

HISTOLOGY AND HISTOCHEMISTRY OF LIMBIC HIPPOCAMPUS IN THE INDIAN BUFFALOES

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ABSTRACT

The brain samples were collected from 10 calves and 10 adult Indian buffaloes. Routine histological and histochemical processing and sectioning were done. The hippocampus was a curved elevation, lying immediately ventral to the splenium of the thalamus. Longitudinal section showed the ependyma, the alveus, the stratum oriens, the stratum pyramidale, the stratum radiatum, the stratum lacunosum and the stratum moleculare from above downwards. The prominent layer was the stratum pyramidale, composed of pyramidal cells in 2-3 rows. The four fields of the cornu ammonis, (CA1, CA2, CA3 and CA4) were identified based on the sizes of the pyramidal cells and their dendritic arborizations, both in the calf and in the adult. The presence of mucopolysaccharides was recorded.

Key words : *Histology, histochemistry, hippocampus, buffaloes*

INTRODUCTION

The functional connotation of the cortex of the limbic brain is not easy to describe. In fact, the adjective “limbic” denotes only an anatomic feature and not a functional property. Anatomically, these cortical limbic structures are interconnected and may be considered to form a common entity. The term “limbic” stems from Broca’s anatomic description of the structures nearest the border “Limbus” of the neocortical mantle, encircling the base of the cerebral hemisphere, which are relatively constant in their development in the brains of all mammals. He called the ring “le grand lobe limbique”, where, the

hippocampus is the major component (Silva *et al.* 1990).

The name hippocampus arises from the resemblance of its cell laminae to the outline of the seahorse. The neuronal networks are plastic with properties of undergoing consistent changes. It is composed of different types of cortex, having only three neuronal layers instead of the six layers found in the cerebrum. Though so much research was done on the functional significance of hippocampus, references from the available literature on buffaloes were meagre. Prompted by the dearth of such work, an attempt was made to explore the histology and histochemistry of the hippocampus.

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MATERIALS AND METHODS

The brain samples of 10 calves and 10 adult Indian buffaloes were collected. Routine processing and sectioning was done. H & E staining and Cajal's Pyridine silver method, Bielschowsky's method, Holmes method, Vogt's method, Cresyl violet method and Golgi Cox method were used for histological study and Aldehyde-thionin-PAS method for histochemical study.

RESULTS AND DISCUSSION

The cytoarchitecture of the hippocampus of Indian buffaloes in the calf and the adult showed the following seven layers in longitudinal section. But in guinea hen, it is of four layers (Showers, 1965). The innermost endyma was constituted of low cuboidal cells with oval nuclei, with their long axes parallel to the surface (Fig. 1). In some places, they were ciliated. The next layer, the alveus was a layer of myelinated nerve fibres, running parallel to the surface. In rodents, alveus contained the axons from pyramidal neurons (Anderson *et al.* 2007)

The third layer the stratum oriens, contained the tuft of arborisation of the basal dendrites arising from the pyramidal cells of the succeeding layer. It also contained a few pyramidal cells (Fig. 2). But in human, it is divided into inner and outer zones (Carpenter, 1976). The hippocampal basket cells (Fig. 2) which were large cells with foamy clear cytoplasm and large nucleus with foamy nucleolus, were found at the junction of this layer with the succeeding layer. This concurs with the finding of Warwick and Williams (1989) in humans. Numerous capillaries were observed in this layer. In rodents, stratum oriens

contained inhibitory basket cells and horizontal trilaminar cells (Anderson *et al.*, 2007).

The stratum pyramidale consisted of small, large or giant pyramidal cells. The neurons possessed spherical, vesicular nuclei with the central nucleolus. But in rabbits, the cells are not pyramidal (Crosby *et al.* 1962). The cornu ammonis in human being was also divided into four fields Cornu ammonis 1, Cornu ammonis 2, Cornu ammonis 3 and Cornu ammonis 4 (Warwick and Williams, 1989). The field Cornu Ammonis 1 (CA1) contained superficial and deep pyramidal cells. This is in agreement with the findings of Lorente (1934) in insectivores bats. The field Cornu Ammonis 2 (CA2) had giant pyramidal cells and they were arranged in several irregular assembly (Fig. 3).

Field Cornu Ammonis 3 (CA3) also had giant pyramidal cells but the dendrites were with thick thorns. CA3 contained synapses from the mossy fibres. In the field Cornu Ammonis 4 (CA4), the pyramidal cells were of a modified type which did not resemble the pyramidal cells of the other fields. CA4 in humans was the deep polymorphic layer of the dentate gyrus (Anderson *et al.* 2007).

Stratum lucidum in rodents was the thinnest strata in the hippocampus (Anderson *et al.* 2007). The bulk of the next layer stratum radiatum was composed of fibres. This concurs with the findings of Green (1964) in human being whereas in rat it is composed of stellate and fuciform cells (Lorente, 1934). The interlacing and branching processes of the apical dendrites of the pyramidal cells mainly formed this layer. It also contained few stellate cells. The last layer, the stratum moleculare had rich plexus of the fibres of the terminal

branches of the apical dendrites of pyramidal cells.

The ependyma and the alveus of the hippocampus showed intense PAS positive

reaction. Reaction in the stratum oriens and the stratum pyramidale (Fig. 4) was moderately high. Other layers showed a mild reaction.

