

## Antibiotics increase risk of hearing loss in patients with deadly bacterial infections

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An image of the (intact) organ of Corti, with three rows of outer hair cells, and one row of inner hair cells, separated by a row of pillar cells. Green is Alexa-488 phalloidin labeling of F-actin, and Blue is Hoescht labeling of nuclei. Credit: Steyger Lab, OHSU



Seeking to stem the tide of permanent hearing loss from the use of lifesaving antibiotics, researchers at Oregon Health & Science University have found that patients stricken with dangerous bacterial infections are at greater risk of hearing loss than previously recognized. Inflammation from the bacterial infections substantially increased susceptibility to hearing impairment by increasing the uptake of aminoglycoside antibiotics into the inner ear, the researchers report. Their findings are published in online in the journal *Science Translational Medicine*.

"Currently, it's accepted that the price that some patients have to pay for surviving a life-threatening <u>bacterial infection</u> is the loss of their ability to hear. We must swiftly bring to clinics everywhere effective alternatives for treating life-threatening infections that do not sacrifice patients' ability to hear," said Peter S. Steyger, Ph.D., professor of otolaryngology, head and neck surgery, Oregon Hearing Research Center, Oregon Health & Science University School of Medicine. "Most instances in which patients are treated with aminoglycosides involve infants with life-threatening infections. The costs of this incalculable loss are borne by patients and society. When infants lose their hearing, they begin a long and arduous process to learn to listen and speak. This can interfere with their educational trajectory and psychosocial development, all of which can have a dramatic impact on their future employability, income and quality of life."

Aminoglycosides, antimicrobials that are indispensable to treating lifethreatening bacterial infections, are toxic to the ear. Relied on by physicians to treat meningitis, bacteremia and respiratory infections in cystic fibrosis, aminoglycosides kill the sensory cells in the inner ear that detect sound and motion.

Infants in neonatal intensive care units, or NICUs, are at particular risk. Each year, approximately 80 percent of 600,000 admissions into NICUs in the United States receive aminoglycosides. The rate of hearing loss in



NICU graduates is 2 to 4 percent compared with 0.1 to 0.3 percent of full-term births from congenital causes of hearing loss.



Two lower power images of the cochlear coils, containing hair cells. Credit: Steyger lab, OHSU



When Steyger and colleagues gave healthy mice a low amount of aminoglycoside, the rodents experienced a small degree of hearing loss. If the mice had an inflammation that is typical of the infections treated with aminoglycosides in humans, the mice experienced a vastly greater degree of hearing loss.

The study lays the groundwork for improving the standard of care guidelines for patients receiving aminoglycosides. To shield patients' hearing, the researchers called for the development of more targeted aminoglycosides and urged clinicians to choose more targeted, non-ototoxic antibiotics or anti-infective drugs to treat <u>patients</u> stricken with severe infections.





Two lower power images of the cochlear coils, containing hair cells. Credit: Steyger lab, OHSU

Due to their widespread availability and low cost, aminoglycosides are used frequently worldwide. Clinical use of aminoglycosides is limited due to the known risk of acute kidney poisoning and permanent <u>hearing</u>



loss, yet are crucial life-savers in cases with potentially fatal infections.

**More information:** Endotoxemia-mediated inflammation potentiates aminoglycoside-induced ototoxicity, <u>stm.sciencemag.org/lookup/doi/...</u> <u>scitranslmed.aac5546</u>

## Provided by Oregon Health & Science University

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