facial nerve activity is routinely monitored intra-operatively. Once the internal processor and intra-cochlear electrode array are in place, device integrity is assessed using Averaged Electrode Voltages (AEVs). Electric ABRs (EABRs) are obtained on at least three electrodes in the implant array: one basal, one apical, and one medial, as well as any electrode that yields an unusual AEV. In cases of partial insertion of the electrode array, information from the intra-operative EABR is important in streamlining the initial programming of the speech processor.

Because electrically elicited acoustic reflex thresholds (EARTs) are so well correlated with loudness comfort levels, they are effectively used post-operatively in programming the cochlear implant speech processor, particularly in our pediatric program. A battery of electrophsyiological tests has been performed on a group of 28 children from our Pediatric Cochlear Implant Program. One goal was to trace cochlear implant integrity and function through the various levels of the auditory system with limited participation from the child. A second goal of the battery was to determine the feasibility of post-operative electrophysiological measures with young cochlear implant users. The battery includes EARTs, AEVs, EABRs, electric Middle Latency Responses (EMLRs), and electric P300 (EP300s) cortical responses. The results of data analysis of each subtest will be presented.

There are several practical issues which require consideration in applying electrophsyiological measures to children with cochlear implants. Most are related to ensuring favorable recording conditions. This requires controlling both electrical and subject "noise" sources. The methods which we employ to address these issues will be presented.

OBJECTIVES:

1. To review electrophysiological measures currently applied to cochlear implant assessment.
2. To present data obtained from an electrophysiological test battery in use in the Pediatric CI Program at Medical College of Virginia.
3. To present practical issues in performing electrophysiological measures with pediatric cochlear implant users.

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PROMONTORY ELECTRICAL STIMULATION IN PATIENTS WITH HEARING LOSS AFTER MIDDLE CRANIAL FOSSA ACOUSTIC TUMOR REMOVAL

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The middle cranial fossa approach to acoustic tumor removal, with the goal of hearing preservation, has proven to be very successful in properly selected patients. Recent refinements in our technique have led to improved postoperative outcomes. Despite these refinements, total hearing loss after attempted auditory preservation still occurs. This postoperative hearing loss, in the presence of cochlear nerve preservation, is felt to result from vascular insult to the cochlea or auditory nerve, or direct trauma to the nerve. Although patients with unilateral hearing loss are not severely disabled, those with neurofibromatosis 2 and bilateral total hearing loss are severely disabled. More than 40 patients with neurofibromatosis 2 and total deafness have undergone rehabilitation with the auditory brainstem implant (ABI). In general, results with the ABI are not as favorable as those in the average cochlear implant patient. The purpose of this study was to investigate the possibility of cochlear implantation in patients with postoperative hearing loss after middle cranial fossa surgery and cochlear nerve preservation. Six patients who underwent middle cranial fossa acoustic tumor resection and suffered postoperative anacusis were studied using promontory electrical stimulation. Three of the six patients had a positive response to stimulation indicating a functional cochlear nerve. These data and their implication for the role of cochlear implantation in this patient population are discussed.

OBJECTIVES:

1. To make the otologic community aware of the potentials for cochlear implantation after total deafness from NF2.
2. To review our management of NF2 patients.
3. To describe evidence for a cochlear etiology for postoperative hearing loss.

COMMUNICATION OUTCOMES RELATED TO EARLY COCHLEAR IMPLANTATION

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Development of oral language and speech production in young profoundly deaf children requires access to a broad spectrum of sound not always available through conventional amplification. Cochlear implants have provided an option for those who cannot benefit from hearing aids. Although numerous publications have reported significantly improved speech perception post-implantation, reports on the development of oral communication skills in young implanted children have been very limited. The purpose of this study was to evaluate the oral language and speech production development in profoundly hearing impaired children implanted below 5 years of age.

The subjects were 33 children under the age of 5 years who received the Nucleus multichannel cochlear prosthesis at NYU Medical Center. The children were evaluated preoperatively and postoperatively at NYU Medical Center for speech perception and at the League for the Hard of Hearing for language development and speech production as part of the joint program between the two institutions. 21 of the children were congenitally deaf and 4 had meningitis prior to the age of 2 years. Language-vocabulary, language-syntax and speech production measures were collected preoperatively and 6, 12, 24 and 36 months postoperatively. Spoken language-vocabulary was assessed using the Peabody Picture Vocabulary test (PPVT) and the Expressive One Word Picture Vocabulary test (EOWPVT) while spoken language-syntax/morphology was measured using the Expressive Language Rating Scale. The development of speech production skills was evaluated using CID Phonetic Inventory Samples which documents suprasegmental, vowel and consonant production over time. Although formal speech perception testing was performed at the implant center, a functional listening evaluation including the Early Speech Perception test and AB monosyllabic words were conducted as part of the communication evaluation allowing for a comparison between speech perception and speech production.

