Study of the Cognitive Component of Nociception by the Tail Flick Method

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The possibility of using the tail flick test as a model for studies of the cognitive component of nociception in rats was evaluated. The results were compared with the data of active avoidance test in a shuttle chamber. The results demonstrate the methodological potentialities of the tail flick test as a convenient model for training of animals in studies of the nociceptive reactions.

Key Words: *tail flick test; bio-test; cognitive component of nociception; rats*

Methods for conditioned reflex training, for example, the shuttle chamber [1], serve as the main models of training with nociceptive electrocutaneous support. The training component is usually neglected in the standard tail flick method [4], which is used for studies of the perceptual and motor components of nociception. However, this method meets the main requirements of active avoidance reflex training: 1) conditioned stimulus (light transmitted through a magnifying glass) is supported by unconditioned (tail removal in response to light and thermal exposure when the nociceptive threshold is attained); 2) conditioned reflex (light) precedes the painful support; and 3) the light and painful support combination are presented repeatedly (6 times).

We evaluated the possibility of using the tail flick method for studies of the cognitive component of nociception in animals.

MATERIALS AND METHODS

Experiments were carried out on male Wistar rats (250-300 g). The bio-test device consisted of a cage with a metal lattice on the floor. The cage was divided into 2 sections connected with a hole. One section was brightly illuminated, the other was dark. The animal was placed into the light section and the time after which it left for the dark section was recorded. Pulsed current (from 1 mA, Nihon Cohden electrostimulator) was switched on after a period equal to three latent periods (LP) before escape into the dark section. Then the LP (in sec) of startle, rearing, running, peeping, and escape to the light section from the moment of stimulation beginning was recorded. The time after which the animals escaped into the dark section was then recorded. Testing was carried out on days 1 and 4.

The classical tail flick method consists in evaluation of the tail flick LP (in sec) in response to light and thermal stimulation (DS20 device, Ugo Basile) [2]. The rat was placed into a special immobilization box and fixed in a horizontal posture with its tail put out. After 30 min (adaptation period) the tail flick LP was measured 6 times at 4-5 min intervals. After testing the number of the minimum LP in each series of 6 stimulations was counted.

Experiments were carried out in accordance with the International Agreements on Humane Handling of Animals (The European Communities Council Directives of 24 November, 1986, 806/609/EEC) and decisions of Ethics Committee of Institute of Physiology.

The results were statistically processed by the Z sign test.

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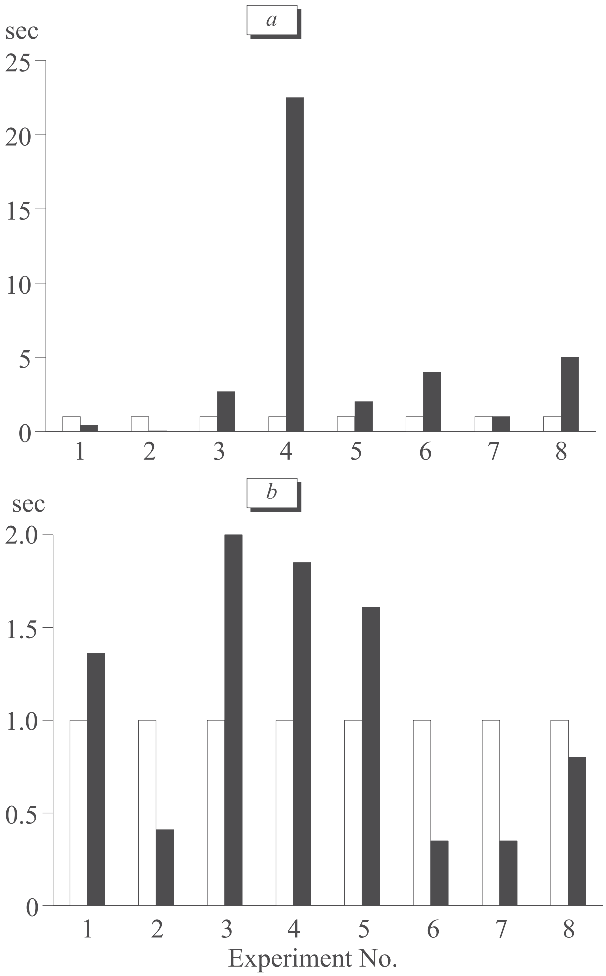

