学位論文抄録

Postnatal development of subfields in the core region of the mouse auditory cortex
（マウス聴覚野のコア領域における生後のサブフィールドの発達）

謎 非凡

熊本大学大学院医学教育部博士課程医学専攻 HIGO Program 4 years コース

指導教員

宋 文杰　教授

熊本大学大学院医学教育部博士課程医学専攻知覚生理学

Abstract of the Thesis

Background and Purpose:

The core region of the rodent auditory cortex has two subfields: the primary auditory area (A1) and the anterior auditory field (AAF). The central issues in the postnatal development of the auditory cortex are to ascertain when cortical neurons start to respond to sound stimulation, and the development of tonotopy. This issue has been mainly addressed in A1 of both mice and rats. But still there is some discrepancy. The postnatal development of AAF, however, has seldomly been studied. How the relative position between A1 and AAF develops during postnatal life is also unknow. Here, we aimed to examine and compare the postnatal development of both A1 and AAF in mice, using a real-time high-resolution optical imaging technique, to address the following specific questions: 1) when the two subfields start to exhibit tonotopy and how tonotopy develops during postnatal development, 2) how the size of each subfield and the relative position between the two subfields change with postnatal development, and 3) how the properties of tone-evoked responses change in the subfields with postnatal development.

Methods:

Voltage-sensitive dye imagine

During experiment, the animal was under anesthesia, their body temperature was maintained, heart rate was monitored and head was fixed. A cranial window over the left auditory cortex was made. The dura mater over the cortex was removed, and the exposed cortex was subsequently stained twice with the voltage-sensitive dye RH-1691. After staining, the cortex was washed and covered with 0.5% agarose in saline. As acoustic stimuli, pure tones with calibration in sound level meter were applied to the right ear of the animal in a double-walled soundproof room. Optical signals were detected and transformed into fractional fluorescence signals ($\Delta F/F_0$) for each tone frequency, then encoded in colour and superimposed on the cortical surface using custom-made software.

Results:

Tone-evoked responses in the mouse auditory cortex were first observed at P12, and tonotopy was found in both A1 and AAF at this age. Quantification of tonotopy revealed a rapid change from P12 to P14 in both A1 and AAF, and a stable level from P14. A similar time course of postnatal development was found for the distance between the 4 kHz site in A1 and AAF, the distance between the 16 kHz site in A1 and AAF, and the angle between the frequency axis of A1 and AAF. The maximum amplitude of tone-evoked signals in both A1 and AAF showed no significant change from P12 to P40, but the latency of the responses to both the 4 kHz and 16 kHz tones decreased during this period, with a more rapid decrease in the latency to 16 kHz tones in both subfields.

Conclusions:

Our results demonstrated that A1 and AAF developed in parallel postnatally, showing a rapid maturation of tonotopy, slow maturation of response latency, and a dorsal-to-ventral order (high-frequency site to low-frequency site) of functional maturation.