STUDIES ON ARCHITECTURAL BIOLOGY OF THE BRAIN OF THE FISH CHANNA ORIENTALIS (SCH)

M.T. Nikam
Department of Zoology, Shri Shivaji Science and Art College, Chikhli, Buldhana District, MS, India

ABSTRACT

Air breathing fishes have a unique position in fishing industry due to their hardy nature and easy maintenance. Channa genus is widely distributed and has resulted in many different designs for special mode of life. Brain is the principal organ of the fish body coordinating various activities and helping the animal to communicate with the environment. The study of fish brain was completely ignored till sixteenth century. The brain is divisible into the prosencephalon, the mesencephalon and the rhombencephalon. The facial lobes are well developed. The development of facial lobes shows its importance in carnivorous fishes. The optic tectum is well developed and it is associated with the reception and elaboration of visual sensations and correlates them with the muscular response of the animal.

***Keywords**: Brain, Channa orientalis, histology, facial lobes, optic tectum*

Introduction

Brain is the principal organ of fish body coordinating various activities and helping the animal to communicate with the environment. The study of the fish brain was completely ignored till 16th century.Brain organisation in the cartilaginous fishes was shown by North Cutt et. al (1978). The telencephalon and reproductive behaviour in teleost macropodus opercularis was observed by Davis et al (1981). Organisation of the nervous system of fishes in relation to locomotion was described by Roberts (1981). Vanegas (1981) studied the optic tectum of lower vertebrates.

The work of Meader (1939); Mukharjee et al. (1950); Pearson and Pearson (1976); Khanna and Singh (1966); Saxena (1967); Srivastava et al. (1977); Singh and Khanna (1978); Chaudhary, (1987); Kabra (1988); Mankar (1993); and Sharma (1995) gave special attention on the brain of fishes. A number of researchers Sinha (1964); Pandey et al. (1994, 1995) have contributed to our knowledge of cranial nerves of different fishes. Channa orientalis was selected to carry out studies on brain.

Material and Methods

The live fishes were brought to the laboratory. Then they were Pithed. The brain was taken out from cranial cavity after breaking the neurocranium by handling with soft brush to avoid any damage to the tissue. Then the dorsal and ventral sides of the brain were observed. Specimens were fixed in 90% alcohol. Abdomen of the fishes were cut open after making few bores in the head region in order to allow better penetration of fixative.

Results and Discussion

The brain of Channa orientalis is housed in the cranial cavity which is filled with a gelatinous fluid. The brain is divisible into three divisions, the prosencephalon, the miesencephalon and the rhombencephalon. The prosencephalon includes the telencephalon and the diencephalon; the mesencephalon, the optic lobes and the rhombencephalon, the metencephalon and the myelencephalon.

Telencephalon

The telencephalon consists of two large spherical solid bodies called cerebral hemispheres, which do not meet each other in the mid-dorsal line as they are separated by a median deep groove. But for the slight swelling along the median groove seen posterior-dorsally. They are very smooth ventrally. From the cerebral hemispheres projects a pair of tiny solid olfactory lobes each of which is small and oval giving out an olfactory nerve anteriorly. The alfactory lobes do not meet each other.

Diencephalon

The diencephalon ventrally shows a good development. Ventrally it gives rise to the infundibulum, which is produced posterolaterally into a pair of prominent lobes, lobí-inferiors. The infundibulum carries a short slit along it mid ventral line, which is covered

by the oval shaped pituitary body. The pituitary body is small and attached to the infundibulum from underside by nerve strand.

