



Effects of Administration of Physiologic Doses of Aldosterone on Hearing Loss in Study Volunteers at Tahoma Clinic

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Abstract

This study was undertaken to assess the effects of the administration of physiologic doses of aldosterone on hearing loss in human volunteers at Tahoma Clinic in Renton, Washington.

We hypothesized that, based on previous studies, administration of physiologic doses of aldosterone would result in sustained improvement in hearing in patients with demonstrated hearing loss due to presbycusis or sudden sensorineural hearing loss without adverse effect.

For the study, 34 study participants with previously identified hearing loss, as demonstrated on audiology testing, were recruited and assessed, through 24-hour urinary aldosterone testing, and interviewed to determine eligibility for the study based on inclusion and exclusion criteria. If all criteria were met, then each participant was given a prescription for 125 mcg of aldosterone to be taken twice daily for three months. Each participant was also instructed to take 300 mg of potassium in divided doses during the day to offset any possible dizziness that might occur with taking aldosterone. At the end of three months, participants were asked to provide follow up audiology testing and 24-hour urinary aldosterone testing.

At the end of the study, 13 out of the 34 study participants had achieved some level of hearing improvement that was sustained on 125 mcg of aldosterone taken twice daily.

Introduction

Hearing loss is a growing health concern, affecting nearly 1 in 10 Americans and 1 in 3 over the age of 65. As the population ages, the numbers affected by hearing loss will continue to increase, profoundly influencing our society and the quality of life of those affected.¹

The consequences of hearing loss go far beyond the obvious.² When hearing progressively declines, patients often lose their ability to recognize and interpret speech, their awareness of things outside of the visual field, and their ability to appreciate meaningful sounds, such as music, nature, and the voices of friends and family members. Cognitive awareness, perception, wellbeing, self-esteem, and function may be altered. Frequently, people with hearing loss are isolated and withdrawn and this causes additional psychological stress. Studies have linked the effects of hearing loss with anxiety, depression, sadness and the choices individuals make

about retirement.³ Problems occur even in those in whom hearing may be partially restored with hearing aids.⁴

Hearing may decline slowly and imperceptibly over time, a process more typical of age-related hearing loss, or occur suddenly, rapidly affecting one or both ears. While there are many hypotheses about the precise causes of hearing loss, the ability to study it is limited by a lack of adequate assessment tools and the inability to biopsy the ear. Clinical management of hearing loss has not progressed as a result because reliable diagnostic tests do not exist.⁵ This, in turn, limits the ability to find appropriate and effective therapies or to design preventive strategies for patients at risk.

Conventional medical management of hearing loss is very limited in its approach. Medical solutions commonly involve the prescription of hearing aids for age-related sensorineural hearing loss or the administration of corticosteroids and other immunosuppressive drugs for sudden hearing loss. Sadly, according to many patients, one of the most common “places” for hearing aids to be found is “still in the dresser drawer,” since they so often cause more problems than they fix in many patients. Although glucocorticoids are used with the assumption that they suppress a hyperactive systemic autoimmune response and reduce inflammation, there is very little evidence supporting inflammatory processes as a primary cause of hearing loss. There are many side effects from the administration of corticosteroids and immunosuppressive drugs without any lasting improvement in hearing being measured.

There may, in fact, be a simple and effective way to improve quality of life and alleviate hearing loss in some patients using the hormone, aldosterone, which has been demonstrated in a number of animal and human studies.^{6, 7, 8, 9, 10} Tahoma Clinic physicians have successfully treated many patients for hearing loss using physiologic doses of aldosterone.

Study Objective

The objective of this study was to assess the relationship between aldosterone and hearing loss involving study participants with established hearing loss using physiologic doses of aldosterone.

