From Tennis Balls to Honeybee Larvae

For all of us – whether we treat tinnitus patients, whether we do research on tinnitus or whether we suffer from tinnitus – the one-million-dollar question is:

What is the best strategy to find a cure?

One possibility to approach this question is to look for strategies followed in the development of treatments for other CNS pathologies. And what does this tell us? It is neither the reductionist approach of the molecular biologists, nor the research infrastructure of the big pharma companies, nor the hypothesis driven research of neuroscientists, which has led to the discovery of most new treatment strategies. Although all these approaches have their merits, it was serendipity which has played a major role in the discovery of innovative CNS acting compounds. The word “serendipity” comes from the title of a Persian fairy tale: The Three Princes of Serendip. In this fairy tale traveling heroes were “always making discoveries, by accidents and sagacity, of things they were not in quest of”. However, following Louis Pasteur’ words “Chance favors the prepared mind”, no discovery in science has been only the result of luck. All accidental findings have been each “recognized, evaluated and acted upon in the light of the discoverer’s total intellectual experience”.

Alexander Fleming was definitely not the first to see that bacteria would not grow close to yeast, but he was the first to recognize the importance of it and to act upon it. Therefore, we should try our best to be prepared, in order to eventually recognize, evaluate and act upon a possible serendipitous discovery that might lead to effective tinnitus treatments. Would this mean that new tinnitus treatments already exist and are already out there awaiting to be recognized?

New ideas may derive from the creativity of a suffering patient (e.g. a tennisball, successful: see Deylgat et al.), they may come from traditional formulations conserved in alternative medicine (e.g. powder of honeybee larvae; not successful, Aoki et al.), or they may come from other fields of medicine and other scientific areas. Charles Darwin recognized natural selection as the driving force of evolution in biology by reading a book by the economist Thomas Malthus.

What can TRI do to facilitate the discovery of the right ideas? We can provide a forum for exchanging thoughts, for disseminating observations and for communicating ideas. We can try to create the environment for serendipity to blossom. We do this by the TRI Newsletter, by the TRI website, and by the yearly TRI meeting. In order to further facilitate the communication within the tinnitus community we have now established a forum on the TRI website and we support the “Tinnitus List”. TRI will continue to drive tinnitus research worldwide towards a cure. You all can help in this endeavor, by contributing with your ideas, your research, your participation at the TRI meeting or with a donation to support tinnitus research. The more we are the faster we will get there!

Ana Belén Elgoyhen         Dirk De Ridder         Berthold Langguth         Sylvia Dorner-Mitschke

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Image Source: www.photocase.de
RESEARCH HIGHLIGHTS

Sedley W, Teki S, Kumar S, Overath T, Barnes GR, Griffiths TD. Gamma band pitch responses in human auditory cortex measured with magnetoencephalography. Neuroimage. 2011 Sep 8. [Epub ahead of print]. Auditory Group, Institute of Neuroscience, Newcastle University Medical School, Newcastle Upon Tyne, Tyne and Wear, NE2 4HH UK.

This study demonstrates that magnetoencephalography can be used in a comparable way for assessing pitch responses like recordings via implanted electrodes.


By demonstrating that bilateral lesions of the dorsal cochlear nucleus (DCN) prevent acoustic trauma induced tinnitus, this study sheds further light on the role of the DCN in the pathophysiology of tinnitus.


This study demonstrates abnormal activity in the auditory nerve in tinnitus patients with normal hearing thresholds. This indicates that damage to the cochlea is not always reflected by threshold shifts. Furthermore, this study shows that the abnormal input leads to a compensatory increase of central gain in the brainstem and that a computational model that is based on mechanisms of homeostatic plasticity can predict these compensatory changes.


The Tinnitus Functional Index is the first tinnitus questionnaire that has been especially developed and validated for detecting changes of tinnitus severity by treatment interventions.
NEWS

RICHARD SALVI NAMED SUNY DISTINGUISHED PROFESSOR BY BOARD OF TRUSTEES

Richard Salvi, professor in the Department of Communicative Disorders and Sciences at the University at Buffalo and Chairman of the Scientific Committee of TRI, has been named a SUNY Distinguished Professor, the highest faculty rank in the system of The State University of New York (SUNY). The distinguished professorship recognizes and honors individuals who have achieved national or international prominence in their fields. Read more ...

ANA BELÉN ELGOYHEN WAS AWARDED THE 2011 TWAS PRIZE IN BIOLOGY

Belén Elgoyhen, leader of the TRI pharmacological workgroup, was honoured for her contributions to the understanding of the molecular basis of hearing. Read more ...

WINFRIED SCHLEE HAS WON A RESEARCH INCENTIVE OF THE UNIVERSITY OF ULM

This Research Bonus is intended for the initial funding of projects of junior researchers. Winfried Schlee received this funding for his geriatric and tinnitus research. Read more ... (in German)

DISCUSSION FORUM AT THE TRI WEBSITE

This area should provide an opportunity to discuss about topics related to TRI and/or Tinnitus Research. Whoever wants to share some ideas or thoughts is welcome to register at http://tinnitusresearch.org/forum.

Current topics:

- Where Good Ideas Come From
  • Editorial of the 18th TRI Newsletter by Ana Belén Elgoyhen, Dirk De Ridder and Berthold Langguth (Sept. 22, 2011)
  • Wisdom of Crowds by Andrew Parr (Sept. 22, 2011)
  • Comment by Peter Kreuzer (Sept. 26, 2011)
- Somatic Tinnitus: Proposal for a Discussion
- How I’ve got relief from Tinnitus
Second Announcement

Registration is open now!

http://www.tri2012.org

The 6th Tinnitus Research Initiative (TRI) conference will be organized from June 13th to 16th, 2012 in Bruges, Belgium by the multidisciplinary TRI Tinnitus Unit Antwerp, Belgium, part of Brain Research center Antwerp for Innovative and Interdisciplinary Neuromodulation (BRAI²N), Antwerp University Hospital & Antwerp University and the Tinnitus Research Initiative. TRI 2012 is the premier venue for scientists and clinicians from around the world to discuss cutting-edge research on tinnitus.

Oral Presentations will cover unpublished preliminary or finalized data, novel ideas and techniques and are 15 minutes in length.

Poster session will also cover unpublished preliminary or finalized data, novel ideas and techniques, with the added value that viewers can study and restudy your information and discuss it with you one on one.

Abstract submission at
http://www.tri2012.org

Deadline for all submissions and proposals: April 1st, 2012

Exhibits related to the theory, practice and education of tinnitus and related techniques are invited. Please request our exhibitor package for details.

More details can be found at the conference website (http://www.tri2012.org/). Contributors are encouraged to contact the conference coordinator for further information.

Organizing committee
Dirk De Ridder, M.D., Ph.D.
Sven Vanneste, Ph.D.
Paul Van de Heyning, M.D., Ph.D.
Berthold Langguth, M.D., Ph.D.
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Upcoming Meetings  Meetings exclusively dedicated to Tinnitus are marked red

**February 2012**

**ARO (The Association for Research in Otolaryngology) 35th MidWinter Meeting**
- **When:** February 25 - 29, 2012
- **Where:** The Manchester Grand Hyatt Hotel, San Diego, CA, USA
- **Detailed information:** [http://www.aro.org/mwm/mwm.html](http://www.aro.org/mwm/mwm.html)

**15. Jahrestagung der Deutschen Gesellschaft für Audiologie (DGA e.V.)**
- **When:** March 7 - 10, 2012
- **Where:** Erlangen, Germany
- **Detailed information:** [http://www.uzh.ch/orl/dga-ev/jahrestagung/jahrestagung.html](http://www.uzh.ch/orl/dga-ev/jahrestagung/jahrestagung.html)

**American Auditory Society, Annual Meeting**
- **When:** March 8 - 10, 2012
- **Where:** Scottsdale, AZ, USA
- **Detailed information:** [http://www.amauditorysoc.org/annual-meeting/reginfo.htm](http://www.amauditorysoc.org/annual-meeting/reginfo.htm)

**Tinnitus & Hyperacusis Therapy Master Class**
- **When:** March 12 - 16, 2012
- **Where:** Birkbeck College University of London, London, UK
- **E-Mail:** hashir.aazh@nhs.net
- **Detailed Information:** [http://www.bbk.ac.uk/maps](http://www.bbk.ac.uk/maps)

**56. Jahrestagung der Deutschen Gesellschaft für Klinische Neurophysiologie und Funktionelle Bildgebung (DGKN)**
- **When:** March 15 – 17, 2012
- **Where:** Koelnmesse, Congress-Centrum Nord, Köln, Germany
- **Detailed Information:** [http://www.dgkn2012.de/](http://www.dgkn2012.de/)

**DAGA 2012: 38. Jahrestagung der Deutschen Gesellschaft für Akustik DEGA**
- **When:** March 19 - 22, 2012
- **Where:** Darmstadt, Germany
- **Detailed information:** [http://www.dega-akustik.de/](http://www.dega-akustik.de/)

**AudiologyNOW!® 2012**
- **When:** March 28 - 31, 2012
- **Where:** Boston, MA, USA
- **Detailed information:** [http://www.audiologynow.org/](http://www.audiologynow.org/)
XXXI World Congress of Audiology
When: April 29 - May 3, 2012
Where: Moscow, Russia
Detailed information: http://www.wca2012.ru/

The 12th International Conference on Cochlear Implants and other Implantable Auditory Technologies
When: May 3 – 5, 2012
Where: Baltimore, MD, USA
Detailed Information: http://ci-2012.com/

The Acoustics 2012
a joint meeting of the 163rd meeting of the Acoustical Society of America (ASA), the 8th meeting of the acoustical Society of China (ASC), the 11th Western Pacific Acoustics Conference (WESPAC) and the Hong Kong Institute of Acoustics (HKIOA)
When: May 13 - 18, 2012
Where: Hong Kong, China
Detailed information: http://acoustics2012hk.org/

83. Jahresversammlung der Deutschen Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie e.V.
When: May 16 – 20, 2012
Where: Rheingoldhalle Mainz, Germany

Symposium of the International Society of Otoneurology
When: May 17 – 19, 2012
Where: Valais, Switzerland
Detailed Information: www.otoneuro.com
AHS 2012 2nd International Conference on Adult Hearing Screening
When: 5. - 7. Juni 2012
Where: Villa Erba Congress Center Cernobbio, Italy
Detailed Information: http://www.ahs2012.org/

18th Annual Meeting of the Organization for Human Brain Mapping (OHBM2012)
When: June 10 - 14, 2012
Where: China National Convention Center Beijing, China
Detailed Information: www.humanbrainmapping.org/OHBM2012

6th INTERNATIONAL TRI CONFERENCE ON TINNITUS 2012
Tinnitus: the Art and Science of Innovation
When: June 13 – 16, 2012
Where: Bruges, Belgium
Detailed Information: http://www.tri2012.org

American Academy of Otolanryngology, Head and Neck Surgery Annual Meeting
When: September 11 - 14, 2012
Where: San Francisco, CA, USA
Detailed Information: http://www.entannualmeeting.org/

57. Internationaler Hörgeräteakustiker-Kongress
Where: Congress Center Messe Frankfurt
Detailed Information: http://www.euha.org

ASHA 2012 Annual Convention
When: November 15–17, 2012
Where: Atlanta, GA, USA
Detailed Information: http://www.asha.org/Events/convention/Future-Conventions/
I Epidemiology

Impact of tinnitus on the quality of life among Saudi patients.
Alsanosi AA.

Department of Otolaryngology & Head and Neck Surgery, King Saud University, PO Box 245, Riyadh 11411, Kingdom of Saudi Arabia. Tel. +966 (1) 4786100. Fax. +966 (1) 4775748.
E-mail: sanosi@hotmail.com.

OBJECTIVE: To assess the impact of tinnitus on the quality of life of Saudi patients, and to compare the findings with those of other studies.

METHODS: A retrospective chart review of 100 tinnitus patients, who visited the Otology/Neurotology Clinic at King Abdulaziz University Hospital, Riyadh, Kingdom of Saudi Arabia between January 2008 and December 2010, and completed the 25-item Tinnitus Handicap Inventory (THI), was conducted. Age, gender, duration of symptoms, laterality, and associated hearing loss were included in the data.

RESULTS: The mean age of 54 men, and 46 women was 47.1+/-13.1 years. The male patients had higher THI total scores, emotional and functional total subscale scores as compared with the female patients. Associated hearing loss was present in 76% of patients. Patients with a long duration of tinnitus had a significantly higher scoring of the emotional (p=0.009), and catastrophic total subscale scores (p=0.006) compared with those with a short duration. The risk of a male patient experiencing a catastrophic score was 3.15 times higher than that in a female patient. Associated hearing loss, and tinnitus over a long duration affected the catastrophic subscale scores more than the other subscales. Fifty-one percent of the patients were grade 4 in the THI.

CONCLUSION: Tinnitus had a negative impact on the quality of life of Saudi patients. The THI may be a useful tool for screening patients, counseling, and charting treatment progress.

Cohort study on the effects of everyday life radio frequency electromagnetic field exposure on non-specific symptoms and tinnitus.

Swiss Tropical and Public Health Institute, Socinstr. 57, P.O. Box, CH-4002 Basel, Switzerland; University of Basel, Petersplatz 1, CH-4003 Basel, Switzerland.

BACKGROUND: There is public concern regarding potential health effects of radio frequency electromagnetic fields (RF-EMF) exposure, as produced by mobile phones or broadcast transmitters. The objective of this study was to investigate the association between RF-EMF exposure and non-specific symptoms and tinnitus in a prospective cohort study.

METHODS: In 2008, 1375 randomly selected participants from Basel, Switzerland, were enrolled in a questionnaire survey with follow-up after one year (participation rate 82%). A score for somatic complaints (von Zerssen list) and headache (HIT-6) was assessed. Far-field environmental RF-EMF exposure was predicted using a validated prediction model. Regarding near-field exposure, self-reported mobile and cordless phone use as well as mobile phone operator data were collected. In multivariate regression models, we investigated whether exposure at baseline (cohort analysis) or changes in exposure between baseline and follow-up (change analysis) were related to changes in health scores.

RESULTS: For participants in the top decile of environmental far-field RF-EMF exposure at baseline, in comparison to participants exposed below the median value, the change in the von Zerssen- and HIT-6-scores between baseline and follow-up was -0.12 (95%-CI: -1.79 to 1.56) and -0.37 (95%-CI: -1.80 to 1.07) units, respectively. Exposure to near-field sources and a change in exposure between baseline
and follow-up were not related to non-specific symptoms. Similarly, no association between RF-EMF exposure and tinnitus was observed.

CONCLUSIONS: In this first cohort study using objective and well-validated RF-EMF exposure measures, we did not observe an association between RF-EMF exposure and non-specific symptoms or tinnitus. Copyright © 2011. Published by Elsevier Ltd.

Tinnitus and hearing in 7-year-old children.
Arch Dis Child. 2011 Nov 18. [Epub ahead of print]

Juul J, Barrenäs ML, Holgers KM.

Department of Otorhinolaryngology, Section for Audiology, Institute of Neuroscience and Physiology, The Sahlgrenska Academy at University of Gothenburg, Sahlgrenska University Hospital, Göteborg, Sweden.

Tinnitus occurs with or without prior noise exposure (noise-induced tinnitus (NIT) and spontaneous tinnitus (ST)), and is considered a symptom related to permanent hearing impairment (HI) or temporary hearing threshold shift (TTS).

Objective
To carry out a cross-sectional interview study on TTS, ST and NIT during a standard audiometric screening of 756 7-year-old children in Gothenburg.

Results
41% out of 756 children reported either NIT or ST on several occasions, 17% reported recurrent TTS and 7% failed the audiometry screening. The probability of ST was 27% for children with no HI or TTS (OR=1.23 (95% CI 1.12 to 1.34)) but 63% (OR=1.16 (95% CI 1.02 to 1.33)) if exhibiting both HI and TTS.

Conclusion
This study confirms an increased occurrence of spontaneous tinnitus in children with TTS or HI and in children with both TTS and HI, in particular, but also in children with normal hearing. Possibly, tinnitus in young children correlates with stress as in adolescents and adults.

Tinnitus in the General Population with a Focus on Noise and Stress: A Public Health Study.

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Department of Research and Development, Halland County Council, Halmstad, Sweden; Department of Primary Health Care, The Sahlgrenska Academy at Gothenburg University, Gothenburg, Sweden; Department of Mathematical Sciences, Chalmers University of Technology, Gothenburg, Sweden; Department of Habilitation and Health, Region Västra Götaland, Hearing Clinic, Borås, Sweden; Göteborg Pediatric Growth Research Center, Department of Pediatrics, Institute of Clinical Sciences, The Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden; Department of Health Sciences at Jönköping Academy, University of Jönköping, Jönköping, Sweden.

OBJECTIVES: To evaluate the influence of noise and stress on the probability of tinnitus in the general population.

DESIGN: Questionnaire data were obtained from 12,166 subjects.

RESULTS: Each year of age increased the odds ratio of tinnitus by about 3%. Men generally showed a higher risk for tinnitus compared with women. Exposure to noise and stress emerged important for the probability of tinnitus. However, for the transition from mild to severe tinnitus, stress turned out to be especially important.

CONCLUSIONS: Stress management strategies should be included in hearing conservation programs, especially for individuals with mild tinnitus who report a high stress load.
Pre-1970s, diving was seen as a predominantly male working occupation. Since then it has become a popular hobby, with increasing access to SCUBA diving while on holiday. For a leisure activity, diving puts the auditory system at the risk of a wide variety of complaints. However, there is still insufficient consensus on the frequency of these conditions, which ultimately would require more attention from hearing-healthcare professionals. A literature search of epidemiology studies of eight auditory complaints was conducted, using both individual and large-scale diving studies, with some reference to large-scale non-diving populations. A higher incidence was found for middle ear barotrauma, eustachian tube dysfunction, and alternobaric vertigo with a high correlation among females. Comparing these findings with a non-diving population found no statistically significant difference for hearing loss or tinnitus.

Increased awareness of health professionals is required, training, and implementation of the Frenzel technique would help resolve the ambiguities of the Valsalva technique underwater. © 2011 Association of Otolaryngologists of India.

II Pathophysiology

The sound of consciousness: neural underpinnings of auditory perception.

Brancucci A, Franciotti R, D'Anselmo A, Della Penna S, Tommasi L.

Departments of Biomedical Sciences and Neuroscience and Imaging, Institute for Advanced Biomedical Technologies of the „G. d'Annunzio“ University Foundation, „G. d'Annunzio“ University of Chieti and Pescara, 66100 Chieti Scalo, Italy.

The neural correlates of consciousness (NCC), i.e., patterns of brain activity that specifically accompany a particular conscious experience, have been investigated mainly in the visual system using particularly suited paradigms, such as binocular rivalry and multistable percepts in combination with neural recordings or neuroimaging.

Through the same principles, we look here for possible NCC in the auditory modality exploiting the properties of the Deutsch's illusion, a stimulation condition in which a sequence of two specular dichotic stimuli presented in alternation causes an illusory segregation of pitch and side (ear of origin), which can yield up to four different auditory percepts per dichotic stimulus.

Using magnetoencephalography in humans, we observed cortical activity specifically accompanying conscious experience of pitch inside an early bilateral network, including the Heschl's gyrus, the middle temporal gyrus, the right inferior, and the superior frontal gyri. The conscious experience of perceived side was instead accompanied by later activity observed bilaterally in the inferior parietal lobe and in the superior frontal gyrus. These results suggest that the NCC are not independent of stimulus features and modality and that, even at the higher cortical levels, the different aspects of a single perceptual scene may not be simultaneously processed.
Degeneration in the ventral cochlear nucleus after severe noise damage in mice.

Feng J, Bendiske J, Most DK.
Southern Connecticut State University, New Haven, Connecticut.

To study the mechanisms of noise-induced hearing loss and the phantom noise, or tinnitus, often associated with it, we used a mouse model of noise damage designed for reproducible and quantitative structural analyses. We selected the posteroventral cochlear nucleus, which has shown considerable plasticity in past studies, and correlated its changes with the distribution of neurotrophin 3 (NT3). We used volume change, optical density analysis, and microscopic cluster analysis to measure the degeneration after noise exposure. There was a fluctuation pattern in the reorganization of nerve terminals. The data suggest that the source and size of the nerve terminals affect their capacity for regeneration. We hypothesize that the deafferentation of ventral cochlear nucleus is the structural basis of noise-induced tinnitus. In addition, the immunofluorescent data show a possible connection between NT3 and astrocytes. There appears to be a compensatory process in the supporting glial cells during this degeneration. Glia may play a role in the mechanisms of noise-induced hearing loss. © 2011 Wiley Periodicals, Inc. Copyright © 2011 Wiley-Liss, Inc.

