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ORGANIZATION OF METENCEPHALON (CEREBELLUM) OF INDIAN HOUSE WALL LIZARD *HEMIDACTYLUS FLAVIVIRIDIS*

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ABSTRACT

Topological organization of the metencephalon (cerebellum) of Indian house wall lizard has been studied by Eager's method. The cerebellum is ill-developed in Indian house wall lizard *Hemidactylus flaviviridis*. The metencephalon (cerebellum) is located between the mesencephalon (mid brain) and myelencephalon (medulla oblongata). It is a narrow, flat and semicircular ridge. This covers the anterior dorsal surface of myelencephalon (medulla oblongata).

The section of rostral part of the metencephalon (cerebellum) has fasciculus longitudinalis medialis, nucleus interpeduncularis, pars ventralis, nucleus raphes superior and nucleus reticularis superior. The section of the caudal part of the metencephalon includes fasciculus longitudinalis medialis, locus coeruleus, nucleus interpeduncularis, pars ventralis, nucleus raphes superior and parabrachial region.

Keywords: Metencephalon, Organization, Eager's Method 1970

INTRODUCTION

The lizards are among the most commonly spotted of all reptiles. There are over 3500 different types of lizards existing in all climates throughout India. The walls and ceilings are their niche where they walk and live their lives. The house wall lizard *Hemidactylus flaviviridis* belongs to the family Gekkonidae of suborder Sauria or Lacertilia is second largest family of this suborder. It is said that lizards are poisonous except two species *Heloderma suspectum* and *Heloderma hornidum* are poisonous. The lizards are predator of insects hence they are useful for farmers and agriculture. These can be used for pest management.

In our present study the metencephalon (cerebellum) of rhombencephalon (hindbrain) region of the brain of *Hemidactylus flaviviridis* for better understanding of its anatomy and phylogenetic character has been presented.

MATERIALS AND METHODS

Ninety seven adult lizards, Sauria or Lacertilia of both sexes weighing 45 to 70 gms were used in this experiment. Animals were kept in the cage in the light and cool atmosphere at a room temperature (25 to 30°C). The experimental lizards were kept isolated in the separate cage from normal animal. Prior to the experiment, the specimens were acclimatized at room temperature for one day. Surgical procedures were performed with sterilized dissecting instruments. The specimens were anaesthetized by immersing with 10% formalin for 10 to 15 minutes prior to the surgery.

Operation Procedure

For perfusion, animals were anaesthetized with chloroform for 2 to 5 minutes. Completely anaesthetized lizard was kept in the operating tray. After fixing the lizard, a small longitudinal incision was made in the middle of the thorax (1cm). The rib cage was cut open right from the middle to expose the viscera. The thorax was opened to expose the heart. The pericardium was removed. Fine syringe of the perfusion set was inserted in the aorta through the posterior part of the ventricle. First of all 50 ml of physiological saline (0.75%) was allowed to pass through the aorta to the entire body, lower part of the ventricle was cut and blood was allowed to release. The whole blood of the body was replaced by physiological saline. One hundred ml. of fixative (10% formalin) was allowed to perfuse through the heart in continuation with

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saline. Precaution was taken to avoid the clotting of the blood which actually leads to incomplete perfusion. After the perfusion of the fixative, the animal become totally stretched. Following perfusion for about 15 minutes, the whole brain and spinal cord were dissected out and post fixed in the perfusion fluid at 4°C for twenty four hours. The brain and spinal cord were cut at 40 µm thick on AO HistoSTAT microtome at –20°C. The serial sections were put in section collecting trays containing 2 to 10% formaldehyde solution. For maintaining the serial orders only 5 sections were placed in each bin of the tray. The sections were processed with Eager's method (1970).

Perfusion

This method is conventional technique for preserving the whole animal body by pumping the fixative through the heart in to the whole body, via vascular system. The perfusion is performed by a simple infusion set. This technique works on the gravity flow principle. The perfusion bottle was kept three feet above to the operating table. The infusion set comprises to ordinary infusion set, a bottle with lid having two outlets, in one of them infusion needle was inserted and in other normal injection needle was inserted to avoid air lock. The infusion set comprises of plastic tube, an air column on both side, needle and a stopper.

RESULTS

The cerebellum is less developed in Indian house wall lizard *H. flaviviridis*. Anteriorly it associates with the midbrain. Posteriorly this joins with the medulla oblongata. This is a narrow, flat and semicircular ridge. It covers the anterior dorsal surface of myelencephalon (medulla oblongata).

