A NEW CLUE TO INFRASOUND – EXPERIMENTAL EVIDENCE SUPPORTING OSMOTIC BASELINE STABILISATION IN THE EAR

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This work examines what defines the low-frequency limit of audibility and concludes that because of the way the cochlea has evolved, the definition of infrasound needs to be extended down to zero frequency, viz. static pressures. Auditory frequency analysis is usually modelled using the two-chamber model of von Békésy, in which the middle chamber serves no obvious mechanical function. Scala media (part of the endolymphatic duct) is, however, associated with cochlear homeostasis and evident regulation of the transverse position of the basilar membrane. This tiny, sandwiched vessel sometimes develops enough osmotic pressure to rupture its membranes. A hypothesis is developed that its central function may be to routinely vary its internal pressure to slowly counterbalance atmospheric (ambient) pressure variation delivered to the perilymph, keeping the basilar membrane in the static position required for optimal hearing sensitivity.

Two key missing pieces of evidence are needed to support this theory: 1) that cochlear fluid pressures vary in ways influenced by endocochlear potential and 2) the now well-documented water channels (AQP5s) lining this endolymphatic chamber are gated to control the flow of water down the documented osmotic gradient. We here present the first direct evidence from micropuncture pressure measurements, accessed through the round-window membrane of living rodents. When appropriately invoked, the data reveal behaviours consistent with aquaporin gating as well as pressure release. It follows that individual susceptibility to infrasound may result from loss of the stabilisation afforded by an ancient form of hydraulic assist.