This Week in The Journal

Cellular/Molecular

NF-κB Rapidly Alters Spine Density via IGF2 Signaling

Michael J. Schmeisser, Bernd Baumann, Svenja Johannsen, Gry F. Vindedal, Vidar Jensen, et al.

(see pages 5688–5703)

Nuclear factor κB (NF-κB), first identified as a lymphocyte transcription factor complex, is a ubiquitous mediator of signal-induced gene transcription. In unstimulated cells, the inhibitor IκB binds to NF-κB, sequestering it in the cytoplasm. Extracellular signals, including glutamate, activate IκB kinase (IKK), which phosphorylates IκB, causing it to dissociate from NF-κB. NF-κB is then free to translocate to the nucleus and activate transcription of target genes. In the CNS, such genes regulate neuronal survival, neurite outgrowth, and synaptic plasticity. Schmeisser et al. report that synaptically enriched IKK and NF-κB can rapidly alter synaptic density. Conditionally expressing dominant-negative (DN) IKK reduced spine density, enrichment of several synaptic proteins, and the number of functionally mature synapses in mouse hippocampal neurons. But switching off DN-IKK expression allowed normal spine density to reappear within 24 h. The effect of DN-IKK likely resulted largely from reduced expression and secretion of insulin-like growth factor 2 (IGF2), whose receptor is enriched at synapses.

Development/Plasticity/Repair

c-Maf Helps Specify RA Afferent Fate

Jia Hu, Tianwen Huang, Tingting Li, Zhen Guo, and Leping Cheng

(see pages 5362–5373)

Rapidly adapting (RA), low-threshold mechanoreceptor afferents—which convey information about skin movements, sustained indentation, and vibration—terminate peripherally in Meissner and Pacinian corpuscles and centrally in laminae III/IV of the spinal dorsal horn. RA afferents can be distinguished from other somatosensory neurons in the dorsal root ganglion by their early expression of Ret, a receptor for glial-derived neurotrophic factors, which is required for the development of both the peripheral end-organs and the central terminals of RA afferents. Hu et al. now show that the transcription factor c-Maf acts upstream of Ret to regulate differentiation of RA mechanoreceptors. c-Maf was expressed in interneurons in laminae III/IV of the spinal cord, as well as in presumptive RA afferents. Knockout of c-Maf reduced expression of Ret and other proteins in RA afferents and spinal cord, reduced glutamatergic innervation of spinal cord laminae III/IV, and disrupted development of Pacinian corpuscles, without affecting neuronal survival.

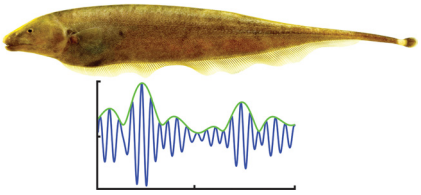
Behavioral/Systems/Cognitive

Balanced Input Creates Second-Order Feature Selectivity

Patrick McGillivray, Katrin Vonderschen, Eric S. Fortune, and Maurice J. Chacron

(see pages 5510–5524)

Sensory stimuli have first- and second-order characteristics that carry important information. In the visual system, for example, luminance is a first-order attribute, whereas contrast is second-order. In weakly electric fish, which communicate via modulations in the frequency and amplitude of their electric organ discharges, the discharge waveform and its amplitude modulation (its envelope) are first- and second-order attributes that provide information about the sex and distance of nearby fish, respectively. Electroreceptor neurons respond to both stimulus waveform and stimulus envelope, as do their target neurons in the electrosensory lateral line lobe (ELL). Different ELL neurons respond to either increases (E-type) or decreases (I-type) in discharge amplitude and project to the torus semicircularis (TS). There, McGillivray et al. suggest, first- and second-order information segregates into separate streams. TS neurons that receive input primarily from high-frequency E-type ELL neurons were selective for waveform, whereas those that receive balanced input from E- and I-type neurons were selective for envelope.



Neurons in the midbrain nucleus TS in electric fish respond to stimulus waveform (blue), envelope (green), or both. See the article by McGillivray et al. for details.

Neurobiology of Disease

Reperfusion Injury May Increase Cerebral Palsy Risk

Alexander Drobyshevsky, Kehuan Luo, Matthew Derrick, Lei Yu, Hongyan Du, et al.

(see pages 5500–5509)

Cerebral palsy (CP) is a disorder of motor control, posture, and muscle tone caused by abnormal brain development stemming from insults occurring before or shortly after birth. In most cases, multiple factors contribute to the development of CP, but maternal infection and prenatal ischemia are the most common antecedents. Drobyshevsky et al. suggest that reperfusion injury is a major factor in the development of CP after stroke. They used the apparent diffusion coefficient (ADC) measured with diffusion-weighted magnetic resonance imaging as an indicator of damage after producing intrauterine hypoxic ischemia in a rabbit model of CP. Animals in which ADC continued to decline during tissue reperfusion were more likely to develop hypertonia or die. Reperfusion injury often occurs after stroke, because ischemia increases vascular permeability and the release of normally intracellular proteins, thus triggering a destructive immune response upon reperfusion. Therefore, activation of immune responses might be a common factor in the development of CP.