Chronic Implanting of Electrodes in the Cerebellar Vermis of the Cat. Morphological Findings

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With 7 Figures

Summary

The morphological modifications of the cerebellar cortex have been evaluated in eight cats with chronic electrodes implanted in the anterior vermis. In a control animal a silastic lamina without electrodes was implanted. Four animals received intermittent stimulations up to 11 hours in one case and 100 hours in the other 3. The stimulation was carried out with pulses of 0.5 msec, 200 cps, and a charge per phase of 0.68 μC. Microscopic examination of the cerebellum showed that the experimental implanting of prostheses on the cerebellar vermis produces tissue lesions consisting of fibrous reaction, imprinting of the cortex, gliosis, and loss of Purkinje cells. These lesions are independent of the electric stimulation, and seem to be related to the pressure of foreign material against the cortex.

Keywords: Cerebellum; cerebellar damage; cerebellar electrodes; neurostimulation; epilepsy; spasticity.

In recent years, on the basis of different experimental works chronic stimulation of the paleocerebellum has been applied in humans, aimed at the treatment of processes such as epilepsy and dystonia.

Different experimental work in monkeys has aimed at establishing the morphological effects of electrical stimulation on the cerebellar cortex, with contradictory results.

Nevertheless, it seems accepted that the implantation of chronic electrodes in the posterior fossa of animals produces a fibrous reaction of variable intensity, and that the intermittent chronic stimulation, with some parameters similar to those used in humans,
does not produce tissue lesions in itself when the cerebellum is examined with the optical microscope. The present paper studies the damage produced by the chronic implanting of electrodes and by the intermittent stimulation of the cerebellar vermis of the cat.

**Materials and Methods**

Nine cats, weighing from 2 to 4 kilograms, were studied. The electrodes used consisted of 2 rectangular laminae of platinum of 6.8 mm² surface, placed at 2 mm distance from each other. The platinum laminae were mounted on silastic, with a total thickness of 0.75 mm.

Under IP anaesthesia with sodium pentobarbital (35 mg/kg) and in aseptic conditions, a craniectomy of the posterior fossa was made. An eight of the animals, the electrodes were inserted subdurally, in the anterior vermis. In one animal only a lamina of silastic of 7 × 4 mm was implanted. In the first three days after the intervention, dexamethasone (0.2 mg/kg) and penicillin (200,000 IU/kg) were administered by intramuscular route. Seven days after the operation, X-ray films were taken to check the positions of the electrodes, and the stimulation was begun in 4 of the animals. A stimulation with rectangular pulses coupled to an insulation unit was used, with an exit impedance of 1000 Ω and a capacity of 2 μF. The rectangular pulses were 0.5 msc in duration, being applied at 200 cps. The load per phase was 0.68 μC. The animals stimulated received the stimulation for 13 hours every day for 15 minutes out of each 30, reaching 11 hours in one of them and 100 hours in the remainder.

Seven animals were killed 20 days after the first operation (one animal with a lamina of silastic without electrodes, 3 animals after 100 hours of effective stimulation and 3 animals with electrodes which did not receive stimulation) and the 2 remaining ones (one animal with electrodes, non stimulated, and 1 animal with 11 hours of stimulation) were killed four months after implantation.

The cats were anaesthetized with IP pentobarbital and perfused with 10% saline formol. The posterior fossa was opened, and the cerebellum and brain stem removed in one piece. The blocks extracted were processed for study in serial optical microscopic cuts, by means of the techniques of HE, v. Giesson, Kluver-Barrera, and reduced silver nitrate.

**Results**

In all the animals with implanted electrodes, regardless of whether or not they were submitted to stimulation, a marked fibrous reaction was observed, covering the electrodes and cables. An evident impression of the electrodes on the surface of the cerebellum was also observed. The degree of adherence and encapsulation seen macroscopically did not appear to be related to the stimulation, but rather to the time which had elapsed since the implanting of the electrodes, it being greater in the two animals studied four months after implantation. In the non-stimulated animals, the microscopic study showed a diminution of thickness of the molecular layer under the electrodes, slight gliosis and an almost complete lack of Purkinje cells, with