Studies have found a direct link between serum levels of aldosterone and age-related hearing loss, or presbycusis. When aldosterone was administered to study participants, hearing was improved with higher levels of aldosterone.⁶ Other studies have shown that aldosterone is as effective as the glucocorticoid, prednisolone, in preserving sudden sensorineural hearing loss without the adverse side effects reported from their administration.^{7, 8, 9, 10}

Adrenal Cortex

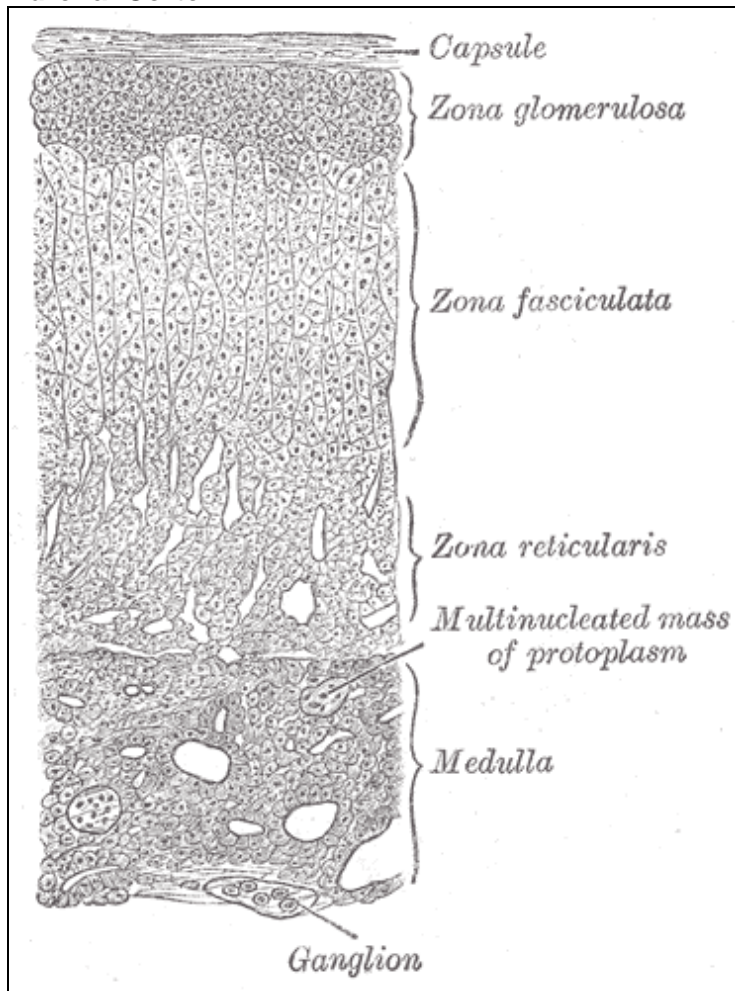


Image adapted from Gray's Anatomy plate (public domain)

The zona glomerulosa of the adrenal cortex secretes the hormone, aldosterone, which is known to control serum sodium (Na^+) and potassium (K^+) levels. Mineralocorticoids like aldosterone increase sodium transport by upregulating sodium channels, leading in turn to an increase in cellular Na^+ , K^+ -adenosine triphosphatase.¹¹

Aldosterone is a safe, natural substance produced by the body that has been demonstrated in studies to have a direct correlation with age-related hearing loss. Whether low aldosterone causes hearing loss or it is a matter of malfunctioning potassium channels requiring help from aldosterone and potassium, aldosterone is a potential solution for age-related hearing loss that could provide relief for many people.¹²

Research Design and Methodology

This study sample consisted of recruitment of 34 between the ages of 41 and 84 for a trial period of 3 months. Participants were recruited through referrals from other Tahoma Clinic doctors, from the existing patient base of Tahoma Clinic, and through community outreach to audiologists and natural health markets.

To be considered for the study, participants needed to:

1. Demonstrate hearing loss on audiology tests.
2. Have a low aldosterone reading confirmed with 24-hour urine hormone testing, confirming low aldosterone and low adrenal function.
3. Commit to a minimum of three months of treatment with physiologic doses of aldosterone, all appointments with physicians, and pre- and post-treatment testing.
4. Consume a normal salt diet and not have any condition requiring sodium restriction.
5. Participate in the study by committing to 10% of the total cost of their care plan and treatment, not to exceed \$300.

