

## HISTOLOGY OF nervous system

The structural unit of the nervous system is the neuron or nerve cell. These Neurons vary greatly in shape in different parts of the nervous system all of them, however, contain a cell body and cytoplasmic processes.

The nervous system is divided anatomically into the central nervous system (CNS) comprising the brain and spinal cord, and the peripheral nervous system (PNS) which constitutes all nervous tissue outside the CNS. Histologically, the entire nervous system consists of variations in the arrangement of neurons and their supporting tissues.

### Neurons

The cell body (perikaryon) is the part of the neuron which contains the nucleus. In many cases the cell body is extremely large. The processes are the cell specialized which are associated with the conduction of impulses. The kinds of processes exist dendrites and axons. The dendrite is defined as the process which conducts impulses towards the cell body. The axon conducts the impulses away from the cell body. Each neuron has only one axon. The receptors are associated with the dendrites with the effectors are associated with the axon.

### Types of neurons

There are three main patterns of neurons according to the arrangement of the axon and dendrites in relation to the cell body.

(1) Multipolar neurons – numerous dendrites project from the cell body. The dendrites may extend from all parts of the cell body or from one pole of the cell body. Most nervous in the body are multipolar.

(2) Bipolar neurons – have only a dendrite which arises from the pole of the cell body opposite to the origin of the axon. They are usually found in the olfactory epithelium, retina and vestibulocochlear apparatus.

(3) Pseudo – unipolar neurons – a single dendrite and the axon arise from a common stem of the cell body. They are located in the dorsal root ganglion and in the cerebro-spinal ganglia.

### Fibers and Tracts

The term “fiber” is applied to any long process, whether it be an axon or a dendrite. From a practical point of view stand point the term “fiber” is most useful since in many instances one cannot distinguish histologically between axons and dendrites. However, the peripheral process of sensory neurons is often classified as a dendrite because it conducts impulses toward the cell body.

Within the CNS, cell bodies are found in grey matter. The fibers are found both in the grey matter, and in the white matter. In many parts of the white matter, the fibers are group of neuronal processes that form discrete bundles whose origin and destination are known. In this case, they are referred to as tracts. this is especially true in the spinal cord.

### Histology of Neuron

In the perikaryon region, the cytoplasm, axon hillock, nucleus and nucleolus are seen. The process of the neuron are not stained very well except with a special stain.

Neurons are held together by supporting cells, throughout the CNS, called neuroglia. Neuron and neuroglia are both derived from the ectoderm.

There kinds of neuroglia are present: astrocytes, oligodendrocytes, and microglia. Microglial cells are capable of phagocytic activity. They probably develop from mesoderm. Astrocytes and oligodendrocytes are often spoken of as supporting cells providing structural support. Their general function is the exchange of metabolites between neurons and vascular system. The cells which line the cavity of the central nervous system are epithelial-like and are called ependyma.

Within the PNS, cell bodies are located in ganglia; the nerve fibers constitute the conducting components of the nerves. The fibers are surrounded by a thin cellular tube called the neurilemma or schwann cell. In most cases, the cell membrane of the schwann cell is modified to form an additional cover of nerve fiber called myelin. Nerve fibers which have such a cover are referred to as myelinated; fibers without a myelin cover are called non myelinated (fibers that go to the viscera are unmyelinated).

Schwann cells are derived from the neural crest. The peripheral nerves have several coverings, of which the schwann cells constituent is most intimately related to the axons. Aside from the schwann cells, there are 3 c. t. coats; an epineurium, perineurium and endoneurium. An epineurium, made up of dense fibrous c.t encloses the entire nerve as in a sleeve (this covering is sufficiently thick to be sutured in operation involving nerve repair) Within the epineurium the axons of the nerve are formed into longitudinally running bundles, or fasciculi, of variable SIZE. These fasciculi are also enclosed in a sleeve of moderately dense fibrous c. t called the perineurium. Within the perineurium the axons and their associated schwann cells are surrounded by a small amount of delicate, loose c.t known as the endoneurium.

### Drawing and Label

Transverse section of a medium sized peripheral nerve

### **Ganglia**

Ganglia are ovoid structures containing neuronal cell bodies and glial cells supporting by c.t in the PNS. Because their serves as relay stations to transmit impulses, one nerve enters and another exist from each ganglion. The direction of the nerve impurse determines wheteher the ganglion will be a sensory or an autonomic ganglion.

### Sensory Ganglia

Sensory ganglia receive afferent impulses that go to the CNS. Two types of sensory ganglia exist. Some are associated with cranial nerves (cranial ganglia); others are associated with the dorsal root of the spinal nerves (spinal ganglia). The spinal ganglia comprise large neuronal cell bodies with prominent fine Nissl bodies surrounded by abundant small flattened glial cells called satetile cells.

A connective tissue frame work and capsule support the ganglion cells. The neurons of these ganglia are pseudounipolar and relay information from the ganglion's nerve endings to the gray matter of the spinal cord via synapses with local neurons

### Autonomic ganglia

Autonomic ganglia appear as bulbous dilatations in autonomic nerves. Some are located within certain organs, especially in the walls of the digestive tract, where they constitute the intramural ganglia. These ganglia are devoid of connective tissue capsules, and their cells are supported by the stoma of the organ in which they are found.

