This Week in The Journal

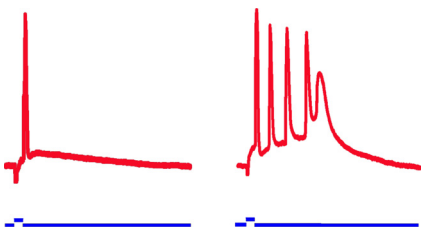
● Cellular/Molecular

Hyposmolarity Inhibits I_M

Anna Caspi, Felix Benninger, and Yoel Yaari

(see pages 11098–11111)

Overhydration sufficient to produce acute plasma hyposmolarity can cause seizures. In rat hippocampal slices, lowering osmolarity enhances the spike afterdepolarization (ADP) in pyramidal neurons, and thus promotes burst firing in response to brief depolarization. The size of the ADP is determined by the interplay between the depolarizing persistent sodium current (I_{NaP}) and the hyperpolarizing M-type potassium current (I_M). Because I_M antagonizes I_{NaP}, inhibiting I_M leads to I_{NaP}-mediated depolarization, which underlies bursting. Potentiation of the ADP by hyposmolarity could therefore be mediated by enhancement of I_{NaP} or inhibition of I_M. Caspi et al. demonstrate that it is the latter. Blocking the channel responsible for I_M reduced delayed rectification similarly to hyposmolarity, and occluded the effect of hyposmolarity. In addition, depletion of intracellular but not extracellular calcium prevented inhibition of I_M, enhancement of ADP, and bursting induced by hyposmolarity, suggesting inhibition of I_M requires release of calcium from intracellular stores.



Injecting a brief depolarizing current pulse (bottom traces) caused a single spike in a hippocampal neuron in normal conditions (left). After incubation in hyposmotic conditions (right), the same current induced a burst of five spikes. See the article by Caspi et al. for details.

▲ Development/Plasticity/Repair

BDNF Contributes to Presynaptic Maturation

Marko Sallert, Tomi Rantamäki, Aino Vesikansa, Heidi Anthoni, Kirsi Harju, et al.

(see pages 11294–11303)

During development, tonic activity of presynaptic kainate receptors at hippocampal CA3–CA1 synapses lowers the probability of vesicle release, so only high-frequency stimulation excites CA1 neurons. As synapses mature, kainate receptor expression decreases, and the probability of release increases. This process is accelerated by long-term potentiation of these synapses. Sallert et al. report that BDNF is required for the developmental down-regulation of kainate receptors. In neonatal hippocampal slices, BDNF increased the frequency of miniature EPSCs (mEPSCs), increased the amplitude of evoked EPSCs, and eliminated short-term facilitation produced by high-frequency pulses, suggesting it increased release probability. Kainate antagonists produced the same effect, but this was occluded by preincubation with BDNF, and it diminished during the first two postnatal weeks. In BDNF-null mice, mEPSC frequency was lower than in wild-type, and the ability of kainate receptor antagonists to increase mEPSC frequency was maintained at neonatal levels for at least two weeks, suggesting that loss of BDNF delayed synaptic maturation.

■ Behavioral/Systems/Cognitive

Axonal Tension Likely Influences Cortical Folding

Reza Rajimehr and Roger B. H. Tootell

(see pages 11149–11152)

Folding of the primate cerebral cortex greatly expands the cortical surface area that can fit into the skull. The distinct patterning of major sulci and gyri is fairly consistent across members of a species, so it is used to demarcate cortical regions. What determines the cortical folding pattern during development? One hypothesis suggests that folding results from tension that develops along corticocortical axons as the brain grows, drawing highly interconnected cortical regions together, forming gyri, while allowing less-interconnected areas to move apart. Rajimehr and Tootell tested this hypothesis by mapping representations of visual stimuli in human and macaque cortex using functional magnetic resonance imaging. They predicted that representations of the vertical meridian, which forms the border between highly interconnected mirror-image representations of a visual hemi-field, should occur on sulci, whereas representations of the horizontal meridian should occur in gyri. They found this to be true across cortical visual areas in both species.

♦ Neurobiology of Disease

Survival of Spiral Ganglion Neurons May Require Efferent Input

Stephen M. Maricich, Anping Xia, Erin L. Mathes, Vincent Y. Wang, John S. Oghalai, et al.

(see pages 11123–11133)

Hearing impairment is usually caused by damage to peripheral auditory structures, but can also result from damage to central nuclei. To create mouse models of central hearing loss, Maricich et al. used two *Cre*-driver mouse lines to conditionally delete the transcription factor *Atoh1* in different subsets of cochlear and accessory auditory nuclei (AAN) neurons. *Atoh1* is required for specification of several auditory cell types, and conditional *Atoh1* knockout resulted in loss of these neurons and deafness. In one mutant line, hair cell function and cochlear structure were normal, yet the number of spiral ganglion neurons (SGNs, which receive inputs from hair cells) was reduced by ~30%. Cochlear nucleus projections to the AAN were absent, and AAN neurons that do not express *Atoh1* were lost. The number of SGNs and AAN neurons were normal at birth but decreased thereafter, suggesting that these neurons depend on inputs from the cochlear nucleus for their survival.