Study participants were excluded if:

1. They did not demonstrate hearing loss on audiology testing or there is a physical cause that has been attributed to their hearing loss.
2. They had a history of other co-morbid conditions, such as hypertension, kidney or liver disease, or diabetes, as identified through a detailed health history, or have a history of congestive heart failure or other health conditions that might be adversely affected by the administration of aldosterone.
3. They had a history of considerable and prolonged noise exposure, infection, or drug ototoxicity that could have caused their hearing loss.
4. They had any condition requiring sodium restriction.

Methods

Study participants were asked to submit audiology testing, 24-hour urinary aldosterone values, and a detailed health history and intake form.

If criteria were met, then the study participant was invited to a first office visit with the investigating doctor(s).

During the interview, information was reviewed and if hearing loss and low aldosterone levels were demonstrated, the study volunteer was given a prescription for 125 mcg of aldosterone, available through Women's International Pharmacy (later Restore Health) in Madison Wisconsin, to be taken twice a day for a minimum of 3 months.

Participants were also instructed to supplement their aldosterone treatment with an over-the-counter source of potassium, such as 99-mg potassium tablets or "Also Salt" or "No salt" products to a range of about 300 mg daily in divided doses with food.

After 3 months, volunteers were asked to do follow-up audiology and 24-hour urinary aldosterone testing.

Follow-up test results were reviewed during a return office call, either in-person or by phone.

Treatment was customized for each volunteer as needed.

Data Collection

A.Data analysis:

Careful records were maintained for each study participant, including volunteer case histories, pre-and post-treatment office visits, audiology testing, and laboratory tests results. Aldosterone test results were recorded prior to taking aldosterone and after taking it for 3 months.

B.Testing procedures:

Aldosterone is a mineralocorticoid secreted by the zona glomerulosa of the adrenal cortex and controlled by many factors, with ACTH and the renin-angiotensin system among the most significant. Aldosterone secretion is affected by acute and chronic stress, growth hormone and plasma concentrations of sodium and potassium.

1.Aldosterone measurements through the 24-hour urinary hormone profile

Aldosterone may be assessed as part of a 24-hour urinary aldosterone profile. Approximately 400 µg of aldosterone is secreted daily by the adrenal glands. Because many things affect aldosterone values, including patient gender, age, medications, severe illness, oral contraceptives and method of testing, standard reference ranges are generally not available. The reference ranges reported for the 24-hour urinary aldosterone profile takes into account the effects of salt consumption on aldosterone as follows:

Salt Intake	Aldosterone Reference Ranges in 24-hour Urine
Normal salt diet	6.0-25.0
Low salt diet	17.0-44.0
High salt diet	0.0-6.0

Aldosterone values obtained with 24-hour urine testing in patients with presbycusis (age-related hearing loss) and sudden sensorineural hearing loss (SNHL) usually fall within the reference range reported for a high salt to normal salt diet and are frequently barely detectible. For the study, no participant was accepted if their 24-hour urinary aldosterone result was above 10.

After treatment with physiologic doses of aldosterone, subsequent 24-hour urine profiles show aldosterone values increasing to the normal to low salt diet ranges, though no results were ever above the range for a low-salt diet.

2.Audiology testing:

The ability to hear is assessed by determining the ear's response to loudness and intensity, measured on a logarithmic scale and recorded as decibels (dB). Sound intensity increases 10-fold for every 10 dB increase and loudness doubles. For example, a sound at 30 dB, like a very quiet whisper, is 1000 times the intensity of the faintest sound that the human ear can hear at 0 dB and 8 times as loud.

