This Week in The Journal

● Cellular/Molecular

Ramping Up A Currents

Alexander C. Jackson and Bruce P. Bean

(see pages 10785–10796)

When it comes to neuronal membrane excitability, a lot is going on at subthreshold membrane potentials. And sometimes you have to sneak up on a cell to find out what is happening. This week, Jackson and Bean wanted to examine how the voltage-dependent activation and inactivation properties of A-type potassium channels (I_A) affected action potential firing. I_A is activated by depolarization, but these channels also inactivate quickly at depolarized membrane potentials. Thus the authors ramped the membrane potential from rest into the subthreshold range, either slowly or quickly, not unlike how neurons normally operate. They used dissociated neurons from the tuberomammillary nucleus that have large A currents. As expected, fast ramps (50–100 mV/s) revealed subthreshold potassium currents, consistent with I_A. The surprise was that the I_A blocker 4-aminopyridine (4-AP) enhanced these currents. The authors explain this anomalous behavior by a model in which 4-AP binds tightly to closed channels, but the channels cannot inactivate until 4-AP unbinds.

▲ Development/Plasticity/Repair

Tracking Fates of Newborn Neurons

Jovica Ninkovic, Tetsuji Mori, and Magdalena Götz

(see pages 10906–10911)

New kids on the block always seem to attract a lot of attention, and so it goes for newborn neurons. These cells in the supraventricular zone and dentate gyrus can be generated in adults and contribute to circuits in the olfactory bulb and hippocampus to varying degrees. This week, Ninkovic et al. tracked their fate by tamoxifen-induced recombination in mice expressing CreERT2 under control of the astrocyte-specific glutamate transporter. A 5 d tamoxifen treatment in 3-month-old mice labeled neural stem cells, leading to reporter expression in a high proportion of newborn neurons that were subsequently generated. By 9 months, reporter-positive neurons accounted for one-third of interneurons in the glomerular layer of the olfactory bulb but a much smaller fraction of the neuronal population in the granule cells layers of the olfactory bulb or dentate gyrus.

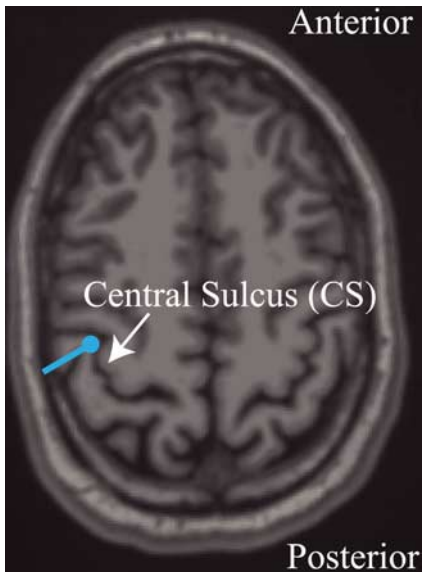
■ Behavioral/Systems/Cognitive

Tactile Detection and the Primary Somatosensory Cortex

Stephanie R. Jones, Dominique L. Pritchett, Steven M. Stufflebeam, Matti Hämäläinen, and Christopher I. Moore

(see pages 10751–10764)

Whether the primary somatosensory cortex (S1) participates in tactile detection has been debated. For example, classic studies of Mountcastle and coworkers found that monkeys could relearn tactile detection tasks after comprehensive S1 lesions. This week, Jones et al. addressed this problem using magnetoencephalography (MEG) in humans. Subjects received brief taps to the right hand using a piezoelectric device driven at 100 Hz. The stimulus was adjusted to 50% detection, and the subjects reported detection with a button press. Using equivalent current dipole calculations, the authors localized a component of the evoked signal to area 3b in the contralateral postcentral gyrus, when subjects reported detection. The signal was consistent with laminar-specific generation in the underlying S1 cortex. The results support previous studies in which field potentials in S1 correlate with "hits" in a tactile detection but not with single-unit recording of area 3b in macaques during "hit" and "miss" trials. To be continued, one supposes.



For a subject who participated in a tactile detection task, the image shows the location (blue dot) and orientation (blue line) of the estimated equivalent current dipole for the MEG signal over the primary somatosensory cortex. See the article by Jones et al. for details.

♦ Neurobiology of Disease

BDNF to the Rescue

Michael Ogier, Hong Wang, Elizabeth Hong, Qifang Wang, Michael E. Greenberg, and David M. Katz

(see pages 10912–10917)

Julie C. Lauterborn, Christopher S. Rex, Eniko Kramár, Lulu Y. Chen, Vijay Pandyarajan, Gary Lynch, and Christine M. Gall

(see pages 10685–10694)

Two articles this week provide evidence for a beneficial effect of BDNF in mouse models of X-linked neurological diseases Rett syndrome and fragile X syndrome. Ogier et al. used mice lacking methyl-CpG binding protein 2 (MeCP2), the loss of function of which causes Rett syndrome. Although MeCP2 has been suggested as a transcriptional repressor of BDNF, mutant neurons had lower levels of BDNF. The levels of BDNF increased with chronic depolarization or after the facilitation of AMPA receptor activation with an ampakine compound. The ampakine also improved respiratory function in the mutant mice. Lauterborn et al. examined hippocampal plasticity in mice lacking expression of the fragile X mental retardation 1 (FmR1) protein. Long-term potentiation (LTP) was severely impaired in brain slices from the CA1 region of mutant mice. However, the LTP was fully restored by infusion of BDNF, despite the fact that the mutant mice had apparently normal levels of BDNF.