

Detecting hearing loss, vertigo via blood tests

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Physician-scientist Dr. Kouros Parham has filed for a patents on a blood test that can provide early diagnosis of hearing loss. In this photo, he uses an otomicroscope to examine the ear of a patient. Credit: Frank Barton/UConn Health Photo

There are more than 30 blood tests in clinical practice today to confirm disease. For heart attacks, cardiologists test the blood for cardiac

enzymes; for osteoporosis, proteins in the blood can signal thinning bones.

But what if a simple blood test was also available to detect common disorders such as hearing loss or [vertigo](#)?

On the hunt for promising biomarkers for these diseases is UConn Health physician-scientist, Dr. Kourosh Parham, associate professor and director of research in the Division of Otolaryngology, Head and Neck Surgery.

Parham has discovered that two recently identified unique inner ear proteins can be detected in minute quantities in the blood, and that their levels correlate with inner ear disorders. This means that these proteins could serve as blood biomarkers, which may help improve the early detection and diagnosis of hearing loss or vertigo.

As a result, he has developed and patented the first-ever blood tests for these conditions and is currently testing their promise at UConn Health.

Hunting for Hearing Loss

Parham started with already identified unique inner ear proteins. He identified a promising candidate for a blood biomarker in a protein of the inner ear called prestin. In his studies, he has demonstrated that changes in prestin level in the blood are linked to hearing loss, at a time before this loss can be measured by hearing tests.

Acquired hearing loss is a widespread condition. Nearly 50 million Americans live with some type of hearing loss or tinnitus (ringing in the ears) that can affect their daily communication and quality of life but also has been shown to put them at higher risk of experiencing poorer health outcomes and twice as likely to develop dementia.

Hearing loss can be inherited but is most often acquired through acoustic trauma, prolonged exposure to loud noise, or toxicity from medications such as chemotherapy, which lead to damage of the intricate cellular components of the inner ear.

Currently, hearing loss can only be diagnosed through hearing tests such as audiograms. There is no way to detect hearing loss at its earliest stages, which leaves patients vulnerable and their doctors frustrated at the limited prevention and intervention options available by the time of diagnosis.

In the inner ear there is a small, snail-shaped structure called the cochlea that helps the body process sound. The cochlea has a series of small fluid-filled canals which contain [outer hair cells](#) that manage the cochlea's ability to tune sound and increase its sensitivity to sound. Outer hair cells are known to show the first damage from excessive noise or toxicity injury.

Parham's new blood test traces the specific protein prestin that is released by outer hair cells when injured. Prestin is located within the inner cellular membranes of outer hair cells. The simple blood test detects inner ear damage, and also helps quantify the extent of the hearing loss through measurement of the protein's level in the blood.

Parham's studies have already proven successful in the laboratory, and he is planning to conduct human clinical trials soon.

"Detecting early warning signs of hearing loss is critical to ease the burden and disability from this condition and to better manage the future overall health of the vulnerable," stresses Parham.

Speeding a Vertigo Diagnosis

Before uncovering a biomarker for hearing loss, Parham's research first led him to discover a unique blood biomarker for benign paroxysmal positional vertigo (BPPV), a common condition – particularly in older adults – that can cause severe dizziness due to inner ear abnormalities.

While it can strike at any age, BPPV is by far the most common cause of vertigo in the elderly. It is challenging to diagnose, however, and this typically results in delayed diagnosis and costly, unnecessary imaging tests.

Vertigo symptoms can include sudden onset of extreme dizziness that may become nauseating, cause loss of balance, and lead to falls and bone fractures. It can have a debilitating impact on a person's daily function and quality of life, with vertigo episodes lasting from two weeks to as much as six months.

Loose ear crystals are the culprit behind this kind of vertigo, which is triggered by a change in head position. The inner ear has crystals, known as otoconia, that act as gravity detectors to help the human body balance. Normally they don't move. However, as we age they can become loose, with a simple turn of the head motion or even simply laying down allowing them to enter the inner ear's sensitive canals. The body's response to this abnormality leads to the onset of vertigo symptoms.

The inner ear secretes a number of unique proteins including Otolin-1. This protein is only expressed in the inner ear, and is one of the building blocks of inner ear crystals. The crystals are made mostly of calcium carbonate.

In findings reported in *Otolaryngology-Head and Neck Surgery* in 2014, Parham reported that these crystals eventually dissolve and their derivatives are released into the body's blood stream, where they can be detected. His study showed the presence of Otolin-1 in the blood of all

study subjects, but much higher levels in the blood of those with BPPV.

Parham hopes that his research into these biomarkers and the blood tests he has developed will establish new clinical norms for detecting early hearing loss, vertigo and other inner ear disorders. "Early identification of at-risk people will allow for intervention before disabling [hearing loss](#) or tinnitus develops," he says, "and hopefully reduce other health complications and financial burdens linked to these [inner ear](#) conditions."

He has filed a patent for the biomarker [blood](#) tests he developed in his lab at UConn Health. "Our rationale was if a simple [blood test](#) can help hunt down this one biomarker for vertigo, then it could most likely also help track down a few others," says Parham.

According to Parham, improved tools to diagnose BPPV in a timely fashion can be followed with maneuvers to guide loose crystals back into place and relieve the dizziness. There are currently no medications to treat vertigo, only medications that can suppress the symptoms.

More information: Kourosch Parham et al. A Geriatric Perspective on Benign Paroxysmal Positional Vertigo, *Journal of the American Geriatrics Society* (2016). [DOI: 10.1111/jgs.13926](https://doi.org/10.1111/jgs.13926)

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