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Spontaneous lesions and other unusual cell types in bovine brain

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ABSTRACT

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The brain in animals suffers with various infectious and non-infectious causes, resulting in overlapping pathological lesions and clinical signs. Therefore, gross and microscopic examination of brain is essential to record lesions and other specialized structures, which are often confused with inflammatory lesions. In the present study, out of 38 intact brain (21 cattle and 17 buffaloes) samples examined, 3 (2 cattle and one buffalo) showed gross lesions, characterized as a circular circumscribed solid mass occupying the white and grey matter in mid cerebrum (1 cattle), a hard calcareous mass adjacent to the hippocampus at the level of the mid cerebral hemisphere (1 buffalo), and a grey colour mass within the cerebrum at the level of fornix (1 cattle). In all the brains processed, involving 7 designated sites, microscopic lesions included: the vascular engorgement (27cases), hemorrhages (14 cases), peri-vascular cuffing (5 cases), neuronal degeneration (9 cases) and gliosis (5 cases), perineuronal oedema (3 cases), multiple aqueducts (1 case) and unusual normal structures (islands of Calleja cells - 3 cases, external granule cells - 1 case, unidentified bodies resembling corpora amylacea - 1 case). These lesions were distributed in the cerebellum (20 cases), brainstem (18 cases), cerebral hemisphere/caudate nucleus (18 cases), thalamus (16 cases) and in the hippocampus (10 cases). However, 8/38 brains did not show any microscopic lesions. The etiological diagnosis in all the spontaneous cases could not be made and required a thorough investigation in cases having lesions of gliosis, perivascular infiltration and degeneration of neurons. During routine examination of brain tissue, thorough knowledge of neuroanatomy is essential to distinguish normal structures, unusual cells and artifacts that are confused with actual lesions.

Keywords: Brain, lesions, pathology, spontaneous, unusual cell types

INTRODUCTION

A gamut of infectious and non-infectious agents affect the nervous system. The lesions produced by these etiologies are often diffuse and limited to certain parts of the brain, which manifest the overlapping clinical signs[1]. The gross changes in the brain like the haemorrhages, tumours, parasitic cysts, abscesses and malacic lesions are easily recognized but contrary, alterations involving the microscopic structures such as neurons, glial, endothelial, ependymal, inflammatory cells, and other special structures need in-depth knowledge of microscopic evaluation[2] .

During evaluation of brain pathology, sometimes non-lesion structures, special cell types and artifacts are seen, which are confused with inflammatory process, if the solid background of the microscopic neuroanatomy is not known. In earlier studies in cattle and buffaloes spontaneous brain lesions have been described with other incidental findings and unusual cell types[3,4,5]. In the present study, altogether 38 brain samples (cattle, 21 and buffaloes, 17) collected from the divisional post mortem facility were used to generate neurohistopathological baseline data.

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MATERIALS AND METHODS

Altogether 38 intact brains of different age groups (mostly adult and a few <1 month) of fallen cattle (21) and buffaloes (17) were collected from Post-mortem facility of the Institute. The brain samples were removed intact from the skull after severing the brain coverings and gently washed with normal saline. The brains were examined grossly soon after collection and fixed in 10% neutral buffered formalin for minimum 14 days. Post fixation, coronal sections (3mm) from 8 designated sites were cut starting from anterior to posterior end to incorporate almost all the neuroanatomical sites[5]. During slicing of the brain, external cut surfaces were observed for presence of any gross lesions. The representative brain sections from designated sites were processed by dehydration and paraffin embedding techniques in order to obtain 5µm thin paraffin sections, stained with Haematoxylin and Eosin (H&E)[6] and examined under light microscope.

