Hyperacusis Research

A nonprofit dedicated to stopping noise-induced pain

Donor Newsletter Volume 1, Winter 2015-16

Welcome to Our New Newsletter!

Our aim is to communicate news and updates to you, our generous contributors, so you can see firsthand the progress that is being made with your donations.

Please let us know if there are topics you would like to hear about in future issues by sending an email to Bryan Pollard, President of Hyperacusis Research, at bryan@hyperacusisresearch.org.

Two New Grants Funded

Hyperacusis Research is excited to fund two Emerging Research Grants for the Hearing Health Foundation's 2015 grant cycle. The first grant covers the important topic of pain mechanisms associated with hyperacusis**,** while the second grant investigates mechanisms associated with moderate noise-induced damage and its effects on the auditory system.

Grant 1: ***the relationship between pain-associated proteins in the auditory pathway and hyperacusis***

Kelly Radziwon, Ph.D.

Center for Hearing and Deafness, State University of New York at Buffalo

Hyperacusis is a condition in which sounds of moderate intensity are perceived as intolerably loud or even painful. Despite an apparent link between pain, inflammation, and hyperacusis in humans, little research has been conducted directly comparing the presence of inflammation along the auditory pathway and the occurrence of hyperacusis. One factor limiting this research has been the lack of a reliable animal behavioral model of hyperacusis. Using reaction time measurements as a marker for loudness perception, Dr. Radziwon has successfully assessed rodents for drug-induced hyperacusis and, more recently, noise-induced hyperacusis. The rodents will be trained to detect noise bursts of varying intensity. As in humans, the rodents will respond faster with increasing sound intensity. Following drug administration or noise exposure, rodents will be deemed to have hyperacusis if they have faster-than-normal reaction times to moderate and high-level sounds. Therefore, the goal of the research is to correlate the presence of pain-related molecules along the auditory pathway with reliable behavioral measures of drug and noise-induced hyperacusis.

Long-term goal: Since the development of a reaction time paradigm that can reliably separate animals with hyperacusis from animals with loudness recruitment and normal loudness perception, Kelly's team can now identify the biological correlates of this hearing disorder. Given that ear pain often co-occurs with hyperacusis, the most relevant biological markers of hyperacusis might be the expression of pain-related molecules found in the auditory system. Therefore, a long-term goal of this project is to determine the relationship between pain-related molecules, inflammation along the auditory pathway, and the perceptual experience of hyperacusis. The work will start by focusing on three molecules - SP, NK1, and TRPV1 - but will adjust the biochemical analysis depending upon the results of this project.

Grant 2: ***neural mechanisms of hyperacusis in the inferior colliculus and cortex of animals with noise-induced auditory neurodegeneration***

Brad Buran, Ph.D.

Oregon Hearing Research Center, Oregon Health & Science University

The development of effective treatments for hyperacusis and tinnitus is limited by existing animal models. Current animal models are generated by high-intensity noise exposure or by the administration of salicylate, the active ingredient in aspirin. In addition to producing symptoms of hyperacusis and tinnitus, both of these manipulations lead to elevated hearing thresholds by damaging inner ear sensory cells. This damage leads to altered auditory processing, which makes it difficult to identify the specific changes that produce hyperacusis and tinnitus. While hearing loss is the primary risk factor for these disorders, they cannot be explained by damage to sensory cells alone. In fact, hyperacusis, tinnitus, and difficulty understanding speech in a noisy setting have been reported even in individuals with normal auditory thresholds. Therefore, the ideal animal model should not have sensory cell damage.

Recent evidence from studies in rodents suggests that moderate noise exposure can cause damage to the auditory nerve without altering hearing thresholds. Rodents with this type of auditory nerve damage show symptoms of hyperacusis. Humans who report tinnitus, but have normal auditory thresholds, exhibit signs of similar damage. It has also been hypothesized that auditory nerve damage leads to increased difficulty understanding speech amid background noise. Thus, moderate noise exposure provides a potential animal model for patients who have normal hearing thresholds yet still experience hyperacusis, tinnitus, or difficulty hearing in noise. We will assess the perceptual effects of this auditory nerve damage by training noise-exposed animals to perform behavioral tests designed to parallel tests of hyperacusis, tinnitus, and difficulty hearing in noise that are conventionally used in human listeners. We will also assess how auditory responses in the central auditory system are altered by this type of auditory deficit in order to determine whether the changes in neural responses may explain the perceptual effects of hyperacusis, tinnitus, and difficulty hearing in noise.

Long-term goal: to understand how hearing loss alters central auditory system function, and how this abnormal function can be ameliorated to improve auditory outcomes.

Boston Dinner A Great Success!