The sections of cerebellum from rostral to caudal part includes fasciculus longitudinalis medialis (FLM), nucleus interpeduncularis, pars ventralis (IPV), nucleus raphes superior (RAS), nucleus reticularis superior (RS), griseum centrale (GC), lamina granularis cerebelli (GL), nucleus lemnisci lateralis (LL), nucleus reticularis superior, pars lateralis (RSL), nucleus reticularis superior, pars medialis (RSM), nucleus cerebellaris lateralis (CERL), locus coeruleus (LC) and parabrachial region (PB).

At the rostral most level to caudal most level of metencephalon and also caudal most to myelencephalon a small region of scattered cells is called as fasciculus longitudinalis medialis (FLM). The cells are small to medium star shaped. The exact boundary of this cell mass can not be made because of the scattered cells. There is no much change in the position and organization of this mass (Figs.1,2,3&4A&B).

The nucleus raphes superior (RAS) is demarcated in the whole metencephalic region of the rhombencephalon. It is situated ventrally to the fasciculus longitudinalis medialis (FLM), dorsally to the nucleus interpeduncularis, pars ventralis (IPV), medially to the nucleus reticularis superior (RS) and extends antero-posterior with tapering arrangement. It is almost oval in the shape. The nucleus interpeduncularis, pars ventralis (IPV) is situated ventro-laterally to the nucleus raphes superior (RAS). The cells of this nucleus are located in the whole metencephalic region. The nucleus reticularis superior (RS) is present on the dorso-lateral region of raphes superior (RAS) and ventro-lateral region of fasciculus longitudinalis medialis (FLM). This zone is situated at the level of the rostral part of the motor nucleus of V. This nucleus consists of small to medium sized cells and is divided into lateral part of reticularis superior (RSL) and medial part of reticularis superior (RSM). The cells of RSL are bigger in size as compared to RSM region (Figs.2,3A&B). The lamina granularis cerebelli (GL) is demarcated above the fourth ventricle (V-IV) (Fig.2A&B). The nucleus lemnisci lateralis (LL) is situated some antero-laterally to (RSL) in the ventral side (Fig.2A&B). The griseum centrale (GC) is located below the fourth ventricle (V-IV) and above the fasciculus longitudinal medialis (FLM) (Fig.3A&B). The nucleus cerebellaris lateralis (CERL) is demarcated laterally to the fourth ventricle (V-IV). It is located in to the medio-lateral part of the metencephalic region (Fig.3A&B). The parabrachial region (PB) is situated antero- laterally to the fourth ventricle (V-IV) (Fig.4A&B). The locus coeruleus

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(LC) is located laterally to the fourth ventricle (V-IV) and below to the parabrachial region (PB) (Fig.4A&B).