RESULTS

Distribution of lesions and other cell types in different anatomical sites in the 38 brain samples have been presented in Table. Out of 38 brain samples, 3 showed gross lesions on cut section. Among these three cases, 1 had a circular circumscribed solid mass

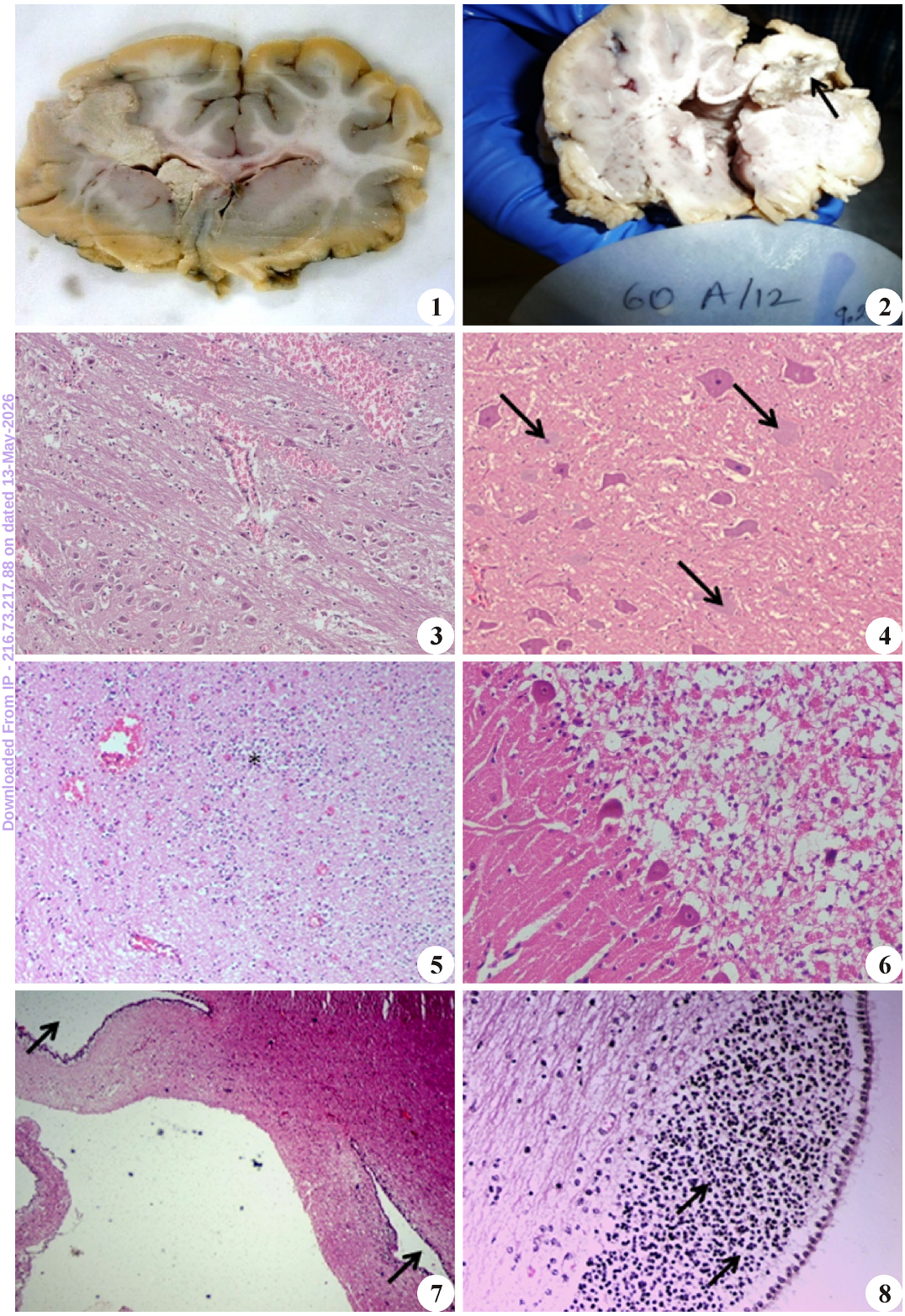

Fig. 1. Cattle brain coronal sections at the mid cerebrum showing grey color mass; **Fig. 2.** Buffalo brain showing hard calcareous mass; **Fig. 3.** Brain section showing congestion and hemorrhages. H&E x100; **Fig. 4.** Brain section showing neuronal degeneration in brain stem. H&E x200; **Fig. 5.** Brain section showing diffuse gliosis. H&E x100; **Fig. 6.** Brain section showing granular cell degeneration in cerebellum. H&E x200; **Fig. 7.** Section of mid brain showing multiple aqueducts. H&E x40; **Fig. 8.** Brain section showing nest of primordial cells in subependymal zone of lateral ventricle. H&E x100

