Modeling the Effects of Hearing Aids on the Aged Brain

Primary Investigator: Jeremy Turner, Ph.D.
Funding Agency: SIU Central Research Committee and National Institutes on Aging (as of July 1)

While nearly 30 million Americans could benefit from using a hearing aid, only about six million actually take advantage of this technology. Many who are fitted with hearing aids stop wearing them because they don't immediately restore normal hearing. Rather than helping them extract the sound signal from the noisy environment, many complain that the aid seems to amplify everything, creating an environment described as too noisy and unbearable.

However, if a patient continues to wear the aid for about a month, the brain seems to adapt to the new input and gets progressively better over the next few months at extracting the signal from the noise, a process called acclimatization. How this acclimatization process works in the brain is poorly understood. In previous studies, Dr. Turner and colleagues began developing a mouse model to study these processes by exposing mice with partial hearing loss to an augmented acoustic environment (AAE), similar to that provided by a hearing aid. At least in the young mouse, considerable reorganization of auditory regions in the brainstem was evident just 10 days after AAE exposure began.

In a new series of experiments, Dr. Turner and colleagues will study whether similar changes occur in the brains of aged mice, as the elderly population is most likely to be fitted with hearing aids. Changes in hearing behavior, auditory brainstem responses, GABA inhibitory neurotransmitter changes and neuronal firing characteristics of auditory cortex neurons are being explored in aged mice after several months of AAE exposure. The hope is that the plastic changes in the brain responsible for acclimatization can be better understood so that we might eventually be able to maximize the effectiveness of hearing aid therapy in the elderly. At the very least, the data might provide educational information that can be given to those receiving hearing aids to demonstrate the need for compliance.

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Investigations into the higher-ordered structure of chromatin

Primary Investigator: Blaine Bartholomew, Ph.D.
Funding Agency: SIU Central Research Committee

This project proposes to develop ways to look at the structure of how DNA is organized inside the cell into the highly compact structure called chromatin. Investigators have previously described the structure of the basic unit of chromatin called nucleosomes. Nucleosomes contain four small, highly basic proteins called histones and wrap DNA around the outside of the protein to form almost two wraps of DNA.

It has proven difficult to get much information about the larger scale structure of chromatin because of its size and complexity. General features can be observed using techniques such as electron microscopy and other biophysical techniques that help measure size and hydrodynamic properties. This research investigates an approach to determine specific structural details of higher ordered chromatin using a technique called protein footprinting. The approach identifies which surfaces of the histone proteins become buried within chromatin when the individual nucleosomes are assembled into arrays. Different structures can be formed by changing how far apart the nucleosomes are on the DNA, the modification of the histone proteins, and the additions of proteins known to promote higher order chromatin that is more compact and structured. These studies will help us better understand how the DNA is organized in the cell and how this organization may be regulated in the cell by chemical modification of certain proteins and the association of other auxiliary proteins.

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Early hormonal signaling and longevity: Role of long-term alterations in glucose homeostasis

Primary Investigator: Andrzej Bartke, Ph.D.
Funding Agency: The Ellison Medical Foundation Senior Scholar Award in Aging

This project is studying the genetic control of aging and longevity. In the mouse, mutation of a single gene can prevent various symptoms of aging, increase stress resistance, reduce risk of cancer, and prolong life by approximately 50 percent. This and other life-extending mutations in the mouse suppress release or actions of several hormones, including growth hormone (GH). Because of correlations of small body size with prolonged longevity in mice and in other species, we suspect that deficiency of growth-promoting hormones early in life is particularly important in determining the onset of aging and life expectancy. To determine whether deficiency of GH and thyroid hormones during the period of rapid postnatal growth is in fact important in the control of aging, this study will treat long-lived mutant mice with growth promoting hormones starting before weaning, at two weeks of age and continuing for six weeks and will evaluate the effects of these treatments on longevity.

Understanding the role of growth, body size, and insulin in the control of aging is important for dealing with public health issues related to the current "epidemics" of childhood obesity, insulin resistance, and diabetes.

For more information about these projects, contact the Office of Research and Faculty Affairs at 217-545-7936.