Electron Microscopic Features of an Experimentally Produced Porencephalic Cyst in the Rat Brain

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Summary. Needle injury of the newborn rat brain resulted regularly in cavity formation, the lining of which at first consisted of a layer of fibrous astrocytes with many thin cytoplasmic projections. Between the second and third weeks the astrocytic surface became smoother and was lined by a basement membrane, usually in association with an overlying layer of pia-like cells. Only after this time did the fine structure of the cavity wall resemble that of Held's membrana gliae limitans superficialis. It is, therefore, suggested that Spatz's "membrana gliae limitans accessoria" be reserved for this differentiated structure and not used to identify the earlier astrocytic lining. No dense glial or connective tissue scarring, as usually seen in the adult brain, was found. Macrophages disappear before the third week, rather than persisting for months, as in the adult. The presence or absence of scar formation and macrophages may only reflect the age at which the injury occurred and may, therefore, be unreliable in distinguishing between cavities due to malformation and to injury.


Key-Words: Electron microscopy — Rat brain, new born — Porencephalic cyst — Brain injury — Glial reactions.

Following injury to the immature brain of both man and animals there is a rapid resorption of the necrotic tissue resulting in cavity formation. Such cavities may be produced by many diseases and are frequently termed "poren—

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cephaly" (Norman). In man the wall of a porencephalic cavity consists of a glial border which is covered by a newly formed membrana gliae limitans (Haller-Vorden and Meyer) similar to the lining of cavities which Spatz studied experimentally in the newborn rabbit spinal cord. Spatz named this lining structure "membrana gliae limitans accessorius" because of its histologic resemblance to the membrana gliae limitans superficialis and perivascularis of Held.

With the electron microscope Held's membrana gliae limitans superficialis has been shown to consist of a layer of fibrous astrocytes whose surface is lined by a basement membrane (Maynard and Pease; Nelson et al.). Since the basement membrane is an integral part of Held's membrane, and since it could not have been recognized by the histological techniques available to Spatz, the present study was undertaken to clarify the fine structural features of the cavity lining and to compare them with the known ultrastructural characteristics of Held's membrane.

Materials and Method

Lesions were produced in newborn Sprague-Dawley rats, and after survival periods of up to 16 weeks the animals were killed and the tissue prepared in the manner previously described (Sumi and Hager).

Results

In the gross specimen a shaggy walled cyst communicating with the ventricle was found 4—5 days after the injury. With time the cavity became larger and its wall more regular so that by the third week the surface was white, smooth and glistening (Fig. 1). Often there was a defect in the overlying cortex, the margins of which were adherent to the dura, but such adhesions were absent in several animals in which the cortical surface was intact and completely covered the cyst.

As seen in the light microscope, five days after the injury the cyst wall was formed by a row of oval-shaped cells with a relatively pale nucleus and a small