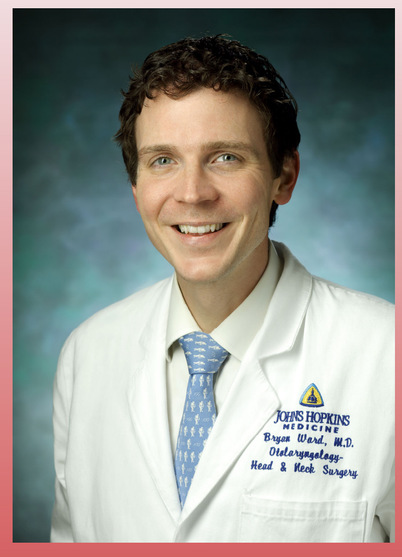
The American Otological Society



CLINICIAN SCIENTIST AWARD 2019-2021

"Magnetic Resonance Imaging to Observe Magnetic Vestibular Stimulation"

Bryan K. Ward, MD
Johns Hopkins University

AMOUNT AWARDED BY AOS: $120,000

ONGOING FUNDING: NIH, NIDCD, K23 DC018302, $200,000 per year - January 1, 2020 – December 30, 2025

PUBLICATIONS:

Sayyid ZN, Jung D, Chen JX, Paez AG, Hua J, Deng F, Carey JP, & Ward, B.K. (2024) Clinical Application of 7T MRI: A Case Study of Vestibular Schwannoma Imaging. *Otology & Neurotology*, (*In Press)*.

Pogson, J. M., Shemesh, A., Roberts, D. C., Zee, D. S., Otero-Milan, J., & Ward, B. K. (2023). Longer duration entry mitigates nystagmus and vertigo in 7-Tesla MRI. *Frontiers in Neurology*, *14*, 1255105.

Akbar, Armaan F., et al. "Acoustic Noise Levels in High-field Magnetic Resonance Imaging Scanners." *OTO open* 7.3 (2023): e79.

Nagururu, N. V., Akbar, A., & Ward, B. K. (2022). Using magnetic resonance imaging to improve diagnosis of peripheral vestibular disorders. *Journal of the Neurological Sciences*, *439*, 120300.

Song, C. I., Pogson, J. M., & Andresen, N. S. MRI With Gadolinium as a Measure of Blood-Labyrinth Barrier Integrity in Patients With Inner Ear Symptoms: A Scoping Review. Front Neurol 2021; 12: 662264.

RESEARCH SUMMARY: High magnetic field scanners like 7 Tesla MRI allow greater signal, potentially increasing image resolution and contrast, but are prone to imaging artifact and may have safety concerns including increased vertigo and greater exposure to acoustic noise. We currently cannot see the sensory structures of the inner ear *in vivo*. The aim of the project was to mitigate safety concerns of vertigo and acoustic noise, while increasing the signal-to-noise around the inner ear in 7 Tesla MRI.

OUTCOMES: Using vestibular physiology, we developed an easy to administer protocol to minimize vertigo in 7 Tesla MRI that is now undergoing a prospective clinical trial. We measured acoustic noise and found it to be within appropriate safety guidelines so long as hearing protection is used. We have developed techniques to minimize magnetic field inhomogeneity artifacts near the inner ear in 7 Tesla. This has allowed higher spatial resolution imaging of the inner ear *in vivo* compared to 3 Tesla MRI.

FURTHER FUNDING HAS ENABLED US TO EXPAND OUR RESEARCH TO:

1. Use human temporal bone histopathology to create an atlas of inner ear imaging
2. Study leakiness of the blood-labyrinth barrier in patients with Meneire's disease and in healthy controls.
3. Develop novel pulse sequences to target different components of the inner ear, including fluid flow and different anatomic regions.

LAY SUMMARY OF FINDINGS AND IMPLICATIONS OF THIS RESEARCH: This research has led us to understand the mechanisms behind vertigo and loud acoustic noise in stronger MRI machines. We have developed ways to use this technology safely and have begun improving the quality of images of people with inner ear disorders. These new, better images are starting to see structures that have never before been visible in living humans and will lead to new understandings of the causes of dizziness and hearing loss .