Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 92, Number 2, March 1983, pp 115 – 119.

Taxonomic value of torus longitudinalis and valvula cerebelli in four species of *Amblypharyngodon* Bleeker (Pisces, Teleostei, Cyprinidae)

N BABU* and N BALAKRISHNAN NAIR

Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum 695 007, India

*Department of Zoology, University College, Trivandrum 695 034, India

MS received 2 November 1982; revised 17 January 1983

Abstract. The configuration of valvula cerebelli and torus longitudinalis shows distinct variations at the level where the tractus mesencephalocerebellaris posterior establishes full connection with the granular valvula in the four species of *Amblypharyngodon*. The taxonomic value of the configurational variations of mesencephalon of the four species has been discussed.

Keywords. *Amblypharyngodon chakaiensis*; torus longitudinalis; tractus mesencephalo cerebellaris; valvula cerebelli; taxonomic value.

1. Introduction

Various taxonomists have attempted to use brain morphology as a taxonomic character to identify phylogenetic affinities (Lissner 1923; Svetovidov 1953; Uchihashi 1953; Uchihashi and Tsuge 1953; Yamaguchi 1961; Miller and Evans 1965). Lissner (1923) proposed a scheme of classification using the brain patterns and finally concluded that ecological factors have such a profound influence that brain lobes could not be used in classification. According to Kuhlenbeck (1975) the configuration of the ganoid and teleostean mesencephalon displays more (taxonomically-related) variations than that of elasmobranchs. In teleosts particularly, wide differences in external morphology and internal structural arrangements are manifested. Recently Tandon and others (Tandon 1978, 1980; Tandon and Kaur 1979) showed that the configuration of the tori longitudinales and valvula cerebelli at the level where the tractus mesencephalo-cerebellaris posterior establishes a full connection with the granular valvula is of some taxonomic importance in the light of the studies on *Barilius* and *Channa*. According to Ariens Kappers *et al* (1936) this tract arises in the nucleus lateralis valvulae. In this paper the utility of these observations has been assessed in species of *Amblypharyngodon*.

2. Material and methods

Live fish were brought to the laboratory and anaesthetised. The entire brain was dissected and fixed in aqueous Bouin's fluid. Paraffin sections (6-8 μ thickness) were cut and stained with Heidenhains iron haematoxylin and counterstained with alcoholic eosin. Ten specimens (5 male and 5 female) of each of the four species were studied.

The specimens measured 85 ± 1 mm in total length and were of comparable state of maturity *viz.* maturing stage.

3. Results

The tori longitudinales arise from the central grey zone of the optic tectum, the two tecta are connected by an intertectal commissure which passes over the tori and some fibres of the commissure may terminate in the mass of the tori. The tori hang in the optocoel. The configuration of the tori and valvula cerebelli at the level where the tractus mesencephalo-cerebellaris posterior establishes full connection with the granular valvula varies in the species of *Amblypharyngodon* and the details of the observations are presented below.

3.1 *Amblypharyngodon mola* (*Ham*) (*figure 1*)

The tori are small, triangular in shape and are widely separated from each other. The base of the tori is separated from the periventricular layer by the intertectal commissure. The optocoel between the tori and valvula cerebelli is quite wide.

The valvula consists of granular and molecular valvula. The granular valvula covers molecular valvula laterally and ventrally. On the ventral side the granular valvula is discontinuous at the point where there is a furrow extending to the centre of the central molecular valvula. The central molecular valvula is circular and the lateral molecular valvulae, resembling the distal segment of the human thumb, projects inwards leaving no vacant space between them.

3.2 *Amblypharyngodon microlepis* (*Bleeker*) (*figure 2*)

