Metabolic activity of auditory cortex after natural ear opening in the Mongolian Gerbil (Meriones unguiculatus)

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The auditory cortex of the adult Mongolian Gerbil consists of seven cortical fields which show a specific geometric pattern and can be clearly distinguished after injection of radioactive 2-Deoxyglucose [1]. Here, we investigated the first appearance of auditory activity in the cortex in early postnatal development of the gerbil.

Experiments were carried out in pups of both sexes at 13, 15, 19, 21, 27 or 31 days after birth (DAB). After injection of 9 µCi 2-fluoro-deoxyglucose (2-DG), gerbils were stimulated with alternating tones of 1 and 2 kHz (250 ms, 70 dB SPL) for 45 minutes. Pups were anaesthetized and decapitated, the brains were removed, frozen on a microtome stage, cut into transversal sections and exposed to X-ray films for two weeks. Autoradiographs were analysed using computized imaging systems. The radial projection from the rostral boundary of the hippocampus to the cortical surface (rHi) served as a reference line in the rostrocaudal direction [1]. The dorsal tip of the striatum (dSt) as a landmark allowed to evaluate the dorsoventral extent of labelled structures.

First auditory activity appeared at DAB 13 rostral to rHi in the adult position of the Anterior Auditory Field (AAF). Two days later (DAB 15), another primary auditory field (AI) could be identified more caudally, but only in its ventral part. Additional labelling could be recognized between AI and AAF. This Intermediate Zone (IZ) extended dorsally roughly to dSt, and its ventral border lay between the ventral tips of primary auditory fields AAF and AI. The Anterioventral Field (AV) became discernible at this age in its adultlike position rostral to the ventral limit of AAF.

At DAB 17, labelling in the dorsal (D), dorsoposterior (DP) and ventro-posterior (VP) fields emerged in their later positions caudally to rHi, but could not be distinguished from each other. The ventral borders of AAF and AI shifted more into the ventral direction. Both, AI and AAF did not reach their adultlike positions until the end of the third postnatal week. At this age, cortical areas rostral to AAF were strongly labelled by 2-DG. Some days later, the Intermediate Zone (IZ) began to fade, its position was partly replaced by a dorsoventral gap of weakly labelled tissue between AAF and AI.

The results suggest that auditory cortex is acoustically activated at the end of the second postnatal week, only a 1-3 days after opening of the external ear channel. Activity starts not in primary auditory cortex AI but in AAF. Several stages are observed which are incomplete reflections of the adult pattern and also exhibit patterns not seen in the adult.