OFFICIAL PUBLICATION OF THE CANADIAN ACADEMY OF AUDIOLOGY
PUBLICATION OFFICIELLE DE L'ACADÉMIE CANADIENNE D'AUDIOLOGIE

Canadian Hearing Report

Revue canadienne d'audition

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Vol. 7 No. 2
May 2012

VEMPs: The Current State of Affairs

Accoustic Shock Disorder

Peer Reviewed

Published by
ANDREW JOHN PUBLISHING INC.
www.andrewjohnpublishing.com

Publications Agreement Number 40025049 | ISSN 1718 1860

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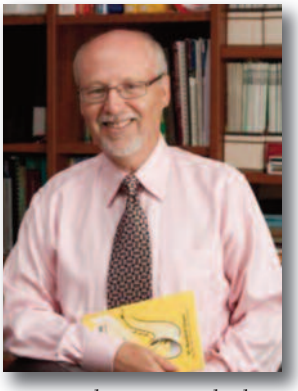

I recall the first convention for my hard of hearing clients that I attended. I believe it was 1983 and was called "A Sound Beginning." The meeting was cosponsored by the Canadian Hearing Society and a new group called the Canadian Hard of Hearing Association (or CHHA). Since that time, CHHA, and other similar groups in Canada and around the world have sprung up to provide what the clinical audiologist could not – namely peer support. Of course, it's not this black and white – many audiologists have organized aural rehabilitation classes within their own clinical practices and facilities and an important aspect of these classes was always what can be learned from the person sitting next me: what tools and strategies did Mrs. Smith know that Mrs. Patel could learn?

Gael Hannan's From the Consumer column in this issue of the *Canadian Hearing Report* touches on her own experiences as a hard of hearing person and how the Canadian Hard of Hearing Association has become such an important part of her life. Although these are conferences for hard of hearing consumers of our services, it would be simplistic to say that a hearing health care professional won't get something important from attending and participating in these meetings. CHHA has provincial meetings and an annual one at the national level. Of the ones that I attend, I must admit to learning as much, if not more, than the target audience. Chatting with a person with hearing loss in a social environment, especially if you don't have the pressures of an overflowing waiting room and an impending meeting in an hour, can be quite instructive.

Several years ago at a CAA convention I attended a talk by Dr. Gary Jacobson on VEMPs – vestibular evoked myogenic potentials. I sat in on it even though I don't routinely do any assessment or vestibular rehabilitation therapy with dizzy patients. It was a fascinating talk and among other things reminded me of the numerous neurological pathways that are implicated in staying vertical on our feet. In this issue, Gary Jacobson and Erin Piker were gracious enough to write an overview article on just this topic. The study of the realm of vestibular pathology seems to be a hit-and-miss educational pathway for many, especially at the doctorate level. One enters into a PhD to study audiology – it is a rarity for someone to only study our vestibular system. In speaking with Dr. Jacobson at the CAA meeting he was in the process of trying to establish just such a doctorate level course of study at his university. For some reason, American trained audiologist have a greater clinical knowledge than their Canadian counterparts in the study and treatment of vestibular disorders. I am not sure why that is the case- possibly re-imbursement? Whatever the reason or reasons, the study of the vestibular system and the rehabilitative treatment of vestibular pathologies is something that we need more of in Canada.

I don't think that this is a coincidence but in From the Blogs, Calvin Staples has chosen to review some of the vestibular-related items from www.hearinghealthmatters.org. This is a weekly blog which is written by some of the leading thinkers in our field. Guest bloggists are frequently invited to contribute on special issues. The *Canadian Hearing Report* has had the honour of being able to reprint several of the blogs on a regular basis. So, if you want to learn more about the vestibular system and the rehabilitation surrounding it, this is an issue to read.

We also continue with our other regular columns, All Things Central, Spotlight on Science, Noise About Noise, and a book review in From the Library. In From the Library, Dr. Vishkha Rawool has written a most delightful text on *Hearing Conservation: In Occupational, Recreational, Educational and Home Settings*. As the title suggests, it's not just about the factory or steel mill- it's also about recreational noise such as music and MP3 players – definitely a worthwhile text to have.

The Canadian Hearing Report does receive books to review from time to time. Current books that are being reviewed involve those about disorders of the auditory system, and CI and implantable hearing aids. If anyone has a special interest in a topic, or topics, please send your contact information my way so that we can match up your areas of interest with a book that we may be considering for review.

Marshall Chasin, MSc, AuD, Aud(C), Reg. CASLPO
Editor in Chief
marshall.chasin@rogers.com

Canadian Hearing Report 2012;7(2):3.

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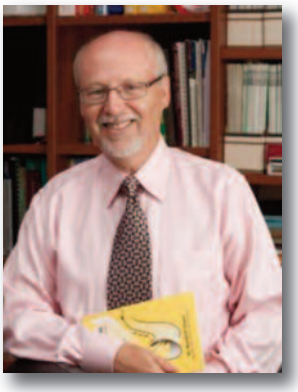

Je me rappelle du premier congrès pour mes clients malentendants auquel j'ai participé. Je crois que c'était en 1983 et le titre en était « A Sound Beginning ». La réunion a été coparrainée par la Société canadienne de l'ouïe et par un groupe qui s'appelle l' « Association des malentendants canadiens » (ou AMEC). Depuis, l'AMEC et d'autres groupes similaires au Canada et dans le monde entier ont surgi afin de fournir ce que l'audiologiste clinicien ne pouvait pas avoir – c'est-à-dire, le soutien des collègues. Bien évidemment, il ne s'agit pas de quelque chose noir sur blanc : beaucoup d'audiologistes ont organisé des classes de rééducation auditive au sein de leurs cabinets et installations cliniques et un aspect important de ces classes a toujours été l'apprentissage de la personne qui est assise à côté de soi : Quelles sont les stratégies que connaissait Mme. Smith que Mme. Patel pouvait apprendre?

Gael Hannan, dans sa chronique sur le point de vue du consommateur dans le dernier numéro de la *Revue canadienne d'audition* parle de sa propre expérience en tant que personne malentendante et dans quelle mesure l'Association des malentendants canadiens est devenue quelque chose d'extrêmement important dans sa vie. Quoique ces congrès ciblent les consommateurs malentendants de nos services, il serait trop simpliste de dire qu'un professionnel des soins de santé de l'ouïe n'obtiendrait pas quelque chose d'important en assistant et en participant à ces réunions.L'AMEC a des réunions à échelle provinciale, et une réunion à échelle nationale. Il me faut admettre que de celles auxquelles je participe j'apprends de la mesure, si non même plus que le public cible. Très riche en enseignements, que de bavarder au sein d'un environnement social avec une personne qui souffre d'une déficience auditive, surtout qu'on ait pas à gérer les contraintes d'une salle d'attente débordée de clients et d'une réunion imminente en une heure.

Il y a plusieurs années, au congrès de l'Académie canadienne d'audiologie, j'ai assisté à une présentation du Dr. Gary Jacobson au sujet des VEMP - les potentiels évoqués myogéniques vestibulaires. J'y ai participé quoique je ne fais pas normalement d'évaluations ou de thérapie de rééducation vestibulaire avec des patients souffrant d'étourdissement. La présentation a été captivante et parmi d'autres choses, m'a rappelé des voies neurologiques multiples qui sont impliquées dans le fait de rester debout sur nos pieds. Gary Jacobson et Erin Piker ont eu l'amabilité d'écrire un article qui constitue un survol sur précisément ce sujet-là. L'étude du domaine de la pathologie vestibulaire paraît être un chemin éducatif aléatoire pour certains d'entre nous, surtout au niveau du doctorat. On initie une thèse de doctorat pour étudier l'audiologie; c'est rare que quelqu'un n'étudie notre système vestibulaire. En parlant avec le Dr. Jacobson à la réunion de l'Académie canadienne d'audiologie, il m'a indiqué qu'il était dans le processus d'établir précisément ce genre de programme d'études à niveau de doctorat dans son institution universitaire. Pour une raison que j'ignore, les audiologistesformés aux Etats-Unis ont d'avantage de connaissances que leurs homologues canadiens en ce qui concerne l'étude et le traitement de troubles vestibulaires. Je ne sais pas quelle en est la raison; peut-être le remboursement? peu importe la raison ou les raisons, le système vestibulaire et les mesures de réadaptation des pathologies vestibulaires sont quelque chose que nous devons étudier davantage au Canada.

Je ne pense pas que cela soit une coïncidence, mais dans *From the Blogs*, Calvin Staples a choisi de passer en revue quelques-uns des sujets du domaine vestibulaire de www.hearinghealthmatters.org. Voilà un blog hebdomadaire écrit par quelques penseurs de haut calibre de notre domaine. Des blogueurs invités sont fréquemment appelés à contribuer en ce qui concerne des enjeux spéciaux. La *Revue canadienne d'audition* a eu l'honneur de pouvoir réimprimer plusieurs des blogs de façon régulière. Si vous voulez donc en savoir davantage sur le système vestibulaire et la rééducation qui le concerne, voilà un numéro que vous devriez lire.

Nous continuons aussi avec nos autres reportages réguliers, *All Things Central, Spotlight on Science, Noise About Noise*, et une critique de livre dans *From the Library*. Dans From the Library, le Dr. Vishkha Rawool a écrit un texte vraiment charmant sur la conservation de l'ouïe dans les environnements professionnels, récréatifs, éducationnels et domestiques. Tel que le suggère le titre, il ne s'agit pas seulement de l'usine ou de l'aciérie – mais il s'agit aussi du bruit récréatif, tel que la musique ou les baladeurs MP3. C'est sans doute un texte qu'il vaut la peine de posséder.