Effect of auditory cortex deactivation on stimulus-specific adaptation in the medial geniculate body.

Antunes FM, Malmierca MS.
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An animal's survival may depend on detecting new events or objects in its environment, and it is likely that the brain has evolved specific mechanisms to detect such changes. In sensory systems, neurons often exhibit stimulus-specific adaptation (SSA) whereby they adapt to frequently occurring stimuli, but resume firing when “surprised” by rare or new ones. In the auditory system, SSA has been identified in the midbrain, thalamus, and auditory cortex (AC). It has been proposed that the SSA observed subcortically originates in the AC as a higher-order property that is transmitted to the subcortical nuclei via corticofugal pathways. Here we report that SSA in the auditory thalamus of the rat remains intact when the AC is deactivated by cooling, thus demonstrating that the AC is not necessary for the generation of SSA in the thalamus. The AC does, however, modulate the responses of thalamic neurons in a way that strongly indicates a gain modulation mechanism. The changes imposed by the AC in thalamic neurons depend on the level of SSA that they exhibit.

Does tinnitus distress depend on age of onset?

Schlee W, Kleinjung T, Hiller W, Goebel G, Kolassa IT, Langguth B.
Department of Clinical and Biological Psychology, University of Ulm, Ulm, Germany.

OBJECTIVES: Tinnitus is the perception of a sound in the absence of any physical source of it. About 5-15% of the population report hearing such a tinnitus and about 1-2% suffer from their tinnitus leading to anxiety, sleep disorders or depression. It is currently not completely understood why some people feel distressed by their tinnitus, while others don’t. Several studies indicate that the amount of tinnitus distress is associated with many factors including comorbid anxiety, comorbid depression, personality, the psychosocial situation, the amount of the related hearing loss and the loudness of the tinnitus. Furthermore, theoretical considerations suggest an impact of the age at tinnitus onset influencing tinnitus distress.
METHODS: Based on a sample of 755 normal hearing tinnitus patients we tested this assumption. All participants answered a questionnaire on the amount of tinnitus distress together with a large variety of clinical and demographic data.

RESULTS: Patients with an earlier onset of tinnitus suffer significantly less than patients with an onset later in life. Furthermore, patients with a later onset of tinnitus describe their course of tinnitus distress as more abrupt and distressing right from the beginning.

CONCLUSION: We argue that a decline of compensatory brain plasticity in older age accounts for this age-dependent tinnitus decompensation.

A neuronal network model with STDP for tinnitus management by sound therapy.
Recent Advances in Applied and Biomedical Informatics and Computational Engineering in Systems Applications - AIC’11, BEBI’11 , pp. 143-147.

Nagashino, H.\textsuperscript{a}, Kinouchi, Y.\textsuperscript{b}, Danesh, A.A.\textsuperscript{c}, Pandya, A.S.\textsuperscript{d}.

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\textsuperscript{c} College of Education, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, United States,
\textsuperscript{d} College of Engineering and Computer Science, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, United States.

Tinnitus is the perception of phantom sound in the ears or in the head. There are many therapeutic approaches for tinnitus and sound therapy is one of the techniques for its treatment. In order to investigate mechanisms of tinnitus generation and the clinical effects of sound therapy from the viewpoint of neural engineering, we have proposed computational models with plasticity by Hebbian hypothesis using a neural oscillator or coupled model neurons described by simplified Hodgkin-Huxley equations. In the present paper, a neuronal network model with synaptic plasticity by STDP (spike-timing-dependent plasticity) hypothesis is proposed for replication of the clinical results that human auditory system temporarily halts perception of tinnitus following sound therapy.

Characterization of the perceived sound of trauma-induced tinnitus in gerbils.

Nowotny M, Remus M, Kössl M, Gaese BH.

Institute of Cell Biology and Neuroscience, Siesmayerstrasse 70A, Goethe University Frankfurt am Main, D-60323 Frankfurt am Main, Germany.

Tinnitus often develops following inner ear pathologies, like acoustic trauma. Therefore, an acoustic trauma model of tinnitus in gerbils was established using a modulated acoustic startle response. Cochlear trauma evoked by exposure to narrow-band noise at 10 kHz was assessed by auditory brainstem responses (ABR) and distortion product otoacoustic emissions (DPOAE). Threshold shift amounted to about 25 dB at frequencies > 10 kHz. Induction of a phantom-noise perception was documented by an acoustic startle response paradigm. A reduction of the gap-prepulse inhibition of acoustic startle (GPIAS) was taken as evidence for tinnitus at the behavioral level. Three to five weeks after trauma the ABR and DPOAE thresholds were back to normal. At that time, a reduction of GPIAS in the frequency range 16-20 kHz indicated a phantom noise perception. Seven weeks post trauma the tinnitus-affected frequency range became narrow and shifted to the center-trauma frequency at 10 kHz. Taken together, by investigating frequency-dependent effects in detail, this study in gerbils found trauma-evoked tinnitus developing in the frequency range bordering the low frequency slope of the induced noise trauma. This supports the theory of lateral inhibition as the physiological basis of tinnitus.
Acoustic over-exposure triggers burst firing in dorsal cochlear nucleus fusiform cells.
Hear Res. 2011 Nov 7. [Epub ahead of print]

Pilati N, Large C, Forsythe ID, Hamann M.
Department of Cell Physiology and Pharmacology, Maurice Shock Medical Science Building, University of Leicester, University Road, Leicester LE1 9HN, UK.

Acoustic over-exposure (AOE) triggers deafness in animals and humans and provokes auditory nerve degeneration. Weeks after exposure there is an increase in the cellular excitability within the dorsal cochlear nucleus (DCN) and this is considered as a possible neural correlate of tinnitus. The origin of this DCN hyperactivity phenomenon is still unknown but it is associated with neurons lying within the fusiform cell layer. Here we investigated changes of excitability within identified fusiform cells following AOE. Wistar rats were exposed to a loud (110 dB SPL) single tone (14.8 kHz) for 4 h. Auditory brainstem response recordings performed 3-4 days after AOE showed that the hearing thresholds were significantly elevated by about 20-30 dB SPL for frequencies above 15 kHz. Control fusiform cells fired with a regular firing pattern as assessed by the coefficient of variation of the inter-spike interval distribution of 0.19 ± 0.11 (n = 5). Three to four days after AOE, 40% of fusiform cells exhibited irregular bursting discharge patterns (coefficient of variation of the inter-spike interval distribution of 1.8 ± 0.6, n = 5; p < 0.05). Additionally the maximal firing following step current injections was reduced in these cells (from 83 ± 11 Hz, n = 5 in unexposed condition to 43 ± 6 Hz, n = 5 after AOE) and this was accompanied by an increased firing gain (from 0.09 ± 0.01 Hz/pA, n = 5 in unexposed condition to 0.56 ± 0.25 Hz/pA, n = 5 after AOE). Current and voltage clamp recordings suggest that the presence of bursts in fusiform cells is related to a down regulation of high voltage activated potassium currents. In conclusion we showed that AOE triggers deafness at early stages and this is correlated with profound changes in the firing pattern and frequency of the DCN major output fusiform cells. The changes here described could represent the initial network imbalance prior to the emergence of tinnitus. Copyright © 2011. Published by Elsevier B.V.

The laminar and temporal structure of stimulus information in the phase of field potentials of auditory cortex.

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Recent studies have shown that the phase of low-frequency local field potentials (LFPs) in sensory cortices carries a significant amount of information about complex naturalistic stimuli, yet the laminar circuit mechanisms and the aspects of stimulus dynamics responsible for generating this phase information remain essentially unknown. Here we investigated these issues by means of an information theoretic analysis of LFPs and current source densities (CSDs) recorded with laminar multi-electrode arrays in the primary auditory area of anesthetized rats during complex acoustic stimulation (music and broadband 1/f stimuli). We found that most LFP phase information originated from discrete „CSD events” consisting of granular-superficial layer dipoles of short duration and large amplitude, which we hypothesize to be triggered by transient thalamocortical activation. These CSD events occurred at rates of 2-4 Hz during both stimulation with complex sounds and silence. During stimulation with complex sounds, these events reliably reset the LFP phases at specific times during the stimulation history. These facts suggest that the informativeness of LFP phase in rat auditory cortex is the result of transient, large-amplitude events, of the „evoked” or „driving” type, reflecting strong depolarization in thalamo-recipent layers of cortex. Finally, the CSD events were characterized by a small number of discrete types of infragranular activation. The extent to which infragranular regions were activated was stimulus dependent. These patterns of infragranular activations may reflect a categorical evaluation of stimulus episodes by the local circuit to determine whether to pass on stimulus information through the output layers.
The role of homocysteine in tinnitus etiology.

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Objectives: The aim of this study is to determine the relationship between homocysteine levels and tinnitus. Methodology: Ninety-nine patients admitted to our clinic with the complaint of tinnitus between June 2004 and January 2007 were included in our study. The patients were divided into four groups; Group 1 and 2: tinnitus with/without coexisting diseases, Group 3 and 4 tinnitus with/without hearing loss. Group 1 includes patients with tinnitus and coexisting disease, and Group 2 includes patients with tinnitus without any other coexisting disease. Group 3, includes patients with tinnitus and hearing loss and Group 4 includes patients with tinnitus without hearing loss. Plasma homocysteine and vitamin B12 levels were detected and compared among these four groups. Results: The ages of the 99 subjects were between 19-70 (mean age 49.48 years); 62 were male and 37 female. Of the 99 patients with tinnitus, 43 (43.4%) were in group A, 56 (56.5%) in group B. The most frequent coexisting disease was hypertension, followed by diabetes mellitus and dyslipidemia which was detected by an internal medicine specialist. When group 1 was compared with group 2 and group 3 with group 4, there was no statistically significant difference in the homocysteine and vitamin B12 levels between the groups. Conclusion: Our study found no statistically significant difference between patient groups in regard to the plasma levels of homocysteine and vitamin B12. Their role in the etiology and therapy of tinnitus may need further investigation. © The Mediterranean Society of Otology and Audiology.

Temporary off-frequency listening after noise trauma.
Hear Res. 2011 Oct 5. [Epub ahead of print]

Etchelecou MC, Coulet O, Derkenne R, Tomasi M, Noreña AJ.
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Hearing loss is routinely estimated from the audiogram, even though this measure gives only a rough approximation of hearing. Indeed, cochlear regions functioning poorly, if at all, called dead regions, are not detected by a simple audiogram. To detect cochlear dead regions, additional measurements of psychophysical tuning curves or thresholds in background noise (TEN test) are required. A first aim of this study was to assess the presence of dead regions after impulse noise trauma using psychophysical tuning curves. The procedure we used was based on a compromise between the need to collect reliable estimates of psychophysical tuning curves and the limited time available to obtain these estimates in a hospital setting. Psychophysical tuning curves were measured using simultaneous masking with a 2-alternative forced choice paradigm, where the target was randomly placed in one of the two masker presentations. It is well known that some components of noise-induced hearing loss are reversible. A second aim of this study was to examine the potential recovery of dead regions after acoustic trauma. A third issue addressed in this article was the relationship between noise-induced dead regions and tinnitus. We found that 70% of the subjects had dead regions after noise trauma, while 88% reported tinnitus. Moreover, we found that the extent of dead regions probably diminished in about 50% of subjects, which highlights the ability of the human auditory system to recover from noise-induced hearing loss. Copyright © 2011 Elsevier B.V. All rights reserved.
Development of three-dimensional time reversal algorithm to locate tinnitus-related hyperactive neurons.

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This paper aims at developing 3-D time reversal (TR) algorithm to locate the positions of tinnitus-related neural activities inside the brain auditory pathways, including the auditory cortex (AC), inferior colliculus (IC), and dorsal cochlear nucleus (DCN), which have been implicated in the etiology of tinnitus. Spontaneous neural network signals will be measured by using multichannel electrode arrays that are implanted on the AC, IC, and DCN of adult Sprague Dawley rats and be taken as input to this TR algorithm. To specify the speeds at which neural signals are traveling through the brain auditory pathways, benchmark tests will be conducted, in which electrical stimulations at pre-determined positions in the AC, IC, and DCN will be used, and the corresponding responses be measured. Once this is done, the precise locations of hyperactivity that is responsible for tinnitus perception can be determined by using TR algorithm to scan through the brain auditory pathways. Note that this 3-D time reversal algorithm will allow for tracing neurons into deeper layers of the AC, IC, and DCN, provided that the electrode arrays are implanted in strategically placed in space. Numerical simulations and preliminary experimental results will be presented.

Bilateral Dorsal Cochlear Nucleus Lesions Prevent Acoustic-Trauma Induced Tinnitus in an Animal Model.

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Animal experiments suggest that chronic tinnitus (“ringing in the ears”) may result from processes that overcompensate for lost afferent input. Abnormally elevated spontaneous neural activity has been found in the dorsal cochlear nucleus (DCN) of animals with psychophysical evidence of tinnitus. However, it has also been reported that DCN ablation fails to reduce established tinnitus. Since other auditory areas have been implicated in tinnitus, the role of the DCN is unresolved. The apparently conflicting electrophysiological and lesion data can be reconciled if the DCN serves as a necessary trigger zone rather than a chronic generator of tinnitus. The present experiment used lesion procedures identical to those that failed to decrease pre-existing tinnitus. The exception was that lesions were done prior to tinnitus induction. Young adult rats were trained and tested using a psychophysical procedure shown to detect tinnitus. Tinnitus was induced by a single unilateral high-level noise exposure. Consistent with the trigger hypothesis, bilateral dorsal DCN lesions made before high-level noise exposure prevented the development of tinnitus. A protective effect stemming from disruption of the afferent pathway could not explain the outcome because unilateral lesions ipsilateral to the noise exposure did not prevent tinnitus and unilateral lesions contralateral to the noise exposure actually exacerbated the tinnitus. The DCN trigger mechanism may involve plastic circuits that, through loss of inhibition, or upregulation of excitation, increase spontaneous neural output to rostral areas such as the inferior colliculus. The increased drive could produce persistent pathological changes in the rostral areas, such as high-frequency bursting and decreased interspike variance, that comprise the chronic tinnitus signal.
Tinnitus with a normal audiogram: physiological evidence for hidden hearing loss and computational model.

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Ever since Pliny the Elder coined the term tinnitus, the perception of sound in the absence of an external sound source has remained enigmatic. Traditional theories assume that tinnitus is triggered by cochlear damage, but many tinnitus patients present with a normal audiogram, i.e., with no direct signs of cochlear damage. Here, we report that in human subjects with tinnitus and a normal audiogram, auditory brainstem responses show a significantly reduced amplitude of the wave I potential (generated by primary auditory nerve fibers) but normal amplitudes of the more centrally generated wave V. This provides direct physiological evidence of “hidden hearing loss” that manifests as reduced neural output from the cochlea, and consequent renormalization of neuronal response magnitude within the brainstem. Employing an established computational model, we demonstrate how tinnitus could arise from a homeostatic response of neurons in the central auditory system to reduced auditory nerve input in the absence of elevated hearing thresholds.

Blast-Induced Tinnitus and Hearing Loss in Rats: Behavioral and Imaging Assays.
J Neurotrauma. 2011 Sep 20. [Epub ahead of print]

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The current study used a rat model to investigate the underlying mechanisms of blast-induced tinnitus, hearing loss and associated traumatic brain injury (TBI). Seven rats were used to evaluate behavioral evidence of tinnitus and hearing loss, and TBI using magnetic resonance imaging following a single 10 ms blast at 14 psi or 194 dB SPL. The results demonstrated that the blast exposure induced early onset of tinnitus and central hearing impairment at a broad frequency range. The induced tinnitus and central hearing impairment tended to shift towards high frequencies over time. Hearing threshold measured with auditory brainstem responses also showed an immediate elevation followed by recovery on day 14, coinciding with behaviorally measured results. Diffusion tensor magnetic resonance imaging results demonstrated significant damage and compensatory plastic changes to certain auditory brain regions, with the majority of changes occurring in the inferior colliculus and medial geniculate body. No significant microstructural changes found in the corpus callosum indicates that the currently adopted blast exposure mainly exerts effects through the auditory pathways rather than through direct impact onto the brain parenchyma. The results showed that this animal model is appropriate for investigation of the mechanisms underlying blast-induced tinnitus, hearing loss and related TBI. Continued investigation along this line will help identify pathology with injury/recovery patterns, aiding development of effective treatment strategies.
III  Diagnostics

Tinnitus measurement with conventional audiometer versus high-frequency audiometer.
Acta Otorrinolaringol Esp. 2011 Dec 5. [Epub ahead of print]

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INTRODUCTION AND OBJECTIVES: Determinations of the psychoacoustic characteristics of tinnitus (frequency and intensity) are valid for diagnosis, treatment, monitoring and research purposes. The aim of this work is to compare the frequency of the tinnitus measured with a standard audiometer and a high frequency audiometer.

METHODS: We used a conventional audiometer (frequency range: 125-12 000Hz) and a high-frequency audiometer (frequency range: 125-18 000Hz) to measure the frequency and intensity of tinnitus in 47 patients with tinnitus as a continuous ringing.

RESULTS: We found statistically-significant differences between the determination of the frequency of tinnitus made with conventional and high-frequency audiometers, as well as a correlation between high-frequency tinnitus and distress expressed by patients.

CONCLUSIONS: 1) The frequency of tinnitus determined by high-frequency audiometer is greater than the frequency determined by conventional audiometer; 2) the higher the frequency of tinnitus, the more discomfort the patient manifests; and 3) there is no relationship between the intensity and discomfort caused by tinnitus. Copyright © 2011 Elsevier España, S.L. All rights reserved.

The Tinnitus Functional Index: Development of a New Clinical Measure for Chronic, Intrusive Tinnitus.
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OBJECTIVES: Chronic subjective tinnitus is a prevalent condition that causes significant distress to millions of Americans. Effective tinnitus treatments are urgently needed, but evaluating them is hampered by the lack of standardized measures that are validated for both intake assessment and evaluation of treatment outcomes. This work was designed to develop a new self-report questionnaire, the Tinnitus Functional Index (TFI), that would have documented validity both for scaling the severity and negative impact of tinnitus for use in intake assessment and for measuring treatment-related changes in tinnitus (responsiveness) and that would provide comprehensive coverage of multiple tinnitus severity domains.

DESIGN: To use preexisting knowledge concerning tinnitus-related problems, an Item Selection Panel (17 expert judges) surveyed the content (175 items) of nine widely used tinnitus questionnaires. From those items, the Panel identified 13 separate domains of tinnitus distress and selected 70 items most likely to be responsive to treatment effects. Eliminating redundant items while retaining good content validity and adding new items to achieve the recommended minimum of 3 to 4 items per domain yielded 43 items, which were then used for constructing TFI Prototype 1. Prototype 1 was tested at five clinics. The 326 participants included consecutive patients receiving tinnitus treatment who provided informed
consent constituting a convenience sample. Construct validity of Prototype 1 as an outcome measure was evaluated by measuring responsiveness of the overall scale and its individual items at 3 and 6 mo follow-up with 65 and 42 participants, respectively. Using a predetermined list of criteria, the 30 best-functioning items were selected for constructing TFI Prototype 2. Prototype 2 was tested at four clinics with 347 participants, including 155 and 86 who provided 3 and 6 mo follow-up data, respectively. Analyses were the same as for Prototype 1. Results were used to select the 25 best-functioning items for the final TFI.

RESULTS: Both prototypes and the final TFI displayed strong measurement properties, with few missing data, high validity for scaling of tinnitus severity, and good reliability. All TFI versions exhibited the same eight factors characterizing tinnitus severity and negative impact. Responsiveness, evaluated by computing effect sizes for responses at follow-up, was satisfactory in all TFI versions. In the final TFI, Cronbach’s alpha was 0.97 and test-retest reliability 0.78. Convergent validity ($r = 0.86$ with Tinnitus Handicap Inventory [THI]; $r = 0.75$ with Visual Analog Scale [VAS]) and discriminant validity ($r = 0.56$ with Beck Depression Inventory-Primary Care [BDI-PC]) were good. The final TFI was successful at detecting improvement from the initial clinic visit to 3 mo with moderate to large effect sizes and from initial to 6 mo with large effect sizes. Effect sizes for the TFI were generally larger than those obtained for the VAS and THI. After careful evaluation, a 13-point reduction was considered a preliminary criterion for meaningful reduction in TFI outcome scores.