Autonomic ganglia usually have mutipolar neurons and neuronal perikarya with fine Nissl bods

The neurons of autonomic ganglia are frequently enveloped by a layer of satellite cells. In intramural ganglia, only a few satellite cells are seen around each neuron. Afferent nerve endings are associated with sensory receptors while efferent nerve endings are associated to the muscle.

### Central Nervous system

The CNS consists of the cerebrum, cerebellum and spinal cord. It has virtually no connective tissue and is therefore a relatively soft gel-like organ.

When sectional, the cerebrum, cerebellum and spinal cord show regions of white matter and gray matter. The differential distribution of myelin in the CNS is responsible for these differences. The main component of white matter is myelinated axons and the myelin-producing oligodendrocytes. White matter does not contain neuronal cell bodies.

Gray matter contains neuronal cell bodies, dendrites, and the initial ininyelina portions of axons and glial cells. Gray matter is prevalent at the surface of the cerebrum and cerebellar cortex, when white matter is present in move central regions

Aggregates of neuronal cell bodies forming islands of gray matter embedded in the white matter are called nuclei.

In the cerebral cortex, the gray matter has six layers of cell with different forms and sizes. With H & E staining technique, only the nuclei of cortical neurons can be identified. The cell layers become evident only after selective staining of sections. The six layers of cell in the cerebral cortex from without inwards are:

- (i) The plexiform or molecular layer. This consists largely of fibers, most of which travel parallel to the surface and relatively few cells.
- (ii) the layer of small pyramidal cells (or outer granular layer). This consists mainly of small cells, many of which have a pyramidal shape.
- (iii) The layer of medium pyramidal cells (or layer of outer layer pyramidal cells (or layer of outer layer of pyramidal cells). This layer is not sharply marked from layer II. However, the cells are somewhat larger and possess a typical pyramidal shape.
- (iv) The granular layer (or inner granular layer). This is existed by the presence of many small satellite shaped cells (granule cells) (or
- (v) The layer of large pyramidal cells (or) inner layer of pyramidal cells. This layer contains pyramidal cells which, in many parts of the cerebrum, are smaller than the pyramidal cells of layer III, but which, in the motor area, are extremely large and referred to as Bet z cells.
- (vi) The layer of polymorphic cells. This layer contains cells with diverse shapes, many of which have a spindle or fusiform shape. These cells are called fusiform cells.

Neurons of some regions of the of the cerebral cortex register afferent (sensory) impulses; in other regions, efferent (motor) neurons generate motor impulses that control voluntary movements. Cells of the cerebral cortex are related to the integration of sensory information and the initiation of voluntary motor responses.

## Cerebellum

The cerebellar cortex form a series of folia supported a biometry cerebellar cortex is more or less the same in appearance, regardless of which region is examined.

The cerebellar cortex has three layers

- (I) An outer molecular layer (or plexiform layer
- (II) A central layer of large Purkinje cells which are characteristic of the cerebellum
- (III) An inner granular layer.

The Purkinje cells have a conspicuous cell body and their dendrites are highly developed (These dendrites occupy most of the molecular layer and are the reason for the sparseness of nuclei). The granular layer is formed by very small neurons in contrast to the less cell-dense molecular layer.

## Spinal cord

In cross sections of the spinal cord, white matter is peripheral and gray matter is central, assuming the shape of an H. In the horizontal bar of this H is an opening, the central canal, which is a remnant.

## Drawing and labeling

of the embryonic neural tube. It is lined by epidermal cells. The gray matter of the legs of the H forms the anterior horns. These contain motor neurons whose axons make up the ventral roots of the spinal nerves. Gray matter also forms the posterior horns (the arms of the H), which receive sensory fibers from neurons in the spinal ganglia (dorsal roots).

Spinal cord neurons are large and multipolar especially in the anterior horns, where large motor neurons are found.

## Hippocampus

The hippocampus is one of the primitive or early parts of the cerebral cortex. The hippocampus itself is an area of primitive motor cortex, very ancient phylogenetically, which has been rolled into the floor of the lateral ventricle.

The hippocampus seems to control the motor pathways which express emotion. Olfaction and emotion can strongly be linked. Furthermore the projection of the hippocampus to the cerebral cortex appear to be concerted with emotional drive required for memory. The hippocampus also has rich projections onto the hypothalamus.

Destruction of the hippocampus in cats produces signs of rage. Possibly the hippocampus normally inhibits the rage reactions of the hypothalamus.

The hippocampus is particularly involved in rabies, and this may account for the rage of the rabid dog. Therefore, gross sections are taken of the hippocampus from most animals in which rabies is suspected at PM.

Histologically, such suspected samples may demonstrate Negri bodies intracytoplasmic inclusion bodies in the neurons, which are pathognomonic for rabies.

In general, 4 layers are identifiable

- (i) The molecular layer
- (ii) The layer of pyramidal cells

- (iii) The layer of polymorphic cells
- (iv) The Alveus