For this study, comprehensive audiology testing was conducted by independent audiologists and involve 3 specific tests to determine the volunteer's response to various frequencies and intensities.

a.Pure-tone audiometry

With pure-tone audiometry, patients are asked to respond to sounds ranging from 125 to 8000 hz played through headphones or in a soundproof booth. Results are reported on a graph indicating the quietest tones detected in each ear over a range of frequencies and intensities. Detection of tones between 10-15 dB is considered normal hearing. Tones detected between 16-25 dB indicate mild hearing loss; tones detected consistently between 31-51 dB or more are considered to be moderate hearing loss; and anything above 91 dB is profound hearing loss. Some research has shown a gender and age-dependent bias to loss of hearing at different frequencies.¹³

b.Speech discrimination

Speech discrimination testing is done during audiometry to assess the patient's speech reception threshold and ability to recognize words. This is commonly assessed at 500, 1000, and 2000 dB and results are plotted on a graph for comparison between the right and left ears.

c.Tympanometry

Tympanometry testing may be done to determine how well sound is transmitted from the outer to the middle ear and identifies conductive hearing loss.

C.Benefits/Risks to study volunteers

Aldosterone is a natural steroid hormone that regulates sodium and potassium in the body and, when used at physiologic doses – or doses normally found in the body - does not pose any harm to study volunteers.

Volunteers were prescribed 125 mcg of aldosterone twice a day during this study, which is considered to be a physiologic dose and not associated with any risk.

Low aldosterone levels have commonly been associated with adrenal insufficiency, or Addison's disease; high levels of serum or urinary aldosterone have been attributed to primary or secondary hyperaldosteronism in association with low plasma renin. High levels of aldosterone, which are much higher than physiologic doses, are associated with health risk, including congestive heart failure, endothelial dysfunction, myocardial fibrosis, and increased myocardial stiffness from increased collagen synthesis.^{14, 15, 16}

In the study, the biggest side effect was related to dizziness due to the potassium-depleting effects of aldosterone and remedied when participants took 300 mg of potassium daily. High blood pressure was a potential side effect, but at physiologic doses, was rarely encountered.

D.Informed consent/confidentiality

Informed consent was obtained from each study participant and confidentiality was maintained for each participant.

Results:

The Aldosterone Research Study was designed to assess the relationship between aldosterone and hearing loss in volunteers with age-related hearing loss (presbycusis) or sensorineural hearing loss in those demonstrating a low aldosterone level at the beginning of the study.

Study participants were recruited based upon demonstrated hearing loss on audiology testing, favorable results on 24-hour urinary aldosterone assessment, and with no uncontrolled or co-morbid health conditions.

Of the 34 participants (11 men, 23 women) recruited for the study who qualified to receive aldosterone:

Those showing improvement.....	13
Complete improvement (close to 100%).....	1
Partial improvement (70%).....	1
Partial improvement (more than 30% and less than 70%).....	8
Slight improvement (5%).....	1
Partial improvement noted with increased dose of aldosterone.....	1
Partial improvement noted with decreased dose of aldosterone.....	1
Subjective improvement noted by participants late in study and referred to be part of follow up study.....	3
No subjective improvement noted but improvement noted on hearing test.....	2
No subjective improvement noted and none observed on hearing test.....	7
Participants who failed to complete study or did not submit final results.....	7
Two participants accepted into study who were later deemed ineligible.....	2

Of the participants who were included in the study, 28 had a diagnosis of age-related hearing loss, one had a diagnosis of Meniere’s disease and three had a diagnosis of sudden sensorineural hearing loss. Of those included in the study but later determined to be ineligible, one had a diagnosis of profound hearing loss and one had a diagnosis of partial hearing loss on one side.

On 24-hour urinary aldosterone testing results, all participants admitted to the study had beginning levels under 10. Of those completing the study, most showed an increase in the 24-hour urinary aldosterone measurements.