Over the 3-year postoperative period, the mean growth in receptive vocabulary was 33 months. A mean growth of 48 months in expressive vocabulary for the same time period was noted; however, children implanted below the age of 3 years, had 53 months growth in expressive vocabulary. The mean preoperative score on Expressive Language Rating Scale was 2 on the scale of 1-8: 1 equalling vocalizations without words and 8 being the use of complex/compound sentences. 3 years postoperatively the mean rating was 7, that is, the use of simple sentences with verb tenses marked and other grammatical elements beginning to emerge. For production of suprasegmental aspects of speech the mean preoperative score was 32% and 3 years postoperatively was 90%. The preoperative production scores for vowels and consonants were 24% and 8%, respectively while the 3-year testing interval production scores were 88% for vowels and 69% for consonants.

These results clearly demonstrate significant improvement in language acquisition and speech production in children implanted below age 5, emulating previously reported gains in speech perception. Factors including the nature and frequency of device programming, rehabilitation, parental involvement and educational setting contribute to the development of linguistic skills following implantation.

OBJECTIVES:

1. To document growth in receptive and expressive spoken language acquisition in a group of children implanted before 5 years of age.
2. To document growth in speech production in a group of children implanted before 5 years of age.
3. To determine the effects of very early implanatation (before 3 years) on oral communication development.

EDUCATIONAL NEEDS AND COST-BENEFIT CONSIDERATIONS IN CHILDREN WITH COCHLEAR IMPLANTS

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While educational "mainstreaming" of the implanted child is an important goal and is often realized with early implantation, the financial costs and benefits entailed by this and other outcomes are key to an initial assessment of cost-benefit. This information will contribute to assessment of the overall cost-effectiveness of cochlear implants in children. Full assessment of cost-effectiveness will depend on:

- the availability and utilization of appropriate educational and rehabilitation services,
- the degree to which speech and language benefits lead to improved speech perception and production, reading comprehension, and other functional capabilities that impact social, educational, and vocational options,
- the impact of the device on general measurements of quality of life.

As an initial step in determining the cost-effectiveness of the device in children, we tracked patterns of use of educational and rehabilitative resource utilization of 35 children in the Johns Hopkins Cochlear Implant Program. We used a matrix that classifies school setting (residential vs. special education vs. nonspecialized "mainstream" setting) and levels of rehabilitative support (speech/language therapy and interpreter use) to map past and current use of these services. We categorized utilization patterns with variables based on age of implantation, duration of deafness, communication mode, linguistic skills, and additional handicapping conditions.

Longitudinal assessment following implantation demonstrates a movement across the continuum toward greater educational independence. Corresponding cost data based on 1995 State of Maryland Department of Education Budget figures indicates that costs per student in highly dependent (residential) settings are more than five-fold greater than those associated with education independent "mainstream" settings. Initial cost-benefit projections based on observed advancement toward educational independence indicate a net present value of the implant to be $99,501 per device (cost savings minus cost). Highly favorable cost-benefit projections will need to be supplemented with measures of the impact of quality of life to determine overall cost-effectiveness.

OBJECTIVES:

1) To provide preliminary assessment of cost-benefit of cochlear implants in children,
2) To describe a method of rating utilization of educational and rehabilitative services by implanted children.
3) To quantify early educational outcomes of cochlear implants and impact of rehabilitative intervention.

COCHLEAR IMPLANTS IN YOUNG CHILDREN: A LONGITUDINAL STUDY OF SPEECH PERCEPTION

Susan B. Waltzman, Ph.D., Noel L. Cohen, M.D., Janet E. Green, M.S.