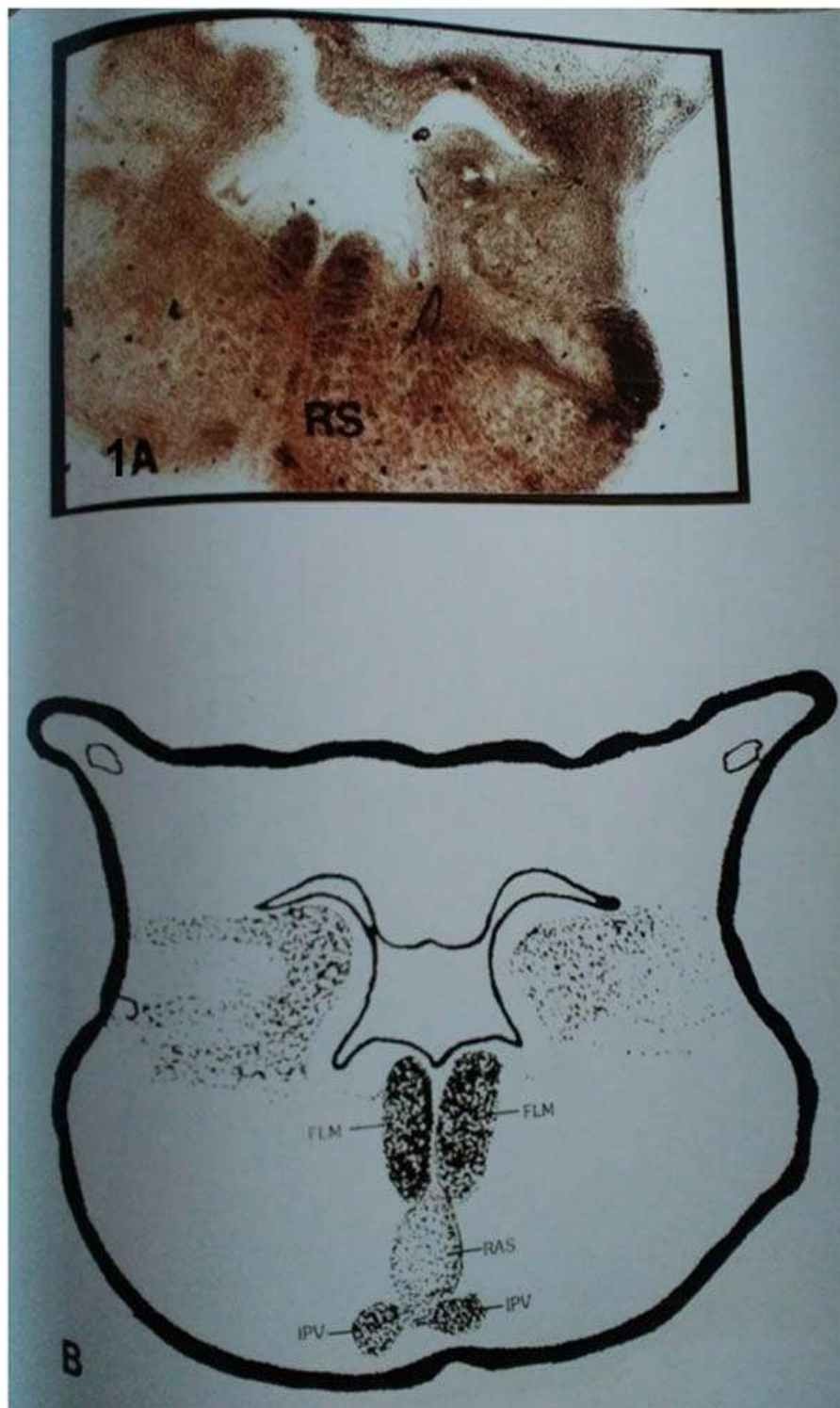


Figure 1A, B

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Figure 2A, B

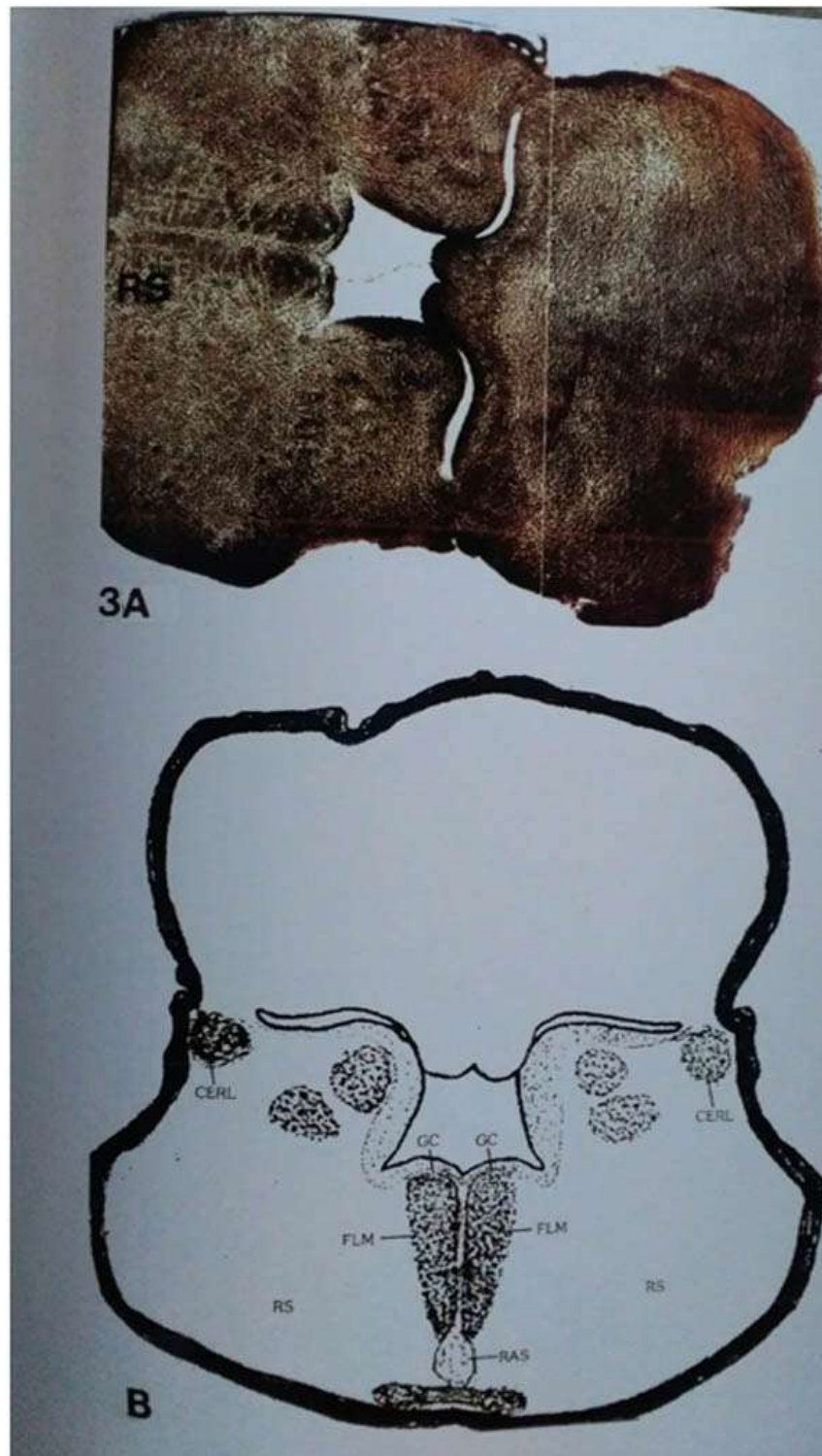


Figure 3A, B

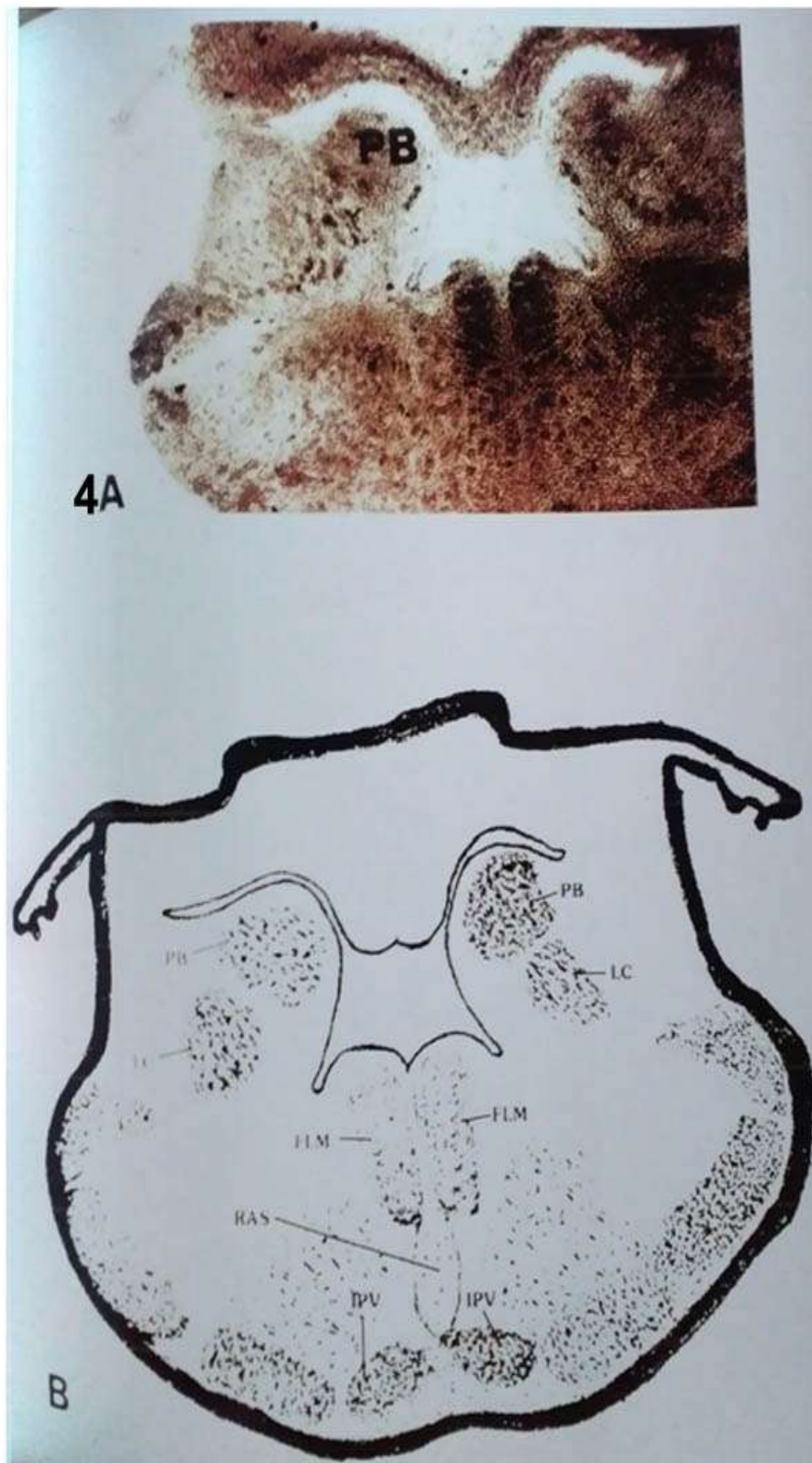


Figure 4A, B

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DISCUSSION

The metencephalon is weakly developed in Indian house wall lizard *H. flaviviridis*. Rostrally the metencephalon unites with mesencephalon. Caudally the metencephalon is connected with myelencephalon. The cerebellum is a narrow, flat and semicircular ridge. The metencephalon covers the anterior dorsal surface of medulla oblongata.

The sections of metencephalon from anterior to posterior portion has fasciculus longitudinalis medialis (FLM), nucleus interpeduncularis, pars ventralis (IPV), nucleus raphes superior (RAS), nucleus reticularis superior (RS), griseum centrale (GC), lamina granularis cerebelli (GL), nucleus lemnisci lateralis (LL), nucleus reticularis superior, pars lateralis (RSL), nucleus reticularis superior, pars medialis (RSM), nucleus cerebellaris lateralis (CERL), locus coeruleus (LC) and parabrachial region (PB).

Ariens Kappers & Hammer (1918) and Larsell (1923) carried out the investigations on the histological structure of the cerebellum of the frog with light microscopic technique mainly the Golgi impregnation and described the different types of the neurons and fibers of the cerebellum. Larsell (1923, 1924 & 1934) in a series of investigations paid his attention mainly upon the structure and histology of the cerebellum in the different anuran amphibians.