Discussion:

Of the 34 participants, 25 completed the study. Of the 34 admitted, 13 showed improvement ranging from slight to nearly 100%, approximately a 35% improvement rate. While it could be argued that the success rate is higher, failure to submit final information and keep follow up appointments was generally associated with the lack of improvement in hearing.

During the study, those who reported hearing improvement maintained that improvement for the duration of the study. Many participants continued to be in contact after the study and for those remaining in contact, hearing improvement was maintained so long as they continued to take aldosterone.

A particularly eloquent testimonial about the study experience was written by one participant, age 71, when he started the aldosterone study:

“In early 2009, as a healthy seventy-year-old man, I suddenly lost most of my hearing. I saw three Ear, Nose, and Throat doctors. One inserted tubes in both ears. That did not help.

One called me an “enigma.” He said the hearing in the left ear was so bad a hearing aid would not help, and a hearing aid in the right ear would provide marginal benefit for a limited amount of time.

The third doctor suggested I reduce my salt intake and switch from regular coffee to decaf.

I was desperate. Without hearing, my entire quality of life would change.

In 2010, research led us to the Tahoma Clinic and aldosterone. After a consultation with Dr. Russel and having a urine test, I started taking a 125-mcg aldosterone pill twice a day. Amazingly, after two weeks, I noticed an improvement in hearing.

Three months later my hearing had improved immensely. While it was not perfect, I could function in most aspects of my life. My limitations were few and trivial (e.g. watching a TV movie, road noises in a car, the pitch of some people’s voices, whispering).

In mid-2012, I changed from two pills per day to alternating from one pill one day and then two pills the next day. Some days I would forget the pills altogether (complacency). I noticed a decline in my hearing. After several months, I went back to two pills per day, and my hearing improved. While hearing can be somewhat subjective to the person hard of hearing, my family members witnessed the improvement.

In November 2012, I had my yearly phone conversation with Dr. Russel. Dr. Russel remembered an amazing fact. During my first consultation with Dr. Russel, my hearing was so bad that my wife had to carry on the phone conversation with Dr. Russel. I was unable to hear well enough to do that. During the latest consultation, my hearing was so good that I carried on the entire half hour consultation, not once asking Dr. Russel to repeat herself or guessing at what she said.

My hearing is not perfect and sometimes I have difficulty because of different factors. But from what it had been, it seems as if a miracle has been performed. If my hearing remained at this level for the rest of my life, I would be so very thankful.”

-Submitted by study participant, JH

Additional Observations

Aldosterone levels

Maintenance of improvement

Availability and cost of aldosterone

Side effects

Blood pressure

Dizziness

During this study, several observations have been made that suggest further study would be warranted.

1. Low adrenal function.

All participants began the study with low aldosterone numbers and many participants showed evidence of low adrenal function, suggesting a possible connection between hearing loss and adrenal insufficiency.

2. Length of study.

Several participants showed evidence of improvement late in the study and on hearing tests, despite no subjective report of improvement. This suggests that aldosterone may need to be used longer than 3 months to achieve results.

3. Dose of aldosterone to achieve results.

In two cases, volunteers achieved improvement in hearing loss after taking either more or less aldosterone than the study was designed to use. This raises the possibility of achieving improvement in hearing loss with different doses than those used during the study.

4. Other factors affecting aldosterone.

This factor could be described as the "Dr. Wright factor," since improvement in hearing loss has been observed in many of Dr. Wright's patients using aldosterone and who have also had improvement in other aspects of their health. Health issues that may affect hearing loss include hormone imbalance, systemic inflammation, insulin resistance and adrenal insufficiency. Perhaps aldosterone should be incorporated into a healthcare regimen after some of these other health issues have been addressed for early and lasting improvement of hearing loss.

5. Stigma of hearing loss and benefit to slowing the process of hearing loss.

During the interview and follow up process, it became clear that hearing loss has had a major effect on quality of life for many volunteers in this study. If aldosterone could be shown to slow the progression of hearing loss, it would provide a valuable treatment option for those affected, even if it did not dramatically reverse or improve hearing.

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