This Week in The Journal

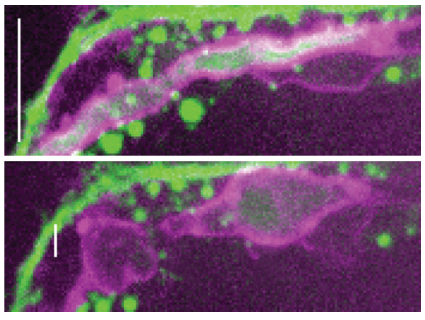
Cellular/Molecular

Slowpoke *Speeds Repolarization at Fly Synaptic Terminals*

Kevin J. Ford and Graeme W. Davis

(see pages 14517–14525)

Voltage-sensitive K^+ channels speed membrane repolarization, thus narrowing action potential (AP) waveforms. The spike waveform at synaptic terminals strongly influences the kinetics of neurotransmitter release. Because recording APs at synaptic terminals is difficult, however, researchers typically examine EPSPs to identify contributors to presynaptic waveform. For example, mutation of *shaker*, which encodes a K_V1-type channel, enlarges EJPs at *Drosophila* neuromuscular junctions, suggesting *shaker* contributes to membrane repolarization in presynaptic terminals. Mutation of *slowpoke*, encoding a Ca^{2+}-activated K^+ channel, does not significantly change EJPs, but it enhances the effect of *shaker* mutations. To directly assess the effects of these channels, Ford and Davis expressed a voltage-sensitive fluorescent protein in motor neurons. Supporting previous conclusions, loss of *shaker* widened presynaptic APs at low extracellular Ca^{2+} concentrations. But previously undetected small depolarizations ("spikeletts") occurred during membrane repolarization in *shaker*-null terminals. Waveform widening and spikeletts disappeared at physiological Ca^{2+} concentration, but reappeared when slowpoke function was disrupted in *shaker* mutants, indicating that slowpoke contributes to AP repolarization under physiological conditions.



After nerve transection, motor axons (green) fragment and Schwann cells (magenta) phagocytose axonal debris. See the article by Rosenberg et al. for details.

Development/Plasticity/Repair

Schwann Cells Provide Directional Cues for Regenerating Axons

Allison F. Rosenberg, Jesse Isaacman-Beck, Clara Franzini-Armstrong, and Michael Granato

(see pages 14668–14681)

Regeneration of PNS axons after injury is aided by perineurial glia, macrophages, and Schwann cells. To elucidate the role of Schwann cells in this process, Rosenberg et al. examined fluorescently labeled cells after transecting motor nerves in larval zebrafish. As axons degenerated, Schwann cells became rounded, phagocytosed axonal debris, and sometimes migrated along the nerve. Within 48 h, ~80% of transected axons had regenerated along their original course and reestablished functional synapses. Most axons failed to reestablish synapses in fish lacking Schwann cells, however. Although severed axons formed growth cones and elongated at normal rates, axonal growth was not directed along the original path: instead, many axons grew laterally. After partial transection of Schwann-cell-lacking nerves, more axons regrew along the original trajectory, but ~50% of axons continued to grow ectopically, indicating that Schwann cells provide directional cues as well as a scaffold for axonal growth. Similar defects were observed in fish lacking DCC, a netrin receptor expressed in motor axons.

Behavioral/Cognitive

Spatial Memory Improves during REM Sleep

Andrew W. Varga, Akifumi Kishi, Janna Mantua, Jason Lim, Viachaslau Koushyk, et al.

(see pages 14571–14577)

The importance of sleep for memory consolidation is well established. In humans, slow-wave sleep (SWS) is particularly important for declarative memory consolidation, whereas rapid eye movement sleep (REMS) improves procedural and emotional memory. Taking a novel approach, Varga et al. have now investigated the contribution of REMS to spatial memory consolidation. People with obstructive sleep apnea who routinely used continuous positive airway pressure (CPAP) therapy to treat the condition learned to navigate a virtual maze, slept overnight in the lab using CPAP therapy, and were tested for spatial memory in the morning. On one of two separate sessions, CPAP pressure was reduced whenever subjects entered REMS and was returned to normal when REMS was exited. This greatly reduced REMS without significantly affecting SWS. Whereas spatial memory improved after undisrupted sleep, performance worsened overnight when REMS was disrupted. In both conditions, maze completion time after sleep was correlated with the mean duration of REMS bouts, suggesting that spatial memory improvements require unfractured REMS.

Neurobiology of Disease

Binge Drinking during Adolescence Reduces White Matter

Wanette M. Vargas, Lynn Bengston, Nicholas W. Gilpin, Brian W. Whitcomb, and Heather N. Richardson

(see pages 14777–14782)

The integrity of the corpus callosum and other fiber bundles is reduced in adolescents with a history of binge drinking compared with controls. Whether reduced white matter integrity results from or predisposes people to alcohol abuse is unknown, however. Vargas et al. addressed this question using a rat model. The density of myelinated axons in the medial prefrontal cortex (mPFC) of adolescent male rats was reduced 2 weeks after the rats were given daily opportunities to binge drink. The area of the anterior branches of the corpus callosum (CC_{FM}), which connects the mPFC to other areas, remained lower than in controls and the amount of degraded myelin protein in this area was elevated 5 months after alcohol consumption ceased. Consistent with this, increased alcohol intake during adolescence was associated with impaired performance on a PFC-dependent spontaneous alternation task in adulthood. In addition, reduced CC_{FM} area was associated with increased consumption of alcohol after deprivation, a model of relapse drinking.