CONCLUSIONS: The TFI should be useful in both clinical and research settings because of its responsiveness to treatment-related change, validity for scaling the overall severity of tinnitus, and comprehensive coverage of multiple domains of tinnitus severity.

Noise-induced tinnitus: A comparison between four clinical groups without apparent hearing loss.

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The number of people with normal hearing thresholds seeking medical help for tinnitus and other hearing problems is increasing. For diagnostic purposes, existence/nonexistence of lesions or combinations of lesions in the inner ear not reflected in the audiogram was evaluated with advanced hearing tests applied to tinnitus patients with certain backgrounds, including noise exposure. For forty-six patients with pronounced tinnitus, and other symptoms, tentative diagnoses were established, including judgments of the influence of four causative factors: (1) acoustic trauma, (2) music, (3) suspected hereditary, and (4) nonauditory, for example, stress or muscular tension. They were analyzed with a test battery sensitive to lesions involving the outer hair cells, damage from impulse noise, and dysfunction of the efferent system. There were significant differences in test results between groups with individuals with the same most likely causative factor. Most patients claiming acoustic trauma had a specific type of result, 'hyper-PMTF' (psychoacoustical modulation transfer function), and abnormal test results of the efferent system. Everyone in the hereditary group had dysfunction of the efferent system. All patients working with music, except one, had some abnormality, but without specific pattern. The nonauditory group mostly had normal test results. The investigation shows that it is possible to diagnose minor cochlear lesions as well as dysfunction of the efferent system, which might be causing the tinnitus. Those abnormalities could not be detected with routine audiological tests. Malfunctioning caused by impulse noise is an obvious example of this. These findings facilitate choice of treatment, rehabilitation programs, and medicolegal decisions.
Psychometric instruments for the diagnosis of tinnitus. [Article in German]
HNO. 2011 Oct 30. [Epub ahead of print]

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Tinnitus is a very complex phenomenon with various mechanisms of origin. Multimodal and interdisciplinary treatment is the most effective form of treatment for patients with chronic tinnitus. In order to assess existing comorbidity in tinnitus patients as well as to treat the patients individually, a comprehensive and differentiated diagnosis is needed. Since standardized guidelines for the use of relevant instruments in the diagnosis of tinnitus have been lacking hitherto, we present here psychometric questionnaires which have already been used effectively in the research, diagnosis and therapy of tinnitus in the present article. The questionnaires measure the severity of tinnitus, depression and anxiety, the perceived stress, personal resources as well as the quality of life of patients.

Temporary off-frequency listening after noise trauma.
Hear Res. 2011 Oct 5. [Epub ahead of print]

Etchelecou MC, Coulet O, Derkenne R, Tomasi M, Noreña AJ.
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Hearing loss is routinely estimated from the audiogram, even though this measure gives only a rough approximation of hearing. Indeed, cochlear regions functioning poorly, if at all, called dead regions, are not detected by a simple audiogram. To detect cochlear dead regions, additional measurements of psychophysical tuning curves or thresholds in background noise (TEN test) are required. A first aim of this study was to assess the presence of dead regions after impulse noise trauma using psychophysical tuning curves. The procedure we used was based on a compromise between the need to collect reliable estimates of psychophysical tuning curves and the limited time available to obtain these estimates in a hospital setting. Psychophysical tuning curves were measured using simultaneous masking with a 2-alternative forced choice paradigm, where the target was randomly placed in one of the two masker presentations. It is well known that some components of noise-induced hearing loss are reversible. A second aim of this study was to examine the potential recovery of dead regions after acoustic trauma. A third issue addressed in this article was the relationship between noise-induced dead regions and tinnitus. We found that 70% of the subjects had dead regions after noise trauma, while 88% reported tinnitus. Moreover, we found that the extent of dead regions probably diminished in about 50% of subjects, which highlights the ability of the human auditory system to recover from noise-induced hearing loss. Copyright © 2011 Elsevier B.V. All rights reserved.

Pilot Study to Evaluate Ecological Momentary Assessment of Tinnitus.
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OBJECTIVES: Because audiometric evaluation, symptom histories, questionnaires, and similar standard assessment tools may not adequately sample the effects of chronic tinnitus on day-to-day activities, there is a need for alternative methodological approaches to study the impact of tinnitus on day-to-day life. An innovative methodological approach that has shown great promise in the study of chronic health problems characterized by reported temporal and/or situational variability in symptoms and distress.
is known as ecological momentary assessment (EMA). EMA involves the real-time measurement of states, situational factors, and symptoms by individuals as they go about their day-to-day activities. The objective of this pilot investigation was to explore the feasibility of using EMA methods to examine within- and between-day effects of tinnitus.

DESIGN: This study was conducted in three phases: (1) design and development of an EMA methodology that could be used to assess effects of tinnitus; (2) refinement of the methodology through the use of two focus groups; and (3) field-test the methodology with individuals who experienced bothersome tinnitus. For Phase 3, each of the 24 participants wore, throughout their waking hours for 2 weeks, a personal digital assistant that produced alerts four times a day. The alerts prompted participants to respond to 19 questions, including 9 relating to situational and mood factors and 10 comprising the Tinnitus Handicap Inventory-Screening version (THI-S). To evaluate for potential reactive effects of performing the EMA protocol, each participant completed the paper-and-pencil version of the full 25-item THI before and after the 2-week EMA period.

RESULTS: Participants responded to the alerts with a 90% compliance rate, providing a total of 1210 completed surveys. At the time of their response, participants indicated that they were in their house or apartment (67.7%), alone (50.2%), happy (50%), and calm (54.5%). Across most responses, participants could hear their tinnitus (97%), and the loudness of their tinnitus averaged 4.7 on a 7-point increasing-loudness scale. The mean THI-S index score (out of a possible maximum 40 points for greatest tinnitus severity) was 17.0 (moderate self-perceived tinnitus handicap). Repeated THI-S index scores varied considerably both within and between participants. Mean 25-item THI scores were not significantly different before and after the EMA period, suggesting little reactivity of the EMA.

CONCLUSIONS: The high compliance rate, positive feedback from participants, lack of reactivity as a result of performing the EMA protocol, and data collected indicate that EMA methodology is feasible with patients who have tinnitus. Outcome data obtained with this methodology cannot be obtained any other way because retrospective questionnaires cannot capture the day-to-day reactions. This methodology has the potential to provide more in-depth and accurate assessments of patients receiving therapy for tinnitus.

[Preliminary investigation of psychologic factors in 76 tinnitus patients].
[Article in Chinese]

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OBJECTIVE: To study the psychological aspects of tinnitus patients, to analyze the distribution of psychologic obstacle in tinnitus patients, and then to provide information for diagnosing and treating tinnitus clinically.

METHOD: All patients were detected their frequency and loudness of tinnitus. Then they were evaluated by symptom checklist 90 (SCL-90), life satisfaction scale, Pittsburgh sleep quality index (PSQI) and tinnitus handicap inventory (THI). All data were analyzed with statistical software SPSS11.0.

RESULT: (1)There was no straight line correlation beween frequency, loudness of tinnitus and the patient's scores from SCL-90, life satisfaction rating scale (LSR), life satisfaction index A (LSIA), LSIB, PSQI, THI. (2) To 76 tinnitus patients, some factors of SCL-90 were higher than internal nom. Compared with internal nom, tinnitus patients' score of LSR, LSIA and LSIB were all lower than it. Many of tinnitus patients had sleep disorder, the ratio was higher than internal nom. (3) Grouping these patients, based on the score of THI. To THI four grade group and THI five grade group, their satisfaction of lives were lower, some factors of SCL-90 were higher than internal nom. To THI five grade group, the ratio about sleep disorder was higher than internal nom.

CONCLUSION: There is no straight line correlation beween frequency, loudness of tinnitus and the patient's scores from SCL-90, LSR, LSIA, LSIB, PSQI, THI. Grouping based on the score of THI, the groups of THI four grade and THI five grade are approved that they have psychologic obstacle obviously, they should be paid close attention.
OBJECTIVE: To analyze the hearing loss profiles in patients with tinnitus, and then provide clinical foundation for further studying the etiology and examination methods of tinnitus.

METHOD: Ear specialist examination, acoustic impedance test, normal frequency pure tone audiometry and extended high frequency audiometry were applied to 200 patients with chief complaint of subjective tinnitus.

RESULT: Among the 200 tinnitus cases, 123 (61.5%) patients were diagnosed with unilateral tinnitus, 77 (38.5%) patients with bilateral tinnitus and 46 (23.0%) cases with normal hearing. In those patients with unilateral tinnitus, by comparing the hearing threshold of affected side and contralateral side (0.125-8 kHz), the difference was statistically significant (P < 0.05), but in extended high frequency (> 10 kHz), the difference between two groups was not statistically significant (P > 0.05). There was significant difference in hearing threshold between tinnitus patients with normal and abnormal hearing in normal frequency (P < 0.05), meantime the detection rate in abnormal hearing group was lower than the normal group.

CONCLUSION: Tinnitus can occur in people with normal hearing. Early in tinnitus, further study need be undertaken on whether the audiometry extended high frequency can offer the early evidence of hearing loss for tinnitus patients or not.

IV Imaging

Assessment of non-motor hearing symptoms in hemifacial spasm using magnetoencephalography.


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BACKGROUND: Hemifacial spasm patients often suffer from non-motor symptoms such as tinnitus. These non-motor symptoms are known to be associated with changes in cortical activity. Magnetoencephalography (MEG) is a technique that can record brain activity noninvasively. To determine the usefulness of MEG in assessing changes in cortical activity associated with non-motor hearing symptoms in hemifacial spasm patients.

METHODS: We used MEG to evaluate the reactivity of the auditory cortex in 26 hemifacial spasm patients. We divided patients into a subjective tinnitus group (n = 10) and a non-tinnitus group (n = 16). The latency and amplitude of the most prominent deflection, N100m, was compared between the two groups.

RESULTS: There was a significant difference in the pure tone audiogram on the spasm side compared with the non-spasm side. After stimulation on the spasm side, the amplitude of the N100m peak in the contralateral hemisphere was lower in the subjective tinnitus group than in the non-tinnitus group.

CONCLUSIONS: Our results indicate that MEG can detect differences in cortical activity between hemifacial spasm patients with and without tinnitus. This suggests that MEG can identify changes in cortical activity associated with non-motor symptoms.
The neural correlates of consciousness (NCC), i.e., patterns of brain activity that specifically accompany a particular conscious experience, have been investigated mainly in the visual system using particularly suited paradigms, such as binocular rivalry and multistable percepts in combination with neural recordings or neuroimaging. Through the same principles, we look here for possible NCC in the auditory modality exploiting the properties of the Deutsch's illusion, a stimulation condition in which a sequence of two specular dichotic stimuli presented in alternation causes an illusory segregation of pitch and side (ear of origin), which can yield up to four different auditory percepts per dichotic stimulus. Using magnetoencephalography in humans, we observed cortical activity specifically accompanying conscious experience of pitch inside an early bilateral network, including the Heschl's gyrus, the middle temporal gyrus, the right inferior, and the superior frontal gyri. The conscious experience of perceived side was instead accompanied by later activity observed bilaterally in the inferior parietal lobe and in the superior frontal gyrus. These results suggest that the NCC are not independent of stimulus features and modality and that, even at the higher cortical levels, the different aspects of a single perceptual scene may not be simultaneously processed.

Discrimination task reveals differences in neural bases of tinnitus and hearing impairment.
Husain FT, Pajor NM, Smith JF, Kim HJ, Rudy S, Zalewski C, Brewer C, Horwitz B.

We investigated auditory perception and cognitive processing in individuals with chronic tinnitus or hearing loss using functional magnetic resonance imaging (fMRI). Our participants belonged to one of three groups: bilateral hearing loss and tinnitus (TIN), bilateral hearing loss without tinnitus (HL), and normal hearing without tinnitus (NH). We employed pure tones and frequency-modulated sweeps as stimuli in two tasks: passive listening and active discrimination. All subjects had normal hearing through 2 kHz and all stimuli were low-pass filtered at 2 kHz so that all participants could hear them equally well. Performance was similar among all three groups for the discrimination task. In all participants, a distributed set of brain regions including the primary and non-primary auditory cortices showed greater response for both tasks compared to rest. Comparing the groups directly, we found decreased activation in the parietal and frontal lobes in the participants with tinnitus compared to the HL group and decreased response in the frontal lobes relative to the NH group. Additionally, the HL subjects exhibited increased response in the anterior cingulate relative to the NH group. Our results suggest that a differential engagement of a putative auditory attention and short-term memory network, comprising regions in the frontal, parietal and temporal cortices and the anterior cingulate, may represent a key difference in the neural bases of chronic tinnitus accompanied by hearing loss relative to hearing loss alone.

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We have previously used direct electrode recordings in two human subjects to identify neural correlates of the perception of pitch (Griffiths, Kumar, Sedley et al., Direct recordings of pitch responses from human auditory cortex, Curr. Biol. 22 (2010), pp. 1128-1132). The present study was carried out to assess virtual-electrode measures of pitch perception based on non-invasive magnetoencephalography (MEG). We recorded pitch responses in 13 healthy volunteers using a passive listening paradigm and the same pitch-evoking stimuli (regular interval noise; RIN) as in the previous study. Source activity was reconstructed using a beamformer approach, which was used to place virtual electrodes in auditory cortex. Time-frequency decomposition of these data revealed oscillatory responses to pitch in the gamma frequency band to occur, in Heschl’s gyrus, from 60Hz upwards. Direct comparison of these pitch responses to the previous depth electrode recordings shows a striking congruence in terms of spectrotemporal profile and anatomical distribution. These findings provide further support that auditory high gamma oscillations occur in association with RIN pitch stimuli, and validate the use of MEG to assess neural correlates of normal and abnormal pitch perception. Copyright © 2011 Elsevier Inc. All rights reserved.


Wang Y, Ding N, Ahmar N, Xiang J, Poeppel D, Simon JZ.

Slow acoustic modulations below 20 Hz, of varying bandwidths, are dominant components of speech and many other natural sounds. The dynamic neural representations of these modulations are difficult to study through noninvasive neural recording methods, however, because of the omnipresent background of slow neural oscillations throughout the brain. We recorded the auditory steady state responses (aSSR) to slow amplitude modulations (AM) from 14 human subjects using magnetoencephalography (MEG). The responses to five AM rates (1.5, 3.5, 7.5, 15.5 and 31.5 Hz), and four types of carrier (pure tone, 1/3-, 2- and 5-octave pink noise) were investigated. The phase-locked aSSR was reliably detected in all conditions. The response power generally decreases with increasing modulation rate, and the response latency is between 100 and 150 ms for all but the highest rates. Response properties depend only weakly on the bandwidth. Analysis of the complex-valued aSSR magnetic fields in the Fourier domain reveals several neural sources with different response phases. These neural sources of the aSSR, when approximated by a single equivalent current dipole (ECD), are distinct from, and medial to, the ECD location of the N1m response. These results demonstrate that the globally synchronized activity in human auditory cortex is phase-locked to slow temporal modulations below 30 Hz and the neural sensitivity decreases with increasing AM rate, with relative insensitivity to bandwidth.
A tennis ball and music as a patients solution for pulsatile tinnitus.

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We present the case of a 74-year-old man with a pulsatile somatosound causing insomnia and daytime irritation. Given the lack of salvation after medical therapy the patient went in search for a solution and found it in a tennis ball and radio. In this case, the somatosound was due to an extracranial arteriovenous malformation, but the differential diagnosis of pulsatile somatosounds is quit extended, ranging form vascular disorders to tumoral processes. This makes these cases challenging for all caretakers.

Neural correlates of tinnitus duration and Distress: A positron emission tomography study.
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Cerebral (18) F-deoxyglucose positron emission tomography (FDG-PET) has shown altered auditory pathway activity in tinnitus. However, the corresponding studies involved only small samples and analyses were restricted to the auditory cortex in most studies. Evidence is growing that also limbic, frontal, and parietal areas are involved in the pathophysiology of chronic tinnitus. These regions are considered to mediate perceptual, attentional, and emotional processes. Thus, the aim of the present study was the systematic evaluation of metabolic brain activity in a large sample of tinnitus patients. Ninety one patients with chronic tinnitus underwent FDG-PET. The effects of tinnitus severity (assessed by a tinnitus questionnaire score), duration and laterality were evaluated with statistical parametric mapping (SPM) in whole brain analyses. In addition, region of interest analyses were performed for primary auditory areas. Tinnitus duration correlated positively with brain metabolism in right inferior frontal, right ventro-medial prefrontal, and right posterior cingulate cortex. Tinnitus distress correlated positively with activation of left and right posterior inferior temporal gyrus as well as left and right posterior parahippocampal-hippocampal interface. Region of interest analysis demonstrated an overactivation of left in contrast to right Heschl's gyrus independently from tinnitus laterality and anatomical hemispheric differences. Tinnitus duration and distress were associated with areas involved in attentional and emotional processing. This is in line with recent findings indicating the relevance of higher order areas in the pathophysiology of tinnitus. Earlier results of asymmetric activation of the auditory cortices in tinnitus were confirmed, i.e., left-sided overactivation was found independently from tinnitus laterality. Hum Brain Mapp, 2011. © 2011 Wiley-Liss, Inc.. Copyright © 2011 Wiley-Liss, Inc.

Real-time fMRI and its application to neurofeedback.

Weiskopf N.
Real-time fMRI (rtfMRI) allows immediate access to experimental results by analyzing data as fast as they are acquired. It was devised soon after the inception of fMRI and has undergone a rapid development since then. The availability of results during the ongoing experiment facilitates a variety of applications such as quality assurance or fast functional localization. RtfMRI can also be used as a brain-computer interface (BCI) with high spatial resolution and whole-brain coverage, overcoming limitations of EEG based BCIs. This review will focus on the application of rtfMRI BCIs to neurofeedback, i.e., the online feedback of the blood oxygen level dependent (BOLD) response. I will motivate its development
and place its beginnings into the contemporary scientific context by providing an account of our early work at the University of Tuebingen, followed by a review of the accomplishments and the current state of rtfMRI neurofeedback. RtfMRI neurofeedback has been used to train self-regulation of the local BOLD response in various different brain areas and to study consequential behavioral effects. Behavioral effects such as modulation of pain, reaction time, linguistic or emotional processing have been shown in healthy and/or patient populations. RtfMRI neurofeedback presents a new paradigm for studying the relation between brain behavior and physiology, because the latter can be regarded as the independent variable (unlike in conventional neuroimaging studies where behavior is the independent variable). The initial results in patient populations improving pain, tinnitus, depression or modulating perception in schizophrenia are encouraging and merit further controlled clinical studies. Copyright © 2011. Published by Elsevier Inc.

The distressed brain: a group blind source separation analysis on tinnitus.

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BACKGROUND: Tinnitus, the perception of a sound without an external sound source, can lead to variable amounts of distress.

METHODOLOGY: In a group of tinnitus patients with variable amounts of tinnitus related distress, as measured by the Tinnitus Questionnaire (TQ), an electroencephalography (EEG) is performed, evaluating the patients' resting state electrical brain activity. This resting state electrical activity is compared with a control group and between patients with low (N=30) and high distress (N=25). The groups are homogeneous for tinnitus type, tinnitus duration or tinnitus laterality. A group blind source separation (BSS) analysis is performed using a large normative sample (N=84), generating seven normative components to which high and low tinnitus patients are compared. A correlation analysis of the obtained normative components' relative power and distress is performed. Furthermore, the functional connectivity as reflected by lagged phase synchronization is analyzed between the brain areas defined by the components. Finally, a group BSS analysis on the Tinnitus group as a whole is performed.