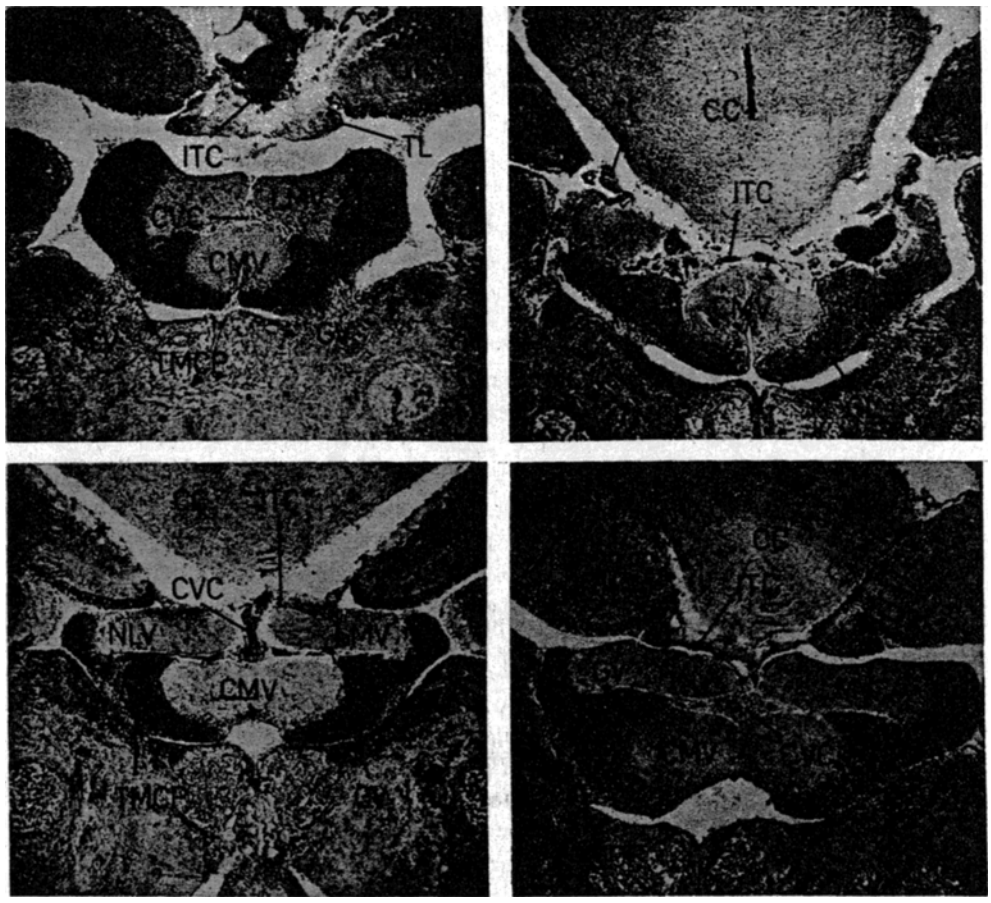
The tori appear like patches of granular matter and are separated very widely from each other and the periventricular layer by a thin intertectal commissure. The optocoel between the tori and valvula cerebelli is narrow and limited to the ventrolateral side and the intertectal commissure is closely placed on the valvula leaving no part of the optocoel between them.

The valvula is better developed in this species than in *A. mola* and is 'V' shaped. The granular valvula is dominant and covers the molecular valvula on the ventrolateral sides. The inward growth of the granular valvula is very prominent. The central molecular valvula is approximately double the size of the lateral molecular valvula which has no inwardly projecting process. Consequently the dorsal boundary of the *Cavum cranii* is placed further up and is formed of a thin intertectal commissure. The lateral molecular valvula is triangular in shape with rounded corners.

3.3 *Amblypharyngodon melettinus* (*Cuv. and Val.*) (*figure 3*)

The tori do not extend up to the level where tractus mesencephalo-cerebellaris posterior establishes full connection with the granular valvula. This is a unique feature of *A. melettinus.* The intertectal commissure is closely placed on the valvula leaving no space between them.

The molecular valvula is differentiated into a central bilobed molecular valvula and thick rectangular lateral molecular valvula and between them lies the *Cavum*



Figures 1-4. Transverse section passing through the region where the tractus mesencephalo-cerebellaris posterior establishes full connection with the granular area of the valvula cerebelli in the four species of *Amblypharyngodon* × 300. **1.** *A. mola* (Hamilton). **2.** *A. microlepis* (Bleeker). **3.** *A. melettinus* (Cuv. and Val.). **4.** *A. chakaiensis* (Babu and Nair).

Abbreviations

CC—Corpus cerebelli; CMV—Central molecular valvula; CVC—*Cavum cranii*, GV — Granular valvula; ITC — Inter tectal commissure; LMV — Lateral molecular valvula; NLV — Nucleus lateralis valvulae; OT — Optic tectum; TL — Torus longitudinalis; TMCP — Tractus mesencephalo-cerebellaris posterior

cranii. The granular valvula as usual covers the molecular valvula on the ventrolateral sides leaving a gap at the mid-ventral position and in addition by a thin layer on the dorsal side of the valvula.

3.4 *Amblypharyngodon chakaiensis Babu and Nair (figure 4)*

The tori are small triangular pieces widely separated having a very narrow cavity of the optocoel between them and the valvula cerebelli. The tori are separated from the periventricular layer by a prominent intertectal commissure. The intertectal commissure

has a downward projecting conical process pointing towards the median gap between the lateral molecular valvulae.

The valvula leaves a conspicuous space of the optocoel ventrally. The granular valvula has a very prominent inward growth which separates the central molecular valvula from the lateral molecular valvula. The *Cavum cranii* is well marked. The central molecular valvula is a bilobed structure with the lateral molecular valvulae rod-shaped.

