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Research Article

SCANNING ELECTRON-MICROSCOPIC STUDIES ON THE SUBCOMMISSURAL ORGAN, REISSNER'S FIBRE AND PINEAL GLAND OF THE BUFFALO CALVES

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ABSTRACT

The present study was conducted on five young male buffalo calves to explore ultrastructural surface features of the subcommissural organ, Reissner's fibre and pineal gland. The subcommissural organ was characterized by presence of apical spherical protrusions and tufts of cilia. Reissner's fibre as cord like structure was constituted by cilia, microvilli and heterogeneous material including the cell debris and extended cranio-caudally towards the ventral surface of the subcommissural organ. Its rough irregular surface and presence of longitudinal grooves reflected functional cleansing capacity in cerebrospinal fluid. The pineal gland showed round to oval pinealocytes with their processes, a few glia cells and fibrous network.

Key words: Subcommissural organ, Reissner's fibre, pineal gland, SEM, buffalo calves

Neurosecretions of the subcommissural organ (SCO) are similar to those of neurohypophysis and hypothalamus indicating glandular and secretory activity of this organ in domestic animals (Talanti, 1958). The secretory material of SCO in saline infused cats plays an important role in the homeostasis of diuresis and regulation of blood pressure (Murphy and Wood, 1966). Reissner's fibre (RF) was observed as a thin string like structure of regular shape resembling the axis cylinder with characteristic high refringence and lying free within the central canal of primates (Reissner, 1860). An organic and functional connection has been postulated between RF and SCO highlighting a supportive role of SCO to RF which was attributed by transmission of the optical reflexes from mid-brain roof to the body musculature (Sargent, 1904). RF was considered as a mechanoreceptor which served to indicate variations in CSF pressure through supraependymal nervous pathways to the choroid plexuses and to the circumventricular organs (Kolmer, 1921). Description on scanning electron-microscopy of these organs in buffalo is not available in the literature. Due to above significance of the SCO, the present study was envisaged to explore the surface features of the SCO, RF and pineal gland in the buffalo calves.

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MATERIALS AND METHODS

The present study was conducted on five young male buffalo calves (1-1½ years age). Brain tissues extending from mammillary body to rostral limit of corpora quadrigemina were collected immediately after death of buffalo calves in the slaughterhouse. After thorough washing in 0.1 M phosphate buffer (pH 7.4), the tissues were fixed for 8 h in 2 per cent glutaraldehyde. Mid sagittal section of the tissues were then cut and washed with the phosphate buffer to expose the SCO, RF and the internal structure of pineal gland. Dehydration, critical point drying, sputter coating and viewing in scanning electron-microscope (Leo-435 VP, Japan) were carried out at EM Laboratory, AIIMS, New Delhi.

RESULTS AND DISCUSSION

Subcommissural organ having a specialized ependyma was present beneath the posterior commissure and extended from recessus

infrapinealis to recessus mesocoelicus forming the roof of III ventricle and partly of the cerebral aqueduct (Figs 1, 2). The SCO presented tufts of cilia which originated from round to oval shaped apical spherical protrusions (ASP) (Fig 2) and formed network with those of adjacent ones as reported in cow (Lindberg and Talanti, 1975), goat (Kumar and Kumar, 2000) and sheep (Saggar *et al.*, 2002). A sparse distribution and absence of cilia has been reported in rat (Collins and Woollam, 1979) and cat (Weindl and Joynt, 1972). ASP had irregular surface due to the presence of small blebs like structure resembling sulci and gyri of brain. Some of the smooth ASP were devoid of cilia representing non-ciliated cells of the SCO in buffaloes. Majority of these protrusions had small pores or holes on the surface. The occurrence of depression toward centre of the protrusion possibly represented absorption as an additional functional capacity of ependymal cells in the goat (Kumar and Kumar, 2000). However, these structures were covered with microvilli in rat (Collins and Woollam, 1979). Weindl and Joynt (1972) speculated that the protruded endings of the ependymal cells in feline SCO led to the secretory function whereas, Schechter and Weiner (1972) hypothesized that these endings represented a morphological correlate of an active secretory process. The presence of heterogeneous material between the protrusions in the buffalo calves, goat and cow supported this hypothesis (Lindberg and Talanti, 1975, Kumar and Kumar, 2000).

Reissner's fibre (RF) representing cilia, microvilli along with heterogeneous material

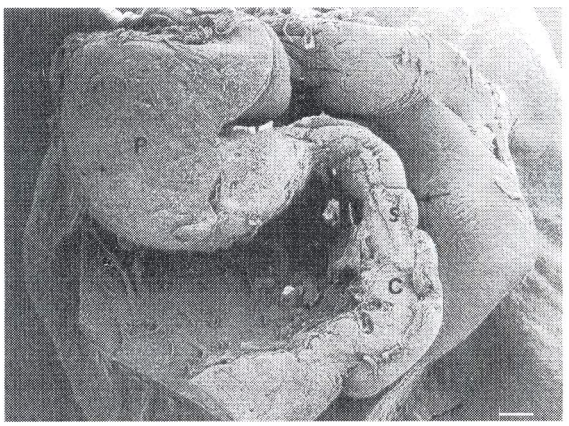

Fig 1. Scanning electron micrograph showing pineal gland (P), posterior commissure (C), subcommissural organ (S) and III ventricle (arrow).
x 12 (bar 300 μ)

