

STUDIES ON CYTOARCHITECTURE OF ABDUCENT NUCLEUS IN THE BUFFALO (*Bubalus bubalis*)*

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ABSTRACT

The cytoarchitecture of the abducent nucleus of the buffalo have been described by materials collected from eight buffaloes. Nissl and myelin stained serial and semi serial sections of brain stem were used for the study. Majority of the neurons in the abducent nucleus were stellate shaped. The neurons had a central or an eccentric nucleus and the Nissl granules were coarse, dark staining and rod-shaped. The mean neuron population in the right and left abducent nucleus respectively was 4,653 and 4,641.

Key words: Cytoarchitecture, Abducent Nucleus, Buffalo

INTRODUCTION

The sense of vision in animals and human beings depends in part on the oculomotor system. The oculomotor system helps in quick localization of target objects and then to follow it during movement relative to the surrounding environment. The nuclei and nerves of oculomotor, trochlear and abducent are the integral part of this system. Information on detailed morphology, extent and cytoarchitecture of abducent nucleus though extensive in man (Olszewski and Baxter, 1954), cat (Taber, 1961), sheep (Rao, 1964) and pig (Breazile, 1967), studies are meager in buffaloes. Hence, the present investigation was undertaken, to study the cytoarchitecture

of the abducent nucleus which not only helps in understanding the control of normal ocular movements, but also helps in diagnosing the various pathological conditions encountered in animals.

MATERIALS AND METHODS

Brains of eight buffaloes, obtained from the Corporation Slaughter House, formed the material used in this study. The heads were collected immediately after slaughter and were perfused with 10 per cent buffered formalin through the common carotid artery till a clear 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 technique.

Transverse serial sections of 20 µm thickness were prepared from six brains. The sections were stained with toluidine blue, neutral red and cresyl fast violet (Keller, 1960) for Nissl substance for cytoarchitectural studies. The true neurons population in the right and left side of the median raphe was determined by following the procedure described by Blinkov and Ponomarev (1965). An ocular micrometer was used to measure the size of the neurons. The cells were measured at a magnification of 600. Only those cells that

had an intact nucleolus were measured. The length and width of a cell was measured and the average was taken to arrive at its diameter. Similarly the size of the nucleus was also was determined. Size of 200 randomly selected neurons and their nuclei (100 each from right and left side) were measured. These diameters were considered as the true diameters. The true diameter of the cell body formed the basis for classification of neurons in the nuclei under study. Neurons were considered large if they were over 50 μ m, medium 26 to 50 μ m and small below 25 μ m in diameter.

RESULTS

Type and structure of neurons

The neurons of the Motor Nucleus of Abducent nerve (MNA) in the buffalo consisted of medium and small sized neurons (Fig 1). Majority of the medium sized cells were stellate in appearance. The small cells were oval or triangular in shape. The neurons had a central or an eccentric nucleus and a variable nucleolus. The Nissl granules were coarse, dark staining and rod shaped (Figs. 1 and 2).

Neuron population

The neuron population in the right motor MNA ranged in number from 4,215 to 4,900 with a mean of $4,653 \pm 108$ and in the left from 4,590 to 4,730 with a mean of $4,641 \pm 22$. However, there was no significant difference in the neuron population of the left and right nuclei of the same specimen ($P \leq 0.05$). The total neuron population of the motor nucleus of abducent nerve (right and left combined) in the animals studied ranged from 8,902 to 9,530 and the mean was $9,204 \pm 100$. (Table-1).

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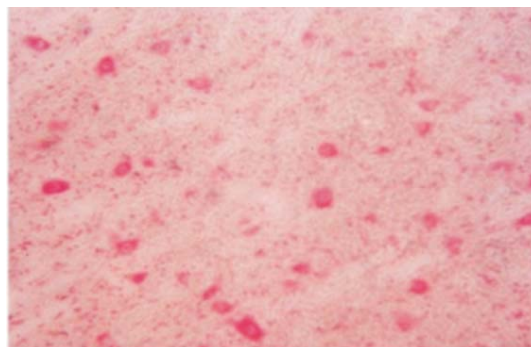


Fig.1. Photomicrograph showing types and distribution of neurons in the motor nucleus of abducent nerve (Paraffin-Neutral red-X100)