4. Discussion

Svetovidov (1953) supported the idea that brain patterns could be used as diagnostic characters in a number of systematic groups. He also believed that in comparative studies among species from distantly related groups ecological influences on the brain lobes are 'over-shadowed' by differences caused by peculiarities of the brain. Miller and Evans (1965) suggested that extreme caution must be exercised in using brain pattern alone to indicate phylogenetic affinities. They showed that brain patterns in *Thoburnia rhothoeca* and *Pantosteus delphinus* are similar because of parallelism in habit preference and feeding behaviour although they belong to different types of *Catastomidae*. Uchihashi (1953) and Uchihashi and Tsuge (1953) related that in teleostei ecological differences strongly influence the external shape of the brain. The present study on *Amblypharyngodon* reveals that there are conspicuous variations in the configurations of the torus longitudinalis and valvula cerebelli even in closely-related species exhibiting parallelism in habitat preference and feeding behaviour. In this case ecological influences are not seen to obscure the diversity caused by peculiarities of the brain. According to Miller and Evans (1965) comparison of brain patterns appears to be most useful taxonomically at the subfamily or tribe level, though they are instructive in numerous cases at the generic and specific levels. But Svetovidov (1953) identified only distantly-related groups based on the peculiarities of the brain. More information is required to raise the status of the configuration of the torus longitudinalis and valvula cerebelli at the level where the tractus mesencephalo-cerebellaris posterior establishes full connection with the granular valvula, as a taxonomic criterion to identify phylogenetic affinities. Till then we share the views of Tandon (1978) that the configuration of the above structures can be taken as additional parameters in establishing taxonomic relations.

A close scrutiny of the results of the present study suggests that of the four species studied, *A. mola* is the 'ancient species'. The comparatively poor development of the valvula cerebelli and the nature of the central and lateral molecular valvulae point to this conclusion. The similarity in the configuration of mesencephalic structures in *A. melettinus* and *A. chakaiensis* shows that these two species are closely related. Babu (1981) in his studies on the morphological peculiarities of the four species also arrived at the same conclusion. But *A. microlepis* exhibits very conspicuous configurational variations from the other three species. The nature of the lateral molecular valvula and its association with intertectal membrane are characteristic. On examining the morphological characters Babu (1981) observed *A. microlepis* to be the more specialized species.

Acknowledgements

One of the authors (NB) is thankful to the Head of the Department of Aquatic Biology and Fisheries, University of Kerala for necessary facilities and to the Director of Collegiate Education, Govt. of Kerala for the award of a teacher fellowship.

References

Ariens Kappers C U, Huber G C and Crosby E C 1936 *Comparative anatomy of the nervous system of vertebrates including man*; Vol. **3** (New York Hafner Publishing Co.)

Babu N 1981 *Studies on the genus Amblypharyngodon* Bleeker (*Pisces - Teleostei - Cyprinidae*) *from South India*; Ph.D. dissertation. University of Kerala, 520

Kuhlenbeck K 1975 *Central nervous system of vertebrates*; (New York: S Karger) Vol. **4**, 1006.

*Lissner H 1923 Das Gehrinder knochen fische; *Wiss. Meeresunters* N.F. 14 *Abt. Heg* **2** 127-188

Miller R J and Evans H E 1965 External morphology of the brain and lips of catastomid fishes; *Copeia* **4** 467-487

*Svetovidov A N 1953 Materials on the structure of fish brain, I. Structure of the brain of cod fishes; *Trudy. Zool. Inst. Akad. Nauk SSR*; B 390-419 (Ichthyological lab. Translation No. 3)

Tandon K K 1978 Tori longitudinales and valvula cerebelli as the basis of identification in fishes; *Curr. Sci.* **47** 600-601

Tandon K K 1980 Tori longitudinales and valvula cerebelli in three species of *Labeo*. *Curr. Sci.* **49** 369

Tandon K K and P Kaur 1979 Taxonomic value of the tori longitudinales and valvula cerebelli in *Channa punctatus* (Bloch) and *Channa marulius* (Ham.). *Curr. Sci.* **48** 511-512

Uchihashi K 1953 Ecological study of Japanese teleosts in relation to brain morphology; *Bull. Jpn. Sea Res. Fish Res. lab.* **11** 1-166

Uchihashi K and Tsuge H 1953 The correlation of the morphology of the Japanese teleostean brains and their ecological differences. *Proc. Annual meeting Zool. Soc. Jpn., Zool. Mag.* **62** 83

Yamaguchi M 1961 Taxonomic and ecological studies on the Japanese cyprinoid fishes on the basis of brain morphology; *Nagasaki Pref. Fish. Exp. Statn. 60th Anniv. Rep.* **1** 1-119

*Not consulted in original