CONCLUSIONS: Tinnitus can be characterized by at least four BSS components, two of which are posterior cingulate based, one based on the subgenual anterior cingulate and one based on the parahippocampus. Only the subgenual component correlates with distress. When performed on a normative sample, group BSS reveals that distress is characterized by two anterior cingulate based components. Spectral analysis of these components demonstrates that distress in tinnitus is related to alpha and beta changes in a network consisting of the subgenual anterior cingulate cortex extending to the pregenual and dorsal anterior cingulate cortex as well as the ventromedial prefrontal cortex/orbitofrontal cortex, insula, and parahippocampus. This network overlaps partially with brain areas implicated in distress in patients suffering from pain, functional somatic syndromes and posttraumatic stress disorder, and might therefore represent a specific distress network.
Emerging pharmacotherapy of tinnitus.
Expert Opin Emerg Drugs. 2011 Dec 8. [Epub ahead of print]

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One in ten adults has clinically significant subjective tinnitus, and for one in hundred, tinnitus severely affects their quality of life. Despite the significant unmet clinical need for a safe and effective drug targeting tinnitus relief, there is currently not a single FDA-approved drug on the market. Even a drug that produces a small but significant effect would have a huge therapeutic impact. In the last few years, there have been significant advances in i) the understanding of the pathophysiology of the different forms of tinnitus, ii) the establishment of valid animal models and iii) the development of clinical trial methodology. A glimpse of hope is appearing in the horizon as an increasing number of pharmaceutical industries now have compounds targeting tinnitus in their pipeline.

Comparison of various treatment modalities for acute tinnitus.

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OBJECTIVES/HYPOTHESIS: Because in most cases the development of tinnitus is triggered by cochlear damage, there exists the opportunity to eliminate tinnitus while the cochlear lesion is still reversible. Therefore, we evaluated the therapeutic effects of various treatment modalities on acute subjective idiopathic tinnitus (SIT) and investigated prognostic factors affecting the treatment outcome.

STUDY DESIGN: Prospective, controlled, double-blind trial.

METHODS: A total 107 patients who underwent treatment for unilateral SIT that had developed within the previous 3 months completed the study. The patients were randomly assigned into three groups according to the treatment modality: group I (n = 32), alprazolam orally for 3 months; group II (n = 35), as for group I plus four intratympanic dexamethasone (ITD) injections; and group III (n = 40), as for group II plus four intravenous injections of lipo-prostaglandin E(1).

RESULTS: The improvement rate of group II (75.8%) was significantly higher than that of group I (40.3%; P < .05), and there was no significant difference in the improvement rate of group III (50.0%) compared with groups I and II (P > .05). The cure rates of group II (25.8%) and group III (20.0%) were significantly higher than that of group I (9.8%; P < .05). There was a significant correlation between the cure rate and duration of symptoms.

CONCLUSIONS: The results of the present study indicate that ITD injection plus alprazolam medication is the best treatment choice for acute SIT within 3 months of development. Laryngoscope, 121:2619-2625, 2011. Copyright © 2011 The American Laryngological, Rhinological, and Otological Society, Inc.
Improvement in cochlear flow in patients with tinnitus with the complex supplement Acustop: a product evaluation.


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AIM: Patients with tinnitus constitute a very large group without a real, specific therapeutic solution. With noninvasive, color duplex it is possible to measure flow in the cochlear artery and to follow duplex flow changes due to treatments in most patients. The aim of this preliminary evaluation was to study flow variations in patients with „mild-to-moderate“ tinnitus, possibly associated to cochlear hypo-perfusion, after administration of Acustop (used as a food supplement). The aim was to improve cochlear flow decreasing the level of tinnitus.

METHODS: Patients with „mild-to-moderate“, „idiopathic“, monolateral tinnitus, present for at least 4 weeks were included; no vertigo or important hearing loss had been observed. The origin of tinnitus had been sudden (hours or days). The tinnitus was associated to a decrease in cochlear flow measured by color Duplex at the affected ear. A group of 42 patients was evaluated; 25 used Acustop; there were 17 controls (follow-up only). Groups were comparable for their clinical problem and other details. The average duration of treatment was 4 weeks.

RESULTS: No side effects were observed and no drop-outs were recorded. Flow velocity at the level of the affected inner ear was significantly lower (both the diastolic and systolic components; P<0.05) in comparison with the other ear. This was considered an indication of the vascular origin of the tinnitus. With Acustop treatment there was a significant improvement in systolic (P<0.05) and diastolic flow velocity (P<0.05). The increase in flow velocity was not significant in controls. An analogue scale line was used to measure symptoms in the Acustop group: it was 8.2;2 at inclusion; it decreased to 3.1;1.5 at 4 weeks (P<0.05). The score was 8.4;2 in controls at inclusion; at 4 weeks the score was 7.1;2.2 (not significant). Tinnitus scale: the value at inclusion of the tinnitus scale in the Acustop group a was 8.5;1.1 versus 8.3;1.2 in controls. After 4 weeks the score was 3.1;1.1 (P<0.05) in the Acustop group vs 7.2 in controls; the difference between the two groups was significant; P<0.025).

CONCLUSION: In conclusion, these results suggest that in selected patients with tinnitus and altered inner ear perfusion Acustop appears to be effective in relieving tinnitus possibly by improving cochlear flow. More studies should be planned to evaluate better the potential applications of Acustop in this very interesting field. This clinical problem affects a large number of patients, without a real therapeutic solution at the moment, decreasing their quality of life and their performing abilities.

Effect of herbal tea treatment on Ménière’s diseases.

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The purpose of this study was to confirm the effect of herbal tea therapy on Ménière’s disease. We studied nine patients with Ménière’s disease who visited the International University of Health and Welfare MITA hospital in 2008. According to criteria of the Japan Society for Equilibrium Research, all the patients were diagnosed as having Ménière’s disease or cochlear Ménière’s disease and underwent audiometric measurements and questionnaires regarding their functional level and tinnitus symptoms every month. Moreover, we instructed these patients to keep a record of the number of times they experienced vertigo. After 6 months of general treatment, we treated the patients with an herbal tea for one year. To minimize adverse effects, we used a blend of herbal teas. This herbal tea was effective as a diuretic, for alleviating vertigo, and for promoting relaxation. We compared the patients' symptoms before and after the herbal tea therapy. Herbal tea therapy was effective for all the patients, and none of the
patients experienced a relapse or adverse effects. Thus, the herbal tea therapy improved their Ménière’s symptoms. Our study provides evidence that herbal tea therapy is useful for preventing the worsening of Ménière’s disease.

A dose-response analysis of the effects of L-baclofen on chronic tinnitus caused by acoustic trauma in rats. 
Neuropharmacology. 2011 Oct 12. [Epub ahead of print]
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Subjective tinnitus is a chronic neurological disorder in which phantom sounds are perceived. Drugs that increase GABAergic neurotransmission in the CNS are sometimes used as a treatment. One such drug is the GABA(B) receptor agonist L-baclofen. The aim of this study was to investigate the effects of L-baclofen on the psychophysical attributes of tinnitus in rats. The effects of 1, 3 or 5 mg/kg L-baclofen (s.c.) on the psychophysical attributes of tinnitus were investigated using a conditioned lick suppression model, following acoustic trauma (a 16 kHz, 110 dB pure tone presented unilaterally for 1 h) in rats. In pre-drug testing, acoustic trauma resulted in a significant increase in the auditory brainstem-evoked response (ABR) threshold in the affected ear (P < 0.008) and a significant decrease in the suppression ratio (SR) compared to sham controls in response to the 20 kHz tones, but not the broadband noise or the 10 kHz tones (P < 0.002). The 3 and 5 mg/kg doses of L-baclofen significantly reversed the frequency-specific decrease in the SR in the acoustic trauma group, indicating that the drug reduced tinnitus. Following washout from the 3 mg/kg dose, but not the 5 mg/kg dose, the significant decrease in the SR for the acoustic trauma group returned, suggesting a return of the tinnitus. These results suggest that L-baclofen should be reconsidered as a drug treatment for tinnitus. Copyright © 2011 Elsevier Ltd. All rights reserved.

Effect of Lyophilized Powder Made From Enzymolyzed Honeybee Larvae on Tinnitus-Related Symptoms, Hearing Levels, and Hypothalamus-Pituitary-Adrenal Axis-Related Hormones.
Ear Hear. 2011 Oct 3. [Epub ahead of print]
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OBJECTIVES: Tinnitus interferes with sleep and concentration which is associated with depression; however, no drug has been effective in treating tinnitus. Our purpose is to evaluate our hypothesis that the treatment with lyophilized powder of enzymolyzed honeybee larvae as a complementary medicine may provide a therapeutic effect on tinnitus-related symptoms.
DESIGN: Sixty tinnitus sufferers participated in a randomized double-blind placebo-controlled trial using the lyophilized powder of enzymolyzed honeybee larvae or a placebo. The Tinnitus Handicap Inventory, a visual analog scale to rate the severity of tinnitus, hearing levels, and hypothalamus-pituitary-adrenal axis-related hormones drawn early in the morning were measured upon entry into the study and after 12 wk of follow-up.
RESULTS: The lyophilized powder of enzymolyzed honeybee larvae was not superior to placebo with regard to the total score on the Tinnitus Handicap Inventory and the visual analog scale. However, subjects in the honeybee larvae group showed significant improvements in some items about depression associated with tinnitus, whereas subjects in the placebo group showed no improvement in any items. The honeybee larvae group showed significant improvements in the hearing levels at 2 and 4 kHz in the audiogram of the better ear. The intervention of the lyophilized powder of enzymolyzed honeybee larvae was associated with lower serum cortisol levels, serum prolactin levels, and cortisol/dehydroepiandrosterone sulfate ratios. The ratios in the placebo group significantly were increased.
CONCLUSIONS: Our results suggest that the lyophilized powder of enzymolyzed honeybee larvae represents an effective complementary medicine to alleviate depression associated with tinnitus by regulating the activity of the hypothalamus-pituitary-adrenal axis. This study was enrolled in the University Hospital Medical Information Network Clinical Trials Registry (UMIN000003022).

Gabapentin for Tinnitus: A Systematic Review.
Am J Audiol. 2011 Sep 22. [Epub ahead of print]
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PURPOSE: The main aim of this study was to assess the effect of gabapentin on tinnitus via a systematic review.
METHOD: An electronic search of literature as well as hand search was conducted. Only double-blind randomized controlled trials (RCTs) that met all of the inclusion criteria were included to this review. The Cochrane Collaboration tool for risk of bias assessment was used to investigate the validity of the included studies. Meta-analysis was not appropriate due to inadequate details in reporting the data in the included studies. Hence, qualitative synthesis and interpretation of the data was carried out.
RESULTS: Two studies that met the inclusion criteria were included to the review. Fourteen studies were excluded. There were substantive within-study clinical heterogeneities with regard to the baseline tinnitus handicap scores, duration of tinnitus as well as severity of hearing loss in the included double-blind RCTs.
CONCLUSION: The authors of the both studies reported that gabapentin was not superior to placebo in their primary outcomes. However, following the assessment of risk of bias, and within-study clinical heterogeneities, this review concludes that there is insufficient evidence regarding the effect of gabapentin on tinnitus.

VI Auditive Stimulation

Cochlear implant in patients with sudden unilateral sensorineural hearing loss and associated tinnitus.
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INTRODUCTION AND OBJECTIVES: To assess the efficacy of cochlear implantation in patients with unilateral sudden sensorineural hearing loss and associated disabling tinnitus.
METHODS: Ten patients suffering from severe-to-profound sudden hearing loss and tinnitus in the affected ear received implants. The sample was comprised of 4 men and 6 women, with a mean age of 42.7 years (range 34-62) at implantation. The severity of the tinnitus was evaluated with the Spanish validated version of the Tinnitus Handicap Inventory (THI) and a visual analogue scale. These assessments were obtained before and after implantation.
RESULTS: Tinnitus suppression was observed in 2 patients. In 7 cases, we observed an improvement in the THI, in different degrees, and 1 patient remained without changes. Tinnitus worsening was not found in the series studied.
CONCLUSIONS: Tinnitus reduction following cochlear implantation can be explained by several mechanisms, such as habituation, acoustic masking, direct stimulation of the cochlear nerve and reorganisation of cortical areas. Even though further research is required, cochlear implantation is an effective method for the treatment of disabling tinnitus in patients with severe-to-profound unilateral sudden sensorineural hearing loss. Copyright © 2011 Elsevier España, S.L. All rights reserved.
New criteria of indication and selection of patients to cochlear implant.

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Numerous changes continue to occur in cochlear implant candidacy. In general, these have been accompanied by concomitant and satisfactory changes in surgical techniques. Together, this has advanced the utility and safety of cochlear implantation. Most devices are now approved for use in patients with severe to profound unilateral hearing loss rather than the prior requirement of a bilateral profound loss. Furthermore, studies have begun utilizing short electrode arrays for shallow insertion in patients with considerable low-frequency residual hearing. This technique will allow the recipient to continue to use acoustically amplified hearing for the low frequencies simultaneously with a cochlear implant for the high frequencies. The advances in design of, and indications for, cochlear implants have been matched by improvements in surgical techniques and decrease in complications. The resulting improvements in safety and efficacy have further encouraged the use of these devices. This paper will review the new concepts in the candidacy of cochlear implant.

Cochlear implantation for total deafness after ipsilateral ventriculoperitoneal shunt surgery: technical report.

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BACKGROUND: Cochlear implantation (CI) becomes more challenging when a programmable ventriculoperitoneal (VP) shunt is present on the same side of the head. We report a successful ipsilateral CI in a patient who suffered bilateral hearing loss after shunt surgery.

METHOD: We describe the CI case of a 49-year-old woman with an implanted VP shunt device, and perform a retrospective review of the clinical, audiological, and radiological features, surgical techniques, and postoperative functional outcomes.

FINDINGS: During CI, the magnet in the core of internal antenna of the CI device was positioned approximately 8 cm from the shunt valve so that it would not be affected by the magnetic field of the programmable valve. Although the CI antenna tip and shunt catheter overlapped, we were very careful not to pull the shunt catheter out of position while the musculoperiosteal flap was elevated.

CONCLUSIONS: The present result suggests that ipsilateral CI is an option for deaf adult patients who have a programmable shunt.
Quantitative approach in treatment of tinnitus by acoustical stimulation.
Proceedings of SPIE - The International Society for Optical Engineering, Volume 8285, 2011, Article number 82854Q.

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Tinnitus is the perception of phantom sounds in the ears or in the head without external sound sources even in the completely silent environment. There is no known effective medical treatment for tinnitus and acoustical stimulation has provided patients with some measure of relief. In this paper treatment method with acoustical stimulation has been investigated and simulated by neural oscillator model, simulation results are confirmed by clinical and physiological reports. © 2011 Copyright Society of Photo-Optical Instrumentation Engineers (SPIE).

Elderly patients benefit from cochlear implantation regarding auditory rehabilitation, quality of life, tinnitus, and stress.

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OBJECTIVES/HYPOTHESIS: To determine the effect of cochlear implantation on quality of life, speech performance, tinnitus, perceived stress, and coping strategy in patients aged ≥70 years in comparison with younger patients.
STUDY DESIGN: Retrospective study.
METHODS: A total of 55 postlingually deafened adults who were unilaterally implanted with a multichannel cochlear implant for at least 6 months were included in the study. Twenty patients were aged ≥70 years (70-84 years), and 35 patients were <70 years (19-67 years). Speech perception was measured using the Freiburg monosyllable test in quiet and the Hochmair-Schulz-Moser sentence test. In addition, the patients filled in six validated questionnaires.
RESULTS: Speech perception and subjectively assessed auditory ability were similar in the two age groups after implantation. Disease-specific quality of life was improved in patients aged ≥70 years and even to a higher extent as compared to younger patients. Tinnitus annoyance and perceived stress were reduced in elderly patients to the same extent as in younger patients in the case of high initial severity level. The scores for the coping subdomain “seeking support” were reduced in elderly patients.
CONCLUSIONS: The present study provides evidence that cochlear implantation constitutes a very successful procedure of auditory rehabilitation, even for patients aged ≥70 years. In addition, elderly patients benefit from implantation, with increased quality of life and reduced tinnitus and stress.
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Neuromonics tinnitus treatment for patients with significant level of hearing loss: An adaptation of the protocol.

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Abstract Objective: In this study, we aimed to explore a variation of the NTT standard protocol that would be more beneficial for those patients with hearing loss >50 dB HL in the worst ear (average hearing thresholds at 0.5, 1, 2, and 4 KHz). Study sample: This study involved 26 subjects who had previously undergone NTT at a single private practice. Design: Patients with high level of hearing loss were divided into two groups: Standard protocol group (SP) concluded the treatment following the standard NTT
protocol proposed by the treatment’s developers and Neuromonics guidelines. Extended protocol group (EP) was treated using a variation of the standard protocol, in which patients continued in stage 1 of the treatment for a prolonged time. Consistent with previously reported studies of the NTT, the tinnitus reaction questionnaire was used to assess tinnitus distress. Clinical outcomes for the two groups were analysed. Results: Both groups achieved statistically significant improvement of their tinnitus distress. EP group achieved quicker clinical benefits when compared to the SP group. Conclusions: Extension of high stimulation period from two to four months may be beneficial for patients with higher level of hearing loss undergoing NTT.

Cochlear implantation: A treatment option for severe to profound hearing loss associated with fabry disease.
Seminars in Hearing 32 (4), pp. 343-353.

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Fabry disease (FD) is a rare multisystemic X-linked lysosomal storage disease. The disease affects many systems of the human body. Sensorineural hearing loss, both sudden and progressive, is one of the many clinical manifestations of this disease. There is limited literature published to date discussing hearing- and balance-related symptoms for this patient population. Cochlear implantation has been mentioned in the literature as a possible treatment option but has not been reported in detail. Recently, a patient with Fabry disease was seen at Mayo Clinic in Rochester, Minnesota. He initially presented with complaints of tinnitus. Four months later, he experienced a severe to profound sudden bilateral sensorineural hearing loss and imbalance. He demonstrated 0% word recognition. After receiving sequential bilateral cochlear implants, his word recognition improved significantly. Following management of this patient, a retrospective study of 75 patients seen at Mayo Clinic for FD revealed 56 were either positive for FD or were carriers. Males represented 61% of this population and 39% were females. Two standardized questionnaires were made available to an online Fabry disease support group. Respondents' results were compared with normative data for each questionnaire. The Fabry group described increased difficulty with various communication tasks when compared with the non-Fabry group. © Georg Thieme Verlag KG Stuttgart • New York.

VII Brain Stimulation

[French guidelines on the use of repetitive transcranial magnetic stimulation (rTMS): Safety and therapeutic indications].
[Article in French]


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During the past decade, a large amount of work on transcranial magnetic stimulation (TMS) has been performed, including the development of new paradigms of stimulation, the integration of imaging data, and the coupling of TMS techniques with electroencephalography or neuroimaging. These accumulating data being difficult to synthesize, several French scientific societies commissioned a group of experts to conduct a comprehensive review of the literature on TMS. This text contains all the consensual findings of the expert group on the mechanisms of action, safety rules and indications of TMS, including repetitive TMS (rTMS). TMS sessions have been conducted in thousands of healthy subjects or patients with various neurological or psychiatric diseases, allowing a better assessment of risks associated with
this technique. The number of reported side effects is extremely low, the most serious complication being the occurrence of seizures. In most reported seizures, the stimulation parameters did not follow the previously published recommendations (Wassermann, 1998) [430] and rTMS was associated to medication that could lower the seizure threshold. Recommendations on the safe use of TMS / rTMS were recently updated (Rossi et al., 2009) [348], establishing new limits for stimulation parameters and fixing the contraindications. The recommendations we propose regarding safety are largely based on this previous report with some modifications. By contrast, the issue of therapeutic indications of rTMS has never been addressed before, the present work being the first attempt of a synthesis and expert consensus on this topic. The use of TMS/rTMS is discussed in the context of chronic pain, movement disorders, stroke, epilepsy, tinnitus and psychiatric disorders. There is already a sufficient level of evidence of published data to retain a therapeutic indication of rTMS in clinical practice (grade A) in chronic neuropathic pain, major depressive episodes, and auditory hallucinations. The number of therapeutic indications of rTMS is expected to increase in coming years, in parallel with the optimisation of stimulation parameters. Copyright © 2011 Elsevier Masson SAS. All rights reserved.

