Sea anemone proteins could repair damaged hearing

August 3 2016

Summer is always the best time of year to get a good blasting at a festival or mega-band concert, but how many of us give a thought to our delicate sense of hearing as our ears are assaulted? Birds are capable of replacing damaged hair cells in the inner ear after exposure to loud sound, but mammals are not, potentially leading to deafness.

However, Glen Watson from the University of Louisiana at Lafayette, USA, explains that one remarkably resilient animal has no problem rescuing damaged hair cells. Sea anemones, which detect passing prey with the vibration-sensitive hair cells covering their tentacles, have remarkable regenerative properties that allow them to rebuild the missing halves of their bodies when they tear themselves in two during reproduction. 'It occurred to me that if any animal could recover from damage to its hair bundles, anemones would be the ones', says Watson. Having discovered a cocktail of proteins in the mucus coating sea anemone bodies that allows them to repair injured hair cells in as little as 8 min, Watson and Pei-Ciao Tang decided to find out what effect the restorative proteins might have on damaged mouse cochlear cells.

The team publishes their discovery that the sea anemone proteins can repair damaged mouse cochlear hair cells in *Journal of Experimental Biology*.

Recalling that growing the delicate hair cells in the lab was very challenging, Watson explains how he and Tang eventually succeeded in dissecting the minute cochleae and attaching the cultured cells to coverslips thanks to advice from Karen Smith and other colleagues. Watson also describes how hair cells have a bundle of minute hair-like structures on the surface - stereocilia - that are tethered at the tips by protein strands in a V-shaped formation and he explains that it is the tethers that break when hair cells are damaged, causing the stereocilia to collapse. Knowing that calcium is an essential component of the tether structures, Watson and Tang transferred the hair cells to an environment lacking calcium for 15 min in an attempt to reproduce the destruction produced by sound in mammalian cochleae. Describing the effects, Watson says, 'The stereocilia splayed rather than occurring in well-organised bundles'. In addition, the hair cells were unable to take up a dye that undamaged hair cells absorb readily; they were severely damaged, in much the same way that the cells in our cochleae are damaged by loud sound.

Having confirmed that the low calcium environment was destructive, Watson and Tang collected the mucus from starlet sea anemones that had damaged tentacle hair cells, isolated the repair proteins and added the protein cocktail to the damaged mouse hair cells for 1h.

The hair cells recovered significantly - the stereocilia were no longer splayed and the cells improved sufficiently to absorb the dye; the sea anemone proteins had repaired the damaged mouse cells. Watson and Tang then searched the mouse genome for examples of the crucial repair proteins and found evidence that mice produce many proteins that are closely related to the sea anemone repair proteins, suggesting that it may be possible to mobilise the same repair mechanisms in mammals with damaged hearing. Watson hopes that this ground-breaking discovery will eventually lead to a treatment for patients with acute hearing loss. However, he acknowledges that this research is in its infancy and is keen to discover the mechanism that could eventually allow sea anemones to restore our hearing.

More information: Pei-Ciao Tang et al, Repair of traumatized mammalian hair cells via sea anemone repair proteins, *The Journal of Experimental Biology* (2016). DOI: 10.1242/jeb.135459

Provided by The Company of Biologists