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Brain in Vertebrates

All the multicellular organisms particularly vertebrates develop a very effective system to receive and transmit the stimuli, to co-ordinate and controls the different activities of the organism which is called as nervous system. The brain is the main and anterior most part of the central nervous system.

In response to the aggregation of sense organ in the head region the brain becomes enlarged and differentiated to a varying degree. The first step in the differentiation of the brain is that

- (i) the mid-dorsal ectoderm form a longitudinal thickening called as neural plate.
- (ii) The neural plate sinks downwards while its edges grow upwards to form neural fold which grow towards each other and fuse to form neural tube.
- (iii) The anterior most wider/thickened part of neural tube called encephalon becomes moulded into three dilated lobes called primary cerebral vesicles. Of these vesicles, the upper is called prosencephalon (Forebrain), the middle is called mesencephalon (mid brain) and the hind one as rhombencephalon (hind brain).
These three primary vesicles give rise to various parts of the brain by thickening and folding etc.
- (iv) The adult brain has also a series of cavities called ventricles filled with cerebrospinal fluid.

Prosencephalon

Telencephalon → cerebral hemisphere, olfactory lobe, corpus striatum, pallidum, olfactory bulb.

Diencephalon → epithalamus, thalamus, hypothalamus and appendages.

Mesencephalon - optic lobe, crura cerebri.

Rhombencephalon

Metencephalon - cerebellum, medulla oblongata

Myelencephalon - part of medulla oblongata.

Meninges :

Meninges are protective membranous wrapper made up of connective tissue which surrounds the brain and spinal cord. The complexity of the meninges increases with the advancement of lower to higher group of organisms.

In fishes, meninges consists of a single membrane - primitive meninx (meninx primitiva), in amphibians, reptiles and birds meninges include a thick, outer dura mater of mesoderm and a thin secondary meninx (pia mater) while in mammals it consists of ^{outer} dura mater, median ^{web like} arachnoid and inner pia mater.

The ventricles, subarachnoid space and subdural space are filled with cerebrospinal fluid. The primary source of this fluid is choroid plexus projects into ventricles at specific sites.

[The average human has about 150ml of cerebrospinal fluid that is replaced several times per day, flushing the CNS. The recent speculation suggest that it might carry chemical messages important in regulating the organism's daily circadian rhythm.]

Brain in different vertebrates :

In Cyclostomata :

(i) The primitive ^{fore brain} (prosencephalon) becomes differentiated into telencephalon and diencephalon, the mid-brain continues as the mesencephalon and the original hind brain divides into metencephalon and myelencephalon, but all these divisions are not well marked and is without marked flexure.

(ii) The telencephalon is small consisting paired olfactory lobes and weakly differentiated corpora striata.

The cerebral hemisphere are small with rudimentary ventricles. The two sides of the brain are connected by anterior commissure in the region of lamina terminalis. The diencephalon forms small infundibulum and thalami (Pineal organ). The epithalamus is connected to pineal organ by a pair of habenular ganglia.

(iii) The optic lobes are one pair with large optic ventricle. The roof of the mesencephalon consists of choroid plexus.

(iv) In Petromyzon, the metencephalon include small transverse band like cerebellum but no pons, while in Myxine both are absent. The myelencephalon or medulla oblongata is well developed and has the 4th ventricle with its roof is vascular and differentiated as the choroid plexus.

In Elasmobranch :

(i) Brain is large and compact and well differentiated

(ii) Olfactory lobes are well developed and connected

with the cerebrum by stalks called olfactory peduncle or tracts.

(iii) Cerebral hemispheres large and anteriorly joined across midline. Their thickened roof is termed as pallium while the ventro-lateral wall as corpora striata. Its posterior margin is marked by a transverse velum above and by the pre-otic recess below. Cerebrum has two lateral ventricle.

(iv) The roof of the diencephalon forms anterior choroid plexus and also bears an elongated pineal body which often penetrates the roof of the skull. Parietal organ is absent. Infundibulum is distinct bearing hypophysis. Two lobi inferiores are present on the sides of infundibulum and two vascular sensory lobes called sacculus vasculosus also present posterior to lobi inferior.

(v) The mesencephalon has two large bilateral optic lobes. Its floor form crura cerebri. choroid plexus absent.

(vi) Cerebellum is large, its upper surface is divided into lobes by narrow grooves forming vesiform bodies called corpora vesiformia.

(vii) The roof of the medulla oblongata provided with choroid plexus.

(viii) Ventricles are well developed in most of the elasmobranch, but in some cases lateral and 3rd ventricles are not well marked.

(ix) 10 pairs of cranial nerves developed from brain.