15. Physical and Physiological Studies on Localized Freezing in the Cat Brain

Dennosuke Jinna, Kiyoo Kamikawa, Keizo Matsumoto and Yoshikuni Moroi
Dept. of Neurosurgery, Osaka University Medical School

Freezing has many advantages over other destructive methods in stereotactic surgery, because freezing lesion has flexibility, reproducibility and predictability with a sharp spherical delimitation, and inhibitory area around it in the C.N.S.

The purpose of this experiments as to investigate those characteristics of the freezing lesions and reversibility of the cooling area. Apparatus used for making the freezing lesions was Cooper's cryosurgery unit, which utilizes liquid nitrogen as a refrigeration source.

The cryoprobe with a 3 mm caliber was placed upon the suprasylvian gyrus of the cat, and was inserted to the required depth as well. Recording electrode and microthermisters are placed at the point with various distances from the tip of probe.

The size of freezing lesions was chiefly depended on the freezing temperature, because it grew gradually larger but became constant if the freezing time was over 3 minutes at each temperature down to $-100^\circ$C. There was no difference of the size of lesion between the surface and the depth. After the cessation of freezing procedure the size of the lesion was assured again by accounting the melting time on time-temperature record of the unit. The freezing point of the cat brain was about $-2^\circ$C and supercooling, which means freezing of tissue by the temperature of $-2^\circ$C or below without ice formation, was also observed. The temperature fall gradient was steep in the cooling area.

The transcallosal response (TCR) was used as a method for indication of the cortical activities in the cooling area. The contralateral cortex was stimulated with bipolar, silver, ball-tipped electrodes. The recording electrode was concentric bipolar with diameters of 0.1 mm–0.2 mm. The TCR showed a biphasic wave with positive and negative portion. Its average latency was a few milliseconds, and the duration of the response was 30–45 msec. In general, the negative portion of the wave was the more unstable to the deflection of the temperature. As the temperature on the recording point fell down, negative portion decreased its amplitude and increased its latency and duration gradually. The positive portion decreased the amplitude with a constant latency. The response was completely abolished, when the temperature of the recording point reached to $15^\circ$C from the body tempera-
ture. The response was started to reappear when the cooling was discontinued, and regained completely within 30 minutes after the cessation of the cooling. When the temperature fell down below $-2^\circ C$, the response was completely abolished and never reappeared on the rewarming process.

The reversibility of the cat cortex was defined with a criteria, that the TCR had been completely abolished once as cooling and regained full response within 30 minutes on rewarming. Such reversible changes were occurred where the temperature ranged from $15^\circ C$ to $-1^\circ C$. This reversible area was situated around the freezing lesion. For instance 3 minutes freezing of $-60^\circ C$ produced a spherical lesion of 8.2 mm in diameter with 2.2 mm width of the reversible area around it. However, if the recording point was supercooled with the temperature below $-2^\circ C$ or more, the response was diminished, but returned completely on rewarming.

The reversibility brings a tremendous benefit in a thalamectomy beside predictability, flexibility and sharp delimation of the freezing lesion.

16. The Localized Heating in the Brain for Temporally Reversible Lesion

Ryoji HAGIWARA, Hidehiko TAKAMATSU, Syuji OKAWARA, Yuji MIYAZAKI and Teruyoshi HASHIBA

Department of Neurosurgery, Sapporo Medical College

The instrument and gird for stereotactic cerebral operation has been established by many surgeons at present. On the other hand, some important point to get effective result by operation have been left for surgeon. The one is most effective target in each case and another is the testing method for target and side-effect during operation. The latter is most important in case of cerebral palsy who has marked cerebral atrophy.

The authors have made experimental study on this point of localized heating with radiofrequency current generator and reported the reversible block of nerve cells and fibers by localized heating.

Experimental studies on the heating reversible lesion were done in cats and dogs with recording by moving pictures. The reversible change of nerve conduction was tested in the internal capsule and sciatic nerve, and of nerve cell was done in the 3rd nerve nucleus in brain stem and in the thalamus. Radiofrequency current was produced by mean of generator which was developed by ourself and heating stainless probe is 1 mm in diameter, insu-