HISTOMORPHOLOGICAL STUDIES ON THE MOTOR DIVISION OF OCULOMOTOR NUCLEUS IN THE BUFFALO *(Bubalus bubalis)**

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Abstract

The morphology of the motor division of oculomotor nucleus in the buffalo has been described by materials collected from eight buffalos. Myelin stained serial and semi serial sections of brain stem were used for the study. The motor nucleus of oculomotor nerve was located ventral to the cerebral aqueduct in a wedge shaped trough formed by the medial longitudinal fasciculus. It extended from the level of junction of the rostral and caudal colliculi to the cranial third of the rostral colliculus. The average length, width and height of the motor nucleus in the buffalo were 8.1mm, 1.75mm and 2.75mm respectively. The motor nucleus in the buffalo was subdivided into a caudal central, dorsomedial, dorsolateral and ventral divisions.

***Key words**: Buffalo, Morphology, Oculomotor nucleus*

The morphology and cytoarchitecture of cranial nerve nuclei in the mesencephalon of the buffalo has received relatively little attention. An understanding of the functions of the body in health and disease demands a sound knowledge of the structures of the nervous system. In the course of certain diseases in which the central nervous system is involved, the nuclei of the brainstem in man exhibit degenerative lesions and even changes in their localization. It has been reported that domestication of animals has its influence on the topography of the nuclei of the brain and spinal cord .Knowledge regarding the morphological and cytoarchitectural details of the central nervous system lead to a better understanding of the evolution of the animal kingdom (Waldron, 1969). Awareness of anatomy of CNS also helps to understand animal behavior.

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The nucleus of oculomotor nerve belongs to general somatic efferent column and has a motor component that controls and coordinates the activity of extraocular muscles. In addition to this, the oculomotor nucleus has a visceral component belonging to the general visceral efferent column. It controls the pupillary light reflex and accommodation and functions as the parasympathetic component. The present investigation is undertaken to determine the morphology, extent and subdivision of motor division of oculomotor nucleus in the buffalo.

Materials and Methods

The material for the present study, brains of eight buffaloes, was obtained from the Corporation Slaughter House, Bangalore. The heads were collected immediately after slaughter and were perfused with 10 per cent buffered formalin through the common carotid artery till a clean fluid came out. Perfused heads were kept for two weeks in 10 percent buffered formalin. The cranium was broken carefully and the brain along with the brainstem were removed and preserved in 10 percent buffered formalin for a further period of two weeks. The brainstems were cut and processed for paraffin embedding.

Transverse serial sections of 20 µm thickness were prepared from six brains. The sections were stained with Weil Weigerts (Lillie, 1954) and Luxol fast blue (Luna, 1968) as myelin stain. One brain was used to prepare sagittal sections and one for horizontal sections. The rostrocacudal limits and shape of the motor division of oculomotor nucleus was studied in the transverse, sagittal and horizontal sections. The length and width of the nucleus was measured in horizontal sections with an ocular micrometer. The height of the nucleus was measured in sagittal and transverse sections.

Results and Discussion

Location and extent of the nucleus

The motor nucleus of oculomotor nerve (MNO) in the buffalo extended from the level of junction of the rostral and caudal colliculi to the cranial third of the rostral colliculus (Fig.5). The extent in man was up to the level of unpaired anterior portion of the parasympathetic nucleus of oculomotor nerve (Olszewski and Baxter, 1954) and in the cat it extended up to middle of parasympathetic nucleus (Taber, 1961). Hence the rostral extent of the nucleus in the buffalo was similar to that in the cat. In the buffalo the MNO in transverse sections was located in the mesencephalic tegmentum ventral to the cerebral aqueduct in a wedge shaped trough formed by the medial longitudinal fasciculus (Figs. 1, 2 & 3) which agrees with the location described by Paterson and Kaiserman-Abramof (1981) in normal and microphthalmic mice and by Tanaka *et al.* (1987) in rats. In the buffalo the MNO was related dorsally to the periaqueductal gray, ventrally and to MLF laterally. The red nucleus was located ventrolateral to the motor nucleus of oculomotor nerve (Fig. 2). The caudal pole of the nuclear complex made its beginning 1mm cranial to the pons and the rostral pole ended 3mm behind the mamillary body. In horizontal sections the MNO appeared very close to the midline (Fig. 4). The cranial pole of MNO was separated form the motor nucleus of trochlear nerve by about 2mm (Fig. 5).

Shape of the nucleus

In accordance with the findings in man (Olszewski and Baxter, 1954) and cat (Taber, 1961) the caudal pole of MNO in the buffalo appeared as a rounded body and the rostral part diminished gradually in its size, where only the ventral subdivision was present. The mid portion of the nucleus in the buffalo appeared as triangular in cross section with base directed dorsally and apex ventrally (Fig. 2). This observation was similar to the description of mid portion of the nucleus in man (Olszewski and Baxter, 1954) and in cat (Taber, 1961).

