This Week in The Journal

Cellular/Molecular

Slow and Fast Axonal Transport Are Linked

Yong Tang, David Scott, Utpal Das, Daniel Gitler, Archan Ganguly, et al.

(see pages 15362–15375)

Many presynaptic proteins are synthesized in the cell body and transported to axon terminals. Membrane proteins are transported in vesicles that bind motor proteins and are carried along microtubules by fast axonal transport. Cytosolic proteins, in contrast, move in large complexes, and although their transport requires motor proteins, their overall rate is much slower than that of membrane proteins because continual disassembly of the complexes causes transient cessation of movement. Tang et al. further elucidate the mechanism of slow axonal transport, showing that transport of at least one cytosolic protein, synapsin, is tightly coupled to fast vesicle transport. Blocking the initial release of transport vesicles from the Golgi reduced transport of synapsin, as did disrupting interactions between synapsin and vesicles. Furthermore, imaging of neurons expressing fluorescently tagged synapsin and membrane-bound synaptophysin revealed cotransport of the proteins. Finally, a biophysical model demonstrated that transient association of synapsin with moving vesicles reproduced movement patterns characteristic of slow axonal transport.

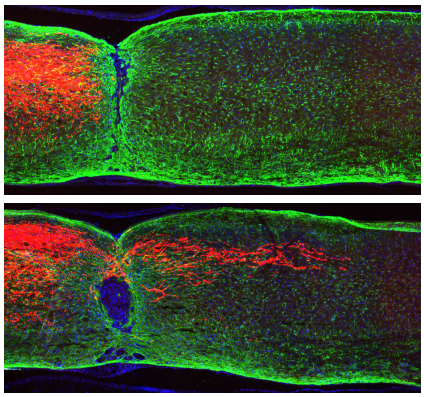
Development/Plasticity/Repair

PTEN Knockdown Increases Axon Regeneration

Katherine Zukor, Stephane Belin, Chen Wang, Nadia Keelan, Xuhua Wang, et al.

(see pages 15350–15361)

The limited capacity for growth of mature axons is a major impediment to functional recovery after spinal cord injury (SCI). Several pathways that regulate growth of mature axons have been identified, and manipulating these pathways promotes axon growth after injury. Knocking out phosphatase and tensin homolog (PTEN),



CST axons (red) do not normally extend beyond the lesion site 8 weeks after SCI (top). Knocking down PTEN in cortical neurons (bottom) allows axons to grow through the lesion, however, possibly by following bridges formed by astrocytes (green). Blue, nuclei. See the article by Zukor et al. for details.

for example, increases regrowth of severed corticospinal tract (CST) axons in mice. Gene deletion is not a viable treatment option for SCI, however. More promisingly, Zukor et al. show that knockdown of PTEN via viral expression of short hairpin RNAs in cortical neurons increased regeneration of CST axons after subsequent SCI. Regenerating axons grew through the lesion and made anatomical synapses in the vicinity of their normal targets. Astrocytes and fibroblasts formed a barrier at the edge of the lesion that appeared to inhibit axon growth, and within the lesion, axons avoided areas rich in fibroblasts and macrophages. Regenerating axons appeared to follow astrocyte bridges across the lesion, however, suggesting astrocytes can promote or inhibit growth.

Behavioral/Cognitive

Neural Activity Patterns Elicited by Hues Are Task Dependent

Gijs Joost Brouwer and David J. Heeger

(see pages 15454–15465)

Humans can distinguish hundreds of hues, but we generally group them into a few color categories (red, green, blue, etc.). Are the neural representations of hues similarly grouped? To answer this question, Brouwer and Heeger used functional imaging to examine neural activity patterns in visual cortical areas as people viewed hues and either assigned them to broad color categories or performed a color-independent task. When subjects were performing the color-naming task, the neural activity patterns elicited in areas VO1 and V4v by any given hue were more similar to patterns elicited by hues in the same color category than to patterns evoked by hues of different colors. This effect was apparent in low-dimensional color spaces derived from the imaging data, which showed clusters of neural activity representing each color category. Such clustering was not apparent in V2 or V3. Interestingly, activity patterns were less clustered when subjects performed the color-independent task, suggesting that neural representations of color are not static, but vary by task.

Neurobiology of Disease

Rescuing Granule Cells Does Not Rescue Cerebellar Learning

Nicholas Gutierrez-Castellanos, Beerend H. J. Winkelman, Leonardo Tolosa-Rodriguez, Benjamin Devenney, Roger H. Reeves, et al.

(see pages 15408–15413)

Numerous physiological problems occur in Down syndrome (DS). Besides cognitive and learning deficits, people with DS have impaired motor function, coordination, and postural control. Such motor deficits may stem from cerebellar abnormalities, including reduced numbers of cerebellar granule cells (CGCs). The sonic hedgehog (Shh) pathway stimulates proliferation of CGC precursors, and treating newborn Ts65Dn mice (which are trisomic for many DS-associated genes) with an agonist of this pathway rescues not only CGC loss, but also spatial learning. Whether the latter effect results from rescue of CGCs or from independent effects of the Shh agonist in the hippocampus is unclear. Gutierrez-Castellanos et al. therefore asked whether Shh agonist improves learning in a task that depends solely on cerebellum: phase reversal adaptation and consolidation of the vestibular ocular reflex. Ts65Dn mice were impaired on this task even when treated with Shh agonist, indicating that rescue of CGCs is insufficient to rescue cerebellar learning and suggesting that improvements in motor learning are independent of cerebellar function.