La *Revue canadienne d'audition* reçoit de temps en temps des livres pour en faire une critique. Ceux qui sont en train d'être passés en revue incluent ceux qui s'agissent du système auditif, les implants cochléaires et les appareils auditifs implantables. Si quelqu'un d'entre vous est intéressé par un certain sujet en particulier, veuillez bien m'envoyer vos coordonnées afin que nous puissions mettre en rapport vos domaines d'intérêt avec un livre que nous pourrions être en train de considérer de passer en revue.

Cordialement,

Marshall Chasin, MSc, AuD, Aud(C), Reg. CASLPO
Éditeur en chef
marshall.chasin@rogers.com

Canadian Hearing Report 2012;7(2):5.

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Canadian Hearing Report
Revue canadienne d'audition
Vol. 7 No 2 • May 2012

Official publication of the Canadian Academy of Audiology

Publication officielle de l'académie canadienne d'audiologie
www.canadianaudiology.com

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MANAGING EDITOR / DIRECTEUR DE LA RÉDACTION
Scott Bryant, scottbryant@andrewjohnpublishing.com

CONTRIBUTORS
Chris Allan, Prudence Allen, Alberto Behar, Marshall Chasin, Gael Hannan, Gary Jacobson, Sean Lennox, Erin Piker, Calvin Staples, Kim Tillery

ART DIRECTOR/DESIGN / DIRECTEUR ARTISTIQUE/DESIGN
Andrea Brierley, abrierley@allegrahamilton.com

SALES AND CIRCULATION COORDINATOR. / COORDONATRICE DES VENTES ET DE LA DIFFUSION
Brenda Robinson, brobinson@andrewjohnpublishing.com

ACCOUNTING / COMPTABILITÉ
Susan McClung

GROUP PUBLISHER / CHEF DE LA DIRECTION
John D. Birkby, jbirkby@andrewjohnpublishing.com

Canadian Hearing Report is published six times annually by Andrew John Publishing Inc. with offices at 115 King Street West, Dundas, On, Canada L9H 1V1.

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FEATURES

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Canadian Academy of Audiology (CAA): Research Grant for Clinical Investigators

Do you have a question you want answered? Do have the desire to learn more about the research process? Do you want to see your name in lights (or at least on a publication)? The Canadian Academy of Audiology (CAA) Research Grant for Clinical Investigators provides financial and practical support to clinical audiologists wanting to investigate a unique research question. The successful applicant will receive the support of the CAA Scientific Advisory Committee (SAC) to help coordinate access to the proper resources (e.g., equipment, people, processes) to see the project to completion. Access to advanced testing facilities or established research personnel and mentors is not an application requirement.

Available for the 2012 year is one award of up to $5,000, or two awards of $2500. This decision will be at the discretion of the CAA SAC and will depend on the number and quality of the submitted grant applications. Funds associated with the CAA Research Grant for Clinical Investigators are proposed to cover only activities and supplies directly associated with new projects. This includes the salaries of the primary investigator(s) and assisting personnel, purchasing necessary equipment (e.g., software), attending workshops, conferences or classes that provide learning opportunities and training directly related to research activities, subject care fees and other essential authorized expenses and supplies. Funds may not be used to cover activities related to any ongoing or completed research projects (including travel).

Applicants must

1. have at minimum a master's degree in audiology or hearing science,
2. be practicing audiologists, and
3. be current members of the Canadian Academy of Audiology (CAA).

Award recipients will be announced at the annual 2012 CAA conference. Successful applicants will be required to present their findings at a CAA conference (registration fees to be waived for one presenter at this event only) and publish in a peer-reviewed journal (e.g., *Canadian Hearing Report* [CHR]) within five years from the date of award approval.

Deadline for submission will be August 15, 2012. See the CAA website (www.canadianaudiology.ca) for the application form, checklist and other details as they become available. Further questions can be directed to research@canadianaudiology.ca.

Canadian Hearing Report 2012;7(2):8.

CALENDAR OF EVENTS

APRIL 2012

April 26–28, 2012
New York State Speech-Language-Hearing Association presents its 52nd Annual Convention
Saratoga Springs, NY • www.nysslha.convention

April 29 – May 3, 2012
World Congress of Audiology
Moscow, Russia • http://www.wca2012.ru/

MAY 2012

May 3-5, 2012
12th International Conference on Cochlear Implants and Other Implantable Auditory Technologies
Baltimore, MD • http://www.ci-2012.com/

JUNE 2012

June 21–24
Hearing Loss Association of America (HLAA)
Providence, Rhode Island
http://www.hearingloss.org/content/convention

June 29–July 12
Alexander Graham Bell Association for the Deaf and Hard of Hearing
Scottsdale, Arizona
http://nc.agbell.org//Page.aspx?pid=1338

AUGUST 2012

August 15–18
SayWhatClub (SWC) - Internet support group for adults with hearing loss: August
Salt Lake City, Utah
http://www.saywhatclub.com/events/SLC-con/SLC-con.html

August 19–22
INTER-NOISE 2012
The theme of the congress is Quieting the World's Cities, and we plan to hold special workshops highlighting city noise codes, and the New York City noise code in particular.
New York City, NY • http://www.internoise2012.com/

OCTOBER 2012

October 10–12
Acoustics Week in Canada Banff Conference
http://www.caa-aca.ca/conferences/Banff2012/index_portal.html

NIHB Update

As CAA previously informed its members, as of January 1, 2012 audiologists are recognized as prescribers for hearing aids by Non-Insured Health Benefits First Nations and Inuit Health Branch of Health Canada (NIHB). CAA is issuing this notice to help clarify the procedural ramifications of this change. The following instructions have been issued by NIHB.

The *NIHB Hearing Aid and Hearing Aid Repair Prior Approval Form* and the *Medical Supplies and Equipment Claim Form* both request information in the prescriber ID field (License/Billing #). Registered audiologists should enter their college registration number in the province where they practice. For the provinces/territories with no college or regulatory body, audiologists should use their membership number with CASLPA or CAA.

The prescriber ID reference field is only requested on the *Medical Supplies and Equipment Claim Form*. The prescriber ID reference field is only requested on the Medical Supplies and Equipment Claim Form. See below for the code assigned, by ChpA, for your province/territory.

Prov/Terr	Prescriber ID/ Reference Code
AB	80
BC	92
SK	78
MB	69
ON	10
QC	52
NB	49
PEI	28
NS	34
NT	A3
YK	B9
NU	C3
NL	19

For copies of the *NIHB Hearing Aid and Hearing Aid Repair Prior Approval Form* and the *Medical Supplies and Equipment Claim Form* visit www.canadian-audiology.ca/professional.html and select Federal Healthcare Partners under the Funding and Advocacy tab.

If you have any questions about this procedure please contact your regional NIHB office. CAA also continues its work with NIHB to help streamline their prior approval process and we hope to have this project completed soon.

Canadian Hearing Report 2012;7(2):9.

Student Bursary Award

Do you or someone you know need support to attend the annual CAA conference?

The purpose of the bursary is to provide some help to enable a limited number of students to have access to the CAA conference educational experience

- to inform choices in their research studies in their final year program,
- to inform future clinical career decisions,
- to enable Canadian audiology students studying abroad to attend, and
- to enable non-audiology students to attend to foster inter-professional relationships and enhance patient care.

Eligible candidates must meet the following criteria

- Must be a Canadian citizen or resident of Canada in one of the following categories:
- Students in a Canadian audiology program attending their penultimate year of study (at the time of the conference they will be attending and for which the travel bursary is being given.
- Canadian students who are studying audiology abroad, any year.
- Non-audiology students who want to attend the conference if the award selection committee deems the application suitable. Some examples of non-audiology categories are: engineers focused on hearing aid design, SLP students interested in audiology topics, ENT residents, and psychology students studying psychoacoustics or the emotional impact of sudden hearing loss.

Applications fulfilling the intent of the bursary will be considered.Deadline for applications is April 30, 2012.

Visit the www.canadianaudiology.ca/professional.html (under NEWS AND EVENTS) for the application form, details, and requirements or contact caa@canadianaudiology.ca.

Canadian Hearing Report 2012;7(2):10.

CANADIAN ACADEMY OF AUDIOLOGY
PO Box 62117 777 Guelph Line, Burlington ON, L7R 4K2
Phone: 905-633-7114/1-800-264-5106 Fax: 905-633-9113 Email: caa@canadianaudiology.ca

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By Calvin Staples, MSc
CStaples@conestogac.on.ca

Recently, I opted to return back to my clinical audiology roots. I find the clinical role of an audiologist to be so critical to overall good general health that I find this occupation very exciting and rewarding. Since my return I continue to find ways for me to carve out my area of focus aside from hearing aids. The quest for what this focus may or may not be had me return to my schooling and review the world of dizziness. I completed numerous vestibular assessments during my first real job as an audiologist in Oklahoma. However, since my return to Canada I have rarely even been exposed to vestibular assessments in clinical audiology. Thus, I thought Alan Desmond's contributions regarding dizziness at hearinghealthmatters.org would be a great starting place for my review.

AN OPEN LETTER TO DISPENSING AUDIOLOGISTS

By Alan Desmond

Adding vestibular services to your practice provides benefits to all involved

Most of you are familiar with the frequently quoted statistics regarding hearing loss and hearing aid use. This quote comes directly from the Better Hearing Institute website: "The last MarkeTrak survey (2004) estimated that 31.5 million people report a hearing difficulty; that is around 10% of the U.S. population."

What might surprise you is that these statistics pale when compared to the estimates on the prevalence of dizziness. The Vestibular Disorders Association reports that 4 out of 10 people will seek medical care for the complaint of "dizziness" at some point in their life. In the elderly population (75 and over), it is the most common reason for a doctor visit.

Unlike hearing loss, which typically requires prolonged, repeated negative experiences to prompt seeking treatment, patients with dizziness are often desperate for immediate relief. Most often, they seek treatment from a primary care physician (PCP), with less than 10% ever seeing a specialist such as Audiology, Neurology or ENT for these complaints. The treatments historically provided at the PCP level (imaging, medication and observation) are notoriously ineffective.

