MedicalXpress

New study finds 'amplifier' helps make connections in the fetal brain

October 11 2016

Fetal brains use a special amplifier in order to transmit signals, according to research published in the journal *eLife* by George Washington University's (GW) Matthew Colonnese, Ph.D. and Yasunobu Murata, Ph.D. Early neural connections are sparse, weak, and unreliable. This unique amplification circuit boosts weak inputs to ensure accurate and powerful information transfer in the developing brain.

"Our question is, what is the brain of the fetus doing? We know it's active, and we know it's generating spontaneous activity, but we also know the circuits are very weak," said Colonnese, professor of pharmacology and physiology and member of the Institute for Neuroscience at the GW School of Medicine and Health Sciences. "Brain activity in a pre-term infant is large - 10 times larger than that of an adult. At the same time, circuits have just ten percent of the connection of an adult. The question became how the activity gets through. That's when we started looking for amplifiers and through our research, identified one of these amplifiers."

Using an animal model, Colonnese and Murata looked at the cerebral cortex and thalamus, key processing areas of the brain, during development. They looked at visual pathways, which have similar activity patterns as humans. In adults, activity in the eye is transmitted to the thalamus, where it is then sent on to the cortex without amplification. There is also a feedback pathway from the cortex back to the thalamus, which is modulatory, and largely acts as a brake. During early brain development however, the feedback input from the cortex multiplies the

retinal input to the thalamus instead of restraining it, resulting in an excitatory feedback loop that causes massive amplification of activity. The amplifier explains how the fetal brain continues to stay active despite weak synapses. While further research is needed, this study may explain the differences in seizures in the young and old, because in adults this brake is necessary to prevent runaway excitation which may cause epilepsy.

"The amplifier only lasts during the fetal period and then a brake comes on. This amplifier goes away after birth, but if it doesn't work or go away properly, does it cause disorders?" said Colonnese. "This is likely one of many unique circuits the fetal brain is using. Research on the fetal brain is so new, and there is so much we don't yet know - it's like going to the moon. More research is needed to learn about overall fetal brain development and the significance of this amplifier."

This study was supported by a grant from the National Eye Institute.

More information: Yasunobu Murata et al, An excitatory cortical feedback loop gates retinal wave transmission in rodent thalamus, *eLife* (2016). DOI: 10.7554/eLife.18816

Provided by George Washington University