Measures of speech perception are difficult to obtain in young deaf children since many assessment tools have been standardized on older hearing children who have a more developed language system. As a consequence, the development of auditory skills in young implanted children is often undocumented until several years after implantation. The resulting dearth of published postoperative results has enabled critics of cochlear implants to claim that no data exist to prove that implants provide congenitally deaf children with word/sentence recognition. Although several articles have been published using mean percent correct scores on small numbers of subjects, longitudinal individual data, which can accurately reflect a growth in skills on a large number of children have not been reported. The purpose of this study was to assess the development of open set speech perception in congenitally profoundly hearing impaired children using cochlear implants for 2 years or more. As of July 1995, 83 congenitally deaf children have been implanted with the Nucleus Mini-22 cochlear prosthesis at NYU Medical Center. 59 of the children were below 5 years of age (Group 1) at time of implantation while the remaining 24 children were above the age of 5 (Group 2). The subjects for this study were all children who had been implanted for 2 or more years consisting of 33 of the children in Group 1 and 14 of the children in Group 2. Preoperative and postoperative evaluations included pure tone audiometry under earphones, warble tone audiometry in the sound field (amplification system or implant) and open set measures of word/sentence recognition. Tests used included GASP words and sentences, PBK words, and Indiana phrases. Tests were administered preoperatively and 6, 12, 18, 24, 36, 48 and 60 months postoperatively. If a child could not perform a task at a given test interval, no matter what the reason, the score assigned was 0%.

Results indicated a significant improvement over time in the ability of all children to perceive words and sentences in the implant only condition. The children implanted at a young age did not have the cognitive skills or language ability to perform the necessary word and sentence recognition tasks until several years post-implantation. As a result, although auditory skills begin to emerge within a relatively short period of time post-implantation in the young population, the children did poorly on tests designed for older normal hearing children. The scores were often 0% at the one or two-year testing interval reflecting either the child's inability to perform the task or slowly developing speech recognition abilities. After a lag period, all children received varying degrees of open set speech recognition, confirming that congenitally deaf children derive benefit from cochlear implants. The experience and skill of the surgeons and programmers, the nature and frequency of rehabilitation and the educational setting must be considered as contributing to performance.

OBJECTIVES:

1. To report results on congenitally deaf children using cochlear implants.
2. To document the development of speech perception in young implanted children.
3. To present individual data which can accurately reflect auditory development.

FACIAL NERVE STIMULATION FOLLOWING NUCLEUS 22 CHANNEL COCHLEAR IMPLANTATION

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Facial nerve stimulation is reported to be an uncommon complication of cochlear implantation, occurring in approximately 3% (102/3502) of adults and 1% (26/2442) of children using the Nucleus 22 Channel Cochlear Implant. We are reporting our experience in Denver for a series of two hundred Nucleus 22 Channel Cochlear Implant patients. Among these patients, 14 (7%) have experienced some degree of facial nerve stimulation. The average age at the time of surgery of this patient series (8 females and 6 males) was 39.7 years. Three of the patients were children, implanted at ages two, four and six years of age. All surgeries were performed by experienced otologists. In all adult patients in our series, there was complete insertion of the active electrodes, but in some of these cases, not all of the stiffening rings could be inserted. All three pediatric patients were post meningitis and required surgical drill out procedures. In addition to these fourteen patients, we also provided follow-up programming for two patients with facial nerve stimulation from other implant centers.

The etiology of hearing loss was quite varied for this group. Among the eleven adult patients, etiologies were as follows: otosclerosis (5); trauma (2); and unknown (4). The three children had lost their hearing due to meningitis. Onset of facial nerve stimulation averaged 4.5 months after surgery, ranging from one month to twelve months. In seven patients (4 adults and 3 children), there was facial nerve stimulation at initial programming. The remaining seven adult patients reported onset of facial nerve stimulation at an average of 6.8 months following surgery, ranging from four months to twelve months.

The initial programming mode for all of the adult patients was BP+1 and the children were initially programmed in common ground mode. In our patient series, facial nerve stimulation was typically traced to active mid to apical electrodes. We have been able to control facial nerve stimulation in all of our patients, and the two additional referred patients, through programming mode changes which we will describe in detail. Several patients required more elaborate programming techniques, such as simultaneous multiple programming modes, in order to control facial nerve stimulation. Familiarity with these more elaborate techniques is important for the management of patients with facial nerve stimulation and should be attempted before the decision is made to deactivate electrodes, stop device use or explant the device. None of the patients in our series required explantation of their device due to facial nerve stimulation, and all of the patients are presently using their implants on a daily basis. Our presentation will include further details of electrode location, radiographic findings, and a summary of the programming changes we have employed to resolve facial nerve stimulation.