A striking difference between the PCP approach to hearing loss versus dizziness is the fact that the PCP usually refers to a specialist for treatment of hearing loss, but most choose to treat the dizzy patient themselves. Keep in mind that there are typically numerous options for the PCP when considering where to send a hearing impaired patient. Currently, in most communities, the options for vestibular management are sparse. Despite the fact that there are MANY more patients complaining of dizziness when compared to hearing loss, there are FAR fewer diagnostic and treatment options available to them.

Offering competent vestibular services is a win/win for everyone involved. The patient benefits from access to evidence based diagnostic and treatment procedures, which have been proven to be more effective and more cost effective than the historical PCP approach. The PCP benefits because they truly do want to do what is best for their patient. If there is no one locally that can educate them and help manage their dizzy patients, they must do the best they can with minimal diagnostic information. The regional specialty balance clinic benefits because you will understand which patients require more sensitive diagnostic and treatment options than you offer, and you will refer these patients on. And finally, you will benefit for the many reasons discussed in the next paragraphs.

First, you distinguish your practice from retail hearing aid offices. It has been established that patients are, on average, significantly more satisfied with services obtained from audiologists than hearing instrument specialists. You know the difference in education, standards and professional commitment between audiologists and hearing instrument dispensers. The general public and even many PCPs may not be aware of or appreciate these differences. Vestibular management is clearly and obviously not within the scope of practice for hearing instrument specialists, so offering these services is

an indication of your additional training and expertise.

Second, fees generated from vestibular testing are not subject to a return policy. Say what you will about the benefits of a return policy on hearing aids; one can't deny that they leave a certain level of uncertainty to financial planning. Currently, Medicare approves approximately $200.00 for a standard ENG/VNG battery.

Third, it brings many patients in to your office that you might otherwise never see. A common denominator for nearly all patients coming to your office is that they have some concern about their hearing. In a vestibular practice, you regularly see people with significant hearing loss that have not taken the step to seek help. You get a glimpse into some of the reasons that 77% of people with hearing loss do not use hearing aids. Many have unsuccessfully tried amplification in the past, and have determined that "hearing aids don't work." Even more have heard this comment from their friends and have decided not to waste their money on hearing aids. Once you have helped them through their vestibular issues and established a trusting relationship, you can comfortably approach their hearing problems.

http://hearinghealthmatters.org/dizzinessdepot/2011/an-open-letter-to-dispensing-audiologists

WHY ARE VESTIBULAR SPECIALISTS SO HARD TO FIND? PART II

By Alan Desmond

Last week we began the discussion about why there are so few vestibular specialists, and I wrote that I thought it had to do with lack of awareness, and economics. This week, we discuss lack of awareness, next week we discuss economics.

Lack of awareness: As an example, the most common cause of episodic vertigo is the result of a simple condition with a long name – benign paroxysmal positional vertigo (BPPV). BPPV accounts for about one half of all inner ear disorders, and about one fourth of all complaints of dizziness and vertigo. The symptoms can be resolved in one office treatment session about 90% of the time. The diagnosis and treatment of this condition do not require any expensive, sophisticated equipment. The treatment (canalith repositioning) is known to be safe, inexpensive and effective. Sound great? The most recent estimate is that less than ten percent of patients with BPPV are ever offered this treatment. How can this happen? A recent survey shows that less than half of primary care physicians are familiar with this treatment.

Another issue complicating matters is the vernacular. "Dizziness" is a vague term that can have a variety of meanings. It can mean vertigo (spinning), lightheadedness, loss of balance, spatial disorientation, or unsteadiness. These are very different sensations with many different possible causes. Unless the examiner asks for a more specific description of symptoms, the direction of logical diagnostic testing or treatment is unclear. A recent study found that only about one third of Geriatricians (physicians specializing in the elderly) inquire about a more specific description of " dizziness." Fortunately, things are better when seeing a specialist, with over 80% of audiologists asking for a more detailed description.[1] One study showed that only 25% of complaints of dizziness involve vertigo (and we know most of that is BPPV), with about 75% meaning lightheadedness or off balance sensation.[2]

This leads to the next obstacle, that is, a clear understanding of the role of medications in treating "dizziness." Many patients are given Antivert (Meclizine) for the complaint of dizziness. While Antivert can be helpful in dealing with the nausea associated with acute vestibular vertigo or motion sickness, it is not helpful for complaints of imbalance, unsteadiness or lightheadedness. Antivert does nothing to speed recovery from inner ear disorders, in fact, it can actually slow down the natural recovery process. The recent clinical guideline for BPPV recommends against the use of Antivert for that condition, yet every day I still see BPPV patients being treated with Antivert.

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http://hearinghealthmatters.org/dizzinessdepot/2011/why-are-vestibular-specialists-so-hard-to-find-part-ii

THE ROLE OF AUDIOMETRY IN VESTIBULAR TESTING

By Alan Desmond

"Why are you doing a hearing test? My hearing is just fine."

I've heard this frequently enough over the years that I know to take a minute to explain to every vestibular patient, before we get started, why we require an audiogram. I keep it pretty straightforward and simple:

"We do a quick hearing test on every patient complaining of dizziness because we have to be sure there is no infection or inflammation behind your eardrum, and we need to make sure there isn't any unexplained difference in hearing between the two ears. Some inner ear problems affect hearing as well. Some do not. Knowing your hearing levels will help us rule out some causes."

Audiometric evaluation is a necessary starting point for a number of reasons, but it primarily provides information about auditory asymmetry, possible retrocochlear pathologies, and the health and integrity of the ear canal and tympanic membrane before caloric irrigation.

Audiometric evaluation consists of pure-tone air and bone-conduction thresholds; speech audiometry, including speech reception threshold (SRT) and speech recognition tests; tympanometry; acoustic reflex threshold and decay tests; speech rollover tests; and, when indicated, otoacoustic emissions (OAEs)

AUDITORY SYMMETRY

Auditory asymmetry refers to a significant difference in threshold hearing levels between the ears and indicates the possibility of peripheral vestibular or auditory nerve pathology. The Mayo Clinic[1] uses a criterion of a *"difference of 15 dB or greater averaged across 500, 1000, 2000, 3000 Hz or differences of 15 dB or greater in speech recognition thresholds"* to determine significant asymmetry.

Although there are numerous causes for asymmetric auditory sensitivity, including middle ear pathologies, various patterns have been linked with specific vestibular disease. Endolymphatic hydrops (Meniere's disease) is frequently accompanied by unilateral, fluctuating, low-frequency sensorineural hearing loss. Acoustic neuroma is often characterized by an asymmetry in the higher frequencies. Perilymph fistula and labyrinthitis are usually accompanied by unilateral sensorineural hearing loss with no specific pattern or configuration of loss.

RETROCOCHLEAR PATHOLOGY

Retrocochlear pathology refers to site of lesion at the cranial nerve (CN) VIII, cerebellopontine angle, or root entry zone of the CN VIII into the brain stem. A number of audiometric findings are suggestive of retrocochlear site of lesion and may be found in acoustic neuroma, multiple sclerosis, and a variety of brain stem lesions. Audiometric signs consistent with possible retrocochlear pathology include the following:

1. Asymmetric, typically high-frequency, sensorineural hearing loss.
2. Speech recognition scores poorer than would be expected based on audiometric configuration and severity.
3. Rollover (decreased speech recognition scores with higher intensity speech presentation levels).
4. Absent or elevated acoustic reflex thresholds or abnormal acoustic reflex decay.

THE EAR CANAL AND TYMPANIC MEMBRANE

The health and integrity of the ear canal and tympanic membrane must be ascertained before beginning vestibular evaluation. Many patients with middle ear pathology will complain of dizziness as well as other auditory symptoms. It is prudent to treat the middle ear problem first to determine whether there is an improvement in the complaint of "dizziness." Also, treatment might remove confounding factors affecting sensitive evaluation, such as aural fullness, tinnitus, and otalgia, which are common to both middle ear and peripheral vestibular disorders. Conditions such as tympanic membrane perforation, cerumen impaction, external otitis, or discharge may contraindicate caloric irrigation of the external auditory canal.

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http://hearinghealthmatters.org/dizzinessdepot/2011/the-role-of-audiometry-in-vestibular-testing/

FURTHER READING

WHY ARE VESTIBULAR SPECIALISTS SO HARD TO FIND? PART IV

http://hearinghealthmatters.org/dizzinessdepot/2012/why-are-vestibular-specialists-so-hard-to-find-part-iv/

WHAT DO YOU MEAN WHEN YOU SAY DIZZY? – PART IV

http://hearinghealthmatters.org/dizzinessdepot/2011/what-do-you-mean-when-you-say-dizzy-part-iv/

Canadian Hearing Report 2012;7(2):12–14.

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Decoding Type of APD: Diagnosis and Treatment

By Kim L. Tillery, PhD, CCC-A
kltillery@gmail.com

About the Author

Dr. Kim L. Tillery, professor and chairperson of the Department of Communication Disorders and Sciences at the State University of New York at Fredonia also has a private practice in diagnosing and treating individuals with (C)APD. She has been honoured to present 90 workshops or presentations at national, international, and regional conferences, and authored and co-authored several chapters and journal articles on (C)APD.