Dimensions of the nucleus

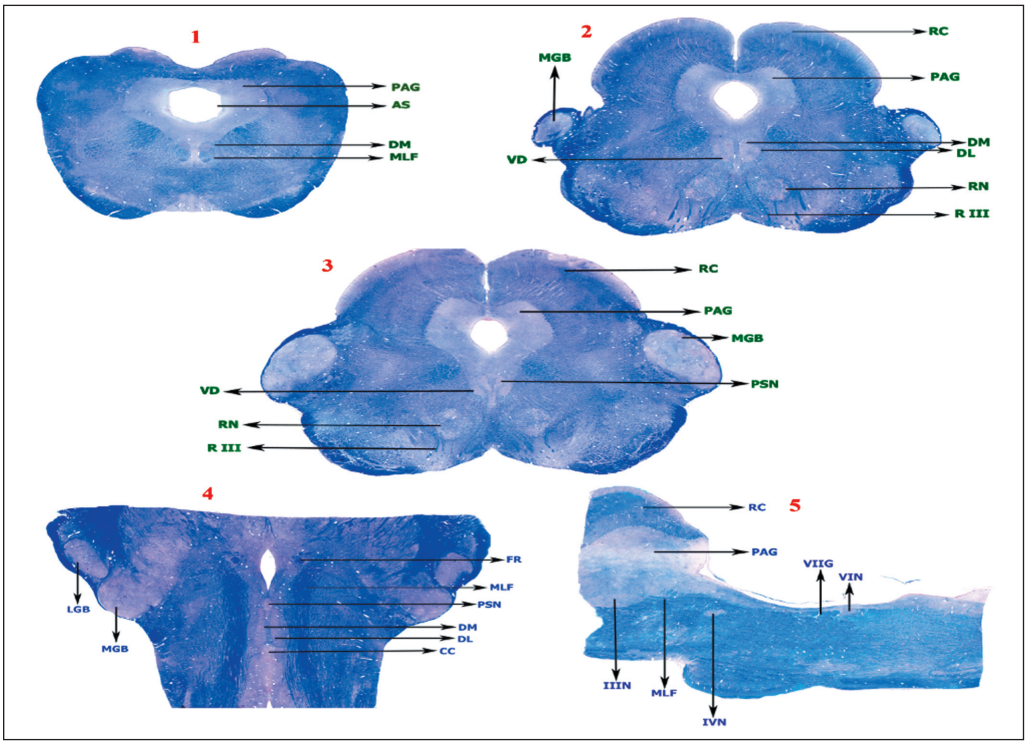
The average length, width and height of the MNO in the buffalo were 8.1mm, 1.75mm and 2.75mm respectively. Adogwa (1999) found that the motor nucleus of oculomotor nerve of the one humped camel was 2.4mm long, 0.7mm wide and 1.1 mm high. The average height of the nucleus exceeded average width

by 0.4mm in the one humped camel (Adogwa, 1999) whereas in the buffalo the difference was 1mm. In man (Olszewski and Baxter, 1954) the length of the nucleus was 5mm whereas in cat (Taber, 1961), it was 2.4mm long. Thus the present study revealed that the average size of MNO in the buffalo was larger compared to other animals which may account for the better mobility of the eyeballs in this species.

Subdivisions of the nucleus

The MNO in the buffalo was subdivided into a caudal central, dorsomedial, dorsolateral and ventral divisions. The caudal central division was unpaired and was located in the midline. In transverse sections the caudal central part made its appearance first, followed by dorsomedial, dorsolateral and ventral. Towards the rostral pole of the nucleus only the ventral subdivision was present (Figs. 1, 2 & 3). The subdivisions of the nucleus in the buffalo are in accordance with the subdivisions in the cat (Roste and Dietrichs, 1988). In the marmoset, Reis and Machado (1981) identified two cell columns of the MNO namely lateral and dorsal central. Olszewski and Baxter (1954) divided the motor nucleus of the oculomotor nerve in man into small dorsal and large ventral parts but Donzelli *et al*. (1998) subdivided the nucleus into dorsal, intermediate and ventral portions.

It is an accepted fact that the oculomotor nerve supplies five muscles of the eyeball (superior rectus, inferior rectus, medial



Figs 1-5. Photographs showing **1**. T.S. of mesencephalon of buffalo to show the caudal pole of motor nucleus of oculomotor nerve. **2**. T.S. of mesencephalon of buffalo to show the middle portion of the motor nucleus of oculomotor nerve. **3**. T.S. of mesencephalon diencephalon junction through the rostral pole of the motor nucleus of the oculomotor nerve. **4**. Horizontal section of mesencephalon of buffalo through the motor nucleus of oculomotor nerve. **5**.Sagittal section of mesencephalon, pons and medulla oblongata of buffalo through the motor nucleus of oculomotor nerve.(Luxol fast blue with neutral red, X2) PAG- Periaqueductal gray, AS- Aqueductus sylvius, DM-Dorsomedial subdivision of motor nucleus of oculomotor nerve (MNO), MLF- Medial longitudinal fasciculus RC- Rostral colliculus, DL-Dorsolateral subdivision of motor nucleus of oculomotor nerve (MNO), VD-Ventral subdivision of motor nucleus of oculomotor nerve (MNO), RN- Red nucleus, R III- Root of oculomotor nerve, MGB- Medial geniculate body, PSN- Parasympathetic nucleus of oculomotor nerve, FR-Fasciculus retrofluxus, CC- Caudal central subdiviiosn of motor nucleus of oculomotor nerve (MNO), IV N- Motor nucleus of trochlear nerve, VII G- Genu of facial nerve, VI N- Motor nucleus of abducent nerve.

rectus, inferior oblique and levator palpebrae superioris) and the abducent nerve supplies the retractor bulbi and lateral rectus muscles (Sisson and Grossman, 1967). Contrary to this, studies in cats (Spencer *et al.,* 1980) and rabbits (Murphy, 1986) using retrograde horseradish peroxidase (HRP) labeling technique revealed that retractor bulbi motor neurons were also found predominantly in the dorsolateral region of the ipsilateral oculomotor nucleus other than the abducent nucleus. Thus according to these authors the retractor bulbi muscle receives axons from both abducent and oculomotor nerves in the cat and the rabbit. Further studies with the help of electron microscopy, histochemistry and retrograde tracer techniques can elaborate the present knowledge of oculomotor nuclei in the buffalo.

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