OBJECTIVES:

1. To present clinical information on 14 patients who developed facial nerve stimulation following multi-channel cochlear implantation.
2. To review the management strategies utilized to successfully resolve facial nerve stimulation in 16 patients.
3. To discuss the possible association of facial nerve stimulation with cochlear otosclerosis and osteoneogenesis.

SOME ANATOMIC OBSERVATIONS ON OTOLITH REPOSITIONING FOR BPPV

Richard A. Buckingham, M.D.

The cause of benign postural positional vertigo (BPPV), a benign disorder of mostly elderly patients, has been blamed on runaway otoliths that are reputed to somehow slip off the utricular macula, wander into the lumen of the membranous labyrinth, and settle on the crista of the posterior semi-circular canal. In this abnormal position, the inertia of the otoliths resting on the cristae causes vertigo when patients change position, especially when they roll over in bed or arise from bed.

An anatomical study of macro, 2-mm thin cross-sections of human temporal bones shows the relation of the utricular macula to the three ampullae and cristae of the semi-circular canals.

The posterior semi-circular canal has been blamed for most of the symptoms of BPPV by mechanism in which the otoconia pass from the macula of the utricle into the common crus and stimulate the far or utriculopedial surface of the crista. That is, the surface of the crista facing away from the utricle. Anatomical evaluation shows that involvement of the crista of the posterior semi-circular canal would more easily be involved by loose otoconia falling off the posterior portion of the utricle and onto the utriculofugal side of the crista, the surface of the crista facing the lumen of utricle. The course through the common crus to the utriculopedial side of the crista is far longer and more tortuous.

Even more interesting anatomically is that loose otoliths, rather than affecting the posterior canal, could more easily slide off the utricular macula onto the utriculofugal crista of the horizontal semi-circular canal.

Thus, patients lying in bed who roll to the right, for instance, should shower their right horizontal semi-circular canal crista with otoconia well before the posterior semi-circular crista could be stimulated. This can be seen on the cross-section.

An additional problem with the present repositioning treatment is that loose otoliths, once repositioned onto the macula of the utricle can easily slide back onto the crista of the posterior canal when the patient lies down in bed. There is no assurance that once the otoliths return to the macula they will be refixed on the stereocilia of the utricle.

OBJECTIVES:

1. To study the relative position of the maculae of the utricle in relation to cristae of the ampullae of the three semi-circular canals.
2. To evaluate recent treatment of BPPV that purport to reposition loose otoconia within the membranous labyrinth.
3. To demonstrate with anatomical cross-sections of the human temporal bones the serious anatomical problems with the theoretical basis of otolith repositioning by contortive head motions.

TRANSTYMPANIC GENTAMICIN THERAPY: UNIVERSITY OF PITTSBURGH EXPERIENCE

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Successful medical treatment for endolymphatic hydrops approaches 70% despite the use of various modalities. Patients with persistent symptoms warrant further intervention that, until recently, meant a surgical ablative or destructive procedure such as an endolymphatic shunt, vestibular nerve section or labyrinthectomy. The ototoxic effects of aminoglycosides are well known. These agents, whether given systemically or directly into the involved ear, have been used to chemically ablate vestibular function. Various investigators have proposed treatment regimes using rapid sequential delivery of aminoglycosides to ablate vestibular function. We report our results using transtympanic gentamicin middle ear injections in the treatment of peripheral vestibulopathies, especially Meniere's disease. Rather than delivering a predetermined fixed dose, patients were treated by a titration method monitoring their symptoms, hearing status and frequently, caloric responses. From 1989 through 1995 we have treated 52 patients, most of whom were treatment failures for Meniere's disease. Our existing treatment protocol, timing and frequency of injections, success rate and complications will be reviewed. Methods for reporting outcomes and patient monitoring will be discussed. The implications and future role of transtympanic aminoglycoside injections in the treatment of peripheral vestibulopathies will be addressed.

OBJECTIVES:

1. To review managment options for treating endolymphatic hydrops.
2 To review the principles of transtympanic gentamicin therapy.
3. To discuss treatment results, complications and the future role of transtympanic therapy.

A COMPARISON OF LONG-TERM HEARING RESULTS AFTER MIDDLE FOSSA VESTIBULAR NEURECTOMY, ENDOLYMPHATIC MASTOID SHUNT AND MEDICAL REGIME.

