Fine structure of an intracerebral epithelial cyst

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The wall of an intracerebral extraventricular cyst was studied with the electron microscope. The lining of the cyst consisted of a single layer of nonciliated, flattened or cuboidal epithelium similar to that in an ependyma. Unlike the ventricular ependyma, the lining cells of the cyst were bordered by a continuous basement membrane abutting on the leptomeninges or on the compressed brain tissue and thus shared some morphological similarities with the choroid plexus epithelium. Although pathogenesis of the cyst remains obscure, the fine structure of the lining cells is suggestive of their neuroepithelial origin. The occurrence of abundant pinocytotic vesicles in these cells further suggests the possibility of cellular transport of fluid to account for the continued expansion of the cyst.

KEY WORDS: intracerebral cyst · ependyma · choroid plexus · neuroepithelial cyst · electronmicroscopy

In addition to the arachnoid cysts there is a group of non-neoplastic intracranial cysts lined essentially by a single layer of epithelium. These cysts usually occur in and about the cerebral ventricles, mostly as "colloid cysts,"17,24,28,33,37,38,40 and on rare occasions within the cerebral hemispheres or subarachnoid space outside the ventricles.2,11,12,14,19,29,41 Likewise, epithelial cysts within the spinal canal have been described under a variety of names.13,18,20-22,25,30,34 The precise nature and origin of the lining cells of these apparently heterogeneous cysts of the central nervous system (CNS) are often obscure and, therefore, open to various interpretations, as indicated by the multiplicity of names. This may, in part, be due to the cyst wall. To our knowledge, only two electron microscopic studies, one of a colloid cyst of the third ventricle and the other an intraspinal cyst, have been reported so far.

This report describes the fine structure of the surgically excised wall of an intracerebral extraventricular cyst. The findings are compared with those reported previously and also with normal epithelial elements of the central nervous system (CNS).

Case Report

A 43-year-old woman with fever and hepatosplenomegaly developed seizures, bi-
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cavity were clearly visible through the opening. Postoperatively, although the neurological deficits were remarkably improved, the patient continued to be febrile and progressively anemic with hepatosplenomegaly. About 1 month after operation, she underwent a laparotomy and a diagnosis of Hodgkin’s disease was made. About 3 months following the craniotomy, the patient died of generalized Hodgkin’s disease. No autopsy was performed.

Pathological Examination of the Cyst Wall

The excised cyst wall included portions of the roof with leptomeninges and the deeper intracerebral part with adjacent brain tissue. A part of the formalin-fixed specimen was embedded in paraffin for conventional microscopy. The remaining part was post-fixed in chrome-osmium and embedded in Epon in the usual manner. Sections 1 μ thick were stained with toluidine blue for light microscopy, and ultrathin sections were stained with uranyl acetate and lead salts prior to electron microscopic study.

Light Microscopic Observations. The lining cells of the cyst consisted of a single layer of flattened or low cuboidal cells (Fig. 2). In most parts, the cells abutted on membranous connective tissue closely related to the leptomeninges or the brain parenchyma. In the deeper part of the cyst, the cells appeared to lie directly on the white matter and closely resembled ventricular lining. However, a continuous basement membrane was discernible between the cells and underlying white matter. No mucinous material was observed in the cells. The surrounding brain tissue was variably compressed, occasionally with a slight degree of gliosis. There was no evidence of destructive or inflammatory lesions.

Electron Microscopic Observations. Due to prior fixation in formalin at room temperature, the preservation of the tissue was rather poor (Figs. 3–5). Despite some variation in the size and shape, the cells lining the various parts of the cyst appeared similar and contained prominent nuclei with margination of chromatin. The cytoplasm contained abundant filaments, frequently in loose bundles, and variable numbers of ribosomes. These filaments measured 60 to
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Fig. 2. Photomicrograph of the epithelial lining of the cyst (C) lying on membranous connective tissue showing resemblance to leptomeninges. Left: An artifactual separation is seen between the cyst wall and surrounding brain containing myelinated fibers. Toluidine blue in Epon embedded section, × 500. Right: Cuboidal cells of the cyst are separated from the cerebral white matter by a continuous basement membrane (arrows). Toluidine blue stain in Epon section, × 500.

80 Å in diameter and appeared similar to those described in ependyma. Mitochondria and endoplasmic reticulum were sparse and generally poorly preserved. No secretory materials could be identified. The basal surface of the cells was bordered usually by two layers of basement membrane that abutted on the extracellular spaces containing a variable number of collagen fibers, or on the astrocytic processes adjacent to myelinated axons. The luminal surface contained a variable number of irregular, relatively short microvillous projections with no surface coating material. No cilia were observed; however, an occasional basal body could be seen. Prominent junctional devices were present between the adjacent cells. However, due to limited preservation of the tissue, no tight junctions could be identified with certainty. In addition, interdigitations and cytoplasmic invaginations were frequently seen on the junctional surface. Another consistent feature was the presence of numerous pinocytotic vesicles predominantly along the basal surface of the cells regardless of their relationship, either to the extracellular space or astrocytic processes.