There are several types of auditory processing disorders (APD), with the decoding type of APD recognized in all three models of CAPD (e.g., Buffalo Model, Bellis/Ferre Model, and Spoken-Language Processing Model). In fact, Bellis indicates that decoding type is probably the only pure form of APD.[1]

Decoding involves misinterpretation of the small segments of language due to a breakdown at the phonemic level. A client with decoding type of APD may show weak discrimination, poor blending of sounds, and difficulty remembering the learned phonemes.[2,3] This individual may exhibit weak oral reading, preferring not to read out loud, and weak spelling skills. Word-finding problems and weak vocabulary skills may result due to poor misperceptions of the spoken message.[4] Often the client will mishear the initial sounds or the final sounds. Imagine a teacher asking the students to take out their math book. The child with a decoding type of APD may mishear this direction as "bath" book even when knowing that there is no such book. A college professor may be discussing the "efferent" pathway and the individual with decoding will mishear it as the "afferent" pathway. Obviously, these examples may happen to all of us every now and then; however, the individual with decoding APD will experience these moments several times during the day.

The primary auditory cortex (left posterior temporal lobe) is the probable site-of-dysfunction.[2,3] Evaluation of this APD type is based on weak right ear performance on the Dichotic Digits Test[5] or on the Competing Sentence Test,[6] as reported by Bellis.[1] Other diagnosis indicators are the weak right competing (RC) and left noncompeting (LNC) measures on the Staggered Spondaic Word (SSW) test,[3] weak Phonemic Synthesis (PS) test[7] scores and qualitative signs (e.g., delays, quiet rehearsals) observed during test taking or daily conversations.[3,4]

We know how to remediate decoding APD. Auditory training involves correcting the misperception of the auditory signal by providing repetition in a variety of ways (e.g., vowel discrimination, "bottom up" therapies, grammatical morpheme target, phonic work, phonemic synthesis and phonemic analysis, and metacognitive and metalinguistic strategies).

CASE STUDY

Rob, a nine-year-old male, was referred for APD testing due to his spelling and reading skills being at least two years below grade level and his diagnosis of attention deficit (at six years). He was receiving occupational therapy and tutorial reading services. Rob received 18 auditory training sessions (two sessions per week) after being diagnosed with primary decoding type of APD. He was motivated and always performed his best.

Table 1 shows pre- and post-therapy results (administered nine weeks apart) of Rob's test scores on the SSW, PS and speech-in-noise tests for both quantitative and qualitative results. (Some CAP tests can reveal qualitative [struggles] information.) Note the

TABLE 1. PRE AND POST THERAPY TEST SCORES OF A CLIENT WHO RECEIVED 18 FORTY-FIVE MINUTE AUDITORY TRAINING SESSIONS IN NINE WEEKS

		RNC	RC	LC	LNC	Delays
SSW	Pre:	2	6	10	3	42
	Post:	1	3	5	2	13
PS	Pre:	Quantitative -	18/25 correct			
		Qualitative -	6/25 correct			
			9 quiet rehearsals / 4 nonfusions /4 delays			
	Post:	Quantitative -	21/25 correct			
		Qualitative -	18/25 correct			
			0 quiet rehearsals / 0 nonfusions /3 delays			
S/N	Pre:	Quiet	Noise	Difference Score		
	Right Ear	92%	48%	44%		
	Left Ear	76%	40%	36%		
	Post:	Quiet	Noise	Difference Score		
	Right Ear	96%	48%	48%		
	Left Ear	92%	40%	52%		

SSW = Staggered Spondaic Word Test); PS = Phonemic Synthesis Test; S/N = Speech-in-Noise Test; RNC = right noncompeting errors; RC = right competing errors; LC = left competing errors = LNC = left non competing errors.

minimal quantitative errors on the SSW test, but there are significant qualitative errors (42 delays). Imagine having to stop the test tape that many times for Rob to be able to respond to the test stimuli. Teacher and parental reports indicated that (prior to therapy) Rob required time to "process" but would "mishear" the information even with extra time to respond.

QUESTIONS

- **Did Rob perform better on the tests due to a learning effect?** No. Nine weeks is enough time to warrant reliable post therapy testing controlling for maturation and learning effects. Note: Rob's qualitative scores improved on both the SSW and PS tests.

- **Would an individual realize that he/she delivered 42 delays on one test?** No. Rob's delays are classic in Decoding type of APD[4] and APD behaviours are preconscious.[8,9]

- **Why was the S/N measure for the left ear found to be worse in the post therapy difference score?** The auditory training targeted Rob's weak left ear word recognition score. While this area improved, the S/N score stayed the same as Rob did not receive speech-in-noise therapy.

- **Should the clinician administer CAP tests and stop the test tape for clients who need time to process?** Yes. If we do not control for delays then we will misdiagnose the type(s) of APD and have a frustrated client during the evaluation.

- **Do you administer the Phonemic Synthesis (PS) test to all clients referred for APD evaluation?** No. The PS test was administered due to Rob's history of reading and spelling struggles; and the weak RC and LNC scores on the SSW test.

- **Do you have further information of Rob's case?** Yes. Rob was retested a few years later and was found to have normal AP and at-grade-level in reading. He won a school contest for writing a children's story. His mother referred other family members for APD testing.

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The Power of Connecting with Others

By Gael Hannan
gdhannan@rogers.com

I enjoy reading professional hearing health care magazines even though I'm science-challenged and don't always get all the technical stuff. When giving my presentation, Sound Sense, the elementary hearing conservation program, if students ask me to explain "decibel" in more detail than as a measurement of sound, I refer them to their science teacher. Now, what I appreciate in the *Canadian Hearing Report* and other journals are the pieces that drill down the ways professionals can provide better service to their clients. Articles on better assessment methods, assistive technology, aural rehabilitation, and best office practices show that hearing health care professionals must offer more than hearing aids, to give their clients the best shot at living successfully with hearing loss. But there's a vital tool that is usually overlooked by the practitioner – directing clients to the power of peer support.

Hearing loss affects communication, which is the glue that connects us to each other. And when that glue becomes brittle or dries up, hearing aids alone cannot repair it. A person with hearing loss will be more successful using both tangible and intangible supports, combining technology emotional and mental acceptance of hearing loss. Who better to help your clients move beyond the stigma, than other people with the same issues? Both individuals and consumer-based organizations can powerfully engage your clients, offering a perspective and support that you cannot, unless you also have hearing loss and are open with your clients about its impact on your life.

When I look back at significant life events, some seem obvious – leaving home, getting my first hearing aid, first good job, meeting my husband, marrying my husband, the birth of a child. Yet some events only gain significance with hindsight, *"Wow THAT sure changed my life!"* One of those invisible forks in the road occurred when I attended my first gathering of hard of hearing people; I came home a changed person.

The term "reaching out to others" sounds like an emotional striving to connect. Yet my only intention in speaking at a Canadian Hard of Hearing Association (CHHA) meeting was to talk about *myself* and the book that I'd decided, in a eureka moment, to write about my life with hearing loss. Someone told me about Joan Miller at CHHA Hamilton, and she invited me to be that month's guest speaker. Even now, I blush to remember my nervy naivety.

Who was I to tell these people a thing or two about being hard of hearing? A 40-year-old, recently graduated from one BTE to two CIs, who knew nothing about hearing loss beyond my uninformed personal experience. Prior to that evening, besides my great-grandmother who had bellowed her way to the grand age of 99, I had never known anyone else with hearing loss.

It was like entering *2001: A Space Odyssey*. People were walking around with big honkin' hearing aids, hand-held transmitters, and FM systems and they were happy! Somebody was fussing with equipment to make the meeting accessible: a room loop, large speakers, two screens, two projectors and, for my very first time, the miracle of real-time captioning.

As I addressed the group of 80 people with my personal story, I sneaked sideways looks at my own words on the screen, keeping up with me as I spoke. (Not an easy feat; I'm a fast talker and I've felled more than one captioner since then.) It was almost an out-of-body experience. Even more disconcerting were the many audience members who were also looking at the screen, rather than me. They gave new meaning to the term "shifty-eyed" as they kept up constant eye movement between the screen and my face and back again. Watching *them* watching *me* made me dizzy!

Many in the audience wore headphones – this was over 15 years ago – attached to their FM receivers. It was like the United Nations with all participants receiving simultaneous translation in their own language, which wasn't far from the reality. Apart from a couple of

senior ladies who promptly fell asleep in the front row, everyone was intently following what was being said, using individual combinations of residual hearing, headphones, FM, caption-reading and speechreading. This access was barrier-breaking and liberating.

It hit me like a rock. I was looking out at 80 people who were just like me – these were my people! We understood each other's issues. Even though I hadn't intended to *reach out*, I felt connected to them and the feeling was powerful. By talking with other people who had hearing loss, I was learning and sharing and all those other nice kindergarten words. I found a new *perspective*. Hearing loss had affected every area of my life, but it wasn't just *my* issue; it was a way of life that I shared with other people. I came home pumped and bubbling, changed but not yet aware of it.

A few months later, I went to my first CHHA National conference. I was pregnant and worried about how I was going to cope as a hard of hearing mom. How would I hear my baby crying in the night? If I didn't hear him burp, would he blow up? I needed answers.

Three knowledge-packed days gave me those answers, new friends, and a revelation. Subconsciously, I had always felt somewhat shamed by my hearing loss, even though I had been raised in an affirmative environment. My family and friends had a better perspective about my hearing loss than I did, because deep down I felt a bit defective and hindered by my hearing loss. And now, by inadvertently reaching out to other people, that shame was permanently replaced by a new and positive perspective.

This time I came home a changed woman and knew it. I looked at my husband almost pityingly because he was *hearing*, the poor man. But he came in handy. A few months later I discovered how to answer the night cries of my hungry baby. My poor, hearing husband jabbed me awake until I stumbled out of bed while he returned to the joy of sleep.

While other consumers cannot replace the services and expertise that my audiologist provides, I know that my success with hearing loss is drawn from the combined resources of other consumers, hearing health care professionals *and* myself. But it took me a long time to learn that and I would like to see that process shortened for other hard of hearing people going forward. Send us your people!

