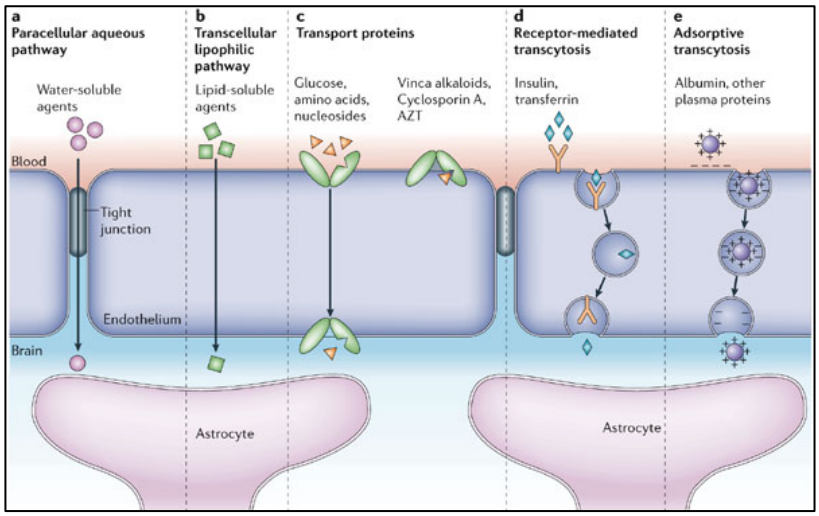
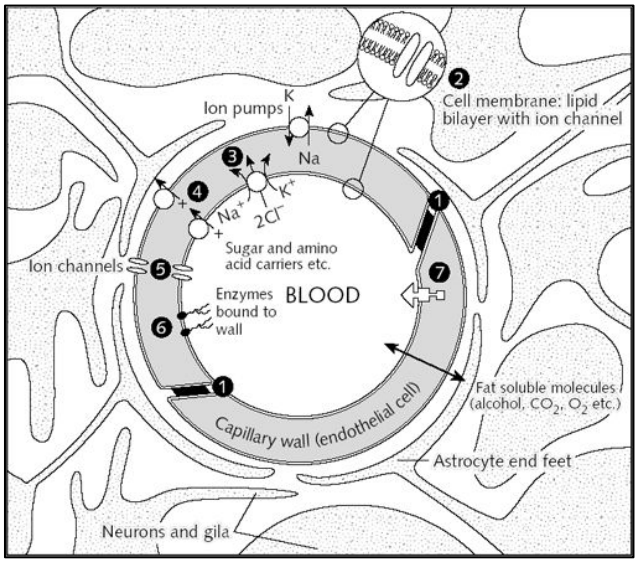
Blood Brain Barrier

Anesthetic Pearls: Anesthetic Implications of Fluid Flux and the Blood Brain Barrier

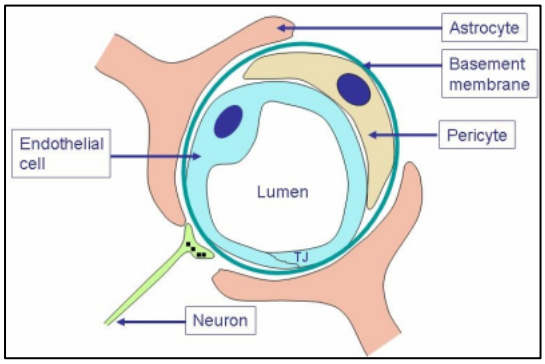
The movement of molecules across the blood brain barrier is determined by size, charge, lipid solubility, and degree of protein binding in blood. Small, non-ionized molecules, gasses (CO_2 and O_2), volatile anesthetics, and lipid soluble molecules freely enter the brain. Most ions, polar molecules (glucose, amino acids), proteins, and especially large molecules (Mannitol) poorly penetrate the blood brain barrier. The movement of small ions (Na^+, K^+, Mg^{2+}, Ca^{2+}) is impeded to some extent by the tight junctions of the barrier.



Water moves freely across the blood brain barrier. Fluid (water) flux is determined by the relative osmotic pressure in the brain and the blood. Water flows into the compartment with the higher osmotic pressure, which is determined by the number of free particles in a solution. The osmotic effect of small ions (Na^+ and K^+) or polar molecules (like glucose) is transitory secondary to osmotic equilibration occurring relatively quickly. However, when marked differences occur, they can cause extreme and rapid fluid shifts in the brain. Thus, marked abnormalities in serum sodium or glucose concentrations should be corrected slowly and cautiously.



Mannitol, an osmotically active substance that does <u>not</u> normally cross the blood-brain barrier, causes a sustained decrease in brain water content, and is often used to decrease brain volume. It is commonly used in neurosurgery to acutely decrease brain swelling / engorgement to increase visualization during calvarium entry and dissection.



The blood brain barrier may be disrupted by severe hypertension, tumors, trauma, strokes, infection, marked hypercapnia, hypoxia, irradiation, ischemia and sustained seizure activity. Under these conditions, fluid movement across the blood-brain barrier becomes dependent on hydrostatic pressure rather than osmotic gradients.