Fig. 1: Section of the brain of 2 year old cattle showing ependymal layer lined by cuboidal cells and the underlying alveus made up of fibres

H & E X 200

E - Ependyma

•! - Alveus

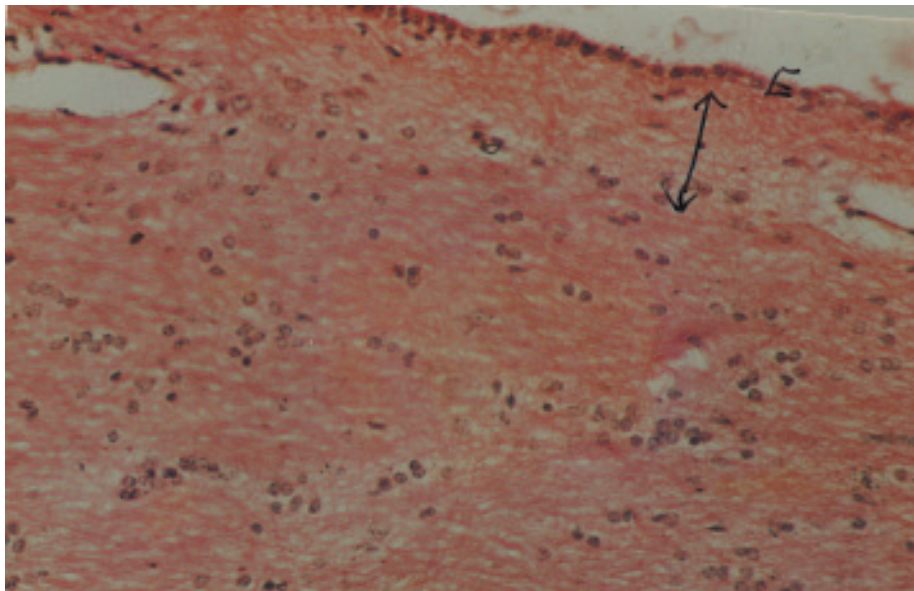


Fig. 2: Section of the brain of 4 year old cattle showing the position of the basket cells at the junction of stratum oriens and the stratum pyramidale in the field of cornu ammonis 1

Cresyl violet X 500

SP – Stratum Pyramidale

SO – Stratum Oriens

HB – Hippocampal basket cells

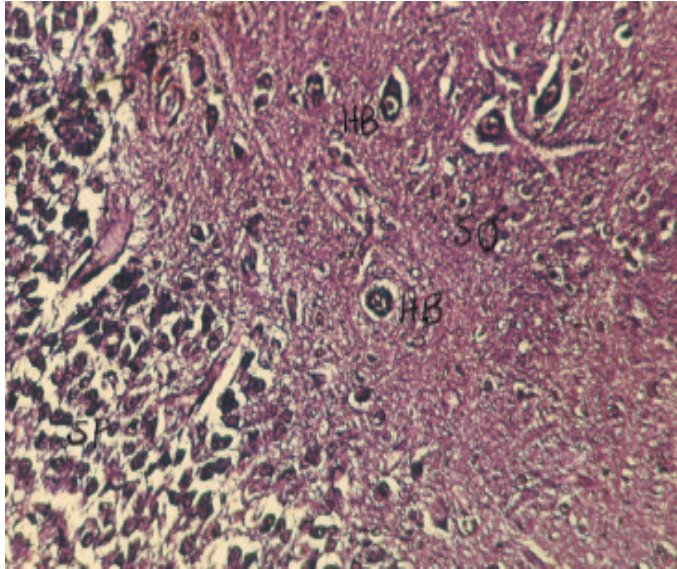
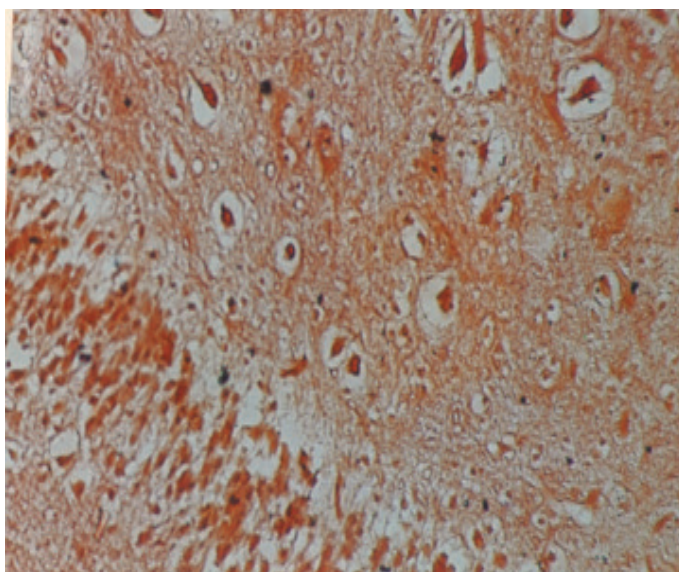


Fig. 3: Section of the brain of 3 year old cattle showing the field of cornu ammonis 2 – Giant pyramidal cells (arrows) arranged in irregular rows. Holmes method X 500



Fig. 4: Section of the brain of 9 months old calf showing the stratum pyrimidale (Field cornu ammonis 4) showing moderately high reaction for PAS reaction

Aldehyde – Thionin – PAS method X 500



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