occupying the white and grey matter of the mid cerebrum and nodulated ventricular choroids plexus (Fig. 1). In another case of buffalo, the mid coronal section of cerebral hemisphere had a hard calcareous mass adjacent to the hippocampus (Fig. 2), while in the third case of cattle, there was a grey colour mass noticed at the level of fornix in the left cerebral hemisphere, compressing caudate nucleus and choroid plexuses. The remaining 35 brains appeared grossly normal. However, on microscopic examination, all 38 cases, irrespective of gross lesions, showed mild to moderate vascular engorgement (27 cases), haemorrhages (14 cases) (Fig. 3), perivascular cuffing (5 cases), neuronal degeneration (9 cases) (Fig. 4), diffuse gliosis (5 cases) (Fig. 5), perineuronal oedema (3 cases), granular cell degeneration (Fig. 6) in known *Pasteurella spp.* positive case, multiple aqueduct in mid brain (adult cattle) (Fig. 7) and 6 cases of unusual normal specialized structures viz., nests of primordial glial cells (Calleja cells) in sub-ependymal region of lateral ventricles and around the blood vessels (3 cases) (Fig. 8), external

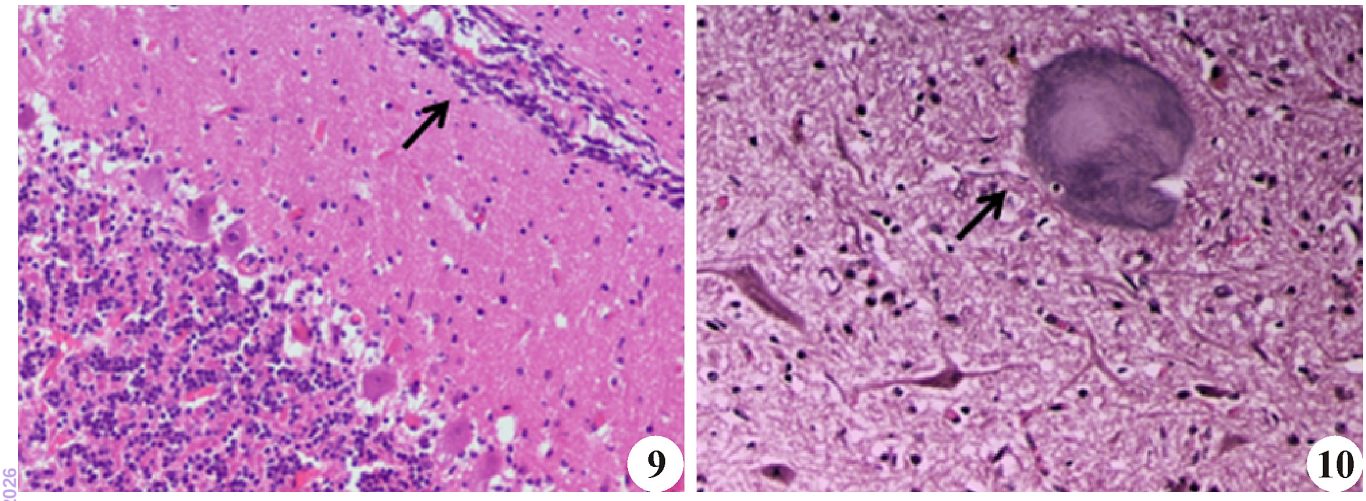

Fig. 9. Brain section of buffalo calf showing external granular cell layer in sub-pia region. H&E x100; **Fig. 10.** Section of brainstem showing large corpora amylacea like body. H&E x100.

Table. Distribution of lesions and other cell types in different sub-anatomical sites of 38 brain samples (21cattle, 17 buffaloes).