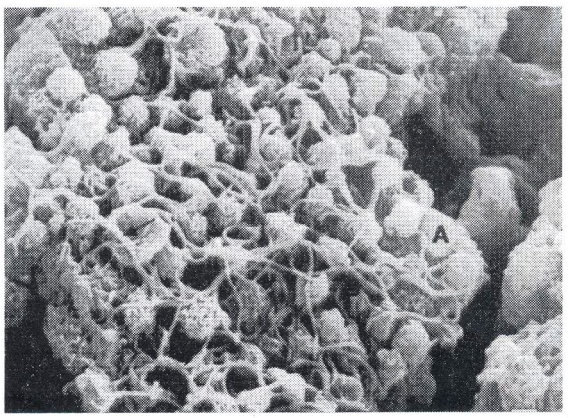

Fig 2. Scanning electron micrograph showing apical spherical protrusion (A) and cilia (arrow) of the SCO.
x 4110 (bar 1 μ)

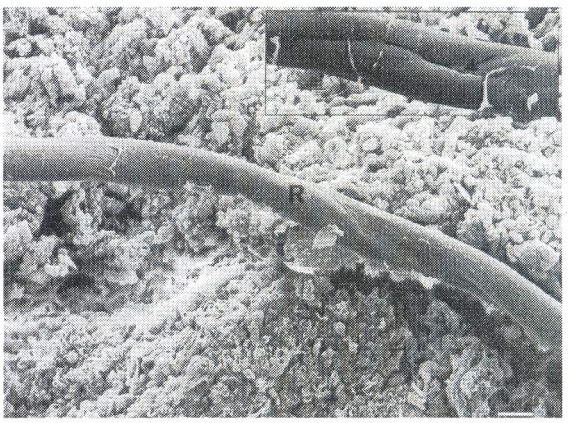

Fig 3. Scanning electron micrograph showing Reissner's fibre (R). Higher magnification presented longitudinal groove (arrow) on the surface of RF (inset).
x 562 (bar 10 μ)

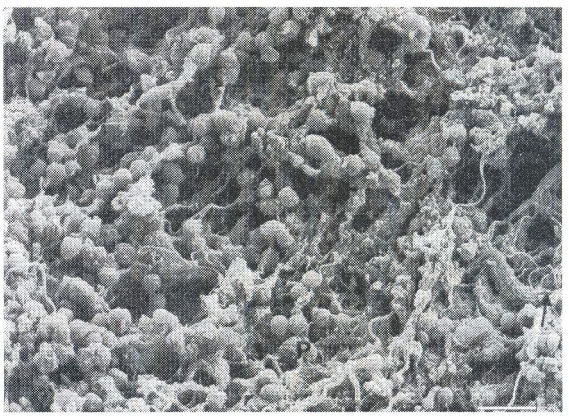

Fig 4. Scanning electron micrograph of pineal gland showing pinealocytes (P) along with their processes.
x 942 (bar 10 μ)

consisting of RBC and cell debris lay in mid line towards the ventricular surface of the SCO ependyma and cerebral aqueduct (Fig 3). This secretory layer of uniform thickness coating ependymal cilia extended throughout the length of the organ as reported in domestic animals (Talanti, 1958, Isomaki *et al.*, 1965, Kumar *et al.*, 1998, Saggar *et al.*, 2002). However, RF has not been reported in the buffaloes on the basis of light microscopic studies (Ramkrishna and Saigal, 1986). The RF originated from ASP of the SCO as reported in rats (Collins and Woollam, 1979) and goat (Kumar *et al.*, 1998). The filaments from ependymal cells along with RBC and other cellular debris gradually coalesced to form a cord like RF towards the free surface of ependyma in buffaloes as reported in goat and primates (Kumar *et al.*, 1998, Castenholz and Zoeltzer, 1980). The RF extended cranio-caudally due to continuous shifting of released secretory material towards the caudal end where it got accumulated in an amorphous loose mass at the level of filum terminale (Leonhardt, 1980). Earlier it was hypothesized that a part of the secretory material was not soluble in CSF which led to the formation of RF due to its condensation (Sterba, 1969). However, functional studies elucidated the formation of RF as a result of a dynamic process involving various mechanisms viz: i) shifting of the secretory material along the fibre structure, ii) prepackaging, packaging and unpackaging of the secretory molecules, iii) chemical modification of the RF molecules at the distal end of the fibre, iv) hydrodynamic factors having influence on the formation and the shape of the fibre (Rodriguez *et al.*, 1992). The amorphous character and degree of tautness of RF in rat suggested it other than a pathway along which substances such as peptides reached lower parts of the brain stem (Woollam and Collins, 1980). Its connection with ependymal cilia might be assisting in the transmission of information regarding CSF pressure to the walls of cerebral aqueduct and IV ventricle in response to the degree of tension. The specific binding of radio-labeled nor-epinephrine produced evidence for detoxifying function of RF (Hess and Sterba, 1973). The RF of buffalo calves presented rough irregular surface due to presence of longitudinal grooves (Fig. 3) and attachment of RBCs and cell debris, thus confirming the postulation presented by Weindl and Schinko (1975) and Kumar *et al.* (1998) regarding its cleansing capacity in the CSF.

The cut surface of the pineal gland exhibited fibrous strands of connective tissue forming an irregular meshwork entrapping the cellular debris (Figs 1, 4). The round to oval shaped pinealocytes were of almost uniform size except a few larger ones which might represented the another type of the pinealocytes (Fig 4). Their outer surface had very small sized microvilli like arrangement. Thread like processes of pinealocytes arising from cell body were oriented in different directions. Pinealocytes having microvilli and kinocilia have been reported in guinea-pig (Krapp, 1978). The pinealocytes of goat with characteristic depression presented a cauliflower like appearance (Kumar *et al.*, 1996a). Round to oval shaped glial cells were of smaller dimensions and possessed large sized processes which frequently intermixed with those of other glial cells and the pinealocytes as reported in goat (Kumar *et al.*, 1996b). At places blood vessels cut in different profiles were also visible as reported in rat (Krstic, 1979).

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