The influence of the rostropontine-ventrolateral region on the sleep-wakefulness cycle

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Summary. Lesions affecting the ventrolateral area of the nucleus reticularis pontis oralis produced, in chronic implanted cats, a significant decrease of paradoxical sleep.

Considerable evidence has been reported in support of the hypothesis that the oral pontine region plays an important role in the sleep-wakefulness cycle (SWC)[1–7], but the influence of its different structures is still not well-defined. The initial aim of the present study was to determine the influence of the structures placed in the ventrolateral-rostropontine region on the SWC of the cat.

Method. 50 adult cats served as experimental subjects. They were equipped with chronic electrodes for recording of EEG, EMG of neck muscles and ocular movements. A deep electrode stereotaxically oriented in the ventrolateral region of oral pons was also provided to produce diathermocoagulation. 3 prelesional recordings (duration 8–24 h) were taken from each animal at weekly intervals. Immediately after producing the lesion, the first postlesional recording was obtained. It was followed by 4 others taken in the following 4 weeks. All the recordings (pre- and postlesional) were made in standard conditions with the animal free in a thermoregulated soundproof chamber. A quantitative statistical analysis (Student's t-test) was carried out comparing pre- and postlesional values. The parameters selected for study were number and duration of episodes of wakefulness (W), drowsiness (D), slow sleep (SS) and paradoxical sleep (PS), as well as the time spent in each state of SWC during every hour and day of recording.

A lesion in the ventrolateral area of oral pontine tegmentum.

The brains were sectioned in series and stained by Nissl's method in order to verify the location and extent of the lesions. In some cases, the anterograde degeneration from the lesion was studied by means of silver impregnation methods[8,9]. 20 cats, not lesioned, were utilized as control animals.

Results. Habitually, no statistically significant differences were found between the values of prelesional recordings and those of control animals. The parameters examined of SWC did not show any statistically significant modification in the animals with lesion in the nucleus tegmenti pontis of Bechterew. Animals with lesion in the lemniscus medialis showed, only in the first postlesional recording, a statistically significant decrease in the total time spent in PS, without modifications in duration of episodes in this state. Any statistical modifications were observed referring to W, D and SS states.

The animals with lesion in the lemniscus lateralis showed a statistically significant decrease of SS, without modifications in duration of periods only in the first recording taken after lesion. Any statistically significant changes were observed in the recordings taken later. The lesion affecting the ventrolateral area of the nucleus reticularis pontis oralis gave rise to a statistically significant decrease in the total time spent in PS. This fact was observed in almost all postlesional recordings. The duration of PS episodes was shorter. In this group of animals, increase of W and D and decrease of SS were observed but their values did not reach statistical significance.

Discussion. Our results in animals with lesion in the nucleus tegmenti pontis of Bechterew agree with the observations of Candia et al.[4], who did not find modifications in the SWC after lesions in this nucleus. In our experience, the changes in SWC after unilateral lesions of the lemniscus medialis and lemniscus lateralis were transient. These changes could be attributed to an unbalance in the SWC produced by the unilateral lesion in long pathways, that which rapidly compensated[1,3]. Lesions in the ventrolateral portion of the nucleus reticularis pontis oralis produced in our animals an important and maintained decrease of PS state. This finding confirms previous observations of Carli and Zanchetti[5] after bilateral lesion of this nucleus. Our results are also in general agreement with the study of Mancia[7], who observed reduction of PS and retrograde

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degeneration in the nucleus reticularis pontis oralis of split brain stem cats. The increase of W and D and the decrease of SS did not reach statistically significant values. Our experiments, therefore, support the hypothesis that the ventrolateral portion of nucleus reticularis pontis oralis has a hypnogenic function and, as was previously reported[2,3], this nucleus has an activating function on EEG.

Results show the importance of controlling exactly the lesions placed at the level of the pons, because little changes in the location and extent of lesions produce quite different modifications of SWC. Variations of SWC due to lesions in the ventrolateral area of nucleus reticularis pontis oralis are different from modifications found after destruction of its dorsomedial part[10]; also modifications are different from those found when the nucleus reticularis pontis caudalis is affected[11] or when there are wider lesions at this level[4]. It is imprecise, therefore, to speak of findings after lesion in the pontine tegmentum without determining the structures involved in the lesion.

