This Week in The Journal

● Cellular/Molecular

Neurocalcin δ Activates I_{sAHP}

Claudio Villalobos and Rodrigo Andrade

(see pages 14361–14365)

In many neurons, calcium influx accompanying action potential bursts activates a potassium current that produces a slow afterhyperpolarization (sAHP) that lasts seconds and inhibits additional spiking. Serotonin, noradrenaline, and acetylcholine increase neuronal excitability by inhibiting this current (I_{sAHP}). The molecular makeup of the channels underlying I_{sAHP} remains unknown, but its activation in hippocampal neurons depends in part on calcium-dependent translocation of the calcium sensor hippocalcin from the cytoplasm to the membrane. Hippocalcin is not highly expressed in all neurons that exhibit I_{sAHP}, however, and its knock-out does not eliminate I_{sAHP} in hippocampal neurons, suggesting that other calcium sensors for I_{sAHP} exist. Villalobos and Andrade propose that a closely related protein, neurocalcin δ, is one such sensor. Overexpression of neurocalcin δ increased the amplitude and slowed the decay of I_{sAHP} in cortical neurons, and its calcium sensitivity was comparable to that of hippocalcin. Neither protein diminished I_{sAHP} inhibition by a cholinergic agonist, suggesting they have redundant functions.

▲ Development/Plasticity/Repair

Activity in Rohon-Beard Cells Inhibits Migration of DRG Neurons

Melissa A. Wright and Angeles B. Ribera

(see pages 14513–14521)

In the developing peripheral nervous system, an overabundance of sensory neurons develops and extends axons to their targets. The targets produce neurotrophins, such as brain-derived neurotrophic factor (BDNF), on which sensory neurons depend for their survival. This dependence is thought to match the number of sensory neurons to the size of the target. Wright and Ribera present evidence that activity can regulate the amount of BDNF produced by target cells, and that when BDNF levels are insufficient, some sensory neurons change fate. Reducing tactile stimulation of zebrafish embryos, and thus decreasing activity of a population of somatosensory neurons (Rohon-Beard cells), caused a small but significant increase in the number of sensory neurons that migrated out of the dorsal root ganglion (DRG). Similarly, suppressing sodium currents in Rohon-Beard cells increased migration of DRG neurons, which subsequently adopted a sympathetic identity. BDNF rescued this effect, whereas blocking BDNF mimicked it, suggesting that BDNF normally prevents migration.

■ Behavioral/Systems/Cognitive

Sleep Spindles May Correlate with Assimilation of Knowledge

Jakke Tamminen, Jessica D. Payne, Robert Stickgold, Erin J. Wamsley, and M. Gareth Gaskell

(see pages 14356–14360)

Sleep is important for memory consolidation: procedural memory appears to be enhanced primarily during rapid eye movement (REM) sleep, whereas declarative memory is most strengthened during non-REM sleep. One electroencephalographic feature of non-REM sleep, spindles, might be specifically related to assimilation of new information into existing conceptual frameworks. Spindles are 10–15 Hz oscillations with progressively increasing then decreasing amplitude that originate in thalamus GABAergic neurons and cause rhythmic bursting by thalamocortical neurons. This activity propagates to the cortex, where it might facilitate long-term potentiation. Tamminen et al. reasoned that if sleep facilitates assimilation of new words into the existing lexicon, then categorization of similar-sounding familiar words should be slowed after subjects slept. Although sleep improved recall of new words, categorization of similar-sounding familiar words slowed with or without sleep. Nonetheless, the slowing of categorization was directly correlated with the number of spindles during sleep, suggesting that spindles facilitate assimilation of new words.

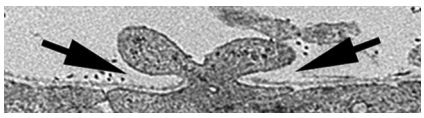
♦ Neurobiology of Disease

Dystroglycan Has Distinct Roles in Neurons and Glia

Jakob S. Satz, Adam P. Ostendorf, Shangwei Hou, Amy Turner, Hajime Kusano, et al.

(see pages 14560–14572)

As the cerebral cortex develops, pyramidal neurons migrate along radial glia that extend from the inner proliferative zone to the glia limitans at the pial surface of the brain. Several genetic mutations cause disruption of the glia limitans, thus allowing neurons to migrate past this barrier and form ectopic clusters on the brain surface—a condition called cobblestone lissencephaly. Many of these mutations cause hypoglycosylation of dystroglycan, a protein expressed in migrating neurons and radial glia that is thought to link the cytoskeleton to the extracellular matrix. Satz et al. found that knocking out dystroglycan in both neurons and glia caused disorganization of radial glia and ectopic clusters of neurons on the brain surface. In contrast, when dystroglycan was eliminated exclusively from neurons, cortical development appeared normal, but long-term potentiation was impaired at mature CA3–CA1 synapses. These data indicate that dystroglycan serves different functions in different cell types and at different developmental stages.



Electron micrograph of cerebral cortex in a mouse embryo lacking dystroglycan in neurons and glia. Arrows indicate where glia limitans is disrupted and cell processes protrude into the subarachnoid space. See the article by Satz et al. for details.