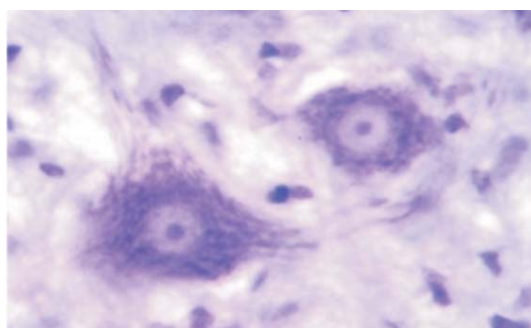


Fig.2. Photomicrograph showing small and medium sized neurons in the motor nucleus of abducent nerve (Paraffin-Cresyl fast violeot-X600)

The Nissl granules were coarse, dark staining and rod shaped (Figs. 1 and 2).

Note: The mean neuron population in the right and left motor nuclei of the abducent nerve showed no significant difference ($P \leq 0.05$).

Size of neurons

The neurons in the nuclei were classified into small and medium sized cells. The mean true diameter of the cell body and the nucleus for medium sized neurons in the MNA were found to be $31.98 \pm 0.4 \mu\text{m}$ and $14.71 \pm 0.18 \mu\text{m}$ respectively. The respective diameters in the small sized neurons were $23.29 \pm 0.3 \mu\text{m}$ and $12.13 \pm 0.24 \mu\text{m}$.

The population of medium sized neurons for both left and right nuclei together was 7,133 and the population of small sized neurons was 2,071. Thus the proportion of

medium to small sized neurons in the motor nucleus of abducent nerve in the buffalo was 7,133: 2,071. The approximate ratio of the two types of cells was 3.5:1.

DISCUSSION

Type and structure of neurons

The neurons of the motor nucleus of abducent nerve in the buffalo consisted of medium and small sized neurons. Majority of the medium sized cells were stellate in appearance. The small cells were oval or triangular in shape. The neurons had a central or an eccentric nucleus and a variable nucleolus and the Nissl granules were coarse, dark staining and rod shaped. These findings were similar to the observations made by Kakade and Salam (1988). In horse (Salam, 1971) and in the cat (Taber, 1961), the nucleus was composed of stellate, fusiform or ovoid cells with central nuclei and deeply stained, coarse Nissl substance while in the ox (Goller, 1963) and sheep (Rao, 1964) it was composed of large and medium sized, typical motor type cells.

Neuron population

The abducent nucleus contains 6154 cells in man, (Walsh, 1957) 41234 cells in rat (Tanaka *et al.*, 1987) and 596 cells in the pigeon (Cabrera *et al.*, 1989). In the buffalo the mean neuron population in the right motor nucleus of abducent was 4653 ± 108 and in the left side was 4641 ± 22 . In comparison with man, the neuron population in the buffalo appeared to be comparatively less even though it supplied lateral rectus and the retractor bulbi muscles. Studies in the cat (Spencer *et al.*, 1980) and rabbits (Murphy *et al.*, 1986) using retrograde horseradish peroxidase (HRP) labeling technique revealed that retractor bulbi motoneurons were also found predominantly in the dorsolateral region of the ipsilateral oculomotor nucleus other than the abducent nucleus. Also gross dissection and examination of the innervation of the retractor bulbi muscle

in the rabbit showed a subdivision of the oculomotor nerve entering that part of the retractor bulbi underlying the superior rectus (Murphy *et al.*, 1986).

Thus the lesser population of neurons in the abducent nucleus of the buffalo may be due to the retractor bulbi muscle also receiving axons from the oculomotor nerve. Whether the muscle receives axons from oculomotor nerve has to be investigated using retrograde labeling techniques and micro dissection.

Size of neurons

As per the results of the present study, the true diameter of the cell body and the nucleus for medium sized neurons in the motor nucleus of abducent nerve of the buffalo were found to be $31.98 \pm 0.4 \mu\text{m}$ and $14.71 \pm 0.18 \mu\text{m}$ respectively. The respective diameters in the small sized neurons were $23.29 \pm 0.3 \mu\text{m}$ and $12.13 \pm 0.24 \mu\text{m}$. But according to Kakade and Salam, (1988) the dimensions of the cell body ranged between 25m and 50m with a mean value of 352.5 m. In the horse, the dimensions of the stellate cells were ranging from 25 to 46 m with an average of 37 μm . For the fusiform and ovoid cells the measurements were 22 to 36 m with an average of 29 μm (Salam, 1971).

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