Cochlear type II spiral ganglion afferent fibres are essential for medial olivocochlear reflex – mediated otoprotection from noise – induced hearing loss

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The medial olivocochlear (MOC) reflex is thought to contribute broadly to controlling hearing dynamics, including balancing hearing sensitivity between ears, which is significant for sound localization, unmasking sound sources in noise, and in protecting the cochlea from acoustic overstimulation. We recently showed that the sensory drive for the MOC reflex suppression of the cochlear amplifier arises from cochlear type II spiral ganglion neurons (SGN) broadly innervating the outer hair cells (Froud *et al.*, 2015). This was evident from study of the peripherin knockout (*Prph-/-*) mouse model, where the PRPH type III intermediate protein normally expressed by the type II SGN fibres, was lacking. We found that without peripherin expression, the type II fibres did not establish synaptic contact with the outer hair cells in the early post-natal period. Cochlear function was normal in these knockout mice when measured by acoustically-evoked auditory brainstem response (ABR) and distortion product otoacoustic emissions (DPOAEs). The latter measures sound transduction and electromechanical sound amplification *via* the 'cochlear amplifier' and the former reflects inner hair cell transduction driving transmission through the type I SGN fibres. However, (*Prph-/-*) mice lacked contralateral suppression of the cochlear amplifier; when noise was presented to the left ear it failed to cause a reduction in the DPOAE in the right ear; hence there was no MOC reflex. Models manipulating the MOC reflex are problematic, requiring surgical sectioning of the brainstem efferent pathway, or pharmacological manipulation. We therefore investigated whether (*Prph-/-*) mice exhibited altered susceptibility to noise-induced hearing loss (NIHL). (*Prph-/-*) and wildtype (WT) littermates were exposed to open-field noise (4 – 32 kHz white noise, 93 dB SPL – 108 dB SPL, 1 hour) under i.p. ketamine (40 mg/kg), xylazine (8 mg/kg), acepromazine (0.5 mg/kg) anaesthesia, with ABR measurements of hearing sensitivity made before and immediately after noise exposure, and again two weeks later. Procedures were approved by the UNSW Animal Care and Ethics Committee. While both the WT and (*Prph-/-*) mice (6 - 8 per group) had equivalent elevated ABR thresholds immediately after noise, by two weeks recovery, only the (*Prph-/-*) mice maintained elevated thresholds, which were evident above 16 kHz. This result provides strong evidence that the MOC reflex driven by sound transduction at the outer hair cells and sensory coding by the type II SGN is critical for oto-protection against NIHL.

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