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The hearing results of 34 patients who underwent middle fossa vestibular nerve section (VNS) and of 19 patients who underwent endolymphatic mastoid shunt (EMS) were compared to 23 patients with Menière's disease who declined surgery (NSM). The audiologic follow-up was of between five and 20 years. Patients were subdivided on the basis of their pre-operative or initial PTA. In the patients who had hearing at lower than 50-dB PTA initially, the PTA declined of 5.0 dB in the VNS group, 11.9 dB in the EMS group and 3.9 dB in the NSM group. In the patients with hearing less than 50-dB PTA initially, the PTA declined of 27.8 dB in VNS, 14.3 in EMS and 26.5 dB in NSM group. This means that VNS and NSM patients with poor hearing have stabilized while patients with a good hearing continue to deteriorate. Patients of EMS group with good hearing deteriorate less than VNS and NSM patients. Useful hearing as defined by an SRT of less than or equal to 70 dB and an SDS of at least 15% was obtained in 27.0% of the patients in the VNS group, 36.8% in the EMS and 34.8% in the NSM group.

OBJECTIVES:

1. **To compare long term hearing results after middle fossa vestibular neurectomy (VNS), endolymphatic mastoid shunt (EMS) and medical regime (NSM) in patients with Meniere's disease.**
2. **To confirm that patients with a poor hearing have stabilized and those with a good hearing continuate to develop a progression of their hearing deterioration.**
3. **To show that VNS and EMS did not alter significantly the natural history of hearing loss in Meniere's disease.**

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LONG-TERM EFFECTS OF MENIERE'S DISEASE ON HEARING AND QUALITY OF LIFE

Sam Kinney, M.D., Sharon A. Sandridge, Ph.D., Craig W. Newman, Ph.D.

Meniere's disease is a chronic disorder that has long-term effects on the vestibular and auditory mechanisms with associated symptoms of hearing loss, dizziness, and tinnitus. The later symptom complex can have a dramatic influence on a patient's quality of life. Functional assessments offer a number of benefits to the clinician including enhanced patient-physician communication, awareness of the social, emotional, and functional impact of a disorder, and a means of quantifying outcome.

The purposes of the present investigation were: (1) to quantify pre- and posttreatment changes in pure-tone sensitivity and word recognition ability for surgical versus medical treatment groups; and (2) to determine the association among Meniere's disease symptons (i.e., dizziness, tinnitus, hearing) and global quality-of-life measures.

METHODS

To date, 43 patients treated for unilateral Meniere's disease have participated; data collection is ongoing. Subjects were divided into two subsamples; a surgically treated group (STG) and a medically treated group (MTG). There were 20 subjects in the STG with a mean age of 47 years (SD=9.2) and there were 23 subjects in the MTG with a mean age of 45 years (SD=12.6). The mean duration between initial diagnosis and posttreatment testing was 7.5 years (SD=5.8). Pre- and posttreatment pure tone audiometry was conducted using standard clinical procedures. Word recognition testing (WRS) was performed using recorded NU-6 word lists. Three disease-specific quality of life measures were administered: Hearing Handicap Inventory for Adults (HHIA), Tinnitus Handicap Inventory (THI), Dizziness Handicap Inventory (DHI). Each of these measures is a 25-item self-administered questionnaire quantifying the consequences of hearing, tinnitus, and dizziness on an individual's everyday function. In addition a global measure of health function was assessed using the SF-36 Health Survey providing information about physical functioning, role limitations based on physical health problems, bodily pain, social function, general mental health, role limitations because of emotional problems, vitality and general health perceptions.

RESULTS AND CONCLUSIONS

The following results are based on the data from 43 subjects. From the pure-tone audiogram, three pure-tone averages were calculated: LFPTA (250, 500, & 1000 Hz), SFPTA (500, 1000, & 2000 Hz), and HFPTA (1000, 2000, & 4000 Hz). Posttreatment HFPTAs were significantly poorer ($p < 0.01$) than pretreatment for the MTG. No other significant differences were observed for PTAs or WRS for between- or within-group analyses.

A two-way ANOVA revealed significant main effect for STG for the disease-specific scales ($p < 0.5$). Post hoc comparisons indicated that the STG perceived less handicap from the tinnitus than from the hearing or dizziness. Nonsignificant correlations were observed between the HHIA and PTAs for the diseased and the nondiseased ears. These findings highlight the importance of including disease-specific scales in the overall assessment. Correlations between the disease-specific scales and the SF36 were calculated. It is noteworthy that significant correlations existed between the three disease-specific scales and the social functioning scale of the SF36, suggesting that dizziness ($r = -0.63$), tinnitus ($r = -0.55$), and hearing loss ($r = -0.59$) impact on normal social activities.