I encourage all hearing health care professionals to tell their clients about organizations like CHHA. Offer them a one year, $25 membership. Whether they attend face-to-face meetings, connect through online forums, or simply read consumer websites, the peer support will add a new dimension to your clients' lives, and to their satisfaction with your service.

Canadian Hearing Report 2012;7(2):20–21.

The Role of Auditory Discrimination Testing and Measures of Neural Integrity in the Assessment of Auditory Processing Abilities in Children

By Prudence Allen, PhD and Chris Allan, MSc
pallen@uwo.ca; callan@nca.uwo.ca

About the Authors

Prudence Allen is director of the National Centre for Audiology at the University of Western Ontario and director of the Child Hearing Research Laboratory at the Centre. She is an associate professor of communication sciences and disorders in the Faculty of Health Sciences. Her research uses behavioural and objective measures to study the perception of complex sounds by typically developing children and those with auditory processing disorders.

Chris Allan is a research audiologist presently working in the Child Hearing Research Laboratory at UWO.

Children who experience academic failure in the early elementary years and/or demonstrate difficulty in listening and in attending to the teacher in a typical classroom setting are frequently referred for an assessment of auditory processing (AP) abilities. Our professional associations (e.g. ASHA; AAA)[1,2] recommend a test battery assessment to examine several different auditory processes. The specific tests are left to the discretion of the audiologist, but areas to be assessed are recommended: auditory discrimination abilities (e.g., difference limens for acoustic features or discrimination between phonemes); temporal processes (e.g., gap detection thresholds, temporal sequencing and pattern perception, forward and backward masking); the perception of competing speech sounds (dichotic listening), the perception of speech that is degraded (e.g., by noise, filtering, changes in level or time altering); tests of binaural interaction including both binaural fusion and separation; electroacoustic measures (otoacoustic emissions, acoustic reflexes) and auditory electrophysiologic measures (evoked potentials).[1] It is also recommended that test interpretation should include comparing test results with established normative data, evaluating inter-test

patterns, relating test performance to reported areas of difficulty and examining obtained test results across disciplines.

A recent survey of audiologists practicing in the area of auditory processing disorders (APD) showed that audiologists generally follow a test battery approach.[3] However, the types of tests chosen were biased towards dichotic tests, monaural low redundancy speech tests, and temporal processing (e.g., pattern recognition and gap detection). Few clinicians reported using tests of auditory discrimination, those designed to evaluate the ability to detect and to discriminate sounds, or electrophysiologic measures that assess the neural integrity of the auditory system underlying those abilities. Accurately encoded auditory signals are essential for a child who is learning new sounds, associating sounds with symbols, and listening in situations where the signal itself may be degraded. Failure to evaluate these aspects of a child's auditory system could compromise our ability to detect AP difficulties.

AP EVALUATION AT THE CHILD HEARING RESEARCH LABORATORY

At the National Centre for Audiology we have found frequent deficiencies in both discrimination abilities and neural integrity in addition to problems on standard clinical tests in AP areas.[4,5] While many children are identified with an APD based upon behavioural test results, some are not. Our work shows that discrimination and neural integrity data provides additional information about encoding abilities that tests typical of most AP test batteries may not.

This report examines three case studies where standard behavioural testing failed to identify the auditory problems of children referred. In all three cases the discrimination tests, supported by electrophysiologic data, revealed subtle but important auditory encoding deficits. Each child received a comprehensive assessment: pure tone thresholds, tympanometry and word discrimination in quiet, and a thorough case history and listening surveys: Fisher's Auditory Problems Checklist[6] and Children's Auditory Performance Scale.[7] The AP tests included the Staggered Spondaic Word (SSW) test,[8] the Colorado State Battery Words in Ipsilateral Competition (WIC) test,[9] the Willeford Battery Filtered Words (FS) test,[10] the Pitch Pattern Sequence (PPS) test,[11] and the Auditory Fusion Test–Revised (AFT-R).[12] A diagnosis of APD was positive if a child scored more than two standard deviations beyond expectations on at least two tests, or more than three standard deviations on any one test.[2]

Children also completed standardized tests of intelligence, academic achievement, vocabulary, language, phonology, memory, and attention. Objective evaluation included acoustic reflex thresholds (ipsi- and contra-lateral stimulation at three frequencies), the auditory brainstem response (ABR) in response to an 80 dB nHL click stimulus presented at two rates, and the examination of middle and late latency responses to a suprathreshold click. All test results were compared to published normative data.

Discrimination tests were administered as part of an experimental battery. Testing included the evaluation of **masking level differences** conducted using a clinical audiometer and several discrimination tasks administered through a custom built system. These tests were administered in an adaptive, three alternative forced choice paradigm with animation sequences to guide the children through the trial blocks. Each child completed at least two blocks of trials in each condition. Skills evaluated included estimation of **discrimination of frequency and intensity** changes in a 1000 Hz signal presented at a suprathreshold level; **temporal integration at threshold** which included the estimation of detection thresholds for signals from 16 to 256 ms duration; **gap detection thresholds** measured in a narrow band noise centered at 1000 Hz; and **frequency resolution** measured via the comparison of masked detection thresholds for a 1000 Hz tonal signal embedded in a flat- or notched-spectrum masker. Because there are no clinical normative data for these measures performance was compared to previously published data for typically developing children.

CASE 1

An 8-year-old male was referred for AP assessment due to academic failure and difficulty in learning to read. Verbal intelligence, attention and memory standard scores were age appropriate, all falling within 1 standard deviation of age expectations. Vocabulary skill was high, phonological abilities were at or above expectations and receptive language skills were within the normal range. Expressive language was low normal. The Fisher's and CHAPS rating scores suggested further investigation of auditory abilities. Peripheral hearing assessment was within normal limits. Test performances on four of the AP tests (SSW, FS, PPS, and WIC) were normal. Only the AFT-R, evaluating the detection of temporal gaps, fell outside the normal range but not by greater than three standard deviations. The child was not identified as having AP difficulties.

Further, auditory discrimination testing

showed that frequency resolution, frequency discrimination and intensity discrimination thresholds fell within the expected range. However, tests of temporal processing, including gap detection and temporal integration were elevated. The gap detection thresholds were consistent with those reported on the AFT-R. These results suggested difficulty detecting brief acoustic events. Electrophysiologic results were consistent with discrimination data, indicating a possible neural transmission problem for brief acoustic events. The ABR test showed normal absolute wave latencies and morphology, but interwave intervals were prolonged by more than two standard deviations in one ear suggesting reduced efficiency of neural transmission through the brainstem. MLR and LLR responses fell within the normal range.

In summary, it was only when the assessment battery included signal encoding and electrophysiologic tests that the presence of a subtle auditory processing disorder affecting the perception of brief acoustic events could be identified.

CASE 2

A 10-year-old male was referred for AP assessment due to academic struggles and difficulty listening in classrooms and noisy environments. Intelligence, vocabulary, language, attention, and memory abilities were age appropriate. Phonological abilities were considered borderline normal. Phonologic awareness was normal, but phonologic memory skill fell more than one standard deviation below expectations. The Fisher's and CHAPS ratings suggested significant concerns about auditory skills and listening abilities, indicating the need for further evaluation of AP abilities. Peripheral hearing thresholds were within the normal range. Four of the five clinical AP tests (SSW, FS, PPS, and WIC) were age appropriate. The AFT-R suggested some difficulty with the detection of brief temporal gaps; however, a diagnosis of APD was not made based on these results.

Discrimination scores revealed several areas of weakness. The detection of small differences in frequency or intensity was poorer than expected and frequency resolution was reduced. Temporal skills including gap detection thresholds and temporal integration were also poorer than expected. Masking level differences, assessing the binaural system, were normal. Overall these results suggested poor acoustic feature resolution and discrimination skills. Electrophysiologic results showed ABR absolute wave latencies within normal limits, but interwave intervals were prolonged by more than one standard deviation. Waveform morphology was very poor with V/I amplitude ratios that were well below 1.0. With an increase in stimulus presentation rate the latency of wave V shifted significantly. MLR wave morphology was poor, only Po was visible, but Pa and Na components were not. The N1 and P2 components of the LLR response could not be identified.

In summary, multiple areas of auditory discrimination showed weaknesses that were supported by observation of abnormalities in neural integrity that extended throughout the auditory system. These findings were not revealed with standard AP test results.

CASE 3

An 8-year-old female was referred for AP assessment as she was struggling in learning to read and spell and had poor listening skills. Verbal intelligence was slightly low, but performance IQ was age appropriate. Vocabulary, language, memory, and attention were at or above age expectations. Phonological memory fell more than one standard deviation below the expectations but phonologic awareness was normal. The Fisher's and CHAPS ratings indicated the need for further investigation of AP abilities. Peripheral hearing tests were within normal limits. All five behavioural AP tests (SSW, FS, PPS, WIC, and AFT-R) were normal and she was not diagnosed with APD.

Auditory discrimination testing revealed several areas of weakness. Frequency discrimination thresholds were elevated and frequency resolution was poor. Intensity discrimination and gap detection thresholds were only slightly elevated. Masking level differences and temporal integration thresholds were age appropriate. Overall, the results suggested poor frequency discrimination and resolution. ABR results showed normal absolute and interwave latencies at a slow presentation rate. When the stimulus rate was increased waveform morphology became significantly degraded. At a faster stimulus presentation rate only wave V could be identified and its latency shift was greater than expected. MLR wave morphology was very poor with only the Po component identifiable. LLR responses were within the normal range.

In summary, the commonly used AP measures did not reveal APD; however, the acoustic discrimination and resolution tasks, and electrophysiologic assessment showed significantly reduced discrimination and frequency resolution with some lesser difficulty in other areas. These discrimination deficits could affect the clarity of complex sounds as they are transmitted through the auditory system.

