Blood-brain barrier (BBB)

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*blood-nerve fiber barrier* – see p. A14 (2)

BBB – selective mechanism (*functional* & *morphological* barrier) that restricts free passage of all but **few lipid-soluble materials** from circulation to CNS parenchyma → constant (within narrow limit) microenvironment of brain tissue.

* 1. **anilino dažai i/v** nudažo visus organizmo audinius, išskyrus CNS – BBB darbas.
  2. **water, O2**, **CO2**, **gliukozė**\*, kai kurios **amino r.**, **lipofilinės medžiagos** – laisvai praeina BBB.

\*highly polar molecule – enters via *facilitated diffusion* (glucose transporter GLUT 1); then other transporters (GLUT 3, GLUT 5 distribute glucose to neurons and glia)

* 1. dauguma jonų, didelės masės molekulės nepraeina pasyviai BBB – reikalingas *aktyvus transportas*.
* BBB makes **neuronal surface** privileged site – tik reikiamos medžiagos pasiekia neurono membraną, nesutrikdydamos poliarizacijos.

Pagrindinė BBB funkcija – *apsaugoti neurono membranos poliarizaciją*

- BBB tiksliau gal būtų vadinti **blood-neuronal barrier**.

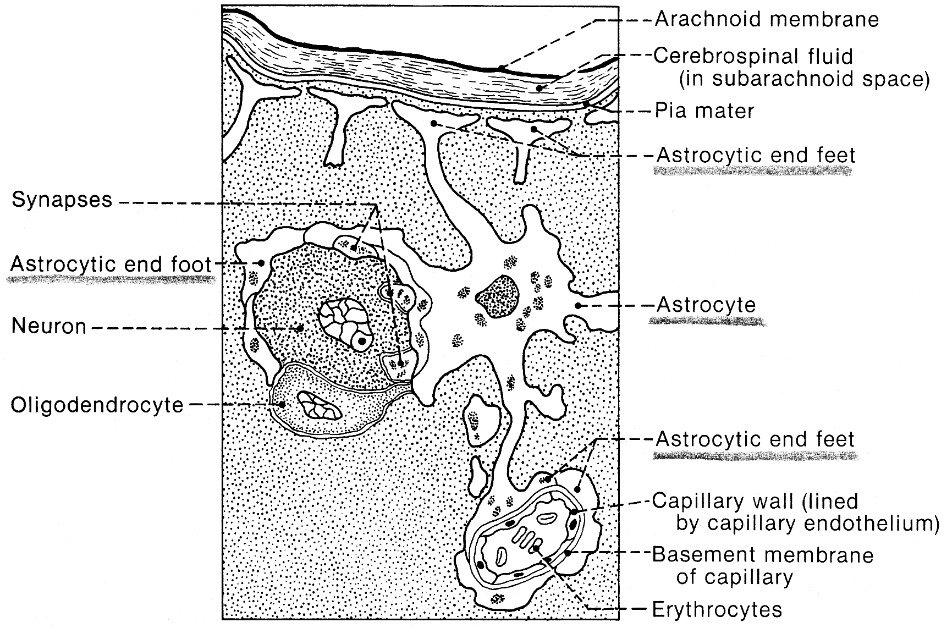
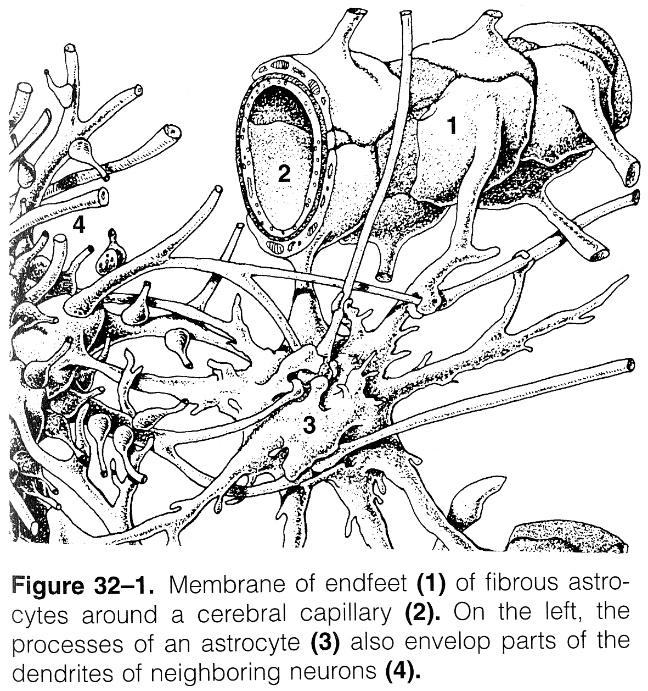
* constant extracellular ionic & molecular composition is more important for normal function of brain than for any other organ!
* small changes in extracellular concentrations of, for example, Na+ or neurotransmitters (glutamate, norepinephrine) greatly alter neuronal function.
* BBB is **unidirectional**; movement of substances from brain to blood is almost unrestricted (due to bulk flow of CSF to venous system).
* BBB is ***not absolute*** – in **circumventricular organs** (neurohypophysis, area postrema, etc) BBB is less effective. see p. A118 (2-3)

Anatomical structures of BBB

* + 1. Dauguma šaltinių teigia – ***BBB resides in vascular endothelium*** – unique endothelial cells (in neural capillary):
       1. **overlapping** (nonfenestrated)
       2. very **tight junctions**
       3. very few **pinocytotic vesicles** (little bulk flow)
          - panašūs kapiliarai randami – retina, iris, inner ear, endoneurium.

Kitos galimai svarbios struktūros:

* + 1. Basement membrane of capillary.
    2. Astrocytic end feet – form ***continuous covering*** (although 20 nm gaps may be present) of external capillary wall; taip pat glaudžiai supa neuronų kūnus (ypač izoliuoja sinapses), smegenų paviršių; astrocytic cytoplasm forms functional “extracellular” space in CNS.



* + 1. Perineuronal satellite cells (astrocytes, microglia, oligodendrocytes).
    2. Surface covering of neuronal membrane (glycoprotein, sialic acid, etc) – final censor!

**Blood-CSF barrier** – resides in choroidal epithelium (tight junctions); features similar to BBB.

Under pathologic conditions

- **BBB breaks down** → sequelae:

*neuronal intoxication* (neuronal discharge inhibited or excited).

*vasogenic cerebral edema* (plasma leakage directly into CNS tissue).

**IV contrast** nudažo audinį.

**drugs** may reach CNS tissue (e.g. antibiotics, neuroprotective drugs) – “window of opportunity”.

N.B. when BBB is intact, drug ability to penetrate into brain tissue depends on its lipid solubility (or presence of carrier proteins).

* pathologic conditions that break down BBB: ***inflammation***, ***trauma***.
* neovessels of ***brain tumors*** have no BBB (capillaries are fenestrated, without tight junctions, not surrounded by astrocytic feet).

Bibliography for ch. “General Histology, Myelination, BBB” → follow this [link >>](http://www.neurosurgeryresident.net/A.%20Neuroscience%20Basics\A.%20Bibliography.pdf)

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