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Section Editors

Central Pontine Myelinolysis: A Metabolic Disorder of Myelin

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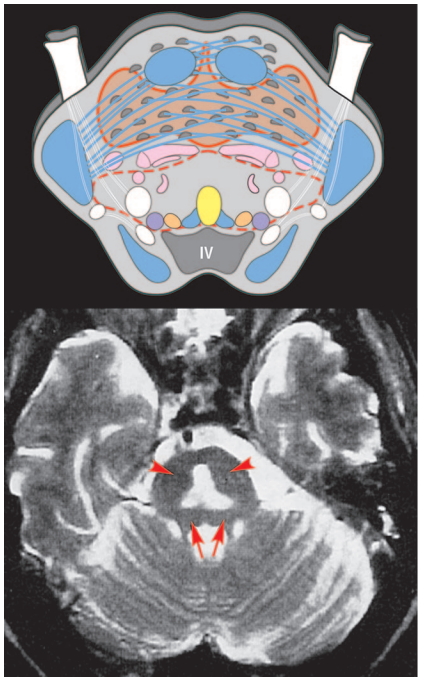

COVER AND FIGURE 1. [Left Top] An axial schematic diagram of the pons (radiographic orientation) illustrates the major nuclei (locus coeruleus, purple; paramedian raphe nuclei, yellow; lateral dorsal tegmental nucleus, light gold; cranial nerve V, white), major tracts (motor, blue; sensory, pink; cranial nerve, white), and the reticular formation (red dashed line). An unusual aspect of the central pons that is believed to underlie its vulnerability to osmotic injury is the intermingling of gray matter (pontine nuclei, dark gray) and white matter (transverse fibers to cerebellum, blue). Osmotic stress often spares the surrounding compact motor and sensory tracts, resulting in the characteristic "trident" or "bat-wing"-shaped area of injury (light orange area). **[Left Bottom]** Axial T_2-weighted MRI illustrates the classic area of injury in the central pons, with sparing of the tegmentum (arrows) and corticospinal tracts (arrowheads). **[Right]** Axial T_2-weighted (top) and coronal FLAIR (bottom) MRIs from a case in which the area of injury was more widespread (image contributed by Dr. Robert Kotloski, Wake Forest University School of Medicine).

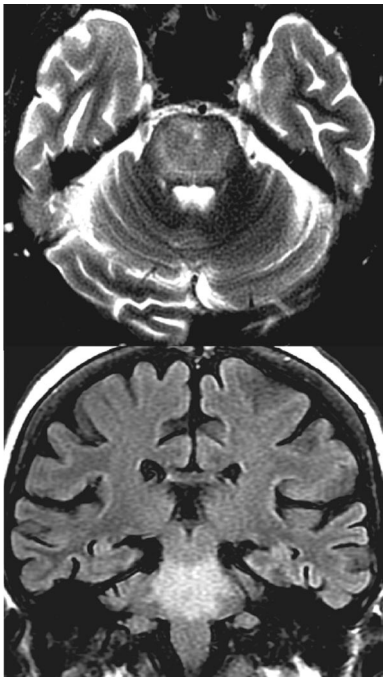

FIGURE 2. Schematics of major changes that occur in the brain during osmotic regulation (astrocytes, blue; neurons, pink; oligodendrocytes and myelin, green; blood vessels, red; changes in osmolality are indicated by changes in color intensity).[1–6] **[Normal State]** The brain and blood are in osmotic balance. Astrocytes extend processes to enclose vessels (single endfoot illustrated), forming part of the blood–brain barrier (BBB). **[Acute Hyponatremia]** As plasma osmolality decreases, blood becomes dilute, as compared with brain, and water moves from blood into brain, causing brain cells to swell (cerebral edema). Cellular swelling occurs primarily in astroglia, rather than neurons. The brain adapts to hyponatremia by losing solutes in order to reestablish normal cell volume. Initially (in hours), cells expel inorganic osmolytes (electrolytes), and water follows, decreasing cell volume back toward normal size. **[Chronic Hyponatremia]** If hyponatremia is sustained, cells must also expel organic osmolytes in order to lose more water and restore normal cell volume. This process is much slower (days). In the chronic hyponatremic state, brain cell volume is normal, but the intracellular osmolality is low, to be in balance with the blood. **[Rapid Correction]** If blood osmolality is raised quickly to normal, the blood becomes much more concentrated than brain, and water moves from brain to blood, causing cells to become dehydrated and shrink. In order to restore normal volume, brain cells must reacquire solutes. Electrolytes are regained relatively quickly; organic osmolytes, very slowly. Osmotic stress caused by rapid correction results in focal loss of oligodendrocytes and myelin, with sparing of neurons and axons, and can cause transient BBB disruption.