CONCLUSION

These case studies involve children whose behaviours were consistent with an APD, but when tested with an AP

behavioural test battery used by most clinicians[3] the children were not identified as having APD. APD evaluation reports for them would indicate that no auditory difficulties were evident in spite of significant auditory discrimination and neural deficits found with additional tests. In all cases, difficulties in discrimination of basic acoustic features were shown to be poor and supported by measures of neural integrity that often revealed poor waveform morphology, reduced amplitude ratios, delayed transmission times, and absent waves arising from the brainstem and thalamic structures. Only when feature encoding was evaluated and examined in conjunction with objective electro-physiologic measures did AP difficulties emerge.

Measures of auditory discrimination and neural integrity may provide a more complete picture of not only a child's ability to detect, but to clearly perceive complex sounds. Because discrimination testing is currently only possible in the research laboratory, efforts are being made to collect more data on how auditory skills develop and identify how to separate clinically significant deficits from maturational effects. We are also working on developing a portable system that will allow for advanced discrimination testing in using acoustically well-defined signals and rigorous psychometric procedures.[13] Measures of neural integrity are currently available and given its importance, we encourage their use in the clinical assessment of children referred for APD.

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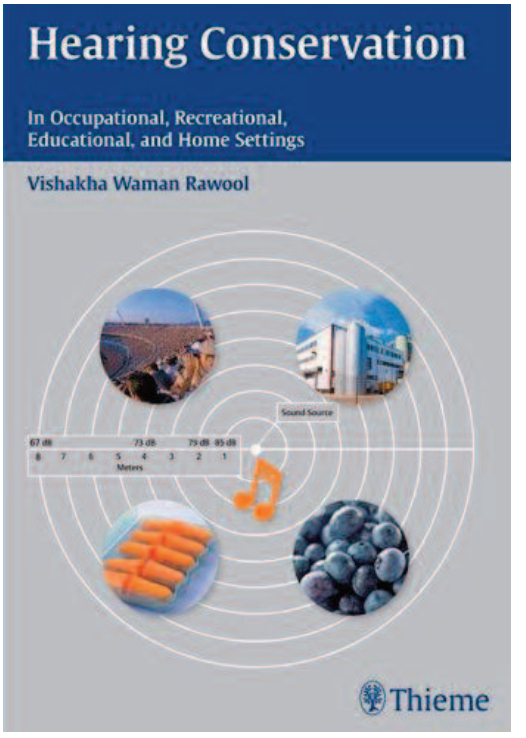
Canadian Hearing Report 2012;7(2):22–25.

Hearing Conservation: In Occupational, Recreational, Educational and Home Settings

by Vishkha Rawool Thieme Medical Publishers, Inc., 2012. 328 pages. SBN 978-1-60406-256-4 (pbk.). C$D 97.50.



Reviewed by Alberto Behar, PEng

Another book on hearing conservation (HC)? Don't we have enough of them? What else is new that hasn't been already published?

The first issue that caught my attention was the title of the first chapter: Introduction to Ototoxins and Hearing Conservation. That was something different. Not that ototoxins and interaction of chemicals and hearing loss is something new, but in most HC texts this subject is not at all dealt with.

Another "new" was Chapter 9: Conservation and Management of Hearing Loss in Musicians. In most books concerns regarding musicians are blended with recreational activities, but not treated as separate issues. So, it was a pleasant surprise that someone is considering that there is something different when dealing with musicians and hearing loss.

The book is divided into 14 chapters. Each of them ends up with a series of review questions and with an extensive list of references, including books and up-to date, peer reviewed articles. All subjects are covered with a series of well presented illustrations including photographs. Tables are clear and easy to understand.

The first chapter introduces the issue of hearing loss as a result of exposure to noise and to ototoxic chemicals. The second chapter introduces the physical concept of noise and noise exposure. It deals among others with standards (mainly from the USA) and regulations and with the instruments and techniques for the measurement of noise.

The third chapter deals with noise control. It contains information regarding standards and recommendations. It analyses in depth the benefits of noise controls. The book explains and illustrates the basic steps for engineering the noise as well as provides basics of vibration control.

Chapter 4 examines different issues related to hearing test (audiometry), from instrumentation to results of the tests and their interpretation. The chapter also explains the legal requirements for recordkeeping and reporting of threshold shifts, although these regulations will vary from jurisdiction to jurisdiction. Chapter 5, "Comprehensive Audiological, Tinnitus and Auditory Processing Evaluations" introduces the reader to higher level examinations, typically reserved for the professional otorhynolaryngologist.

The following three chapters deal with the core issues in hearing conservation: hearing protectors and training and evaluation of the effectiveness of the HC programs. Almost a quarter of the book deals with those important issues, that will be, most probably, the portion of the book that will be most often consulted by the HC practitioner.

The last chapter deal with H.C. of non-occupational noise, as well as with problems related to educational settings.

In summary, this is a book that will be of great service to practitioners involved in developing, implementing and maintaining hearing conservation programs.

Canadian Hearing Report 2012;7(2):26.

Let's Talk Properly

Alberto Behar, PEng, CIH
behar@sympatico.ca

What does "talking properly" mean? The question seems so simple, that one doesn't know what to answer. Is it to talk without profanity? Or to use the proper syntax for the verbs we use. Or to use the proper terms for whatever we are talking about?

There are many meanings to it. However, here we will focus on only the last question – the one on proper terms. And we will address only two words and one expression.

SOUND LEVEL OR SOUND INTENSITY.

Let's start with the words. There is a joke common among acousticians: how you recognize someone trained in health related studies: The answer is: he uses the term "intensity" whenever he means "level." Why is that? Just because intensity is something used more often and also, has more general applications.

We speak of the intensity of our feelings in the same way as we will talk about a intense feeling in a play or movie. Level, on the other hand is a term reserved mainly for heights: so many meters above the ground, or, third level instead of third floor.

However, in sound there are exact definitions for both terms. The ANSI Standard S1.1-1960 OR1971 defines the sound pressure level of a sound as 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure.
Mathematically it is:

$$SL = 20Lg(P/P0)$$

The sound intensity, on the other hand, defined in the same standard, is in a specified direction at a point, the average rate of sound energy transmitted in the specified direction, through a unit area normal to this direction, at the point considered.

Sound pressure level is expressed in dB.

Sound intensity is expressed in W/m2

So, while sound pressure level is a scalar (no direction involved), intensity is a vector, something that depends of the direction the sound energy is travelling.

To make things even more complex, there is also sound intensity level, measured in dB, but then we are becoming much more technical, something reserved for acousticians.

So, what do we really need to know? In summary, forget about the sound intensity and stick to sound level.

DECIBEL LEVEL

This is another no-no! Would you use the expression "meter length"? Or "litre volume"? Then why use "decibel level" that is definitely wrong. Better say a level of XYZ decibels!

IN SUMMARY

Let's talk properly and use the exact terms for what we want to convey.

Canadian Hearing Report 2012;7(2):27.

Acoustic Shock Disorder

By Sean Lennox, MSc
sglennox@gmail.com

About the Author

Sean Lennox, MSc is an audiologist in private practice in Ottawa.

Acoustic shock disorder (ASD) is a little known syndrome that can follow abrupt loud noise exposure. I didn't learn about this syndrome until I met patient A.W. last year and I was left searching for answers as she suffered from the effects of loud noise exposure. Please be advised that this is not a typical hyperacusis or tinnitus case and the interested audiologist should search the current literature themselves prior to suspecting ASD as a final diagnosis (Table 1).

CASE HISTORY

Patient A.W. is a 40-year-old female call centre employee who works for a major cell phone company. Her initial consultation occurred November 12, 2010. She reported a sudden significant hearing loss on her right side that was accompanied by a plugged sensation, hyperacusis, and distressing humming tinnitus. A.W. also experienced bouts of vertigo that lasted for about an hour and she had been experiencing them about once a day. She reported that the onset of her symptoms coincided with a brief loud squawking sound that was emitted from her headset during a call to a client September 12, 2010. The loud sound lasted around 3 seconds as she tried to frantically remove the headset. Peak output of the telephone headset was measured using a sound level meter with a fast response at 128 dBA. A.W. immediately experienced a plugged sensation on her right side followed by the humming tinnitus that lasted the rest of the day. She reports that the hearing loss didn't occur until the following morning and the first episode of vertigo was experienced that evening. Since impact noise exposure incident intermittent stabbing otalgia, increased anxiety when in even low levels of ambient noise, were reported.

EVALUATION

At the initial visit A.W was found to have a moderate low frequency rising to normal at 2000 Hz sensorineural hearing loss on the right side. Right ear middle ear immittence and acoustic reflexes were normal and the word recognition score was degraded to 70%. Additional electrophysiological tests of brainstem and auditory nerve function were found to be normal bilaterally. Her loudness discomfort levels were between 65 and 80 dB HL overall which is considerably lower than expected. A physiologic test of outer hair cell function (otoacoustic emission test) was inconclusive because of ambient noise. A tinnitus evaluation was done 2 weeks later on November 28, 2010 and she matched the tinnitus to 500 Hz pure tone at 3 dB SL. MML level using broad band noise was 45 dB HL. Residual inhibition was negative. Given these results there was little confidence in attributing her hearing loss and accompanying symptoms to a transient loud noise exposure, and endolymphatic hydrops, and specifically Meniere's disease needed to be ruled out.