Dorsolateral Prefrontal Cortex Transcranial Magnetic Stimulation and Electrode Implant for Intractable Tinnitus.
World Neurosurg. 2011 Nov 7. [Epub ahead of print]
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OBJECTIVE: Tinnitus is a distressing symptom that affects up to 15% of the population; no satisfactory treatment exists. We present a novel surgical approach for the treatment of intractable tinnitus based on electrical extradural stimulation of the dorsolateral prefrontal cortex via an electrode implant. Tinnitus can be considered an auditory phantom phenomenon similar to deafferentation pain in the somatosensory system. It is characterized by gamma-band activity in the frontal cortex that can be visualized with the use of electroencephalography, magnetoencephalography, and functional magnetic resonance imaging (fMRI).
CASE DESCRIPTION: Transcranial magnetic stimulation (TMS) is a noninvasive technique capable of modulating the ongoing activity of the human brain. When linked with a neuronavigation system, fMRI-guided frontal cortex TMS can be performed in a placebo-controlled way. If it is successful in suppressing tinnitus, this focal and temporary effect can be maintained in perpetuity by implanting a cortical electrode. A neuronavigation-based auditory fMRI-guided frontal cortex TMS session was performed in a patient experiencing intractable tinnitus, yielding 50% tinnitus suppression. Two extradural electrodes were subsequently implanted, also based on auditory fMRI-guided navigation. Postoperatively the tinnitus has improved by 66.67% and progressively continues to improve for more than one year. Focal extradural electrical stimulation of the dorsolateral prefrontal cortex at the area of cortical plasticity is capable of suppressing contralateral tinnitus partially.
CONCLUSION: TMS might be a possible method for noninvasive studies of surgical candidates for implantation of stimulating electrodes for tinnitus suppression. Copyright © 2011 Elsevier Inc. All rights reserved.
Can Temporal Repetitive Transcranial Magnetic Stimulation be Enhanced by Targeting Affective Components of Tinnitus with Frontal rTMS? A Randomized Controlled Pilot Trial.  
Department of Psychiatry and Psychotherapy, University of Regensburg, Regensburg, Germany.  
Objectives: Low-frequency repetitive transcranial magnetic stimulation (rTMS) of the temporal cortex has been investigated as a new treatment tool for chronic tinnitus during the last years and has shown moderate efficacy. However, there is growing evidence that tinnitus is not a pathology of a specific brain region, but rather the result of network dysfunction involving both auditory and non-auditory brain regions. In functional imaging studies the right dorsolateral prefrontal cortex has been identified as an important hub in tinnitus related networks and has been shown to particularly reflect the affective components of tinnitus. Based on these findings we aimed to investigate whether the effects of left low-frequency rTMS can be enhanced by antecedent right prefrontal low-frequency rTMS. Study Design: Fifty-six patients were randomized to receive either low-frequency left temporal rTMS or a combination of low-frequency right prefrontal followed by low-frequency left temporal rTMS. The change of the tinnitus questionnaire (TQ) score was the primary outcome, secondary outcome parameters included the Tinnitus Handicap Inventory, numeric rating scales, and the Beck Depression Inventory. The study is registered in clinicaltrials.gov (NCT01261949). Results: Directly after therapy there was a significant improvement of the TQ-score in both groups. Comparison of both groups revealed a trend toward more pronounced effects for the combined group (effect size: Cohen’s d = 0.176), but this effect did not reach significance. A persistent trend toward better efficacy was also observed in all other outcome criteria. Conclusion: Additional stimulation of the right prefrontal cortex seems to be a promising strategy for enhancing TMS effects over the temporal cortex. These results further support the involvement of the right DLPFC in the pathophysiology of tinnitus. The small effect size might be due to the study design comparing the protocol to an active control condition.  

Top down prefrontal affective modulation of tinnitus with multiple sessions of tDCS of dorsolateral prefrontal cortex. 
Brain Stimul. 2011 Oct 5. [Epub ahead of print] 
Faber M, Vanneste S, Fregni F, De Ridder D.  
Bra(2)n, Tinnitus Research Initiative Clinic Antwerp and Department of Neurosurgery, University Hospital Antwerp, Antwerp, Belgium.  
Most forms of tinnitus are attributable to reorganization and hyperactivity in the auditory central nervous system with coactivation of nonauditory brain structures. One such nonauditory brain area is the dorsolateral prefrontal cortex (DLPFC), which is important for the integration of sensory and emotional aspects of tinnitus. Based on extensive evidence that transcranial direct current stimulation can induce significant effects on DLPFC-related cognitive function, we aimed to investigate whether left or right anodal DLFPC tDCS is associated with modulation of tinnitus. We conducted a double-blind, placebo-controlled cross-over study in which 15 subjects with tinnitus were randomly assigned to receive active and sham anodal tDCS over left (n = 8) or right DLPFC (n = 7) for six sessions in a counterbalanced order; the cathode electrode was placed in the contralateral DLPFC. The results demonstrate that both active conditions irrespective of the anodal position can decrease tinnitus annoyance but it is not associated with improvements in tinnitus intensity when comparing pre-tDCS versus post-tDCS as well as comparing sham-tDCS versus real tDCS. Also, we show that the anode electrode placed over the left DLPFC modulates depression when comparing pre-tDCS versus post-tDCS as well as comparing sham-tDCS versus real tDCS. In addition, we also show that the anode electrode placed over the right DLPFC modulates anxiety when comparing pre-tDCS versus post-tDCS. This latter effect does not remain when we compare sham-tDCS versus real tDCS. This study further supports the involvement of the prefrontal
cortex in the neural network associated with tinnitus, and also provides initial evidence for a potential brain stimulation site for tinnitus treatment in association with other treatments that can reduce tinnitus intensity. Copyright © 2011 Elsevier Inc. All rights reserved.

Repetitive transcranial magnetic stimulation for tinnitus.


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BACKGROUND: Tinnitus is the perception of sound, in the ear or in the head, in the absence of any external acoustic stimulation. Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive means of inducing electrical currents in the brain, and has received increasing attention in recent years for the treatment of many neuropsychiatric disorders, including tinnitus.

OBJECTIVES: To assess the effectiveness and safety of rTMS versus placebo in patients with tinnitus.

SEARCH STRATEGY: We searched the Cochrane Ear, Nose and Throat Disorders Group Trials Register; the Cochrane Central Register of Controlled Trials (CENTRAL); PubMed; EMBASE; CINAHL; Web of Science; BIOSIS Previews; Cambridge Scientific Abstracts; ICTR and additional sources for published and unpublished trials. The date of the most recent search was 24 May 2011.

SELECTION CRITERIA: Randomised controlled trials of rTMS versus sham rTMS.

DATA COLLECTION AND ANALYSIS: Two review authors reviewed the titles, abstracts and keywords of all records retrieved. Three review authors independently collected and extracted data, and assessed the risk of bias of the trials.

MAIN RESULTS: Five trials comprising of 233 participants met our inclusion criteria. Each study described the use of a different rTMS device that delivered different waveforms at different frequencies. All five trials were relatively small studies but generally they demonstrated a low risk of bias. When considering the impact of tinnitus on patients’ quality of life, the results of only one study demonstrated a statistically significant improvement in Tinnitus Handicap Inventory (THI) scores at four months follow-up (defined as a ‘partial improvement’ by the study authors (THI reduction of 21% to 80%)) when low-frequency rTMS was compared with a sham control treatment. However, no statistically significant improvement was demonstrated by another two studies that considered rTMS at the same frequency. Furthermore, this single positive finding should be taken in the context of the many different variables which were recorded at many different points in time by the study authors. In accordance with our pre-specified subgroup analysis we extracted the data from one study to consider the differential effectiveness between ‘lower’ low-frequency rTMS (1 Hz) and ‘higher’ low-frequency rTMS (10 Hz, 25 Hz). In doing this we were able to demonstrate a statistically significant difference between rTMS employing a frequency of 1 Hz and the sham group when considering tinnitus severity and disability after four months follow-up (‘partial’ improvement). However, no statistically significant difference was demonstrated between 10 Hz and 25 Hz rTMS, and the sham control group, when considering the severity and disability of tinnitus at four months follow-up. When considering tinnitus loudness in patients undergoing rTMS we were able to demonstrate a statistically significant reduction in tinnitus loudness when the results of two studies were pooled (risk ratio 4.17, 95% confidence interval 1.30 to 13.40). However, this finding was based on two small trials and consequently the confidence interval was particularly wide. No serious adverse effects were reported in any of the trials.

AUTHORS’ CONCLUSIONS: There is very limited support for the use of low-frequency rTMS for the treatment of patients with tinnitus. When considering the impact of tinnitus on patients’ quality of life, support is from a single study with a low risk of bias based on a single outcome measure at a single point in time. When considering the impact on tinnitus loudness, this is based on the analysis of pooled data with a large confidence interval. Studies suggest that rTMS is a safe treatment for tinnitus in the short-term, however there were insufficient data to provide any support for the safety of this treatment in the long-term. More prospective, randomised, placebo-controlled, double-blind studies with large sample sizes are needed to confirm the effectiveness of rTMS for tinnitus patients. Uniform, validated, tinnitus-specific questionnaires and measurement scales should be used in future studies.
Excitability changes induced in the human auditory cortex by transcranial direct current stimulation: direct electrophysiological evidence.
Exp Brain Res. 2011 Oct 1. [Epub ahead of print]

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Transcranial direct current stimulation (tDCS) can systematically modify behavior by inducing changes in the underlying brain function. Objective electrophysiological evidence for tDCS-induced excitability changes has been demonstrated for the visual and somatosensory cortex, while evidence for excitability changes in the auditory cortex is lacking. In the present study, we applied tDCS over the left temporal as well as the left temporo-parietal cortex and investigated tDCS-induced effects on auditory evoked potentials after anodal, cathodal, and sham stimulation. Results show that anodal and cathodal tDCS can modify auditory cortex reactivity. Moreover, auditory evoked potentials were differentially modulated as a function of site of stimulation. While anodal tDCS over the temporal cortex increased auditory P50 amplitudes, cathodal tDCS over the temporo-parietal cortex induced larger N1 amplitudes. The results directly demonstrate excitability changes in the auditory cortex induced by active tDCS over the temporal and temporo-parietal cortex and might contribute to the understanding of mechanisms involved in the successful treatment of auditory disorders like tinnitus via tDCS.

VIII Behavioral Therapy

Group or individual tinnitus therapy: What matters to participants.
Audiological Medicine, Volume 9, Issue 3, September 2011, Pages 110-116.

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Objective: To explore the ‘active ingredient’ of tinnitus therapy groups. Study design: The design was an inductive qualitative study informed by grounded theory. Eight participants, four from a tinnitus group and four from individual therapy with similar content, were invited to discuss their experiences of tinnitus therapy. The interviews were transcribed and analysed using a constant comparative approach. Results: The findings revealed that group experiences facilitate information exchange and social comparison, which facilitates coping. Conclusions: The human dynamics of groups may have an additional therapeutic benefit. © 2011 Informa Healthcare.

IX Somatic Tinnitus

Role of greater occipital nerve blocks and trigger point injections for patients with dizziness and headache.

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BACKGROUND: The trigeminocervical system is integral in cervicogenic headache. Cervicogenic headache frequently coexists with complaints of dizziness, tinnitus, nausea, imbalance, hearing complaints, and ear/eye pain. Controversy exists as to whether this constellation of symptoms may be cervically mediated.
OBJECTIVES: To determine whether a wider spectrum of cervically mediated symptoms exist, and to
investigate a potential role of greater occipital nerve blocks (GON) and trigger point injections (TPI) in these patients.

METHODS: Retrospective review of GON/TPI performed in a tertiary otoneurology/headache clinic from May 2006 to March 2007 for suspected cervically mediated symptoms. Data included chief complaint, secondary symptoms, response to injection, pre-GON/TPI posterior vertex sensation changes to pinprick, cervical spine examination, and response to vibration of cervical and suboccipital musculature. RESULTS: Total number of 147 patients were included. Chief complaints in decreasing frequency: dizziness (93%), tinnitus (4%), headache (3%), and ear discomfort (0.7%). Overall symptoms in decreasing frequency: dizziness (97%), headache (88%), neck pain (63%), tinnitus (23%), and ear discomfort (22%). Improvements after GON/TPI: neck range of motion (71%), headache (57%), neck pain (52%), ear discomfort (47%), dizziness (46%), and tinnitus (30%). Dizziness responders had neck position asymmetries (84%), reproducible dizziness by cervical and suboccipital musculature vibration (75%), and preinjection posterior vertex sensory changes (60%).

CONCLUSIONS: A wider spectrum of cervically mediated symptoms may exist by influence of trigemino-cervical and vestibular circuitry through cervical afferent neuromodulation. Certain examination findings may help to predict benefit from GON/TPI.

Temporomandibular disorders, otologic symptoms and depression levels in tinnitus patients.

Hilgenberg PB, Saldanha AD, Cunha CO, Rubo JH, Conti PC.

Bauru School of Dentistry, University of São Paulo, São Paulo, Brazil.

The aim of this study was to determine the prevalence of signs and symptoms of temporomandibular disorders (TMD) and otologic symptoms in patients with and without tinnitus. The influence of the level of depression was also addressed. The tinnitus group was comprised of 100 patients with tinnitus, and control group was comprised of 100 individuals without tinnitus. All subjects were evaluated using the research diagnostic criteria for temporomandibular disorders (RDC/TMD) to determine the presence of TMD and depression level. Chi-square, Spearman Correlation and Mann-Whitney tests were used in statistical analysis, with a 5% significance level. TMD signs and symptoms were detected in 85% of patients with tinnitus and in 55% of controls (P ≤ 0.001). The severity of pain and higher depression levels were positively associated with tinnitus (P ≤ 0.001). It was concluded that tinnitus is associated with TMD and with otalgia, dizziness/vertigo, stuffy sensations, hypoacusis sensation and hyperacusis, as well as with higher depression levels. © 2011 Blackwell Publishing Ltd.

The effects of acupuncture on the inner ear originated tinnitus.
Journal of Research in Medical Sciences, Volume 16, Issue 9, September 2011, Pages 1217-1223.

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ª Department of Otolaryngology-Head and Neck Surgery, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran,
ª Department of Anesthesiology, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.

BACKGROUND: Tinnitus is a chronic and bothering problem which in some patients may lead to some psychological reactions. While tinnitus may be caused due to some definable structural abnormalities, sometimes no structural etiologic defect can be found. This study aimed to evaluate the therapeutic effects of acupuncture on the inner ear originated tinnitus in the latter mentioned group. METHODS: This prospective clinical trial study has been done in Alzahra and Kashani hospitals in Isfahan, Iran during 2010-2011. Simple sampling was used to select patients who were then divided into two groups of true acupuncture group and placebo group. The number of patients in each group was 27. The hospital anxiety and depression scale (HADS), tinnitus severity index questionnaire, and tinnitus loudness scale were completed by the patients. Two latter questionnaires were completed again after the 5th
and 10th sessions of acupuncture treatment. The case group was treated with effective acupuncture with true acupuncture needles while the control group was treated ineffectively, i.e. similar to the usual acupuncture method but with fake needles. Independent t-test was used to compare the mean of tinnitus severity index and loudness scores between the two groups. We also used repeated measures ANOVA test to compare the mean of tinnitus severity index and loudness for different assessments in either group. RESULTS: After the 5th and 10th sessions of treatment, the mean of tinnitus severity index reduced significantly only in the case group (p = 0.002, and p = 0.001, respectively). In addition, the quality of life in the case group also improved after the treatment. Moreover, the mean of tinnitus loudness also reduced significantly only in the case group after 5 and 10 sessions of treatment (p = 0.001, and p < 0.001, respectively). CONCLUSIONS: It seems that acupuncture can improve tinnitus in some selected patients.

X Surgical Treatment


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Sigmoid sinus diverticulum, a rare dural sinus anomaly, is regarded as one of the very rare causes of pulsatile tinnitus, and there have been only a few reports on their surgical or endovascular management. We describe a 31-year-old woman presenting with a three-year pulsatile tinnitus in her right ear. After finding the small bony defect in her right temporal bone on CT which was filled with contrast after enhancement, we confirmed the presence of sigmoid sinus diverticulum with the cerebral angiogram and embolized it with two detachable coils in awake status. Right after filling the two coils into the sac, thanks to her alert consciousness, she was able to refer the disappearance of her tinnitus. The operation was finished only with the detachment of the coils.

En bloc surgical removal of an asymptomatic glomus tympanicum tumor.

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Glomus tympanicum (GT) tumors are usually characterized by pulsatile tinnitus and hearing loss. We report on a woman 53 years of age who was diagnosed with a GT tumor within her right ear with no associated tinnitus or hearing loss on presentation. An early GT tumor without the characteristic symptoms is seldom encountered. Although several papers have dealt with GT tumor diagnosis and management, very few have demonstrated such a condition in which the entire GT tumor appeared in the middle ear cavity and was totally removed during the operation. There was no recurrence at 24 months of follow-up. We describe a novel surgical technique in this article and demonstrate an en bloc GT surgical removal that has been seldom published before in the literature. © 2011.
XI Holistic

The effects of acupuncture on the inner ear originated tinnitus.
Journal of Research in Medical Sciences, Volume 16, Issue 9, September 2011, Pages 1217-1223.

Rogha, M.\textsuperscript{a}, Rezvani, M.\textsuperscript{b}, Khodami, A.R.\textsuperscript{a}
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\textsuperscript{b} Department of Anesthesiology, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.

BACKGROUND: Tinnitus is a chronic and bothering problem which in some patients may lead to some psychological reactions. While tinnitus may be caused due to some definable structural abnormalities, sometimes no structural etiologic defect can be found. This study aimed to evaluate the therapeutic effects of acupuncture on the inner ear originated tinnitus in the latter mentioned group.

METHODS: This prospective clinical trial study has been done in Alzahra and Kashani hospitals in Isfahan, Iran during 2010-2011. Simple sampling was used to select patients who were then divided into two groups of true acupuncture group and placebo group. The number of patients in each group was 27. The hospital anxiety and depression scale (HADS), tinnitus severity index questionnaire, and tinnitus loudness scale were completed by the patients. Two latter questionnaires were completed again after the 5th and 10th sessions of acupuncture treatment. The case group was treated with effective acupuncture with true acupuncture needles while the control group was treated ineffectively, i.e. similar to the usual acupuncture method but with fake needles. Independent t-test was used to compare the mean of tinnitus severity index and loudness scores between the two groups. We also used repeated measures ANOVA test to compare the mean of tinnitus severity index and loudness for different assessments in either group.

RESULTS: After the 5th and 10th sessions of treatment, the mean of tinnitus severity index reduced significantly only in the case group ($p = 0.002$, and $p = 0.001$, respectively). In addition, the quality of life in the case group also improved after the treatment. Moreover, the mean of tinnitus loudness also reduced significantly only in the case group after 5 and 10 sessions of treatment ($p = 0.001$, and $p < 0.001$, respectively).

CONCLUSIONS: It seems that acupuncture can improve tinnitus in some selected patients.

XII Review

no publications this time

XIII Others

Mining tinnitus data based on clustering and new temporal features.
Studies in Computational Intelligence, Volume 375, 2011, Pages 227-245.

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Tinnitus problems affect a significant portion of the population and are difficult to treat. Sound therapy for Tinnitus is a promising, expensive, and complex treatment, where the complete process may span from several months to a couple of years. The goal of this research is to explore different combinations of important factors leading to a significant recovery, and their relationships to different category of Tinnitus.
problems. Our findings are extracted from the data stored in a clinical database, where confidential information had been stripped off. The domain knowledge spans different disciplines such as otology as well as audiology. Complexities were encountered with temporal data and text data of certain features. New temporal features together with rule generating techniques and clustering methods are presented with a ultimate goal to explore the relationships among the treatment factors and to learn the essence of Tinnitus problems. © 2011 Springer-Verlag Berlin Heidelberg.

XIV Case Reports

Carotid artery-cochlear dehiscence: A review.
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This case report describes carotid-cochlear dehiscence, a rare and possibly fatal condition if missed or ignored on initial work-up of several otologic procedures. Thinning of the bony plate separating the carotid canal from other anatomic structures can occur anywhere along the course of the canal, including the carotid-cochlear bony plate. This condition should be recognized by all otolaryngologists in that it can mimic other otologic pathologies. The aim of this report was to call attention to this condition and its associated mimicking symptoms and inform on its proper management. The idea for this review was formed from the case of a patient who presented with pulsatile tinnitus and was found to have carotid-cochlear dehiscence. Carotid-cochlear dehiscence is a rare anatomic variation of which the neurotologic surgeon should be aware. This condition can mimic common otolaryngologic pathologies that regularly present themselves in clinical settings. We present what we believe to be the fourth reported case of carotid-cochlear dehiscence in the literature. The patient presented having only the complaint of pulsatile tinnitus and was later diagnosed with this rare condition. We advocate a thorough preoperative work-up, including high-resolution computed tomography and careful operative planning in a case-specific manner. This is especially important when common pathologies do not become apparent after careful investigation. Laryngoscope, 121:2658-2660, 2011. Copyright © 2011 The American Laryngological, Rhinological, and Otological Society, Inc.