Sl. No.	Sub-anatomic sites	Gross and microscopic findings
1.	Mid Cerebrum (2+18)	**Gross**: Circumscribed solid mass (1), grey colour mass (1) **Microscopic**: Engorgement of blood vessels (11), haemorrhages (4), neuronal degeneration (1), gliosis (1), perineural oedema (1)
2.	Hippocampus and pyriform lobe (1+10)	**Gross**: Hard calcareous mass (1) **Microscopic**: Engorgement of blood vessels (6), haemorrhages (1), aberrant glial cells in dentate gyrus (1), perineural oedema (1), dark stained large body resembling corpora amylacea (1)
3.	Thalamus (16)	**Microscopic**: Engorgement of blood vessels (8), Haemorrhages (6), perineural oedema (2)
4.	Midbrain (10)	**Microscopic**: Haemorrhage (5), Neuronal degeneration (1), perivascular cuffing (1), gliosis (2), multiple aqueduct (1)
5.	Pons (8)	**Microscopic**: Engorgement of blood vessels (4), haemorrhage (3), gliosis (1)
6.	Cerebellum (20)	**Microscopic**: Engorgement of blood vessels (14), neuronal degeneration (1), irregular granular layers (1), gliosis (1), granule cell degeneration (1), Calleja cells* (1), external granule cell layer* (1)
7.	Medulla oblongata (6)	**Microscopic**: Engorgement of blood vessels (5), haemorrhage (1)

* Normal cell types confused with inflammatory cells

granular cell layer in subpia region (2 weeks old buffalo calf) (Fig. 9), dark stained body resembling corpora amylacea in brainstem (Fig. 10), and mononuclear like cells in the blood vessels of grey and white matter of the cerebellum (1 case). These lesions were present either singly or in combination in the cerebellum (20/38 cases), brainstem (18/38 cases), cerebral hemisphere/caudate nucleus (18/38 cases), thalamus (16/38 cases) and in the hippocampus (10/38) cases. Eight out of 38 brains did not show any microscopic lesions.

DISCUSSION

A very few studies have been carried out on spontaneous brain affection in cattle and buffaloes in India[3,7,8]. In the present study, spontaneously occurring brain lesions could be observed grossly only in 3 cases, while microscopic lesions were more in the occurrence (78.9%). Gross lesions in the form of visible mass in the cerebrum (2 cases) and adjacent to the hippocampus (1 case) were noticed during slicing of brains signifying the importance of systematic brain examination. Further, representative coronal sections of fixed brains from designated sites on microscopic examination showed a combination of microscopic changes mostly involving more than one anatomic site in 30/38 cases. These lesions were distributed more in cerebellum

followed by brainstem and cerebral hemisphere/caudate nucleus, thalamus, hippocampus indicating susceptibility of these sites to various insults. The earlier researchers have also reported similar findings[9,10]. There was relatively more frequency of vascular changes as compared to gliosis, perivascular cuffing and neuronal degeneration as has been reported earlier[3,7,8]. The involvement of vasculature of brain (27/38 cases) could have been due to infectious causes or autolytic changes[11]. Similarly perineuronal edema could be due to post mortem shrinkage since no protein droplets were seen around the vasculature[5]. In a known positive *Pasteurella* case, the degeneration of granule cells could have been due to bacterial toxins. In one case, there were multiple aqueducts indicating congenital defects as described by Maxie and Youssef[10]. Mild perivascular cuffing in 5 cases pointed towards obscure etiology as the same could not be establish. The neuronal degeneration in 9 cases probably might have occurred due to hypoxia/ hypoglycaemia[12].

During microscopic evaluation, certain normal specialized structures were also noticed, which are often confused with pathological changes. These structures included the nests of primordial glial cells in sub-ependymal plate (3 cases) often confused with inflammatory cells; external germinal cells beyond the piamater of the cerebellum resembling infiltrates, and dark stained unidentified structures resembling swollen neuron in the brainstem, simulating degeneration. Similar structures have been described earlier in animals[5,11,12]. The subventricular germinal cell zone is designated as island of Calleja. These structures are found in the ventricles, in folds around the mesencephalic duct and in the frontal lobe white matter, olfactory peduncles and cortex. These germinal cells are multipotent and can differentiate into neurons and glial subtypes[5]. The external germinal cells have been described as normal dividing germinal cells (up to 12 cells in thickness), which give rise to different cell types of the cerebellum and are sensitive to various insults. These cells remain persisted till many days after the birth, depending upon the species (calf up to 6 months) and then disappear. In the present case, only one cell thick external germinal layer was noticed in 2 weeks old buffalo calf. In all the above cases, no etiological factors could be identified. The present study concludes that vascular changes, artifacts and other normal neuroanatomical structures should be described cautiously while describing actual lesions. However, inflammatory lesions like perivascular cuffing, gliosis and neuronal degeneration should be investigated to rule out possible etiological factors.

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