

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)
 - 3) dauguma **jonų, didelės masės molekulių** 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:

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

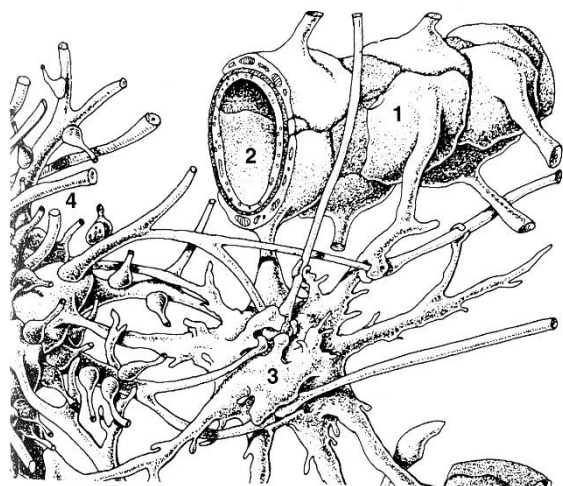
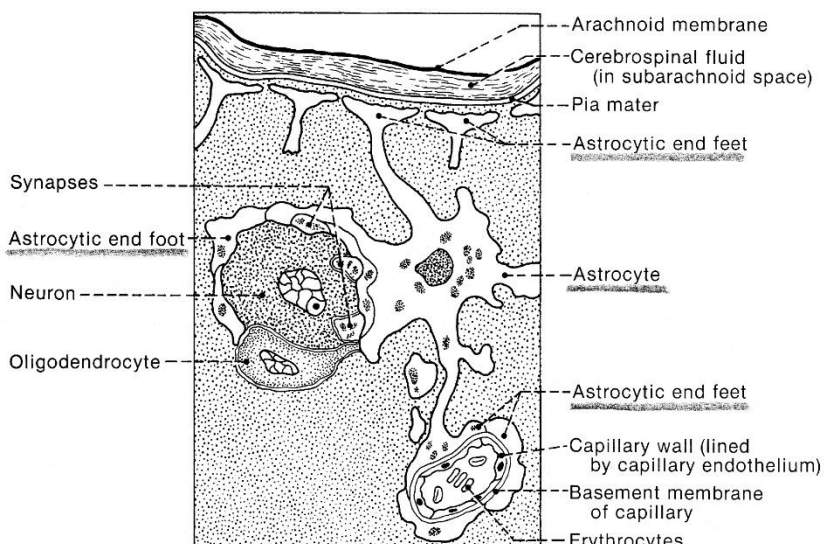


Figure 32-1. Membrane of endfeet (1) of fibrous astrocytes around a cerebral capillary (2). On the left, the processes of an astrocyte (3) also envelop parts of the dendrites of neighboring neurons (4).



4. **Perineuronal satellite cells** (astrocytes, microglia, oligodendrocytes).
5. **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:

- 1) **neuronal intoxication** (neuronal discharge inhibited or excited).
- 2) **vasogenic cerebral edema** (plasma leakage directly into CNS tissue).
- 3) **IV contrast** nudažo audinį.
- 4) **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 >>](#)