Images in clinical medicine. Internal-carotid-artery dissection and cranial-nerve palsies.
Peltz E, Köhrmann M.
University of Erlangen-Nuremberg, Erlangen, Germany.

A 45-year-old woman presented to the emergency department 3 days after the acute onset of severe dysphagia, breathy dysphonia, and earache and pulsatile tinnitus in the left ear. Her medical history was unremarkable. Physical examination revealed leftward deviation of the protruded tongue that was consistent with a lesion in cranial nerve XII, hypernasal speech and rightward deviation of the soft palate on phonation that was consistent with lesions in cranial nerves IX and X, and a paralyzed left vocal cord detected on laryngoscopic examination that was consistent with a lesion in cranial nerve X (see video). Axial magnetic resonance images ...
Hypoacusia in a patient treated by isotretinoin.


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Isotretinoin is the most effective treatment for severe acne, but there are several adverse effects associated with its use, some of them very exceptional (<1/10000). We report one case of hypoacusia and tinnitus in a 15-year-old boy treated with isotretinoin during 6 weeks, who quickly improved after isotretinoin withdrawal. Also, we comment other publications about hearing alterations in patients treated with isotretinoin and other retinoids.

Cerebellopontine angle metastasis of a parotid mucoepidermoid carcinoma arising from perineural invasion along the facial nerve.
Br J Neurosurg. 2011 Nov 18. [Epub ahead of print]

Wilson JR, Kumar R, Hille PT.

Department of Neurosurgery, General Infirmary at Leeds, Leeds Teaching Hospitals NHS Trust, Leeds, West Yorkshire, UK.

Abstract A 72-year-old male was referred with left sided hearing loss, tinnitus and disequilibrium with radiological appearances suggestive of an intracanalicular left vestibular schwannoma. The patient then developed left sided trigeminal nerve sensory loss over the next 9 months with an enlarging parotid swelling. The eventual diagnosis was a destructive lesion in the left cerebellopontine angle (CPA) arising from metastatic perineural invasion along the facial nerve by a parotid mucoepidermoid carcinoma. Surgical resection and targeted beam radiotherapy achieved a survival period of 9 months.

Tuberculous otitis media.


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Chronic tuberculous otitis media is a rare disease that is clinically variable and nonspecific. We present a case of a 38-year-old man who had presented tinnitus, ear fullness, otalgia and otorrhea for 5 months, without improvement through the use of topical antibiotic drops. He had mixed hearing loss of moderate severity. He underwent mastoidectomy because of suspected chronic suppurative otitis media, but continued to present hearing loss, otorrhea and tympanic membrane perforation. In revision operation, material was collected for specific otitis analysis and aural tuberculosis was diagnosed. The patient was treated for 6 months and showed improvement following the first two weeks of treatment. Tuberculous otitis media may be diagnosed late, mainly because it is often not suspected. This can lead to inappropriate treatment and possible complications. Cases of chronic otitis media that are unresponsive to the usual therapy or show unexpected postoperative evolution should be investigated for tuberculosis. © The Mediterranean Society of Otology and Audiology.
Pulsatile tinnitus caused by an unusual dural arteriovenous fistula.

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Pulsatile tinnitus can be the only symptom of serious underlying pathology and one of many symptoms of a neurological disorder. Dural arteriovenous fistula (DAVF) is a common cause of pulsatile tinnitus. Transverse and sigmoid dural sinuses are the most common sites involved, followed by the cavernous sinus. We herein report a case of unusual DAVF and discuss its clinical features and radiological findings. The DAVF in question was situated between the internal maxillary artery and external jugular vein, causing pulsatile tinnitus. We attempted embolization of the DAVF without success but the symptoms nevertheless resolved. © The Mediterranean Society of Otology and Audiology.

[Article in German]

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We present the case of a female patient suffering from recurrent vertigo and low-frequency hearing loss who was admitted for inpatient treatment with the diagnosis of Ménière’s disease. After evaluation of all diagnostic examinations, including psychosomatic evaluation, a diagnosis of vestibular migraine with accompanying psychogenic vertigo could be confirmed and was treated accordingly. Neurotologic findings and the corresponding literature are reported.

Endovascular treatment of two concomitant causes of pulsatile tinnitus: sigmoid sinus stenosis and ipsilateral jugular bulb diverticulum. Case report and literature review.

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Division of Neurosurgery, Department of Experimental and Clinical Medicine, University “Magna Græcia”, Catanzaro, Italy.

We describe a rare case of highly invalidating pulsatile tinnitus associated with both stenosis of the sigmoid sinus and ipsilateral jugular bulb diverticulum. Both conditions were successfully treated by positioning a stent across the sigmoid sinus and jugular bulb. To our knowledge, the present clinical case represents the first report of such an approach. The therapeutic decision-making is discussed in relation to the etiopathologic hypothesis put forward.
Neurally mediated syncope presenting with paroxysmal positional vertigo and tinnitus.
Auris Nasus Larynx. 2011 Nov 5. [Epub ahead of print]

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Department of Otorhinolaryngology, Hino Municipal Hospital, Hino, Tokyo, Japan; Department of Otorhinolaryngology, Keio University, Tokyo, Japan; Department of Cardiology, Hino Municipal Hospital, Hino, Tokyo, Japan.

A 72-year-old man with positional vertigo and tinnitus was referred to us. He did not want to perform provoking test except once due to his fear. No positional nystagmus was provoked. He found that his attacks usually occurred when he lay on his right ear. From his clinical history, benign paroxysmal positional vertigo was suspected. Conventional pharmacotherapy as well as non-specific physical therapy did not have significant effect. His feeling of positional vertigo with pyrosis was actually presyncope. We suspected cardiovascular disorders, and referred him to a cardiologist. Portable cardiogram monitoring revealed paroxysmal bradycardia. He was diagnosed with neurally mediated syncope, and a pacemaker was implanted. His paroxysmal dizziness soon disappeared. It is important to study the clinical history of the patients in detail, as they are not always able to accurately explain their symptoms. We should carefully rule out cardiovascular disorders, especially when we see the patients with suspected BPPV without the characteristic positional nystagmus. Copyright © 2011 Elsevier Ireland Ltd. All rights reserved.

Treatment options for subjective tinnitus: Self reports from a sample of general practitioners and ENT physicians within Europe and the USA.
BMC Health Serv Res. 2011 Nov 4;11(1):302. [Epub ahead of print]


Background: Tinnitus affects about 10-15% of the general population and risks for developing tinnitus are rising through increased exposure to leisure noise through listening to personal music players at high volume. The disorder has a considerable heterogeneity and so no single mechanism is likely to explain the presence of tinnitus in all those affected. As such there is no standardized management pathway nor singly effective treatment for the condition. Choice of clinical intervention is a multi-factorial decision based on many factors, including assessment of patient needs and the healthcare context. The present research surveyed clinicians working in six Westernised countries with the aims: a) to establish the range of referral pathways, b) to evaluate the typical treatment options for categories of subjective tinnitus defined as acute or chronic, and c) to seek clinical opinion about levels of satisfaction with current standards of practice.

Methods: A structured online questionnaire was conducted with 712 physicians who reported seeing at least one tinnitus patients in the previous three months. They were 370 general practitioners (GPs) and 365 ear-nose-throat specialists (ENTs) from the US, Germany, UK, France, Italy and Spain.

Results: Our international comparison of health systems for tinnitus revealed that although the characteristics of tinnitus appeared broadly similar across countries, the patient’s experience of clinical services differed widely. GPs and ENTs were always involved in referral and management to some degree, but multi-disciplinary teams engaged either neurology (Germany, Italy and Spain) or audiology (UK and US) professionals. For acute subjective tinnitus, pharmacological prescriptions were common, while audiological and psychological approaches were more typical for chronic subjective tinnitus; with several specific treatment options being highly country specific. All therapy options were associated with low levels of satisfaction.

Conclusions: Despite a large variety of treatment options, the low success rates of tinnitus therapy lead to frustration of physicians and patients alike. For subjective tinnitus in particular, effective therapeutic options with guidelines about key diagnostic criteria are urgently needed.
A tennis ball and music as a patient's solution for pulsatile tinnitus.

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We present the case of a 74-year-old man with a pulsatile somatosound causing insomnia and daytime irritation. Given the lack of salvation after medical therapy the patient went in search for a solution and found it in a tennis ball and radio. In this case, the somatosound was due to an extracranial arteriovenous malformation, but the differential diagnosis of pulsatile somatosounds is quite extended, ranging from vascular disorders to tumoral processes. This makes these cases challenging for all caretakers.

Ramsay-Hunt syndrome presenting laryngeal paralysis.

Gómez-Torres A, Medinilla Vallejo A, Abrante Jiménez A, Esteban Ortega F.

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The Ramsay-Hunt syndrome is the association of facial palsy and varicella-zoster virus infection with involvement of the ear canal and eardrum. It may be associated with deafness, tinnitus and dizziness. It can sometimes affect the lower cranial nerves. A case of an immunocompetent patient with affection of the VII, VIII and X cranial nerves is presented. Copyright © 2011 Elsevier España, S.L. All rights reserved.

[An unusual lesion of the nasopharynx: Oncocytic metaplasia].
[Article in French]


Oncocytic metaplasia of the nasopharynx is an exceptional lesion which exact etiopathogenesis, although largely discussed, still remains controversial. The purpose of this paper is to present the epidemiological characteristics and clinical signs of this lesion and to study its pathogenesis and its therapeutic modalities. We report two cases that occurred respectively in a 53- and 60-year-old woman. The first presented with pharyngeal dysesthesia and otalgia. The endoscopic examination revealed an irregularity of the posterior wall of the nasopharynx. The second patient presented with tinnitus, discomfort of the left ear and bilateral hearing loss. Endoscopic exam revealed a bilateral structural abnormality to the eardrum. Microscopy showed focal oncocytic metaplasia of the nasopharynx mucosa in both cases. There was a positive outcare for both patients after excisional biopsy. Oncocytic metaplasia seems to be in relation to the stimulation of sympathetic neuropeptidergic nerve fibers which target epithelial, connective, endothelial and lymphoid cells. Copyright © 2011 Elsevier Masson SAS. All rights reserved.
Spontaneous pneumarthrosis of the atlantoaxial joint.

Felasi MA, Venail F, Lonjon N.
Departments of Neurosurgery and...

The authors describe the case of a 29-year-old man presenting with left retrooccipital and cervical pain associated with left ear fullness and rhythmic tinnitus. Head rotation movements on the right side and the Valsalva maneuver increased symptoms. A CT scan identified hyperpneumatization of the left temporal bone extending to the occipital bone as well as pneumarthrosis of the atlantoaxial joint. Surgical treatment involving obliteration of the fistula with bone and fat grafts via a computer-aided transmastoid approach was proposed. The surgery resolved all of the patient’s symptoms except for the ear fullness. In this case the authors described an original treatment for spontaneous atlantoaxial pneumarthrosis. Long-term follow-up is needed to evaluate the risk of the recurrence of abnormal occipital bone pneumatization and to assess joint function.

Brainstem hemorrhage presented as audiovestibular syndromes.

Chou CI, Lin HC, Wu KC, Shu MT.
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Brainstem hemorrhage usually presented with acute multiple neurologic dysfunction, and the prognosis was poor. Rarely, it can manifest with audiovestibular symptoms only. Here, we report a case of brainstem hemorrhage involving the right middle cerebellar peduncle and dorsal lateral pons presented with constant nonpulsatile tinnitus and rotatory vertigo. We believed that rotatory nystagmus should be regarded as a central sign until proven otherwise even if the neurologic signs are subtle. Copyright © 2011 Elsevier Inc. All rights reserved.

A case of intraosseous dural arteriovenous fistulas involving diploic vein treated with transarterial Onyx embolization.

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Intracranial dural arteriovenous fistulas (DAVFs) are abnormal arteriovenous connections that lie within the dura. Intraosseous DAVFs involving diploic venous system are extremely rare. A 46-year-old woman presented with headache and right pulsatile tinnitus for three weeks. The tinnitus started after yelling. Digital subtraction angiography revealed DAVF within the basal portion of right parietal bone along the middle meningeal artery (MMA) groove. The fistula was fed by frontal branch of right MMA and drained into right transverse sigmoid sinus junction through dilated middle meningeal vein. The intraosseous DAVF involving diploic vein was successfully obliterated with Onyx embolization via transarterial route. © 2011 The Korean Neurosurgical Society.
Skull base tumor in a patient with phacomatosis pigmentovascularis
Brain Pathology 21 (6), pp. 705-708.

Carvalho, C.H., Batista, L.M., Bornemann, A., Acioly, M.A., Tatagiba, M.

A 58-year-old man with clinical diagnosis of phacomatosis pigmentovascularis (PPV) experienced tinnitus and progressive hearing loss due to a jugular foramen tumor. Attached to the tumor capsule, were several pigmented spots. Pathological examination revealed a tumor composed by two different tissues, namely a Schwannoma grade I associated with a leptomeningeal blue nevus. The neuropathological aspects of this unusual association are discussed. The association of PPV with a pigmented skull base tumor has not been described to date and illustrates the importance of systemic examination in PPV. © 2011 International Society of Neuropathology.

XV Specific Forms of Tinnitus

[Traumatology of the ear and temporal bone].
[Article in German]
HNO. 2011 Dec;59(12):1233-44.

Thomas JP, Minovi A, Dazert S.
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In addition to injuries to the pinna otologic traumatology comprises in particular injuries of the tympanic membrane and ossicular chain, temporal bone fractures together with accompanying impairment of the labyrinth and facial nerve as well as acoustic trauma and barotrauma. Depending on the mechanism of injury and typical symptoms, such as hemorrhagic otorrhea, hearing loss, vertigo, tinnitus, facial nerve palsy, otoliquorrhea or pseudorhinoliquorrhea, further investigations should be planned. The present article provides an overview of the necessary further diagnostic measures as well as the therapeutic options currently available for all forms of injury mentioned here.

Assessment of non-motor hearing symptoms in hemifacial spasm using magnetoencephalography.

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BACKGROUND: Hemifacial spasm patients often suffer from non-motor symptoms such as tinnitus. These non-motor symptoms are known to be associated with changes in cortical activity. Magnetoencephalography (MEG) is a technique that can record brain activity noninvasively. To determine the usefulness of MEG in assessing changes in cortical activity associated with non-motor hearing symptoms in hemifacial spasm patients.

METHODS: We used MEG to evaluate the reactivity of the auditory cortex in 26 hemifacial spasm patients. We divided patients into a subjective tinnitus group (n = 10) and a non-tinnitus group (n = 16). The latency and amplitude of the most prominent deflection, N100m, was compared between the two groups.

RESULTS: There was a significant difference in the pure tone audiogram on the spasm side compared with the non-spasm side. After stimulation on the spasm side, the amplitude of the N100m peak in the contralateral hemisphere was lower in the subjective tinnitus group than in the non-tinnitus group.

CONCLUSIONS: Our results indicate that MEG can detect differences in cortical activity between hemifacial spasm patients with and without tinnitus. This suggests that MEG can identify changes in cortical activity associated with non-motor symptoms.
The consequences of tinnitus in long-standing Ménière's disease.
Auris Nasus Larynx. 2011 Nov 15. [Epub ahead of print]

Stephens D, Pyykkö I, Yoshida T, Kentala E, Levo H, Auramo Y, Poe D.

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OBJECTIVE: To explore the perceived consequences of tinnitus in patients with long-standing Ménière’s disease (MD).

METHOD: A questionnaire-based cross-sectional investigation of 183 randomly selected members of the Finnish Ménière’s Federation. It assessed general health related quality of life (EQ-5D), a participation restriction scale, self-listed consequences and a rating of effects of MD on life.

RESULTS: When the effects of the other cardinal symptoms of Ménière’s disease were partialled out, the main reported impacts of tinnitus related to anxiety, sleep and depression. It also contributed to some difficult listening situations and to interactions with significant others. Tinnitus explained a significant component of disease-specific quality of life (QoL), but did not relate significantly to the generic measures used. However, the measure ‘mood’ in the QoL scale was significantly associated with severe tinnitus.

CONCLUSION: The most important specific impacts of tinnitus in chronic Ménière’s disease relate to broadly psychological factors and mood. Copyright © 2011. Published by Elsevier Ireland Ltd.

Conservative management of Vestibular Schwannoma - A prospective cohort study: Treatment, Symptoms and Quality of Life.
Neurosurgery. 2011 Nov 3. [Epub ahead of print]

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BACKGROUND: One hundred ninety-three patients with sporadic unilateral VS given conservative management were enrolled into a prospective study.

OBJECTIVE: To evaluate the efficacy of conservative management and determine the effect of an initial conservative management on the quality of life and severity of audio vestibular symptoms.

METHODS: The patients underwent MRI scans, clinical examination and quality of life assessment by two validated questionnaires (SF-36 and GBI). Using regression analysis of clustered data, we analyzed possible association between tumor growth and symptoms and tested whether our earlier finding that vertigo is associated with reduced QOL could be verified.

RESULTS: The median follow-up time was 43 months (range 9-115 SD 21.48). Results are based on 703 clinical controls and 642 (SF-36) and 638 (GBI) questionnaires. Seven patients were lost to follow-up. Approximately 40 % of patients were in need of treatment during follow-up. We found a statistically significant association between tinnitus and vertigo and tumor growth. Vertigo was found to significantly reduce QOL. There was a significant drop in the Social Function subscales of both SF-36 and GBI, possibly attributable to progressive hearing loss. Otherwise, there was no overall trend towards any change in QOL during the observation period. QOL seemed to be little affected by treatment.

CONCLUSION: There was a small, but statistically significant improvement in vestibular complaints, and no change in the occurrence of tinnitus. With the exception of hearing loss caused by surgery, treatment did not affect symptoms or QOL significantly. Growth was associated with the occurrence of tinnitus and balance problems.
**Tinnitus complaint behaviour in long-standing Menière’s disorder: its association with the other cardinal symptoms.**

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Objective: To explore factors that determines tinnitus complaint behaviour in patients with chronic long-standing Menière’s disorder.

Design and setting: A questionnaire-based cross-sectional investigation. This included the Oto-neurological questionnaire, the Hearing Disability and Handicap Scale (HDHS), Hearing Measurement Scale (HMS) on sound localisation and the Dizziness Handicap Questionnaire (DHQ).

Participants: Randomly selected 183 members of the Finnish Menière’s Federation.

Intervention: Postal questionnaire. Main outcome measure: International Tinnitus Inventory and impact of tinnitus.

Results: The 183 patients, [36 men and 147 women; mean age, 63 years] had their Meniere’s disorder-like symptoms, with a mean of 18 years [range, 1-43], 19% of patients ranked tinnitus as their most severe symptom, and 10% experienced tinnitus as causing a severe or very severe impact. Regression analysis indicated that 41% of International Tinnitus Inventory variance and 28% of tinnitus impact variance were explained by the cardinal symptoms of Menière’s disorder. Furthermore, 40% of International Tinnitus Inventory and 25% of tinnitus impact variance were explained by symptom-related disabilities (HDHS, HMS and DHQ). Aural pressure, hearing loss and gait problems were the most important predictors of tinnitus complaint. Understanding what people say and limitation of activities because of vertigo were the most important related disabilities.

Conclusion: Tinnitus shares a significant variance with the other cardinal symptoms in patients with long-standing Menière’s disorder. As the impact is significantly related to activity limitations based on hearing disability and vertigo, the results suggest that therapeutic efforts to reduce tinnitus in Menière’s disorder should include the alleviation of balance and hearing problems. © 2011 Blackwell Publishing Ltd.

**High Prevalence of Systemic Autoimmune Diseases in Patients with Menière’s Disease.**


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BACKGROUND: Autoimmunity appears to be associated with the pathophysiology of Meniere’s disease (MD), an inner ear disorder characterized by episodes of vertigo associated with hearing loss and tinnitus. However, the prevalence of autoimmune diseases (AD) in patients with MD has not been studied in individuals with uni or bilateral sensorineural hearing loss (SNHL).

