A LOCAL CORTICAL COOLING BLOCK

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The method of blocking separate portions of the central nervous system by cooling is not new.

In 1892 A. Cherevkov [2], when investigating the contribution of different parts of the cerebral cortex to control of the blood pressure, applied pieces of ice directly to its surface. Trendelenburg [5], in order to isolate portions of spinal cord wrapped portions of it with guinea pig gut washed in physiological saline through which a cooling fluid was passed. A. A. Iushchenko and his co-workers [3] made special hooks from silver tubing through which cooled saline was passed. In this way either one or both sides of the spinal cord could be blocked. The same authors [1, 4] made a capsule for cooling portions of cerebral cortex, but this has not been widely used.

In following up this work we have constructed a special capsule for low temperature block of separate portions of the cortex in cats and dogs [1].

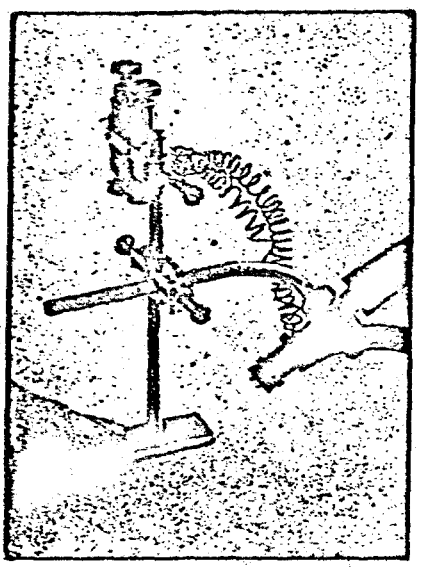

Fig. 1. General view of capsule. The electrodes can be seen at the base.

The capsule consists of a copper tube 3-5 mm in diameter, at the end of which there is a funnel-shaped expansion with a thin sheet of copper soldered to its base, and it is this portion which is brought directly into contact with the nervous tissue. The tube can be of various diameters depending on the dimensions of the portion to be blocked. We have made capsules with diameters from 5 to 8 mm, as well as a capsule which covers the sigmoid gyrus in both hemispheres. The cooling fluid is led in through a rubber tube which is joined to the capsule from above. An outflow tube leads off at an angle from the funnel-shaped portion of the capsule; if this tube is fixed at right angles to the surface of the funnel it interferes with the placing of the capsule. Saturated saline was used as a cooling fluid. This solution was passed through a glass coil placed in a vessel containing a 1 : 3—1 : 4 mixture of salt and snow (or ice). Under these conditions the temperature of the capsule was reduced to 8-12°C. The rate of flow of the solution through the capsule was controlled by a Mor clamp. In our experiments the rate was 1-2 liters per hour.

In certain cases, for instance for testing whether the block has been effected, electrical stimulation may be necessary. In order not to remove the capsule during the experiment, electrodes insulated with lacquer except for the tips are brought out below the base. These leads are fixed to the capsule by a special adhesive, e. g. BF-2. The capsule is held by a special stand, whose base is fixed with a small screw to the bone of the skull (Fig. 2). With this type of fixation the position of the capsule is not affected by movements of the animal during the experiment.

For control over the cooling action, thermocouple measurements were made of the temperature of the nervous tissue immediately under the capsule and at the periphery. Temperature was also measured at a point 2-3 mm below the surface.

Fig. 2. General view of capsule fixed to head of cat.

In an acute preparation the temperature of the surface varies between 33 and 34°C, while at a depth of 2-3 mm the variation is between 35-36°C. The maximum temperature drop occurs 35-45 minutes after starting the cooling. The superficial temperature is then 19-20°C, while the deeper thermocouple records 20-21°C (Fig. 3). The temperature of the brain is also reduced around the periphery of the cooled portion. Tests showed that with the setup just described, there is a temperature gradient such that at 1 mm from the capsule the temperature is 20.3°C, at 2 mm – 25.4°C, at 4 mm – 30°C and at 6-7 mm it is equal to that of the rest of the brain surface.

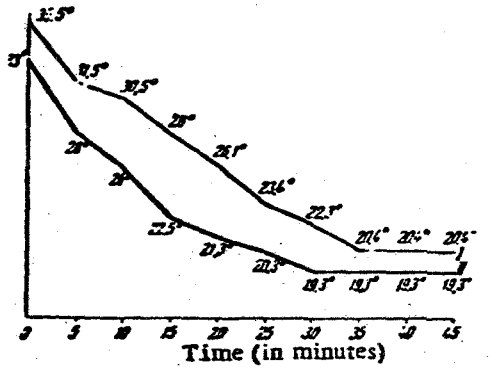

Fig. 3. Cooling curve of portion of brain. I) At depth of 2-3 mm; II) at surface.

There is no doubt that reducing the temperature to 19-20°C in the region of the capsule should constitute an effective block.

This was confirmed by a method which we devised: whereas electrical stimulation of a certain area before cooling evoked a marked pressor and respiratory response after 35-45 min. cooling it had no effect.

The method we have described allows separate areas of the cortex to be blocked. The importance of the method is that the block is temporary.

SUMMARY

The authors designed a special capsule for local exclusion of cerebral cortex by low temperatures. Cold solution is passed through this apparatus which decreases the cortical temperature down to 19-20 C. The capsule is supplied by electrodes, which allow stimulation of various areas of the brain by electric current (for control) during cooling.

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* In Russian.