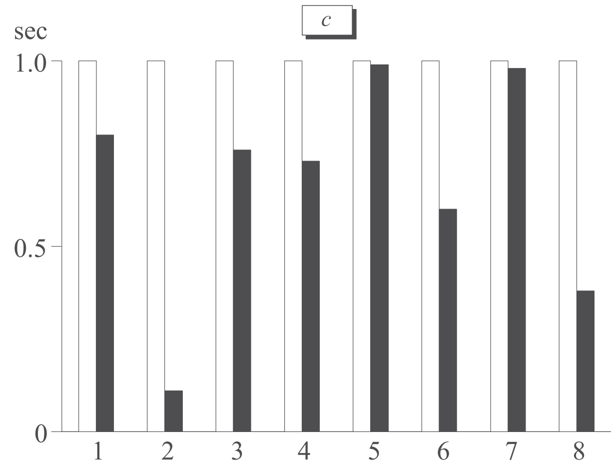

Fig. 1. Latent period of animal migration in the shuttle chamber on day 4. Light bars: basal values; dark bars: day 4. *a*) first venture to the dark section; *b*) migration from dark section into light one after the nociceptive threshold is attained; *c*) return to dark section.

RESULTS

In experimental series I, carried out on 8 rats, the training of animals on a bio-test device was studied.

On day 4 the time after which the animals migrated into the dark section increased in 5 rats (Fig. 1). The time of startle, rearing, running, and peeping did not change. The strength of current at which the animal escaped into the light section after electrocutaneous stimulation of the limbs decreased in 6 animals. The time before running to the light section decreased in 4 cases. Return to the dark section was more rapid in all cases.

Studies of the tail flick LP was carried out in 48 rats. The animals exhibited some individual features in this test. More than half (28 rats) shifted the tail from its tip to base, thus distributing the warming on a larger surface. Others (8 rats) did not allow putting the tail on the hot point. The rest 12 animals bent the tail in an arch, preventing the local warming of the tail, this suggesting their previous training.

The number of the minimum LP before tail flick gradually increased from the 1st to 5th presentation, after which it reduced (Fig. 2). It seems that a lesser number of animals by presentation 6 indicated the involvement of the antinociceptive mechanisms.

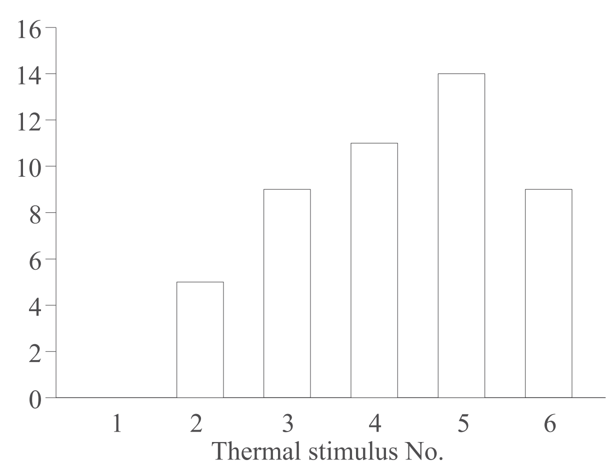

Fig. 2. Relationship between the number of the tail flick minimum LP and the stimulus presented.

The cognitive component of pain reflects the individual emotional evaluation of pain, depending on the frequency and strength of a previous nociceptive exposure [3]. Conditioned reflex methods, suggesting repeated nociceptive exposure for support, are adequate approaches to its studies. The methods used in our study are comparable. The animal was trained to actively avoid the nociceptive stimulation by passing from one section to the other or by the tail flick motor reaction. The light served as the conditioned stimulus. The tail flick test has an important advantage in comparison with the shuttle chamber. Due to limited mobility it is possible to record simultaneously other parameters (pneumogram, ECG, EEG, *etc.*), which is impossible during recording of these parameters in free animals. We suggest the tail flick test as the most convenient method for studies of the cognitive component of the nociceptive reaction in rats.

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