Effects of Adrenalectomy on local traumatic Lesion of the Brain

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With 3 Figures in the Text

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Clinical practice generally suggests that corticosteroids decrease cerebral edema (POLITOFF et al. 1962; RASMUSSEN, GULATI 1962). However, the only experimental work that ratifies this observation (PRADOS et al. 1945; RAMONDI et al. 1959) merely indicates that corticosteroids may be able to prevent the edema; according to other workers (PAPIVS 1963), corticosteroids have no effect after the tissues are swollen. Moreover, different investigators point out that prolonged steroid treatment may, itself, cause cerebral edema (BENSON, PHARSAH 1960; COHN 1963; GREER 1963). No published observations are available on the relationship between brain edema and adrenal deficiency.

Corticosteroids induce important changes in the structure of the cellular membranes (WILLMER 1961) so, if the blood-brain barrier is indeed a series of cellular membranes (POLITOFF et al. 1963), its permeability is probably affected by the presence or lack of these hormones. It therefore seemed interesting to ascertain the effect of adrenal insufficiency on the blood-brain barrier and on cerebral edema in rats.

Material and Methods

One hundred and twenty male albino rats were deliberately chosen of different ages, weighed with a precision of ± 2 g, then treated as described below for each group and finally made to inhale ether until they died. Rats that died spontaneously were eliminated from further consideration.

Within an hour after death of the animals, the brains were uniformly excised, carefully including both olfactory bulbs, both flocculi and the first cervical segment. Whenever excision was unsatisfactory, the rat was eliminated from statistical calculations but not from histological examination.

Each brain was weighed on an analytical balance to the 0.001 g, fixed for 1—3 days in Cajal’s fixative (formaldehyde ammonium bromide) and studied by different techniques (paraffin or frozen slices): hematoxylin and eosin, cresyl violet stain, PAS (periodic acid Schiff sulfite leucofuchsins reaction) (LILLIE 1954), silver impregnation (SCHABERG 1960), Gros-Bielschowsky (GASSER 1961), Da Fano-Bielschowsky (GASSER 1961), Cajal’s Gold Sublimate (GASSER 1961), Herxheimer’s Scharlach R (GASSER 1961), methods II, III, IV, and V of Rio Hortega (RIO HORTEGA 1942).

Some rats received an intraperitoneal injection of trypan blue (0.6 ml of 1% solution of Merck Trypan Blue per 100 g body weight) which was later shown up in histological slices with Scharlach’s carmine (GASSER 1961).

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The rats were classified as follows:

1. Group N (normal): 35 rats were killed and their brains processed as described above.
2. Group NT (normal + trypan blue): 7 rats were weighed, injected with trypan blue, and killed 24 hours later. Their brains were treated as usual.
3. Group Sh+S (sham-adrenalectomy + stereotactic cerebral lesion): under ether anesthesia, 14 animals were operated upon as for bilateral adrenalectomy, except that the adrenal glands were not excised. For ten days the rats were fed a normal diet, but drinking water was substituted by 0.9% NaCl solution. On the tenth day, under ether anesthesia, a lesion was made in the right cerebral hemisphere of each rat with a sterile needle 0.25 mm in diameter which was introduced through an opening made with a dentist's trephine by means of a stereotactic instrument (Lab Tronics). The needle crossed the brain vertically, 8.2 mm anterior to the interaural line and 5 mm exterior to the midline, according to the De Groot atlas (De Groot 1963). These distances were suitably modified when the animal was too small. Immediately after this operation, 12 of these rats received an intraperitoneal injection of trypan blue. Twenty-four hours later the rats were killed and their brains treated as usual.
4. Group A (adrenalectomy): 30 animals were adrenalectomized, then fed for ten or eleven days as group Sh+S. On the tenth or eleventh day the survivors were killed and their brains excised, weighed and stained as usual.
5. Group A+SS (adrenalectomy + stereotactic cerebral lesion + saline solution): 26 rats were adrenalectomized and fed for ten days as group Sh+S. On the tenth day they underwent the stereotactic operation described for group Sh+S. Twenty-four hours later they were killed and their brains treated as usual. Fifteen of these animals received a trypan blue injection immediately after the stereotactic procedure.
6. Group A+Sw (adrenalectomy + stereotactic cerebral lesion + distilled water): An additional group of 8 rats was treated as group A+SS except that they were given distilled water to drink.

Results

Mortality

Effect of adrenalectomy. Predictably, mortality within ten days was only 10.7% for the 56 adrenalectomized rats that drank saline solution (groups A and A+SS) but 37.5% for the 8 adrenalectomized rats that were given distilled water instead (group A+Sw).

Effect of trypan blue. The injection seemed to have no ill effect on group NT. Of group Sh+S, the 2 rats that did not receive trypan blue could be killed 24 hours after the stereotactic operation, while one of those injected (8.3%) died prematurely. Of group A+SS, all 11 rats that were not injected could be killed 24 hours after the stereotactic operation, while 11 of the 15 that received trypan blue (73.3%) died prematurely.

Effect of the stereotactic cerebral lesion. 48 rats underwent the operation; of the 13 that died within 24 hours, 12 had received trypan blue and the other belonged to the group that drank distilled water.

Anatomical Results—Macroscopical Changes

Group N: Normal.

Group NT: Trypan blue was only observed in the choroid plexuses, the area postrema and the hypothalamus.

Group Sh+S: Trypan blue was found as in group NT and also along the path of the needle.

Group A: was not different from group N.

Group A+SS. The brain and the cranial nerves were always very much enlarged; brain tissue was frequently soft and easily protruded through any