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BRIEF COMMUNICATION

Effect of Scopolamine on the Electrical Resistance of the Paw Pads of Mice

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ORIKASA, S., M. SAITO AND T. KAWASHIMA. *Effect of scopolamine on the electrical resistance of the paw pads of mice.* PHARMACOL BIOCHEM BEHAV **41**(4) 855–857, 1992. – We examined the electrical resistance of the paw pads of mice under the same conditions as used previously in studies of the passive avoidance response. Administration of scopolamine (0.05–1 mg/kg, SC) 10 or 30 min prior to placement of animals in an experimental box resulted in a profound increase in electrical resistance. In contrast, subcutaneous injection of butylscopolamine (1–20 mg/kg), diazepam (1 or 2 mg/kg), or pentobarbital (10 or 20 mg/kg) did not substantially alter subject resistance. Scopolamine may act on the CNS to induce increased paw skin resistance.

Scopolamine Electrical resistance Paw pad Mouse

A passive avoidance response motivated by an electrical shock has often been applied to assess learning ability and memory in animals (3). When a constant-voltage circuit is used to deliver shock in avoidance experiments, a change of skin resistance may affect pain and perception and invalidate learning experiments. In an attempt to avoid this problem, it has been popular to add a high-value resistor in series with the shock grid. More preferably, a constant-current generator can be used. The affect of drugs on subject resistance, however, remains an important consideration in interpretation of results in shock experiments because it is uncertain whether these systems can regulate shock levels satisfactorily when subject resistance is increased to high levels.

Scopolamine induces learning failures in man (6), and animals administered this drug have been used as an experimental model for amnesia (7). It has been reported that scopolamine does not affect foot-shock sensitivity in the rat (9). Other investigators have reported that scopolamine increases the skin resistance of the rat (2) and decreases the reactivity of the rat to foot-shock (1). It is difficult to compare these results because of methodological differences, but it seems that the conclusions are inconsistent.

The aim of the present experiment was to elucidate whether scopolamine affects the electrical resistance of the paw pads of mice when subjects are recipients of an electrical shock. The experimental conditions were the same as conditions in examination used previously (5). The effects of several other drugs were also investigated.

METHOD

Animals

Male ddY mice (SLC, Japan) weighing 23–27 g were used. Mice were housed in a housing room (22 ± 2°C, 55 ± 5%) with free access to food and water. Mice were acclimatized in an acclimation cage for more than 2 h in an experimental room (22 ± 2°C, 55 ± 5%). A group of 5–12 mice was used. Animals were used only once.

Procedure

A step-through type passive avoidance response apparatus (O'Hara) was used in the present experiment. This apparatus consists of a bright-dark experimental box and a controller. An electrical stimulation device with a constant-voltage circuit was present in this controller. Each mouse was placed in the bright compartment and, when it entered the dark compartment and crossed a photo beam, an electrical shock (AC 60 V) was applied to the paw pads from the electrical stimulation device through a floor grid made of stainless steel rods. The voltage difference between terminals of a protective resistor

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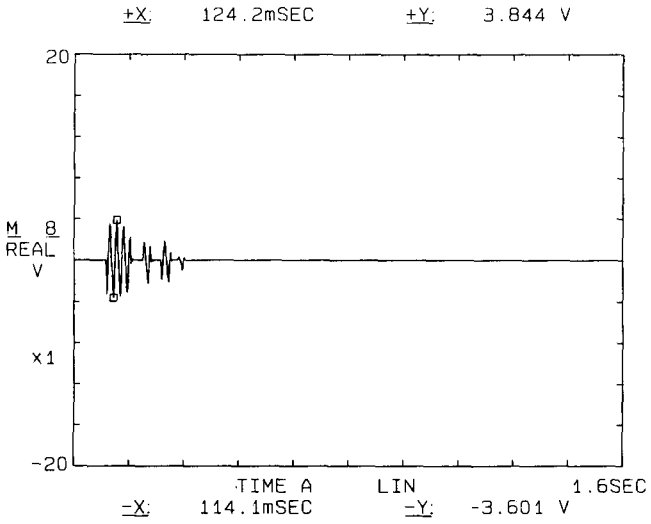

FIG. 1. One typical trace of the voltage difference between terminals of the protective resistor in experiments in which mice received saline 30 min prior to the trials. The trace was drawn on a plotter-printer.

in the circuit of the electrical stimulation device was measured. Subject resistance was calculated from the maximal value in the voltage difference sampled.

Drugs

Scopolamine hydrobromide injection (Kyorin), scopolamine butylbromide injection (Tanabe), diazepam injection (Yamanouchi), and sodium pentobarbital injection (Dainippon) were used. The drugs were diluted or suspended in physiological saline injection (Otuka) immediately before administration.

