ANESTHESIA EFFECT ON RABBIT HYPOTHALAMIC NEURON IMPULSE ACTIVITY

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Neuronal impulse activity in the thermoregulation center in the anterior and posterior sections of the rabbit hypothalamus was studied in chronic experiments and in intravenously injected anesthetics (urethane and chloralose). Anesthesia decreased the neuronal firing rate, changed the impulse activity pattern, and decreased the number of neurons responding to skin thermal stimulation. These changes were most pronounced in the posterior hypothalamic section.

INTRODUCTION

The effect of anesthetics on brain neuron activity is a problem which has both theoretical and practical interest. However, to evaluate the effect of different types of narcotics, it is difficult to compare data obtained by individual authors in experiments, because different types of animals and anesthetics are often used to study different brain structures. Moreover, local and individual sensitivities to the narcotics are possible.

In this work, data obtained on two groups of rabbits, in chronic experiments and under anesthesia (urethane and chloralose) are reported. The neuronal impulse activity of the thermoregulation center in the anterior and posterior hypothalamic sections was studied under thermally neutral conditions and under thermal effects on the skin.

METHODS

Chinchilla rabbits weighing 3.0-3.5 kg were utilized. In both experimental series (without and with anesthesia), procedures were carried out preceding the operation, micro-
Fig. 1. Mean firing rate distribution of neurons of the anterior (a) and posterior (b) hypothalamic sections in unanesthetized (white bars) and anesthetized (black bars) rabbits. Abscissa axis) mean firing rates of neurons, impulse/sec; ordinate axis) common firing rate values for impulses indicated on the abscissa.

Six to seven days before the onset of experimentation, thermocouples were inserted into the rabbit brains and special Plexiglass plates were installed onto the skull. Micromanipulators with microelectrodes were attached to these plates later on in the experiment. The detailed method of the operation was described earlier [2, 9].

Openings, not more than 2 mm in diameter, were made in the skull over the medial preoptic region (coordinates A2-3, LI) and dorsal and ventral hypothalamic nuclei (coordinates PI, LI) [18]. During the experiment, tungsten microelectrodes (tip diameter of 1-3 μm) for extracellular output of neuronal activity were inserted into these openings.

Metallic thermodes were fixed snugly unto the body skin and the edge of the nose for thermal stimulation. Water of different temperature was passed through the thermodes: 30-31°C (initial background), 7-10°C (skin cooling), and 40-42°C (skin heating).

The rabbits were placed on the machine during testing. The temperature was maintained in the neutral zone (22-24°C) in the experimental chamber. The rabbits were injected intravenously with urethane (1 g/kg) and chloralose (40 mg/kg) before each test in the experimental series conducted under anesthesia.

RESULTS

Of the 60 rabbits studied, 194 neurons in the anterior and 345 neurons in the posterior sections of the hypothalamus had background neuronal activity.

The characteristics of neuronal activity such as background impulse activity (mean frequencies and their pattern and types of impulse activities) and the quantity of thermosensitive units reacting to thermal stimulation were studied.

The background impulse activity of neurons of the posterior and anterior sections of the hypothalamus were recorded under neutral temperatures of 22-24°C. In this case, the brain temperature of rabbits not anesthetized averaged 38.80°C ± 0.05, whereas under anesthesia, 38.30°C ± 0.14.

Figure 1 shows the normal distribution of average impulse frequencies of all of the neurons of the anterior and posterior hypothalamic sections that were studied with or without anesthesia. The distribution pattern of the firing rates differed significantly from control, therefore nonparametric comparison criteria was used for statistical distribution analysis [8].

The firing rate distribution of neurons in the anterior section of the hypothalamus did not differ significantly between unanesthetized and anesthetized rabbits. The mean firing