Discussion

The lining cells of both the colloid cyst and extramedullary cyst of the spinal cord reported by others were bordered by a layer of basement membrane and abutted on the extracellular space containing collagen. On the basis of the presence of cilia in some of the lining cells, it was concluded that the colloid cyst was ependymal in origin. The lining of the intraspinal cyst, however, consisted of two distinct types of cells, ciliated and nonciliated, the latter containing secretory material and surface coating; the cells were unlike those normally present in the CNS, but appeared similar to the epithelium of the respiratory tract.

The lining cells of the cyst in our case differed from both former cases. The cells were of one type and contained no cilia, secretory material, or surface coating. Furthermore, two layers of basement membrane bordered the cells that abutted not only on the extracellular space containing collagen, but directly on the brain tissue in some areas.

When examined with the light microscope, the flattened lining cells of the cyst related to the leptomeninges simulated arachnoid cells while the cuboidal cells overlying the brain substance at the deeper part of the cyst closely resembled ependymal lining of the ventricle. Electron microscopically, however, the cells appeared quite unlike those lining the leptomeninges. Although several features in these cells were
Fig. 3. Electron micrographs of the cells lining the cyst. Upper: Sparse and irregular microvilli are bordered by a prominent basement membrane (arrows) facing an extracellular space containing collagen (compare with Fig. 2 left). × 4500. Lower: Higher magnification showing junctional devices (arrows) between adjacent cells with interdigitations. Cytoplasm contains abundant filaments and many pinocytotic vesicles. The basement membrane borders the cells abutting on collagen-containing extracellular space (E). × 25,000.
similar to those seen in the ependymal lining of the ventricles,⁴,⁸,⁴³,⁴⁶ such as the junctional complexes with interdigitation, abundant cytoplasmic filaments, and microvillous projections, there were certain differences. The occurrence of basement membrane on the basal surface of the ventricular ependyma has been observed only in focal areas in proximity to the blood vessels.⁸,¹⁶,⁴⁶ Basement membrane has also been occasionally observed in relation to the ependyma of the central canal in the region of the filum terminale¹⁵ and in ependymoma of the same region.²⁹ A continuous basement membrane bordering the lining cells of the cyst as described in our case is not seen in the ventricular wall. In this regard, the cells resembled choroid plexus epithelium.⁶,⁷,⁴² However, among other features, the presence of sparse organelles, notably mitochondria, and also scanty short and irregular microvilli in these cells were at variance with the normal choroidal epithelium.⁶,⁷,⁴²

Lack of cilia in the lining cells of this cyst appears to be another difference between these cells and those of ventricular ependymas. Although variable in number, the presence of cilia is generally considered a characteristic feature of the ependyma.⁴,⁸,⁴³,⁴⁶,⁴⁷ It should be noted, however, that the ventricular ependyma in adults¹⁰ and also in certain specialized regions⁴⁵ may appear nonciliated. On the other hand, cells with prominent cilia are frequently seen in the region of the pituitary gland³²,³⁵,³⁷ and also have been reported in teratomatous cysts.²¹,²⁶ The mere presence or absence of cilia, therefore, does not seem to be helpful in ascertaining the nature of the lining cells of cysts occurring in the CNS. It is therefore evident that, despite some differences, the lining cells of the cyst we have described shared certain basic
Fl. 5. Electron micrograph of cells lining the deeper part of the cyst (compare with Fig. 2 right). A continuous basement membrane borders the basal surface of cells overlying the cerebral white matter containing myelinated axons. × 10,000.

The possibility that the cyst might be teratomatous does not seem likely because of the lack of any distinctive features in the cells that could be related to the lining cells of the respiratory or alimentary tracts.

Epithelial-lined cysts of the CNS frequently appear as mass lesions in adult life. This indicates continued expansion of the cysts, especially because the occurrence of such cysts is generally assumed to be on a developmental basis. Active mucinous secretion by the lining epithelium may, when present, account for the expansion. In the absence of any detectable secretory material in the lining cells, as described in our case and also previously by others, the mechanism of expansion of the cysts remains unexplained. Our observation of numerous pinacytotic vesicles in the lining cells of this cyst is interesting because of their possible relation to active cellular transport of fluid as has been suggested in the ventricular ependyma. This hypothesis may explain both the fluid content and the progressive expansion of the cyst.

Among the various epithelial-lined cysts of the brain, the colloid cysts of the third ventricle are recognized as a distinct entity. Due to the diverse histological appearance of the lining cells, the origin of these cysts is variously ascribed to ependyma, choroid plexus, paraphysis, or respiratory epithelium. On the other hand, the rare occurrence of epithelial cells elsewhere in the brain with no anatomical contiguity with the ventricle or choroid plexus have been designated as ependymal cysts. The fine structure of the lining cells of our cyst indeed indicates their morphological similarity to the ependyma. Whether these cysts represent an entity distinct from those occurring in the midline as “colloid cysts” in terms of their origin and subsequent development remains to be determined. Elucidation of the fine structure of these apparently heterogeneous cysts in various parts of the CNS may shed some light on the obscurity and controversy that currently exist surrounding the nature and development of these potentially serious lesions.

References
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