OBJECTIVES:

1. To quantify changes in pure-tone sensitivity and word recognition scores following medical or surgical treatment for Meniere's disease.
2. To determine the association among disease-specific quality of life measures and a global quality of life measure.
3. To quantify long-term perceived hearing, dizziness, and tinnitus handicap, and general health status following medical or surgical treatment for Meniere's disease.

MANAGEMENT OF ACOUSTIC NEUROMA IN THE ELDERLY POPULATION

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Ongoing controversy regarding the optimal treatment of acoustic neuromas in the elderly population has prompted us to examine our experience in order to arrive at an optimal treatment algorithm. Forty-seven elderly patients with acoustic neuromas ranging in age from 70 to 90 years of age were retrospectively reviewed. In 18 patients, surgical intervention was required for tumors of large size at presentation and tumors that demonstrated significant growth. The most commonly performed approach was translabyrinthine resection. In the remainder of cases, the size of the tumor was followed by serial MRI examinations and deemed to be sufficiently slow growing to preclude surgical intervention. Our followup times for this group ranged from 6 to 180 months. Trends concerning facial nerve results, complication rates and duration of hospital stay are discussed and contrasted to our overall experience of over 1300 acoustic neuroma cases. We conclude that elderly patients with small acoustic neuromas and non-life threatening symptoms should be offered a trial of observation prior to definitive intervention.

OBJECTIVES:

1. To demonstrate biological behavior of acoustic neuromas in the elderly population.
2. To examine results of surgery in this population.
3. To compare treatment results with results from the younger acoustic neuroma age group.

ACOUSTIC NEUROMA SURGERY: OUTCOME ANALYSIS OF PATIENT PERCEIVED DISABILITY

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Success or failure of surgical therapy has traditionally been measured using outcome criteria derived from the clinician's perception of hearing, balance, and facial mimetic function as indicators of patient outcome. Knowledge of problems commonly encountered by those undergoing acoustic neuroma surgery and their relative importance to the patient may provide more accurate counseling regarding therapy choices. We employed a functional outcomes questionnaire surveying 130 post-operative acoustic neuroma patients to measure the relative impact of symptoms related to their postoperative condition. Patients ranked their symptoms according to relative disability and graded them in degree of severity. Regardless of approach, most patients felt hearing loss was their most significant disability, (83 of 130 respondents). Of those with troubling or disabling symptoms, hearing loss was again the most common complaint (50 respondents). When troubling or disabling facial or balance symptoms were reported, patients considered them their most significant problem in 56% and 44% of cases respectively. Relative significance of each symptom was unaffected by age at diagnosis. A disproportionately higher number of those who underwent translabyrinthine resection reported facial weakness as their most disabling symptom. Proportionately fewer patients with small 0 to 1.5 cm tumors ranked hearing loss as their primary disability; while proportionately more of those with tumors 2.5 cm or larger experienced significant troubling or disabling facial symptoms. Postoperatively, the House Brackmann grading scale was found to have a sensitivity of 90.5% and specificity of 81.8% for grades 2 to 6 with respect to patient complaints of facial dysfunction. Irrespective of traditionally applied risk stratification criteria, patients felt hearing loss resulted in the most common and most severe morbidity associated with acoustic neuroma management. Outcome analysis provides quantitative information useful to the clinician in discussing potential lifestyle alterations with patients contemplating acoustic neuroma management.

OBJECTIVES:

1. To quantitate severity of symptoms experienced by the acoustic neuroma patient following surgical management.
2. To describe the rank-order impact of post-operative symptoms on patient lifestyle.
3. To correlate conventionally applied risk stratification criteria of morbidity with patient perspective of their disabilities on lifestyle following tumor removal.

ENDOSCOPICALLY ASSISTED PREVENTION OF CEREBROSPINAL FLUID LEAK IN SUBOCCIPITAL ACOUSTIC NEUROMA SURGERY

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Cerebrospinal fluid (CSF) rhinorrhea after acoustic neuroma excision remains one of the most common post-operative complications. Suboccipital(SO) approaches are reported to have CSF leak rates of up to 27%, with an average rate of 12%. Attempts to minimize leakage have involved packing open air cells within the petrous bone defect around the internal auditory canal (IAC) using a variety of materials. Failure to recognize patent cells due to the limited line-of=sight visualization of conventional operating microscopes may be an important cause of postoperative CSF leak.