METHODS AND FINDINGS: We estimated the prevalence of AD in 690 outpatients with MD with uni or bilateral SNHL from otoneurology clinics at six tertiary referral hospitals by using clinical criteria and an immune panel (lymphocyte populations, antinuclear antibodies, C3, C4 and proinflammatory cytokines TNFα, INFγ). The observed prevalence of rheumatoid arthritis (RA), systemic lupus erythematosus (SLE) and ankylosing spondylitis (AS) was higher than expected for the general population (1.39 for RA, 0.87 for SLE and 0.70 for AS, respectively). Systemic AD were more frequently observed in patients with MD and diagnostic criteria for migraine than cases with MD and tension-type headache (p=0.007). There were clinical differences between patients with uni or bilateral SNHL, but no differences were found in...
the immune profile. Multiple linear regression showed that changes in lymphocytes subpopulations were associated with hearing loss and persistence of vertigo, suggesting a role for the immune response in MD.

CONCLUSIONS: Despite some limitations, MD displays an elevated prevalence of systemic AD such as RA, SLE and AS. This finding, which suggests an autoimmune background in a subset of patients with MD, has important implications for the treatment of MD.

Sudden Brief Unilateral Tapering Tinnitus: Prevalence and Properties.
Otol Neurotol. 2011 Oct 1. [Epub ahead of print]

Oron Y, Roth Y, Levine RA.

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OBJECTIVE: To systematically characterize unilateral tinnitus typically lasting less than a minute.

STUDY DESIGN: Observational study.

SETTING: Outpatient clinic in a tertiary referral hospital.


INTERVENTIONS: Study I: Structured interview regarding SBUTTs and other types of tinnitus. Study II: Maintaining an SBUTT log for 4 consecutive months.

MAIN OUTCOME MEASURES: Study I: Retrospective prevalence of SBUTTs. Study II: Prospective frequency and characteristics of SBUTTs.

RESULTS: Study I: 76% of the participants recalled having at least one SBUTT in the past. There was no significant difference in the incidence of SBUTTs with respect to handedness, age, sex, the presence or absence of chronic tinnitus, whether tinnitus could be brought on by exposure to loud sounds, or whether auditory perception could be modulated with strong muscle contractions of the neck or jaw. Study II: SBUTTs mean rate was 1.2 per month (range, 0-11.5). The rate in people with chronic tinnitus was twice that of those without chronic tinnitus. Right ear SBUTTs predominated nearly 2 to 1. Pitch estimates ranged between 0.1 and 4.4 kHz; 75% of SBUTTs lasted 25 seconds or less. A quarter occurred with simultaneous ear fullness.

CONCLUSION: In the 76% of adults with SBUTTs, the average rate of occurrence was about once a month. SBUTTs are twice as common for the right ear as the left. One of 4 SBUTTs occurs with ear fullness. A quarter of adults never recalled ever having an SBUTT.

Clinical Characteristics of Acoustic Trauma Caused by Gunshot Noise in Mass Rifle Drills without Ear Protection.

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Department of Otorhinolaryngology- Head and Neck Surgery, Chung-Ang University College of Medicine, Seoul, Korea.

One of the major occupational hazards of working in military service is being subjected to intense impulse noise. We analyzed the clinical presentation of acoustic traumas, induced by mass rifle gunshot noise during military training, in unprotected patients. We evaluated 189 soldiers who had otologic symptoms after rifle shooting exercises without using any hearing protection. All soldiers had been training on the K2 rifle. We took medical histories; conducted physical examinations and hearing evaluations (pure-tone audiometry, speech audiometry, and impedence audiometry); and distributed the Newmann's Tinnitus Handicap Inventory (THI) survey. In addition, we evaluated a normal control group of 64 subjects of similar age who had never fired a rifle. In the patient group, the most common
and irritating reported symptom was tinnitus (94.2%), and the average THI score in the patient group was 39.51 ± 14.87, which was significantly higher than the control group score (0.56 ± 3.94) (p < 0.001). Average outcomes of post-exposure air conduction thresholds were 21.33 ± 13.25 dB HL in the affected ears. These levels also were significantly higher than those of the control group (9.16 ± 4.07 dB HL) (p < 0.001). Hearing loss was most prominent at high frequencies. An asymmetry of hearing loss related to head position during shooting was not observed. Acoustic trauma induced by gunshot noise can cause permanent tinnitus and hearing loss. Hearing protection (bilateral earplugs) and environmental reform are necessary.

Blast-Induced Tinnitus and Hearing Loss in Rats: Behavioral and Imaging Assays.
J Neurotrauma. 2011 Sep 20. [Epub ahead of print]
Wayne State University, Otolaryngology, Detroit, Michigan, United States; johnnymao@msn.com.
The current study used a rat model to investigate the underlying mechanisms of blast-induced tinnitus, hearing loss and associated traumatic brain injury (TBI). Seven rats were used to evaluate behavioral evidence of tinnitus and hearing loss, and TBI using magnetic resonance imaging following a single 10 ms blast at 14 psi or 194 dB SPL. The results demonstrated that the blast exposure induced early onset of tinnitus and central hearing impairment at a broad frequency range. The induced tinnitus and central hearing impairment tended to shift towards high frequencies over time. Hearing threshold measured with auditory brainstem responses also showed an immediate elevation followed by recovery on day 14, coinciding with behaviorally measured results. Diffusion tensor magnetic resonance imaging results demonstrated significant damage and compensatory plastic changes to certain auditory brain regions, with the majority of changes occurring in the inferior colliculus and medial geniculate body. No significant microstructural changes found in the corpus callosum indicates that the currently adopted blast exposure mainly exerts effects through the auditory pathways rather than through direct impact onto the brain parenchyma. The results showed that this animal model is appropriate for investigation of the mechanisms underlying blast-induced tinnitus, hearing loss and related TBI. Continued investigation along this line will help identify pathology with injury/recovery patterns, aiding development of effective treatment strategies.

Development of the jugular bulb: a radiologic study.
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OBJECTIVE: Jugular bulb (JB) abnormalities such as JB diverticulum and high-riding JBs of the temporal bone can erode into the inner ear and present with hearing loss, vestibular disturbance, and pulsatile tinnitus. Their cause and potential to progress remain to be studied. This comprehensive radiologic study investigates the postnatal development of the venous system from transverse sinus to internal jugular vein (IJV).
SETTING: Academic medical center. PATIENTS, INTERVENTION, MAIN OUTCOME MEASURE:: Measurements of the transverse and sigmoid sinus, the JB, IJV, and carotid artery were made from computed tomographic scans of the neck with intravenous contrast in infants (n = 5), children (n = 13), adults (n = 35), and the elderly (n = 15).
RESULTS: Jugular bulbs were not detected in patients younger than 2 years, enlarged in adulthood, and remained stable in the elderly. The venous system was larger in men than in women. From transverse sinus to IJV, the greatest variation in size was just proximal and distal to the JB with greater symmetry observed as blood returned to the heart. Right-sided venous dominance was most common occurring in 70% to 80% of cases.
CONCLUSION: The JB is a dynamic structure that forms after 2 years, and its size stabilizes in...
adulthood. The determinants in its exact position and size are multifactorial and may be related to blood flow. Improved understanding of this structure's development may help to better understand the cause of the high-riding JB and JB diverticulum, both of which may cause clinical symptoms.

Osteoradionecrosis of the temporal bone [Martwica popromienna kości skroniowej].
[Article in Polish]
Bartoszewicz, R., Bruzgielewicz, A., Osuch-Wójcikiewicz, E., Sokołowski, J., Niemczyk, K.
Katedra i Klinika Otolaryngologii Warszawskiego, Uniwersytetu Medycznego, ul. Banacha 1a, 02-097 Warszawa, Poland.

Introduction: Radiotherapy is an effective, modern method of treating malignant neoplasms of head and neck and also intracranial tumours. Technological development and computerization of equipment used in radiotherapy enabled introduction of modern methods of treatment allowing decrease the risk of postradiation complications but not eliminating them completely. Postradiant necrosis of temporal bone that is osteoradionecrosis (ORN) is a quite well known complication of radiotherapy of head and neck tumours. Secretory otitis media, conductive deafness, excretion of sequesters through external auditory canal, inflammation and atresia of external auditory canal are common findings during examination. Cases of disseminated osteoradionecrosis need to be qualified for operation due to potential intratemporal and intracranial complications. Radical excision of necrotic tissue gives possibility of parallel cochlear implantation among patients with total bilateral deafness, which is a consequence of radiotherapy. Aims: Aim of this study was clinical and epidemiological analysis of consequences and complications inside temporal bone which occurred after radiotherapy in the head and neck area. Conservative and surgical treatment possibilities according to progression of postradiant changes and severity of ailments were analyzed. Circumstances of conducting lateral petrosectomy with parallel cochlear implantation in case of osteoradionecrosis proceeding with total bilateral deafness were highlighted. Material and methods: Retrospective analysis of 12 patients treated in the Department of Otolaryngology at the Medical University of Warsaw in 2000-2010 for postradiant consequences and complications inside the temporal bone was performed. The diagnosis of osteoradionecrosis was based on clinical ENT examination including meticulous microscopic examination, audiologic evaluation and CT scans of temporal bone. Results: The group consisted of 5 men and 7 women. In 8 patients changes were unilateral and in 4 - bilateral. In total, 16 cases (ears) of osteoradionecrosis in the area of temporal bone were analyzed. Patients were mainly complaining about hearing loss or deafness, tinnitus, otalgia, otorhoea, feeling of fullness and distension in the ear. Presence of effusion in the middle ear was an indication for ventilation tube insertion. Cases of ORN potentially endangered by further complications needed surgical treatment, therein lateral petrosectomy. Case of osteoradionecrosis proceeding with total bilateral deafness needed a concurrent cochlear implantation. Only the patients with diffuse osteoradionecrosis confirmed by CT scans were qualified for surgery. Conclusions: Radiotherapy of head and neck tumours is charged with risk of complications, both early and appearing later after therapy. Osteoradionecrosis is found many years after radiation and the course of illness is repeatedly tricky and potentially life-threatening. In the face of complications resulting from the essence of illness surgical treatment, therein lateral petrosectomy is necessary. Complications of radiotherapy cannot eliminate it as a method of independent treatment nor combined with other methods.
Treatment results of temporal bone area paragangliomas [Wyniki leczenia przyzwojaków kości skroniowej]
[Article in Polish]

Niemczyk, K., Łukawska, I., Kulesza, A., Bruzielewicz, A., Bartoszewicz, R.

Katedra i Klinika Otolaryngologii, Warszawskiego Uniwersytetu Medycznego, ul. Banacha 1A, 02-097 Warszawa, Poland

Introduction: Temporal bone paragangliomas are rare, benign neuroendocrine tumors. Depend on their location at skull base, they can extend intracranially and extracranially. They characterize by slowly growth and late nonspecific clinical manifestation. Location of tumor and anatomical condition require suitable operational technique and cause related complications. Aim: The aim of this study was analysis of surgical procedure and evaluation of treatment results of patients with paragangliomas of the temporal bone hospitalized in Department of Otolaryngology of Warsaw Medical University in years 2000-2010.

Material and methods: 34 cases of patients were retrospectively studied. Clinical data, level of tumor advancement according to Glasscock & Jackson and Fisch classification were analyzed. Intraoperative and imaging studies data were used to evaluate extent of lesions. Suitable operative approaches and outcome of treatment were also analyzed. Results: In group of 34 patients 26 of them had monocentric and 8 multicentric neoplasms. Age ranged 15-73-years-old. Most common symptoms were: loss of hearing, tinnitus and headache. Preoperative embolization was carried in 10 cases. Most common surgery technique: tympanotomy and hypotympanotomy posterior and infratemporal fossa of Fisch type A approaches. Radiotherapy was used in 2 cases and surgery with radiation therapy in 7 cases. Most commonly observed complication in surgical treatment was intermittent paresis. Conclusion: Main aim of temporal bone area paragangliomas treatment is radical removal of tumor. Adequate surgical technique is selected according to localization and extension of tumor. Preoperative embolization is performed during large paragangliomas treatment. Radiotherapy is a good alternative to surgery in selected patients. Risk of postoperative cranial nerves palsy rise with level of tumor advancement.

Posterior cranial fossa tumours as a cause of sudden hearing deterioration and/or vertigo | [Guzy tylnego dołu czaszki jako przyczyna nagłego pogorszenia słuchu i/lub wystąpienia zawrotów głowy]
[Article in Polish]

Zielińska-Bliniewska, H., Michalska, J., Pietkiewicz, P., Miłoński, J., Kuśmierczyk, K., Olszewski, J.

Klinika Otolaryngologii i Onkologii Laryngologicznej II, Katedry Otolaryngologii, UM W łodzi, Poland

Introduction: The aim of the work was to analyse sudden deterioration of hearing and/or vertigo occurrence as an early symptom of posterior cranial fossa tumours. Material and methods: Among 1,394 people who reported vertigo and hearing impairment and were hospitalised at the Department of Otolaryngology and Laryngological Oncology Military Teaching Hospital in Lodz within the years of 2007-2010 twenty-seven patients were analysed. This group included 19 women aged 20-80 (mean age 45.7 years) and 8 men aged 25-73 (mean age 54.0 years) who had posterior cranial fossa tumours diagnosed on the basis of MRI. Each patient underwent a detailed interview, ototrinolaryngological and otoneurological examinations, pure tone, speech and impedance audiometry, suprathreshold tests (SISI, TDT), tinnitus pitch and frequency evaluation, auditory brainstem response (ABR), complete videonystagmography. Results: The studied material revealed: acoustic neuroma in 15 patients, cerebellar meningioma in 5 patients, cerebellar cyst in 4 patients and cerebellar angioma in 3 patients. Sudden vertigo was present in 27 patients, including mixed-type vertigo in 15 cases and central vertigo in 12 cases. In 19 patients dizziness was accompanied by tinnitus. In 22 patients hearing disorders were diagnosed in a form of: sensorineural hearing loss in 14 subjects, bilateral in 7 subjects, left-lateral in 5 subjects and right-lateral in 2 subjects respectively, as well as deafness in 8 patients, including left ear...
deafness in 5 cases, right ear deafness in 1 case and bilateral deafness in 2 cases (7.4%). Conclusions: The early phase diagnosis of a posterior cranial fossa tumour as a cause of sudden hearing deterioration and/or vertigo is very seldom and often accidental because GPs, also otolaryngologists, who follow routine and economy, are not used to referring given patients for complete and objective audiological, otoneurological and imaging diagnostics.

Clinicopathologic features of endolymphatic sac tumor at cerebellopontine angle. [Article in Chinese]
Du, J., Wang, J.-M., Cul, Y., Li, G.-L.
Department of Neuropathology, Beijing Neurosurgical Institute, Capital Medical University, Beijing 100050, China.

Objective: To study the clinicopathologic features and immunophenotype of endolymphatic sac tumor (ELST) and normal endolymphatic sac. Methods: The clinical and histologic features were evaluated in 5 cases of ELST. Eight cases of choroid plexus papilloma at cerebellopontine angle and 2 cases of normal endolymphatic sac were used as controls. Immunohistochemical study for vimentin, AE1/AE3, CK8/18, CK5/6, EMA, GFAP, synaptophysin, S-100 protein, CEA, TTF-1, VEGF, D2-40, calponin, calretinin and Ki-67 was carried out. Results: The age of onset of ELST ranged from 23 to 35 years (median =24 years). The male-to-female ratio was 2-3. The clinical presentation was tinnitus, otalgia, hearing loss, otorrhagia with effusion and headache. The duration of symptoms ranged from 6 months to 10 years. Local recurrences were noted in 3 cases. Radiologically, the tumors were located at cerebellopontine angle and demonstrated petrous bone destruction. Histologic examination showed that the tumors had a papillary-glandular pattern. The papillae were covered by a single layer of low cuboidal cells. The tumor cells had distinct cell borders and contained eosinophilic to clear cytoplasm. The nuclei were slightly atypical and sometimes apically located. Focal dilated glandular structures with colloid-like material were also identified. The surrounding stroma was vascularized. All of the 5 cases had dural or petrous bone infiltration. Immunohistochemical study showed that all of the 5 cases were positive for AE1/AE3, CK8/18, CK5/6, EMA, GFAP, synaptophysin, S-100 protein, CEA, TTF-1, VEGF, D2-40, calponin, calretinin and Ki-67 index measured less than 1%. The staining for D2-40, calretinin, CEA and TTF-1 was negative. The 2 cases of the normal endolymphatic sac were positive for AE1/AE3 and CK8/18, and negative for CK5/6, EMA, S-100 protein, GFAP and synaptophysin. The 8 cases of choroid plexus papilloma were positive for synaptophysin. Seven cases were also positive for S-100 protein, 2 cases for GFAP and 1 case for D2-40. All of the 8 cases were negative for EMA, CK5/6 and calponin. Conclusions: ELST is a rare slow-growing and potentially malignant tumor with a tendency of bone invasion and local recurrence. Distant metastasis is not observed. It must be distinguished from choroid plexus papilloma occurring at cerebellopontine angle. Correlation with clinical, radiologic and immunohistochemical findings would also be helpful.
Clinical Trials

Source: www.clinicaltrials.gov (20th December 2011)

Cognitive Training for Firefighters With Tinnitus (FEMAICT)

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<th>Current Primary Outcome Measures</th>
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<tr>
<td>Change from Baseline in Tinnitus Handicap Inventory [ Time Frame: Baseline and 2 months later ] [ Designated as safety issue: No ]</td>
</tr>
<tr>
<td>Patient-based rating scale of tinnitus severity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original Primary Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same as current</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Secondary Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change from Baseline in California Verbal Learning Test [ Time Frame: Baseline and 2 months ] [ Designated as safety issue: No ] Neuropsychological test to assess an individual’s verbal learning and memory abilities</td>
</tr>
<tr>
<td>Change from Baseline in Paced Auditory Serial Addition Test [ Time Frame: Baseline and 2 months later ] [ Designated as safety issue: No ] The Paced Auditory Serial Addition Test (PASAT) is a measure of cognitive function that specifically assesses auditory information processing, speed, and flexibility.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original Secondary Outcome Measures</th>
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</thead>
<tbody>
<tr>
<td>Same as current</td>
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</table>

Descriptive Information

<table>
<thead>
<tr>
<th>Brief Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Training for Firefighters With Tinnitus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Official Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigating the Impact of Cognitive Training for Firefighters With Tinnitus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brief Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmation of efficacy and safety of acoustic CR®-neuromodulation fThe purpose of this research study is to determine whether the Brain Fitness Program-Tinnitus affects how tinnitus is perceived and if its use aids in the recovery of cognitive functions that may be affected by tinnitus. The investigators hope to better understand areas of the brain involved with or changed because of tinnitus. The investigators also hope to see if the Brain Fitness Program-Tinnitus impacts changes in those areas of the brain the investigators believe may be affected by tinnitus.</td>
</tr>
</tbody>
</table>
The objective of this pilot research project is to advance knowledge about the role of attention, control, and other cortical networks in the development and maintenance of bothersome tinnitus.

The investigators have three specific aims. First, determine whether the Brain Fitness Program-Tinnitus affects the tinnitus percept and aids the recovery of cognitive functions apparently "highjacked" by the tinnitus. Brain Fitness Program-Tinnitus was developed to improve cognitive function by engaging the brain’s neuroplasticity; the program is novel, non-invasive, and inexpensive. Second, establish specific default mode, attention system, and cognitive control network deficits in patients with bothersome tinnitus through the use of advanced neuroimaging techniques. Third, assess whether exposure to the Brain Fitness Program-Tinnitus impacts changes in the default mode, attention system, and cognitive control network deficits.

The investigators will employ a randomized clinical trial design among a cohort of active-duty firefighters who experience bothersome tinnitus. A planned enrollment of 40 firefighters with tinnitus in the clinical trial will have sufficient statistical power to detect a 17-point change in Tinnitus Handicap Inventory scores. In addition, a previously developed fcMRI protocol will be used to study brain activity in regions associated with voluntary, involuntary, and executive control of attention in 60 firefighters (40 firefighters enrolled in the clinical trial and 20 firefighters without tinnitus).