Mesencephalon

The mesencephalon represents the mid brain and consists of the two large rounded optic lobes, given off dorsa-laterally from the dorsal floor. The lobes are separated and slightly diverted posteriorly outwards forming a triangular space between them in which lies a small median body – Valvula cerebelli. From the antero-ventral end of the optic lobes arise optic nerves, which pass forward and cross each other in front of the infundibulum without forming any chiasma. The optic nerve is a thick strip. The metencephalon represents the anterior portion of the hindbrain and consists of the cerebellum and valvula cerebelli, both arising medially from its roof. **Fig. (1)**

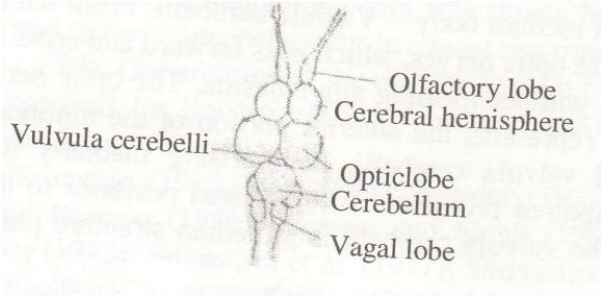

Fig 1

The cerebellum is an unpaired prominent lobe situated posterior to the optic lobes and valvula cerebella. The valvula cercbelli is a median structure placed in front of the cerebellar stalk

Myelencephalon

Myelencephalon represents the posterior portion of the hindbrain and the formed of medulla oblongata bearing dorsally two pairs of thick swellings, the facial and vagal lobes. The facial lobes are paired small bodies marked off from the dorsolateral walls of the Myelencephalon. Anteriorly these are joined together by a transverse mass. Posterior to the facial lobes are the vagal lobes. These are not prominent and are given off from the dorsal wall of myelencephalon. A middorsal groove is present between these lobes. The facial and vagal lobes enclose an oblique cavity between them.

Histology of Brain

Histological optic tectum of midbrain showed four distinct zones. The outermost zone has bandles of nerve fibres called stratum fibrosum marginalae. The second layer consist of intercalated cells, blood capilaries and blood carpuscles called as stratum, grisum centrilae. The third layer stratum fibrosum profundum showed alternate light and dark bands and the innermost layer has irregularly arranged ependiymal cell with basophilla (Fig. 2).

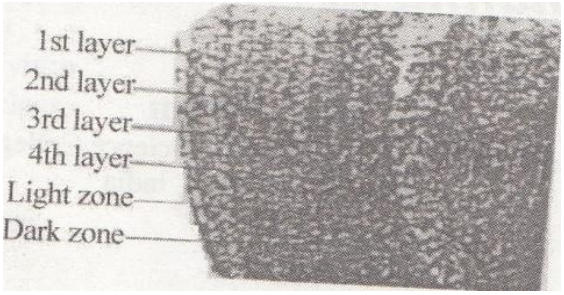

Fig. 2

Srivastav et al. (1977) observed small bilobe d olfactory lobes in Chandanama. Khanna and Singh (1966), Saxena (1967) presence of alfactory lobe: in carnivorous fishes. In Channaorientalis the optic lobes are tiny and solid.

According a Shrivastav et al., (1977); Sharma (1995), bilobed cerebrum is present in Chanda nama, Sciaena coiter, Labeopungasia. A pair of solid elongated telancephalic lobes are found in Noemacheilusr upicola (Singh and Khanna, 1978). In the fish Channa orientalis two large spherical solid cerebral hemispheres are present.

Diencephalon

In Noemacheilusr upicola, Chanda nama, Labeo dero and Labeo pungasia consists of infundibulum (Shrivastav et. al. 1977 and Sharma, 1995); But in the present work infundibulum with a pituitary body is observed (Fig. 3).

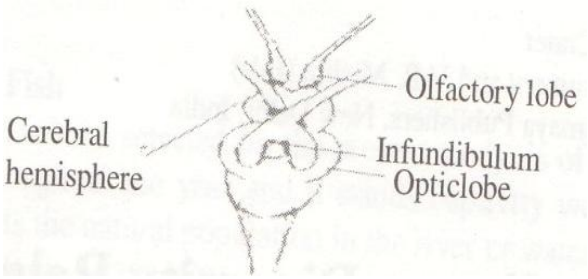

Fig. 3

A pair of small optic lobes were reported by Singh and Khanna (1978). Metencephalon or cerebeelum is well developed in Labeo demo (Sharma, 1995). The presence of large vulvula cerebelli of cyprinoid type in N. rupicola (Singh, 1970) shows well developed gustatory sense and the active habits of the fish (Khanna and Singh, 1966). Hindbrain of Channaorientalis is showed unpaired cerebellum and vulvula cerebelli as noted in the present work. The better development of facial lobes reveals the importance of the interior part of the buccopharyngeal cavity in carnivorous fishes (Srivastav et al., 1977)