Our Boston-area fundraising dinner was a great success! We exceeded our goal of raising $20,000 for research, with more funds still coming in. After welcoming the 80 attendees, the sponsors, Michael and Betsy Maholchic, shared a video made by their son, who suffers from severe noise-induced hyperacusis caused by loud music and a job at a noisy restaurant.

Dr. Charles Liberman, otology professor at Harvard Medical School, gave a brief overview of the auditory system and how sound waves are turned into neural signals by sensory fibers in the inner ear. He explained how loud sounds can damage these sensory fibers. Dr. Liberman also described the cochlear pain fibers that hyperacusis likely activates, and reviewed the lab research that sheds light on what is going wrong with these fibers.

Bryan Pollard described how sometimes there's a dramatic event or turning point that changes a person's life. For many who have hyperacusis with pain, that defining event is the moment hyperacusis began. It starts a chapter in a person's life that is difficult to get beyond due to the disabling effects of noise-induced pain. That's why support and funding are critical — so we can work toward a cure that will allow people to progress to the next chapter in their lives.

Every table at the dinner included a bowl of foam earplugs. Bryan demonstrated the correct way to insert them and reviewed the kinds of noise situations during which one should use them. He also pointed out the drawbacks of earplugs — including the difficulty of communicating and of understanding speech while wearing them.

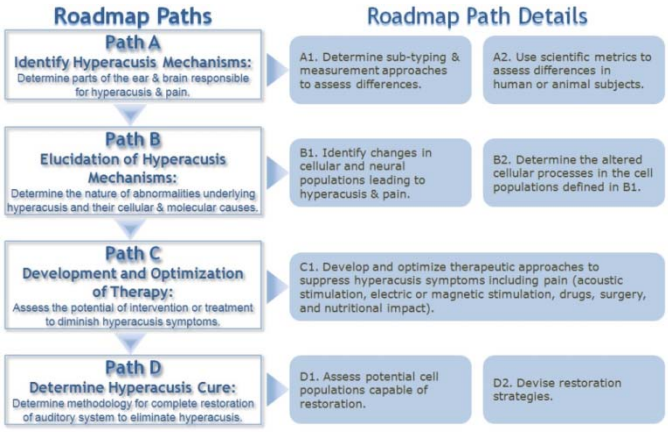
2015 ARO Mid-Winter Meeting

Hyperacusis Research was excited to participate in the Association for Research in Otolaryngology's Midwinter Meeting for the third consecutive year. The conference, held in Baltimore, MD in February 2015, brought together over 1,000 of the world's top otolaryngology researchers. Bryan Pollard met with many researchers and other partners, and hosted our "Roadmap to a Cure" event.

At the event, several families with loved ones afflicted by hyperacusis shared their stories. They were also able to spend time communicating the difficulties of hyperacusis directly to researchers. Just after an unusually heavy snowstorm, Steven Barad, MD, and his wife Beverly, along with Michael and Betsy Maholchic, met with our Scientific Advisor, Dr. Rich Salvi, Clinical Professor of Otolaryngology, SUNY Buffalo, and James Kaltenbach, Staff and Director of Otology Research, Cleveland Clinic. The families explained the painful realities of hyperacusis. The discussion also included ways to augment our research efforts. Dr. Salvi highlighted the need for NIH grants and other large sources of funding such as the Department of Defense, and the potential impact of congressional legislation.

Dr. Paul Fuchs, Bordley Professor and Director of Research of Otolaryngology, Johns Hopkins University School of Medicine, explained how his work had focused on understanding the function of the Type II nerve fibers for the auditory system. He explained how Type II fibers have similarities to pain fibers and are excited by the release of ATP (which can be released in very loud noise exposures that induce tissue damage in the cochlea). This work builds the basis for the idea that Type II fibers are pain fibers and are likely responsible for the pain anyone can experience from very loud sounds. Research is needed to determine whether these pain fibers are being activated in those with hyperacusis at much lower sound levels than normal. Dr. Fuchs was intrigued to discover that his work has significant implications for hyperacusis, a condition he had not previously considered relevant to his work. Our discussion with him, and the attention he has subsequently paid to hyperacusis, highlight an important dimension of Hyperacusis Research's mission.

Hyperacusis Roadmap to a Cure



2016 ARO Mid-Winter Meeting

Hyperacusis Research has organized a symposium entitled "Auditory Nociception and Pain Hyperacusis" at the upcoming 2016 ARO meeting. We look forward to sharing updates with you in our next newsletter.

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Hyperacusis Research
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Hyperacusis Research is a 501(c)(3) non-profit organization devoted to finding a cure for hyperacusis through accelerating research by connecting patients to researchers. Contributions are fully tax-deductible as allowed by law and are gratefully welcomed by credit card online at www.hyperacusisresearch.org or by check to our mailing address printed above.

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