Monitoring over the next 2 months to check for symptom stability was recommended as it was only 2 months since the acoustic trauma occurred. In

TABLE 1 OVERVIEW OF ACOUSTIC SHOCK DISORDER

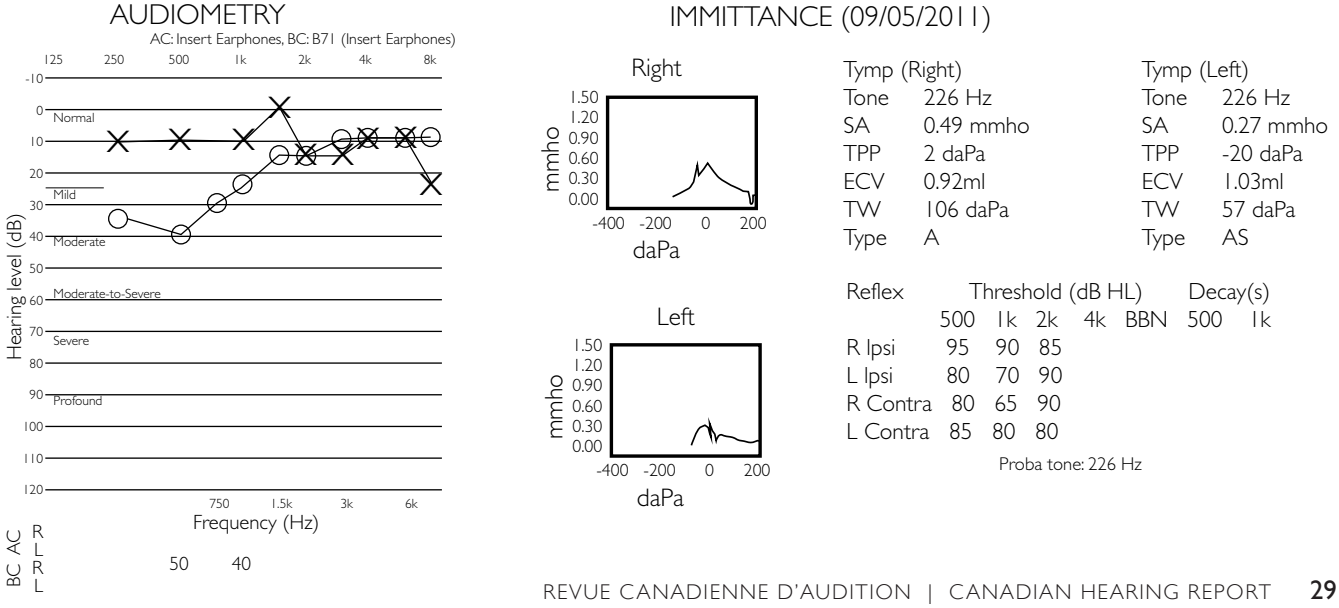
Cause	ASD typically coincides with sudden, unexpected, and intense sound.
Symptoms	Post Traumatic Sound Exposure: • Hyperacusis as wells complete phonophobia • Pain of ear and face ipsilateral to loud sound exposure • Anxiety and depression following exposure • Constant roaring or humming tinnitus ipsilateral to loud sound exposure • Constant ear fullness and plugged sensation • Intermittent unsteadiness and vertigo • Sensorineural hearing loss of any configuration, resolution of symptoms over time
Assessment and Diagnosis	• Case history of sudden loud noise exposure (Hx of sudden loud noise exposure) • Tinnitus and hyperacusis evaluation (lower LDLs and low frequency tinnitus) • Retro cochlear and endocochlear assessment: Auditory brainstem response and electrocochleography testing (Expect normal results) • Balance assessment: VNG and posturography (Expect normal results) • Must rule out episodic nature of which would be consistent with endolymphatic hydrous and Meniere's (Expect normal) • Neurologic assessment: MRI to rule out transient ischemic attack or stroke (Expect normal)
Treatment	• Hyperacusis counselling and sound enrichment at all times • Monitoring of symptoms every 2-3 months • Advising patient not to wear earplugs unless they are in hazardous acoustic enviroments

the interim she had a videonystamography (VNG) assessment done which showed normal oculomotor and vestibular function bilaterally. A consult with an otolaryngologist was scheduled and he ruled out Meniere's based on the information provided to him and patient history. He agreed that the audiologic profile did not match the typical noise induced hearing loss audiometric configuration. An audiogram done January 12, 2011 showed a stable low frequency SNHL on the right side and she was still reporting a fullness on the right side, bothersome unilateral tinnitus, otalgia, hyperacusis, phobia of loud sounds, and vertiginous episodes every week or so (Figure 1).

INTERPRETATION

Confirming the stability of the aural symptoms encouraged me to consult the current literature on the likelihood that a transient noise exposure could have contributed to the hearing loss and cluster of symptoms she was experiencing. A thorough literature search indicated a syndrome called acoustic shock disorder / syndrome (ASD). ASD is a cluster of symptoms

Figure 1. Patient A.W's audiogram.



including: "…otalgia, altered hearing, aural fullness, imbalance, tinnitus, dislike or even fear of loud noises, and anxiety and/or depression"1 following an acoustic trauma from a transient loud sound. The otalgia, dizziness, plugged sensation, hyperacusis, general anxiety/depression and phobia to sound in the affected ear was highlighted in many studies[1–3] although hearing loss for ASD is not as predictable and tends to fully recover.[3,4] Most of these symptoms have been attributed to the prolonged dysynchrony of the tensor tympani and stapedius muscle reflexes[2,3] which are associated with the physiologic startle reflex.[1]

At her 1-year post-noise exposure visit her hearing on her right ear returned to normal. However, she still experiences the symptoms of hyperacusis, tinnitus, and aural pressure, however, at a diminished level. A.W. was still suffering from a general phobia of loud sounds and reported she could not return to work especially in a noisy work environment.

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Canadian Hearing Report 2012;7(2):28–30.

Vestibular Evoked Myogenic Potentials: The Current State of Affairs

By Gary Jacobson, PhD, FASHA and Erin Piker AuD
gary.jacobson@Vanderbilt.Edu

About the Authors

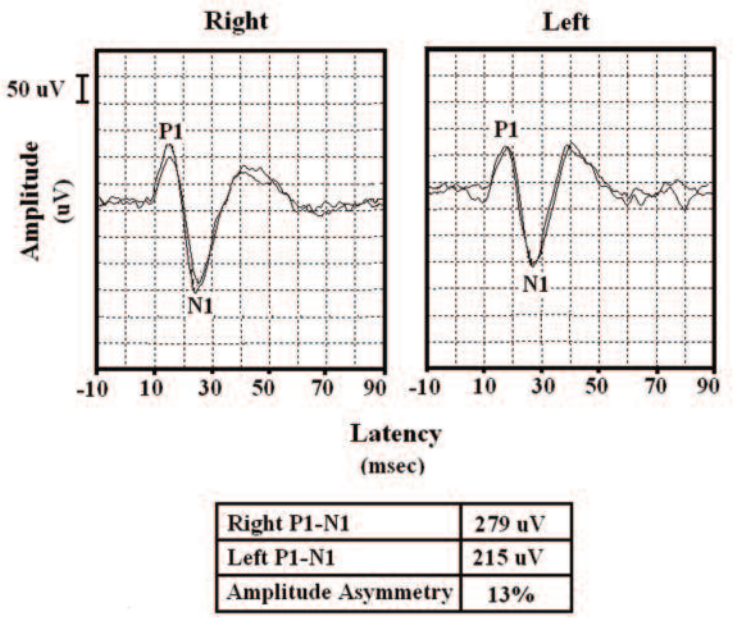
Gary P. Jacobson, PhD, FASHA is a professor in the Department of Hearing and Speech Sciences, Vanderbilt University and director, Division of Audiology at the Vanderbilt Bill Wilkerson Center for Otolaryngology and Communication Sciences.

Erin G. Piker, AuD, completed her doctor of audiology (AuD) at Vanderbilt University in 2008 and has worked as a clinical audiologist in the Balance Disorders Laboratory since 2008. In addition to her work in the clinic, Dr. Piker is a research assistant in the electrophysiology research lab. Dr. Piker is working on completing her PhD through the Department of Hearing and Speech Sciences at Vanderbilt University with an emphasis on the vestibular system. Her dissertation is entitled "The effects of age on the frequency tuning of the cervical and ocular VEMP."

In the late 1960s and early 1970s evoked potentials were in their infancy. Much of the interest was directed toward what we refer to now as "late responses." These are the evoked responses that occur from approximately 50 ms to +250 ms. Investigators attempted to use these responses to estimate auditory thresholds. However these late responses were profoundly affected by subject state (e.g., attention) and soon the interest in these responses waned. In the same period of time interest peaked in both auditory *neurogenic* middle latency responses and auditory myogenic, or, *"sonomotor"* middle latency responses. The AMLRs represented an admixture of both cortical and subcortical auditory pathway sources. They were smaller in amplitude than the long latency components but were slightly less affected by the state of the subject. The sonomotor responses were sound evoked muscle reflexes that would appear as reproducible positive-negative or negative-positive waveforms if a signal averaging computer was triggered at sound onset. The responses had a peak latency in the 10–15 ms post-stimulus onset and were quite large (i.e., by a factor of 10×–100×) when compared to neurogenic responses like the middle latency auditory evoked response. The sonomotor responses were evoked by auditory transients and could be recorded from the inion, post-auricular area, and, masseter muscle. In that era the auditory AMLR was referred to as a "fast" evoked response since the auditory brainstem response (ABR) had not yet been discovered by Jewett and Williston.[1] Soon, the ABR would be discovered and the result would be a deluge of papers that would continue until, at least, the early 1990s when neuroimaging techniques improved to the point where they "trumped" functional electrophysiological measures. Later, there would occur an interest in neurodiagnostic applications of middle latency auditory evoked potentials as well as the discovery of otoacoustic emissions during the 1980s and 1990s.

It was not until the late 1990s that there

Figure 1. Model wearing electrodes to record the cervical vestibular evoked myogenic potential (cVEMP. The electrode montage is middle of the sternocleidomastoid muscle (SCM, active) referenced to either an electrode placed on the dorsum of the hand, or the chin (reference). The ground electrode is placed at Fpz.