<table>
<thead>
<tr>
<th>Study Phase</th>
<th>Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Type</td>
<td>Intervenotional</td>
</tr>
</tbody>
</table>
| Study Design| Allocation: Randomized  
             Endpoint Classification: Efficacy Study  
             Intervention Model: Parallel Assignment  
             Masking: Open Label  
             Primary Purpose: Treatment |
| Condition   | Tinnitus |
| Intervention| Behavioral: Brain Fitness Program - Tinnitus  
             Brain Fitness Program-Tinnitus was developed to improve cognitive function by engaging the brain’s neuroplasticity; the program is novel, non-invasive, and inexpensive. |
| Study Arms / Comparison Groups |  
• Brain Fitness Program - Tinnitus: Experimental  
  Brain Fitness Program-Tinnitus was developed to improve cognitive function by engaging the brain’s neuroplasticity; the program is novel, non-invasive, and inexpensive.  
  Intervention: Behavioral: Brain Fitness Program - Tinnitus  
• No treatment: No Intervention |
<p>| Recruitment Information | |
| Recruitment Status | Not yet recruiting |
| Estimated Enrollment | 60 |
| Estimated Completion Date | October 2013 |</p>
<table>
<thead>
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<th>Estimated Primary Completion Date</th>
<th>June 2013  (final data collection date for primary outcome measure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility Criteria</td>
<td>Inclusion Criteria:</td>
</tr>
<tr>
<td></td>
<td>• Active-duty firefighters from study selected firehouses</td>
</tr>
<tr>
<td></td>
<td>• Able to give informed consent</td>
</tr>
<tr>
<td></td>
<td>• Men and women between the ages of 20 and 40 years</td>
</tr>
<tr>
<td></td>
<td>• Must be able to read, write, and understand English</td>
</tr>
<tr>
<td></td>
<td>• Must have had audiogram in past 18 months and be willing to</td>
</tr>
<tr>
<td></td>
<td>provide the results to the research team</td>
</tr>
<tr>
<td></td>
<td>• Subjective, unilateral or bilateral, non-pulsatile tinnitus of 6</td>
</tr>
<tr>
<td></td>
<td>month’s duration or greater</td>
</tr>
<tr>
<td></td>
<td>• Score on the Tinnitus Handicap Inventory (Newman, Jacobson,</td>
</tr>
<tr>
<td></td>
<td>and Spitzer 1996) of 30 or greater</td>
</tr>
<tr>
<td></td>
<td>• Either “Bothered a lot” or “Extremely bothered” on the Global</td>
</tr>
<tr>
<td></td>
<td>Bothersome scale</td>
</tr>
<tr>
<td></td>
<td>• Have access to uninterrupted use of computer in quiet setting for</td>
</tr>
<tr>
<td></td>
<td>minimum of 1 hour per day/5 days per week for 2 months.</td>
</tr>
<tr>
<td></td>
<td>• Be willing to be randomized to either arm of the study.</td>
</tr>
<tr>
<td></td>
<td>Exclusion Criteria:</td>
</tr>
<tr>
<td></td>
<td>• Currently taking medication for depression, anxiety, or other DSM</td>
</tr>
<tr>
<td></td>
<td>IV Axis 1 disorder</td>
</tr>
<tr>
<td></td>
<td>• History of head trauma sufficient to cause loss of consciousness</td>
</tr>
<tr>
<td></td>
<td>for ≥30 minutes</td>
</tr>
<tr>
<td></td>
<td>• History of surgery to the brain</td>
</tr>
<tr>
<td></td>
<td>• History of claustrophobia, which will prevent subject from</td>
</tr>
<tr>
<td></td>
<td>completing MRI</td>
</tr>
<tr>
<td></td>
<td>• Presence of metallic implants in the head and upper cervical</td>
</tr>
<tr>
<td></td>
<td>region that are non-MRI compatible and would prohibit use of MRI</td>
</tr>
<tr>
<td></td>
<td>• Patients with cardiac pacemakers, intracardiac lines, implanted</td>
</tr>
<tr>
<td></td>
<td>medication pumps, implanted electrodes in the brain, or any other</td>
</tr>
<tr>
<td></td>
<td>contraindication for MRI scan</td>
</tr>
<tr>
<td></td>
<td>• Currently pregnant</td>
</tr>
<tr>
<td></td>
<td>• Patients with an acute or chronic unstable medical condition,</td>
</tr>
<tr>
<td></td>
<td>which, in the opinion of the investigator, would prevent them from</td>
</tr>
<tr>
<td></td>
<td>successfully participating in the study</td>
</tr>
<tr>
<td></td>
<td>• Patients with any active ear disease, which, in the opinion of the</td>
</tr>
<tr>
<td></td>
<td>PI, needs to be further evaluated</td>
</tr>
<tr>
<td></td>
<td>• Patients with symptoms of depression as evidenced by a score of</td>
</tr>
<tr>
<td></td>
<td>10 or greater on the PHQ-9</td>
</tr>
<tr>
<td></td>
<td>• Any psychiatric co-morbidity that may complicate the interpretation</td>
</tr>
<tr>
<td></td>
<td>of study results</td>
</tr>
<tr>
<td></td>
<td>• History of seizure disorder or any other neurological condition</td>
</tr>
<tr>
<td></td>
<td>• Weight over 350 pounds</td>
</tr>
<tr>
<td></td>
<td>• Inability to lay flat for 2 hours</td>
</tr>
</tbody>
</table>
- Active alcohol and/or drug dependence or history of alcohol and/or drug dependence within the last year
- Any medical condition, which, in the opinion of the PI, confounds study results or places the subject at greater risk
- Prior use of Posit Science Brain Fitness Program, or any other cognitive training program (regular or tinnitus) in the past year
- Patients with hyperacusis (hyper-sensitivity to noises) or misophonia (abnormally strong reactions of the autonomic and limbic systems to sound)
- Tinnitus related to cochlear implantation, retrocochlear lesion, Meniere’s Disease, or other known anatomic lesions of the ear or temporal bone
- Tinnitus related to a Workman’s Compensation claim or litigation-related event that is still pending.
- History of irritable bowel syndrome, fibromyalgia, chronic fatigue syndrome, or other illnesses or disorders that falls into the category of functional somatic syndromes. (Barsky and Borus 1999)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ages</td>
<td>20 Years to 40 Years</td>
</tr>
<tr>
<td>Accepts Healthy Volunteers</td>
<td>Yes</td>
</tr>
<tr>
<td>Contacts</td>
<td>Joyce Nicklaus, RN, BSN 314-362-7508 <a href="mailto:nicklausj@ent.wustl.edu">nicklausj@ent.wustl.edu</a></td>
</tr>
<tr>
<td>Locations</td>
<td>Washington University School of Medicine St. Louis, Missouri, United States, 63110</td>
</tr>
<tr>
<td>Location Countries</td>
<td>United States</td>
</tr>
</tbody>
</table>

**Administrative Information**

- **NCT ID**: NCT01458821
- **Other Study ID Numbers**: 201110046, EMW-2010-FP-00601
- **Responsible Party**: Jay F. Piccirillo, MD, Washington University School of Medicine
- **Study Sponsor**: Washington University School of Medicine
- **Collaborators**: Federal Emergency Management Agency
- **Investigators**: Principal Investigator: Jay F Piccirillo, MD, Washington, University School of Medicine
- **Information Provided By**: Washington University School of Medicine
- **Verification Date**: October 2011
- **Health Authority**: United States: Federal Government; United States: Institutional Review Board
New Therapy for Patients With Severe Tinnitus

<table>
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<tr>
<th>Tracking Information</th>
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<tbody>
<tr>
<td>First Received Date</td>
<td>November 23, 2011</td>
</tr>
<tr>
<td>Last Updated Date</td>
<td>November 25, 2011</td>
</tr>
<tr>
<td>Start Date</td>
<td>September 2011</td>
</tr>
<tr>
<td>Estimated Primary Completion Date</td>
<td>July 2013 (final data collection date for primary outcome measure)</td>
</tr>
</tbody>
</table>
| Current Primary Outcome Measures | Tinnitus Handicap Inventory [Time Frame: baseline, post treatment, and 3month follow-up] [Designated as safety issue: No]  
Primary outcome measure is score on the THI, with a 20-point or greater decrease from baseline representing a clinically significant improvement to be tested for statistical significance at the 5 percent confidence level. |
| Original Primary Outcome Measures | Same as current |
| Change History       | Complete list of historical versions of study NCT01480193 on ClinicalTrials.gov Archive Site |

<table>
<thead>
<tr>
<th>Descriptive Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief Title</td>
<td>New Therapy for Patients With Severe Tinnitus</td>
</tr>
<tr>
<td>Official Title</td>
<td>Preliminary Clinical Trial of an Integrative Therapy With Severe Tinnitus</td>
</tr>
</tbody>
</table>
| Brief Summary           | Tinnitus is a common problem for which there is no universally effective treatment. The best available estimates indicate that 10 - 15% of adults report having tinnitus symptoms, but only 20% of those who report tinnitus suffer from it and subsequently seek treatment. Only formally reported by the U.S. Department of Veterans Affairs (VA), the economic impact of tinnitus is thought to be substantial. The VA reported in 2004 that 289,159 veterans received a disability award for their tinnitus amounting to a total annual compensation amount of over $345.5 million. Individuals with persistent severe tinnitus are unable to habituate to the tinnitus sound that most likely originates in the central auditory system (CAS) in response to peripheral injury. In a widely referenced study, it has been hypothesized that lack of habituation is secondary to abnormal processing of sensory information. Specifically, processing by the limbic system and autonomic nervous system is apparently abnormal in patients with increased levels of cortical arousal and inadequate coping mechanisms. In otolaryngology and audiology clinics, 'sound-based and educational therapies' (SBE) are the focus of most current therapies, and utilize enhanced sound input to the CAS. While SBE treatments may well provide a starting point for tinnitus treatment, additional treatment options are necessary particularly for those with significant non-auditory aspects of tinnitus (e.g., anxiety, depression, interference with daily life) as well as for those who do not experience significant improvement with SBE. Furthermore, commonly used forms of SBE [e.g., Tinnitus Retraining Therapy (TRT)] can require over a
year to become effective and may not be used in patients with hearing that is too poor to be modified by sound input. Based on prevalence data from tinnitus sufferers who seek treatment and the known percentage who do not respond to commonly used therapies, we estimate that 1.2 million individuals are not able to benefit at all from current, widely used treatment strategies. A new strategy to augment those currently used could empower patients to exert control over their tinnitus symptoms without the use of medications, expensive devices such as the Neuromonics device, or extended programs such as TRT. An alternative strategy may be useful both for patients who are not candidates for SBE and for those who respond poorly. An Integrative Medicine approach provides a likely solution. To date, there has been no systematic study of the benefits of an Integrative Medicine approach for severe tinnitus, particularly for non-auditory aspects of tinnitus symptoms. The goal of the proposed study is to determine if an integrative medicine approach which targets treatment of the nonauditory aspects of tinnitus suffering is more effective in alleviating tinnitus symptoms when added to current commonly applied SBE therapies, compared with SBE alone. If successful, this approach will be applied to a larger patient population in future studies to test the generalizability and the durability of the effect. Our eventual goal is to develop a streamlined approach that individualizes tinnitus treatment based on symptoms and patient characteristics, and that can be widely applied in general medical practice.

<table>
<thead>
<tr>
<th>Study Phase</th>
<th>Phase I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Type</td>
<td>Interventional</td>
</tr>
</tbody>
</table>
| Study Design| Allocation: Randomized  
Endpoint Classification: Efficacy Study  
Intervention Model: Parallel Assignment  
Masking: Open Label  
Primary Purpose: Treatment |
| Condition   | Tinnitus |
| Intervention| • Other: Sound Based and Educational Therapies  
The SBE program will consist of two hour-long individual counseling and sound therapy sessions based on the Department of Veterans Affairs Progressive Audiologic Tinnitus Management approach. SBE treatment incorporates the use of education, counseling, increased relaxation and decreased stress, along with the integration of sound therapy to better manage the impact of tinnitus.  
• Other: Integrated Medicine Therapies and Sound Based Education Therapies  
3 Cognitive Based Therapy Sessions, 9 Telephonic Health Coaching Sessions 5 Acupuncture Sessions Group-Based 8 week Mindfulness Based Stress Reduction  
• Other: Integrated Medicine Therapies and SBE  
2 Sound Based and Educational Sessions 3 Cognitive Based Therapy Sessions 9 Telephonic Health Coaching Sessions 5 Acupuncture Sessions Group-Based 8 week Mindfulness Based Stress Reduction |

60
Study Arms / Comparison Groups

- Sound Based and Educational Therapies: Active Comparator
  - The SBE program will consist of two hour-long individual counseling and sound therapy sessions based on the Department of Veterans Affairs Progressive Audiologic Tinnitus Management approach. SBE treatment incorporates the use of education, counseling, increased relaxation and decreased stress, along with the integration of sound therapy to better manage the impact of tinnitus.
  - Interventions:
    - Other: Sound Based and Educational Therapies
    - Other: Integrated Medicine Therapies and Sound Based Education Therapies
    - Integrated Medicine Therapies and SBE: Experimental
  - 2 Sound Based and Educational Sessions
  - 3 Cognitive Based Therapy Sessions
  - 9 Telephonic Health Coaching Sessions
  - 5 Acupuncture Sessions
  - Group-Based 8 week Mindfulness Based Stress Reduction
  - Intervention: Other: Integrated Medicine Therapies and SBE

Recruitment Information

<table>
<thead>
<tr>
<th>Recruitment Status</th>
<th>Recruiting</th>
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<tbody>
<tr>
<td>Estimated Enrollment</td>
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<tr>
<td>Estimated Completion Date</td>
<td>October 2013</td>
</tr>
<tr>
<td>Estimated Primary Completion Date</td>
<td>July 2013 (final data collection date for primary outcome measure)</td>
</tr>
<tr>
<td>Eligibility Criteria</td>
<td>Inclusion Criteria:</td>
</tr>
<tr>
<td></td>
<td>1. Debilitating tinnitus, defined by score on the Tinnitus Hearing Inventory &gt; 38;</td>
</tr>
<tr>
<td></td>
<td>2. Participation not ruled out by baseline medical exam (see below);</td>
</tr>
<tr>
<td></td>
<td>3. Age 18 or older (no upper age limit);</td>
</tr>
<tr>
<td></td>
<td>4. No acute systemic illness requiring frequent treatment such as chemotherapy, dialysis, and no such treatment in the past 3 months,</td>
</tr>
<tr>
<td></td>
<td>5. Able to speak, read and write in English,</td>
</tr>
<tr>
<td></td>
<td>6. Willingness to participate fully in either treatment arm when randomized,</td>
</tr>
<tr>
<td></td>
<td>7. Not currently enrolled in another clinical trial or taking an experimental</td>
</tr>
<tr>
<td></td>
<td>8. No previous experience with either Sound Based and Educational (SBE) therapies as applied in this study or an Integrated Medicine approach specifically for the treatment of tinnitus symptoms; and</td>
</tr>
<tr>
<td></td>
<td>9. Adequate hearing to allow participation in the SBE treatment program.</td>
</tr>
<tr>
<td>Gender</td>
<td>Both</td>
</tr>
<tr>
<td>Ages</td>
<td>18 Years and older</td>
</tr>
<tr>
<td>Accepts Healthy Volunteers</td>
<td>No</td>
</tr>
</tbody>
</table>
### Contacts
Contact: Debara Tucci, PhD (919)684-69 debara.tucci@dm.duke.edu

### Location Countries
United States

### Administrative Information

<table>
<thead>
<tr>
<th>Category</th>
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<tbody>
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<td>Pro00030594, 1R21DC011643-01</td>
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<tr>
<td>Has Data Monitoring Committee</td>
<td>No</td>
</tr>
<tr>
<td>Responsible Party</td>
<td>( Duke University )</td>
</tr>
<tr>
<td>Study Sponsor</td>
<td>Duke University</td>
</tr>
<tr>
<td>Collaborators</td>
<td>National Institutes of Health (NIH)</td>
</tr>
<tr>
<td></td>
<td>National Institute on Deafness and Other Communication Disorders (NIDCD)</td>
</tr>
<tr>
<td>Investigators</td>
<td>Principal Investigator: Debara Tucci, MD Duke University</td>
</tr>
<tr>
<td></td>
<td>Sub-Investigator: Ruth Q Wolever, Ph.D.</td>
</tr>
<tr>
<td></td>
<td>Sub-Investigator: Rebecca Price, AuD</td>
</tr>
<tr>
<td>Information Provided By</td>
<td>Duke University</td>
</tr>
<tr>
<td>Verification Date</td>
<td>November 2011</td>
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<tr>
<td>Health Authority</td>
<td>United States: Institutional Review Board</td>
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</table>

### Customized Acoustic Stimulation for the Treatment of Tinnitus

### Tracking Information

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<tr>
<th>Category</th>
<th>Details</th>
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<td>First Received Date</td>
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<tr>
<td>Last Updated Date</td>
<td>December 5, 2011</td>
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<tr>
<td>Start Date</td>
<td>January 2010</td>
</tr>
<tr>
<td>Estimated Primary Completion Date</td>
<td>July 2012 (final data collection date for primary outcome measure)</td>
</tr>
<tr>
<td>Current Primary Outcome Measures</td>
<td>• Change in score of tinnitus loudness [ Time Frame: Before treatment; 1 minute; 1 hour; 1, 2, 4 and 6 months ] [ Designated as safety issue: No ]</td>
</tr>
<tr>
<td></td>
<td>• Change in score of tinnitus annoyance [ Time Frame: Before treatment; 1 minute; 1 hour; 1, 2, 4 and 6 months ] [ Designated as safety issue: No ]</td>
</tr>
<tr>
<td></td>
<td>• Change in residual inhibition [ Time Frame: 1 minute; 1 hour; 1, 2, 4 and 6 months ] [ Designated as safety issue: No ]</td>
</tr>
<tr>
<td></td>
<td>• Change in score of Tinnitus Handicap Inventory (THI) [ Time Frame: Before treatment; 1, 2, 4 and 6 months ] [ Designated as safety issue: No ]</td>
</tr>
<tr>
<td><strong>Original Primary Outcome Measures</strong></td>
<td><strong>Same as current</strong></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Change History</strong></td>
<td>Complete list of historical versions of study NCT01487447 on ClinicalTrials.gov Archive Site</td>
</tr>
</tbody>
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## Descriptive Information

<table>
<thead>
<tr>
<th><strong>Brief Title</strong></th>
<th>Customized Acoustic Stimulation for the Treatment of Tinnitus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brief Summary</strong></td>
<td>The purpose of this study is to determine the efficacy of a customized sound therapy in reducing tinnitus loudness and increasing the residual inhibition.</td>
</tr>
</tbody>
</table>
| **Study Phase** | Phase II  
Phase III |
| **Study Design** | Allocation: Randomized  
Intervention Model: Crossover Assignment  
Masking: Open Label  
Primary Purpose: Treatment |
| **Condition** | Tinnitus |
| **Intervention** |  
• Other: Customized Sound treatment with customized sound therapy  
• Other: Regular Masker treatment with white noise |
| **Study Arms / Comparison Groups** |  
• Intervention: Experimental  
• Control: Active Comparator  
• Intervention: Other: Customized sound  
• Intervention: Other: Regular Masker |

## Recruitment Information

<table>
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<tr>
<th><strong>Recruitment Status</strong></th>
<th>Recruiting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated Enrollment</strong></td>
<td>60</td>
</tr>
<tr>
<td><strong>Estimated Primary Completion Date</strong></td>
<td>July 2012 (final data collection date for primary outcome measure)</td>
</tr>
</tbody>
</table>
| **Eligibility Criteria** | Inclusion Criteria:  
• 18 years or older  
• Male or female  
• Tinnitus present for 6 months or more  
• Adequate command of English  
Exclusion Criteria:  
• Active illicit drug use, alcohol dependence  
• Treatable cause of tinnitus  
• History of psychosis  
• Subjects on medications known to cause tinnitus (aspirin, ibuprofen, naproxen) which could not be stopped will be excluded. |
<p>| <strong>Gender</strong> | Both |
| <strong>Ages</strong> | 18 Years and older |</p>
<table>
<thead>
<tr>
<th>Accepts Healthy Volunteers</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts</td>
<td>Contact: Hamid R Djalilian, MD 7144565753 <a href="mailto:hdjalili@uci.edu">hdjalili@uci.edu</a></td>
</tr>
<tr>
<td>Location Countries</td>
<td>United States</td>
</tr>
<tr>
<td>Location</td>
<td>UC Irvine Medical Center Orange, California, United States, 92868</td>
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**Administrative Information**

<table>
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<tr>
<td>Responsible Party</td>
<td>( University of California, Irvine )</td>
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<tr>
<td>Study Sponsor</td>
<td>University of California, Irvine</td>
</tr>
<tr>
<td>Investigators</td>
<td>Principal Investigator: Hamid R Djalilian, MD</td>
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<tr>
<td>Information Provided By</td>
<td>University of California, Irvine</td>
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<tr>
<td>Verification Date</td>
<td>December 2011</td>
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<tr>
<td>Health Authority</td>
<td>United States: Food and Drug Administration</td>
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