Discussion to S-B-1.

A Special Type of Brain Swelling—Brain Swelling owing to Brain Damage after Boron-Neutron Capture Therapy—Electron Microscopic Study

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A trial to treat human brain tumors by using a nuclear reaction that will take place in the tumor tissue with $^{10}_5\text{B} + ^1_0\text{n} \rightarrow ^7_3\text{Li} + ^4_2\text{He} + 2.4 \times 10^8 \text{ eV}$ resulted in a sort of failure when the group at Harvard, MIT and Brookhaven National Laboratory performed the therapy on gliomas in 1960 and 1961. One of the causes for the failure was studied electron-microscopically by the authors.

The neutron source used for the experiment was that of MIT Nuclear Reactor with a flux of $1.5 \times 10^{10}/\text{cm}^2/\text{sec}$. 4 mg of boron-10 in the form of $\text{Na}_2\text{B}_{10}\text{H}_{10}$ was injected into each adult cat per kilogram of the body weight. After intravenous injection of the compound, half an hour later, neutron irradiation was done for 15 minutes, and all the animals were killed 6 hours later, with intracardiac injection of glutar aldehyde. Brain specimens were obtained through the burr holes which had previously been made in the left parietal region of each cat. After glutar aldehyde and osmium fixation, lead staining and uranyl staining and epon embedding, the samples were studied with JEM-7A electron microscopes. The group of animals that had been pre-treated with steroid (20 mg of Prednisolone succinate per capita) showed preservation of fine structures of the cerebrovascular endothelial lining. However, the non-treated group showed marked destruction of the endothelial lining, including disappearance or clumping of ribosomes, destruction of cristae of mitochondrion, disruption of endothelial membrane, increased number of Golgi apparatus or of endoplasmic reticulum and increased pinocytosis—all the changes in the endothelial cells mostly and not in the surrounding structures of the vascular wall.

This finding well correlates to the previous findings under light microscopes reported by Asbury et al. that the cause of brain damage due to the Boron-neutron capture therapy was owing to intracapillary radiation caused by the nuclear reaction with the boron contained in the blood.