Right P1-N1	279 uV
Left P1-N1	215 uV
Amplitude Asymmetry	13%

Figure 2. Illustration of a normal cervical vestibular evoked myogenic potential (cVEMP). Notice that the response is biphasic consisting of an initial positivity (P1 or P13) followed by a negativity (N1 or N23).

occurred a Renaissance of interest in sonomotor responses. Specifically it was the investigators Colebatch and Halmagyi[2] who published the first reports of a new sonomotor response that they referred to as the vestibular evoked myogenic potential, or, simply VEMP. This response, which we now call the cervical VEMP, or "cVEMP," is recorded from the sternocleidomastoid muscle (SCM; see Figure 1) in response to high intensity acoustical transients (i.e., best using tone bursts at 500–750 Hz). The response represented a sound-evoked attenuation of the activated SCM and was represented by a positive wave (P1) followed by a negative wave (N1; see Figure 2). A series of investigations showed this response to be present in deaf individuals who had intact vestibular systems, and absent in individuals who had inferior vestibular neuritis, or vestibular neurectomies. The results of a number of investigations have proven that the cVEMP originates from the saccule of the vestibular end organ. The electrical activity from the saccule is routed through the inferior vestibular nerve to the vestibular nuclei. From the vestibular nuclei the electrical activity descends through the vestibulospinal pathway to the motor nucleus of CN11 (i.e., the spinal accessory nerve) and from there to CN11 to the SCM. Abnormalities in the amplitude of the cVEMP usually imply that either or both the saccule and/or inferior vestibular nerve are impaired. Abnormalities on the latency of the cVEMP suggest an impairment in conduction through the nerve, or descending vestibulospinal pathways.

More recently, in the mid 2000s, there was reported a VEMP very different from the cVEMP. Like the cVEMP the new VEMP was recorded in response to high intensity acoustical transients. However, unlike the cVEMP, the response was best recorded with a non-inverting electrode placed below the margin of the lower eye lid of the contralateral eye (the ear stimulated) when the patient is looking up (Figure 3). Instead of representing a stimulus-evoked *attenuation* of EMG activity, this response represented the stimulus evoked *onset* of EMG activity (i.e., like a stapedial reflex). This response is called the ocular VEMP, or oVEMP.

The oVEMP is a negative-positive biphasic response and is recordable both contralaterally and ipsilaterally. That is, monaural stimulation yields bilateral oVEMPs in some normal subjects,

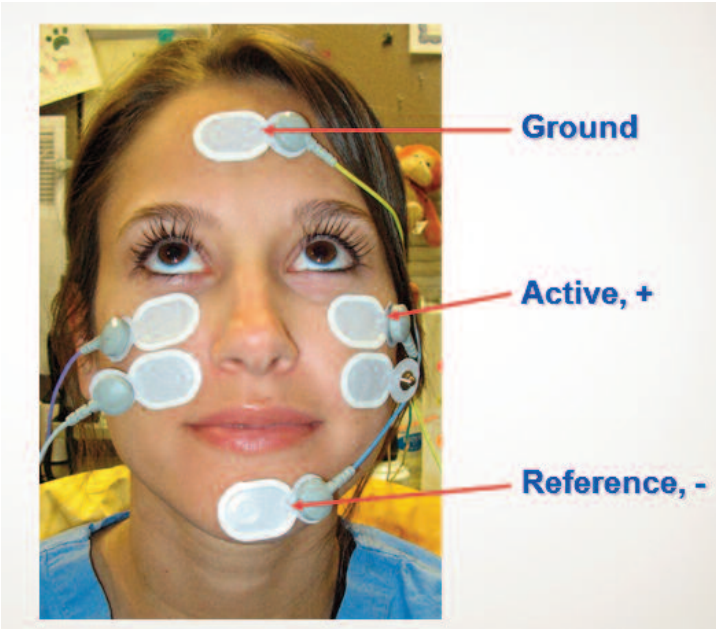


Figure 3. Model wearing electrodes for the recording of both the ipsilateral and contralateral oVEMP. There are two possible electrode montages: (1) infraorbital electrode (active) referenced to a second infraorbital electrode placed ~2–3 cm inferior to the first infraorbital electrode (reference), and, (2) infraorbital electrode (active) referenced to a common reference at the chin (reference electrode).

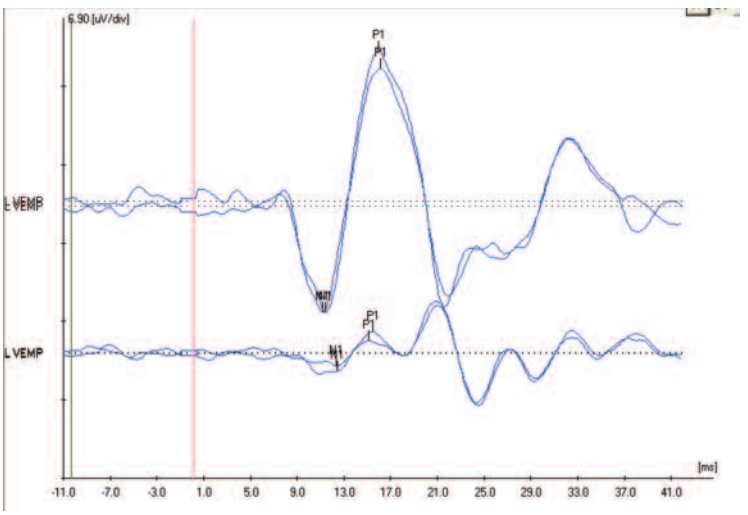


Figure 4. Illustration of an oVEMP recorded following stimulation of the left ear. The top tracing is the contralateral recording (i.e., stimulus left, record from right infraorbital location). The bottom tracing is the ipsilateral recording (i.e., stimulus left, record from the left infraorbital location). Notice that the amplitude of the contralateral recording is significantly larger and occurs earlier than the ipsilateral recording.

although the majority of the response is mediated by an ascending crossed pathway which is the vestibulocular reflex (VOR). As such, the oVEMP response is largest when recorded from electrodes located inferior to each eye, contralateral (i.e., to the ear that is stimulated) with gaze directed upward. Upward gaze places the contralateral inferior oblique muscle proximal to the infraorbital recording electrode.

The same stimulus used to evoke the cVEMP is used to evoke the oVEMP (i.e., air conduction [AC] tone bursts, AC clicks, and bone conduction [BC] tone bursts). Although there has been some disagreement in the literature about what constitutes the best tone burst frequency for recording the cVEMP versus the oVEMP our experience suggests that "the best frequencies" for AC stimulation are the same. Interestingly, mechanical head taps and BC tone bursts also can be used to evoke (cVEMPs and) oVEMPs in cases of conductive hearing loss. However these stimuli are often not readily available in the clinic. High frequency AC stimulation (5 kHz tone burst) has been shown to result in either no response or an oVEMP that is markedly reduced in amplitude. Additionally, oVEMPs evoked with AC clicks are reportedly absent in 50% of normal subjects, whereas 90% of healthy subjects reportedly generate oVEMPs in response to low-mid frequency (i.e., 500–1000 Hz) air conduction tone bursts at a high stimulus intensity (i.e., 95 dB nHL).[3] The oVEMP in response to a 500 Hz AC tone burst consists of a negative wave occurring ~10–12 ms (N10) that is followed by a positive wave ~15–17 ms (P15; Figure 4). oVEMP mean peak-to-peak amplitude is substantially smaller than the cVEMP and tends to ranges from ~2–10 μV. The upper limit of oVEMP interaural amplitude asymmetry is reportedly 35% for 500 Hz AC tone bursts.[3,4]

The big difference in the cVEMP and oVEMP are their peripheral generators and central pathways. It is now widely accepted that the oVEMP originates from the utricle. The output of the utricle flows through the superior vestibular nerve to the vestibular nuclei. From the vestibular nuclei the activity is routed through the VOR. The VOR routes the electrical activity to the extraocular muscles.

Recently, a series of reports have been published suggesting that the combination of the results of the caloric test, cVEMP and oVEMP might provide complementary

information and permit topological localization of peripheral vestibular system lesions.[5] That is, we begin with the understanding that the caloric response occurs only if the horizontal semicircular canal and superior vestibular nerve are intact. A normal cVEMP tells us that the ipsilateral saccule and inferior vestibular nerves are intact. Lastly, a normal oVEMP suggests that the contralateral utricle and contralateral superior vestibular nerve are intact. Stated slightly differently, an impairment affecting the left horizontal semicircular canal in isolation would be expected to yield a left unilateral weakness; however, the cVEMP and oVEMP tests would be normal. An impairment affecting the superior vestibular nerve (e.g., superior vestibular neuritis) would produce abnormal caloric and oVEMP tests (i.e., since both the horizontal semicircular canal and utricle route their signals through the superior vestibular nerve) but produce a normal cVEMP test. Likewise, a lesion isolated to the saccule, or, inferior vestibular nerve (e.g., inferior vestibular neuritis) would produce normal caloric and oVEMP test results and an abnormal cVEMP test. Abnormal latencies for either the cVEMP or oVEMP responses would suggest the presence of a central vestibular system impairment.

The prospect of topological localization of peripheral vestibular system impairment using functional quantitative assessments has become even more exciting with the introduction of high resolution video recording techniques. This technology enables clinicians to record eye movements that occur in response to short duration, high acceleration, movements of the head. This assessment is referred to as the video head impulse test.[6] The introduction of this technology has made it possible to record eye movements that occur following activation of the anterior and posterior semicircular canals. Thus, it is reasonable to expect, in the next few years, that audiologists will have the technology necessary to stimulate, record, and measure responses from each of the anterior, posterior and horizontal semicircular canals and the utricle and saccule. The major question that will remain is: "Now that we are able to selectively assess the function of the each vestibular end organ and nerve, what can be done to eliminate the disorder or disease and/or rehabilitate the patient?"

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Canadian Hearing Report 2012;7(2):31–34.

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