A prospective study was undertaken to compare CSF rhinorrhea rates in 38 consecutive suboccipital(SO) acoustic neuroma operations performed prior to endoscopic assistance with the succeeding 24 operations in which endoscopic techniques were used. The petrous defect around the IAC was inspected endoscopically to locate all patent air cells which were then specifically sealed with bone wax and covered with a fat graft. Bone wax and fat grafts were applied only using microscopic inspection in the first group.

Postoperative CSF rhinorrhea occurred in 7/38 (18.4%) operations in which no endoscopic technique was used and in 0/24 operations in which endoscopes were used. The use of endoscopes to visualize the temporal bone air cells that cannot otherwise be directly observed, appears to reduce the incidence of post operative CSF leak in SO acoustic neuroma surgery.

OBJECTIVES:

1. To suggest that failure to pack petrous air cells is leading cause of CSF leaks.
2. To give careful attention to packing these cells so can reduce CSF leaks.
3. To discuss that endoscopic visualization helps locate cells that may be otherwise missed.

FOCAL INFARCTION OF THE CEREBELLAR PEDUNCLE AS A CAUSE OF PERSISTENT CEREBELLAR DYSFUNCTION FOLLOWING ACOUSTIC NEUROMA SURGERY: A REPORT OF 8 CASES

Peter Rigby M.D., Steven Cheung, M.D., David Sim, FRCS Ed., Robert Jackler, M.D., Lawrence Pitts, M.D.

Persistent cerebellar dysfunction following resection of an acoustic neuroma is fairly common, particularly after removal of large lesions. This has usually been attributed to direct cerebellar injury due to brain retraction. We have observed 8 patients who suffered a prolonged period of cerebellar dysfunction, lasting months postoperatively, in whom the lateral cerebellar hemisphere appeared unaffected on postoperative imaging studies. In each case, a focal lesion of the cerebellar peduncle was identified on postoperative MRI scans. This parenchymal injury most likely stems from interruption of terminal branches of the anteroinferior cerebellar artery (AICA). These small vessels are intimately related to the capsule of the tumor and may provide blood supply to both the neoplasm and brain parenchyma. It has long been recognized that interruption of the proximal segment of the AICA results in a severe injury to the pons with resultant devastating neurological sequellae. A limited AICA syndrome due to loss of its distal ramifications seems a more probable explanation for peduncular infarction than venous insufficiency or direct surgical trauma. Distal AICA compromise appears to be associated with large tumor size, preoperative thinning of the cerebellar peduncle, and concomitant fourth ventricular compression. Long term functional outcome (> 1 year) was mixed. Only half (4/8) recovered to normal ambulatory function, two had mild gait disturbance, one required use of a cane, and one needed a walker for mobility.

OBJECTIVES:

1) To describe clinical and radiographic findings of eight patients status post acoustic neuroma surgery presenting with persistent cerebellar dysfunction.
2) To relate clinical and radiographic findings in this group to vascular s yndromes known to occur in the cerebellopontine angle.
3) To provide probable pathogenesis, and suggest tumor characteristics that may increase risk of this type of vascular injury.

COCHLEAR IMPLANTATION IN PEDIATRIC PATIENTS WITH MONDINI DEFORMITIES

Laura L. Downey, M.D., Ronald A. Hoffman, M.D.

Cochlear implantation has become a routine procedure in children with profound hearing loss and normal cochlear anatomy. In those cases where the cochlea is malformed the procedure and postoperative success may be more complicated. To address these issues a survey of 200 institutions performing pediatric implants was taken. Of the 102 responders there were 22 patients with deformities ranging from a common cavity to greater than 1.4 turns with dilation of the cochlea. Facial nerve anatomy was abnormal in 3 patients and there was one temporary postoperative paralysis. CSF "gushers" were reported in 10 cases. All but one patient continues to use the device. A synopsis of the patients, the complications, operative management and postoperative function is presented.

OBJECTIVES:

1. **To present a nationwide experience of cochlear implantation in pediatric patients with Mondini deformities.**
2. **To discuss complications and surgical treatment of these patients.**
3. **To review the literature for cochlear implantation in Mondini deformity patients.**

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