Symposium (E)

Brain Oedema and Blood Brain Barrier

Chairman :

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E1. On Blood Brain Barrier.

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In this study, blood-brain-barrier was examined morphologically with the use of electron microscope.

In the capillaries which does not possess the barrier mechanism, endothelial cells are surrounded by the single layer of basement-membrane. This in turn, is surrounded by a perivascular space filled with mesenchymal elements. At the outer margin of the pericapillary space the parenchymal cells lined again with a basement-membrane, are observed. In the cerebral capillaries on the other hand, the endothelial cells are directly surrounded by the watery cytoplasm of glial cells. There are interposed between the glial and endothelial elements two layers of basement-membranes.

Thus it is quite understandable that the metabolic exchange may be slower across the pericapillary glial cells in cerebral capillaries than it is across the pericapillary space in other organs.

The most striking morphological change observed in the cerebral capillaries in earlier stage of cerebral edema, is marked increase in amount of the cytoplasm of pericapillary glial cells. In later stage, the layers of the basement-membranes become loose and somewhat swollen and here and there, it is found to be detached.

Interesting enough, mitochondria in the glial cells tend to concentrate along the capillary wall.

Thus the glial cells curtain the excessive flow of metabolites at the hydro-dynamic or osmotic change of blood stream, through its colloid-chemical properties. Also later, the glial cells through the function of mitochondria, i.e., through its biological properties serves as a buffer, sparing the nerve cell from the direct

invasion of unphysiological metabolites. Besides the glial cells which, no doubt, play the most important role in the B.B.B. mechanism, also we found importance of other anatomical structures as the regulating factors of capillary permeability through the experimental studies on the cerebral capillaries in the new-born rat, on those in gliomas and in other pathological conditions.

As a conclusion, we are of opinion that B.B.B. represents a peculiar mode of capillary permeability in which the whole anatomical structures lying between plasm and nerve cells, i.e., endothelial cells, basement-membranes and pericapillary glial cells are taking their own part respectively.

E2. Brain Edema.

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Brain edema was experimentally produced in cats and dogs by various procedures for the purpose of observing under what conditions brain edema is easy to occur. For evaluation of brain edema, the water content of the brain, which is divided into the free, the bound and the total water, was measured in the cerebral cortex, white matter, brain-stem and cerebellum by Hatschek's cobalt-chloride method.

Increase of the free and total water was seen by general anesthesia with ether, avertin or narcopon-scopolamine, while no increase by Ravonal, dial or procaine-hydrochloride anesthesia. Under hypotensive anesthesia with C_6 or or hypothermia with chlor-promazine, no increase of water content was observed, even though ether was given.

When O_2 content in blood showed a decrease of 18-22% or more, or when CO_2 content an increase of 8-10% or more, the free and the total water content of the brain started to increase rapidly.

When various surgical procedures such as rubbing, concussion or compression were applied upon the surface of brain, the increase of the free and total water content was seen and was more marked in cases having comprssion.

There was also seen an increase of the free and the total water in case of loss of blood to the amount of 1% of body weight by acute hemorrhage from the superior sagittal sinus or common carotid artery and also in case of ligation of the bilateral jugular veins.

Investigation of the influences of concentration and temperature of saline solution for irrigation fluid on surface of the bain revealed that the physiologic saline solution at the temperature between $20^{\circ}C$ - $30^{\circ}C$ was the best, with which the water content did not increase after 4 hours of irrigation.

Intravenous injection of physiologic saline solution, Ringer's solution or 5%