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Construction of a thin film P_{O_2}-electrode using gold paste

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Summary. A thin film gold electrode for biological oxygen measurement was constructed using gold paste. This electrode is easy to construct, has high sensitivity and is disturbed only slightly by bubbling of the surrounding fluid. As an application, the electrode was used to measure oxygen consumption of the skin and yielded a reasonable value.

In the measurement of biological oxygen tension, 3 fundamental performances are required for the polarographic oxygen electrode; i.e. high sensitivity, rapid response and resistance to the effects by movements of surrounding fluid. These requirements oppose one another and can hardly be realized in 1 electrode: High sensitivity needs a large surface area of the active electrode, rapid response and resistance to fluid movements require a small electrode surface. To effect a compromise of these requirements, Saito and Mochizuki[3], Saito[4] introduced a ultra-thin film ring electrode of sputtered platinum. The construction of this electrode needs careful control of the sputtering apparatus, but the elaborately constructed electrode often becomes unstable, probably because the heat expansion of insulated platinum film is markedly larger than that of the insulating glass. To avoid such difficulties, Kimmich and Kreuzer[5] recommended to insulate a ring of a platinum foil of about 3 µm thick by means of polyvinyl chloride. The oxygen current of their electrode, however, is still affected by fluid movements, when utilized without covering. Therefore, it seems worthwhile to examine another method of construction of the thinner film ring electrode. In the present study, we investigated the applicability of gold paste, which is used for the painting of china, to the construction of oxygen electrode.

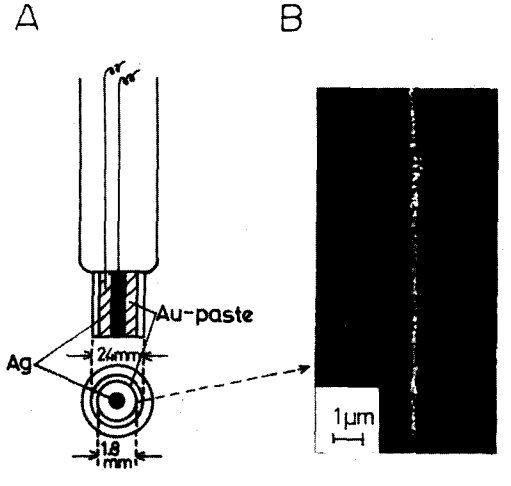

Fig. 1, *A* Schematic illustration of the gold paste electrode. *B* A microscopic photograph of a part of the gold paste active surface immersed in oil (n= 1.515) and illuminated with a light beam having a suitable incident angle. Olympus oil objective Hi M 100× and occular 10× were used.

Construction of the electrode. The structure of the electrode is schematically shown in figure 1, A. A thin glass tube (OD 2 mm) is painted with diluted gold paste and heated for 60 min at a temperature of 400 °C. This tube is then inserted in another glass tube which serves as insulation. Air is then removed from the tubes with a vacuum pump. The tube is heated while the vacuum pump is still running, which causes the outer tube to melt and shrink onto the inner glass tube and insulate the gold film. The tip of this glass tube, having an insulated gold film in it, is cut off and polished gently on artificial leather with cerium oxide powder, so that a smooth thin ring of gold film is exposed on the surface flush with the polished cut end of the glass tube. Then a silver wire coated with silver chloride is inserted into the glass tube and mounted in a suitable position at the cut end by means of epoxi-resin. This Ag-AgCl wire serves as the reference electrode against the gold film, which is charged at −0.7 V.

Characteristics and testing of the electrode. The sensitivity and reproducibility of oxygen current of this electrode was tested in a saline solution bubbled with air and nitrogen. The oxygen current is of the order of 10^{-11} A/Torr and its response to alternate bubbling with air and nitrogen was reproducible within a relative error of 6% over 7 h. When air bubbling was stopped, the oxygen current quickly decreased by 5% of total current and remained at that level. This means that the disturbance

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