Brain parenchyma

Brain parenchyma refers to the functional tissue of the brain, consisting primarily of neurons and glial cells. This tissue is responsible for the brain's core functions, including cognition, memory, sensory processing, and motor control.

Composition

Neurons: The primary functional units of the nervous system

Glial cells: Supporting cells including astrocytes, oligodendrocytes, and microglia

Neuropil: A dense network of neuronal and glial cell processes

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Extracellular fluid: 1400 ml.

The brain parenchyma consists of neurons and glial cells.

These are supported and maintained by three types of glial cells. Oligodendroglia surround and insulate them, while astroglia physically support them and provide them with nutrition. They also eat debris and parts of dead neurons, as do microglia, the third type. Additionally, they regulate the concentration of ions in the space in between cells in the brain parenchyma, which keeps the organ as a whole functioning properly, and support the blood-brain barrier, which prevents certain substances from entering the brain via blood vessels. These cells also help with repairs following an injury.

Location

Makes up the bulk of the cerebral cortex, subcortical structures, brainstem, and cerebellum

Distinct from cerebrospinal fluid, blood vessels, and meninges

Functions

Information processing and transmission

Memory formation and storage

Sensory interpretation

Motor control and coordination

Higher-order cognitive functions

Clinical significance

Various neurological disorders can affect brain parenchyma, such as:

Stroke

Tumors

Neurodegenerative diseases (e.g., Alzheimer's, Parkinson's)

Infections (e.g., encephalitis)

Traumatic brain injuries

Imaging

Brain parenchyma can be visualized using various neuroimaging techniques, including:

Magnetic Resonance Imaging (MRI)

Computed Tomography (CT)

Positron Emission Tomography (PET)

Understanding the structure and function of brain parenchyma is crucial for neuroscience research, diagnosing neurological conditions, and developing targeted treatments for brain disorders.

Unlike every other organ in the body, the brain parenchyma lacks a traditional lymphatic system to drain fluids and central nervous system (CNS) antigens. It was historically assumed that all brain wastes were removed by endogenous processing, such as phagocytosis and autophagy, while excess fluids drained directly into the blood. However, the twin discoveries of the glial-lymphatic (glymphatic) system and meningeal lymphatics have transformed our understanding of brain waste clearance. The glymphatic system describes the movement of fluids through the subarachnoid space (SAS), the influx along periarterial spaces into the brain parenchyma, and the ultimate efflux back into the SAS along perivenous spaces where it comes into direct contact with the meningeal lymphatics. The dura mater of the meninges contains a bona fide lymphatic network that can drain CSF that has entered the dura. Together, these pathways provide insights into the clearance of molecules and fluids from the brain, and show that the CNS is physically connected to the adaptive immune system. [1)]

The brain parenchyma is the functional tissue in the brain. It's comprised of two types of cells that are used specifically for cognition and controlling the rest of the body.

The remaining brain tissue is known as stroma, which is the supportive or structural tissue.

Intraaxial is a term that denotes lesions that are within the brain parenchyma, in contrast to extra axial, which describes lesions outside the brain.

1)
Smyth LCD, Beschorner N, Nedergaard M, Kipnis J. Cellular Contributions to Glymphatic and Lymphatic Waste Clearance in the Brain. Cold Spring Harb Perspect Biol. 2024 Aug 12:a041370. doi: 10.1101/cshperspect.a041370. Epub ahead of print. PMID: 39134379.