References

1. Ariens Kappers, Huber G.C. and E.C. Crosby, (1967). The comparative anatomy of the nervous system of vertebrates including man. Vol 1-3, Hafner Publication co-Newyork, U.S.A.
2. Choudhary M.V. 1987. Effects of Pesticides Contamination of Fresh Water Eco-system on Rasbora Daniconius (Hamil) Ph.D. thesis submitted to Amravati University, Amravati.
3. Davis, R.E.,J.Kassel and M.Martinez (1981): The telencephalon and reproductive behaviour in the teleost Macropodus opercularis (L) ;effects of lesions on the incidence of spawning and egg cannibalism, in Brain Mechanisms of behaviour in Lower Vertebrates, Laming, P.R.ed.Cambridge University Press 239-255
4. Khanna and Singh 1966. Proceedings Nat Aew Su India 36 B (III) 306-316
5. Mankar C.R. 1992. Toxicity and Physiological Impact of Three Selected Pesticides on Channa Orientalis (sch) Ph.D. thesis submitted to Amravati University, Amravati.
6. Meader, R.G. 1939. The Forebrain of Bony Fishes Brain Res. Amsterdam, 2:657-669
7. Mookerjee, Ganguli and Meekeji 1950. Study on the Structure of the Brains of Some Indian Fishes in Relation to their Feeding Habits Proceedings Zool. Soc. Beng; 5: 119145
8. North Cutt, R. G. , Neary, T. J. And Senn, D. G. (1978) : observation on the Brain of Coelacanth Latemaria chalumnae : external anatomy and quantitative analysis. J. Morph. 155, 181 – 192.
9. Peanson K. L. and Peanson 1976. The Vertabrate Brain Acad Press London,
10. Pandey, A. K. And K. Pandey (1994) : Biochemical Estimation of lipid in liver and muscle of some fresh water fishes. Environ. & Eco. 12(4) : 880 – 883.
11. Pandey, K.C., s. H. Singh and Yogesh kumar (1995): Cranial nerves of Labeo rohita (Ham.) Uttar Pradesh J. Zool. 15(3) : 199 – 203.
12. Sinha, B. M. (1964) : Cranial nerves of Wallago attu. Proc Nat. Acad Sci. India 34:42-48.
13. U.K. Saxena P.K. 1967. The Cranial Nerwes of Mudeet, MphinousCuchla (Ham) Acta Anat 67: 306-320
14. Sharma S. N. 1995. Variations in the Morphology of the Brain of Four Species of Fish in Relation to Feeding Behaviour - Environ and Elo, 13(3): 669-67)
15. Sherekar P.Y. 1986. Some Physiological Aspects of the Fish Channa Orientalis (Sch) Exposed to Pollutants Ph. D. thesis submitted to the Amravati University, Amravati •
16. Shrivastava, G. J., V.M.S. Srivastava, and P. K. Gupta 1977. Brain in Relation to Feeding Hobbits in Two Fishes Geobios. 5: 57-61.
17. Singh, H.R. and S.S. Khanna 1978. Correlation of Habit and Structure of the Brain in Neomacheilus Rupicola (Hora). Proceedings Nat Aead. Su. India, 48(B): IV 189-192
18. Vanegas , H(1981); The teleostean optic tectum ; neuronal substrates for behavioural mechanisms, in Brain Mechanisms of behaviour in lower vertebrates , Laming , P.R. ed . Cambridge University Press113-121