Statistical Analysis

Kendall's rank correlation analysis followed by the Kruskal-Wallis test was employed for detection of statistical significance.

RESULTS

Figure 1 shows one typical trace of the voltage difference between the terminals of the protective resistor in experiments in which mice received saline 30 min prior to the trials.

Administration of scopolamine (0.05-1 mg/kg, SC) 10 or 30 min prior to the trials increased subject resistance in a dose-dependent manner ($p < 0.01$). Injection of butylscopolamine (1-20 mg/kg, SC) 30 min prior to the trials, however, did not significantly affect subject resistance. Injection of diazepam (1 or 2 mg/kg, SC) 10 min prior to the trials slightly increased subject resistance ($p < 0.05$), although injection of nonanesthetic doses of pentobarbital (10 or 20 mg/kg, SC) 10 min prior to the trials did not significantly alter subject resistance. These results are shown in Fig. 2.

DISCUSSION

Subject resistance *apparently* fluctuates widely because of movement of animals. This is the reason why the minimal value of resistance within the data sampled was taken as the subject resistance.

Muenzinger and Mize (4) reported that resistance of an albino rat is typically about 300 kΩ and the highest value they observed with the 77 rats tested was 1.1 MΩ. Horsburgh (2) reported that subject resistance was less than 5 MΩ in most test sessions, but a test session in which subject resistance was

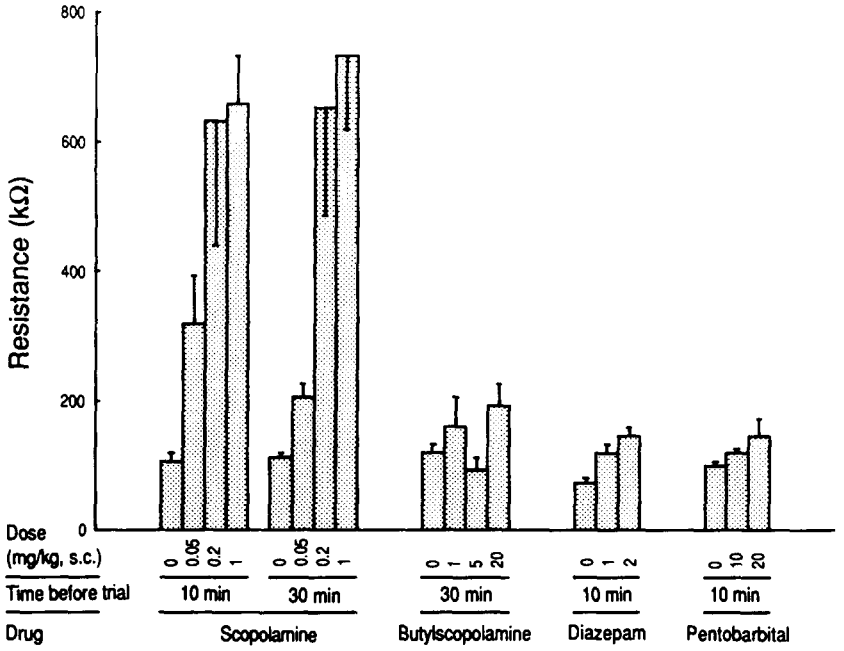

FIG. 2. Effects of scopolamine, butylscopolamine, diazepam, and pentobarbital on the electrical resistance of the paw pads in mice. Vertical bars show the SEM.

greater than 15 MΩ was also observed. It seems that the variations of subject resistance in the present study were smaller than reported by others. This may be due to measuring subject resistance of animals under a specific situation, that is, it was measured precisely when the mouse had just entered into the dark compartment, and the minimal resistance was calculated.

Electrodermal activity is dependent on secretions of the sweat gland, which is almost exclusively innervated by cholinergic sympathetic fibers. This nature of the sweat gland has important implications in any analysis of electrodermal activity in patients medicated with a drug having anticholinergic properties (8). In the present experiment, administration of scopolamine increased subject resistance whereas butylscopolamine did not alter subject resistance. It is well known that quaternary ammonium compounds pass with difficulty into the CNS (10). Therefore, these observations suggest scopolamine acts on the CNS, rather than on the peripheral nervous system, to increase subject resistance, and the evidence is an important consideration in interpretation of results in passive avoidance response experiments.

On the other hand, none of the other drugs investigated in the present experiment intensely affected subject resistance, although some variations were observed that were much smaller than the deflection induced by scopolamine. Their limited affects on subject resistance may be unimportant in practice for interpretation of results in passive avoidance response experiments.

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