Newman and Cruce (1982) studied reticular formation of brain stem in 16 genera (11 families) of reptiles. It has been observed that reticular neurons in the crocodilians and snakes tend to be larger than those found in the lizards and turtles. It has been concluded that the reticular formation is simpler in older reptilian lineages and complex in more modern lineages.

Ten Donkelaar and De Boer-Van (1984) investigated the various descending components of the medial longitudinal fasciculus (FLM) in *Varanus exanthematicus* using horse radish peroxidase (HRP) technique. They described not only the interstitiospinal, reticulospinal and vestibulospinal components in *Varanus* but also made positional relations of the various fiber components within the FLM and found that results are comparable with that of mammals.

Bangma *et al.* (1984) studied the cerebellar efferent in *Varanus exanthematicus* and found both ascending and descending contralateral projections and concluded that such projections are common for terrestrial vertebrates.

Bangma and Ten Donkelaar (1984) described the corticonuclear projection in *Varanus*. They indicated that all the projections of the Purkinje cells appeared to be strictly ipsilateral and concluded that in reptiles a longitudinal organization of cerebellar corticonuclear projections exists, which may be basic for terrestrial vertebrates.

Ten Donkelaar *et al.* (1985) continued studies on *Varanus* and reported vestibular and internuclear components of fasciculus longitudinalis medialis (FLM). They studied vestibulo-oculomotor and vestibulospinal projections by multiple retrograde tracer technique.

The brain stem reticular formation has been studied in many species of reptiles (Newman and Cruce, 1982). They have found that reticular neurons in crocodilians and snakes are larger than those found in lizards and turtles. The reticular formation is divided into seven nuclei. A reticularis inferior (RI) is found in myelencephalon, a reticularis medius (RM) in the caudal two third of the metencephalon and a reticularis superior in the rostral metencephalon and caudal mesencephalon. Reticularis inferior can be subdivided into a dorsal and a ventral region. All reptilian species possess reticularis inferior (dorsal) and reticular medius but ventral portion of reticularis inferior is absent in turtles. These divisions are clearly observed in the present investigation on Indian house wall lizard but quite variable in appearance. The myelencephalic raphes nucleus is also quite variable in its morphology among the different reptilian families. A reticularis ventrolateralis observed in the present study is also found in snakes and teiid lizards. All the divisions and subdivisions of reticular formation have been topologically demarcated in the house wall lizard – *H. flaviviridis* which have been mentioned in observation, are comparable with mammalian species also.

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The mid line group of nerves extending from the level of lower midbrain to the level of lower rhombencephalon, called nucleus raphes observed in the present study is identical in other reptiles.

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