PHYSIOLOGY

Role of Caudomedial Portion in Left and Right Cingulum Bundle in Perceptual and Emotional Components of Nociception in Rats

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The effects of electrocoagulation of caudomedial portion of the left and right cingulum bundles on tail-flick latency and vocalization threshold were examined on rats. We revealed a tendency to a decrease in the tail-flick latency and more pronounced elevation of the vocalization threshold after destruction of the right cingulum bundle. These findings indicate functional asymmetry of the cingulum bundle in the realization of the emotional nociceptive reaction.

Key Words: *cingulum bundle; emotional and perceptual nociceptive components; rat*

Unilateral intervention into the cingulate cortex and cingulum bundle in humans and animals moderates chronic pains, including incurable pans [6]. Various interventions in the region of the cingulum bundle affect behavioral nociceptive reactions in animals [5]. This structure is currently examined to find the region, whose stimulation or damage can produce maximum analgesic effect. It cannot be excluded that the left and right cingulum bundles play different roles in nociception, which reflects functional asymmetry of brain structures. Differences in anisotropy were demonstrated in the left- and right-handed humans [5].

Our aim was to reveal the differences between the left and right cingulum bundles in the realization of nociception in rats.

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MATERIALS AND METHODS

Experiments were carried out on mature male Wistar rats (n=16) weighing 250-300 g.

The perceptual component of nociception was assessed by the tail-flick latency (TFL) in response to radiant heat stimulation of the tail in a DS20 apparatus (Ugo Basile). TFL was calculated as the mean of 6 tests performed every 4-5 min.

The emotional component was determined by vocalization threshold (VT) in response to electrocutaneous stimulation (ECS) of the tail with a Nikon Kohden electrical stimulator (pulse duration 0.5 msec, repetition rate 10 Hz).

Coagulation of the left and right cingulum bundles were performed as follows: the rats were scalped 20-25 min after intramuscular injection of ketamine (10 mg/kg) and the skull was drilled under stereotaxic control (TSE systems) according to the following coordinates [7]: 4.3 mm caudally from bregma; 1 mm to the left and to the right from the median suture. A bipolar coagulating electrode was immersed by 2 mm. Electrocoagulation was performed at 0.5 mA for 20 sec. After the experiment, the damaged area was controlled histologically.

After 4-day recovery period, the perceptual and emotional components of the nociceptive reaction were measured.

The data were processed statistically using Student *t* test.

All experimental procedures were carried out in accordance to European Economic Community Directive 86/609/EEC [8] on the protection of animals used for experimental and other scientific purposes under the control of Ethical Committee of P. K. Anokhin Institute of Normal Physiology.

RESULTS

Local destruction of the left cingulum bundle had little effects on TFL, while similar destruction in the right cingulum bundle decreased this parameter ($p<0.03$, Fig. 1). There are data on functional specialization of the right hemisphere in perception, memorizing of visual patterns, and solving the problems evoking emotional stress with activation of the hippocampus and amygdale [1].

Electrocoagulation of the left portion of the cingulum bundle led to a less significant ($p<0.03$) elevation of nociceptive threshold during ECS of the tail compared to destruction of the right portion ($p<0.01$; Fig. 2, *a*, *b*).

Therefore, local destruction of the caudomedial portion of the right cingulum bundle produces more pronounced inhibition of perceptional and emotional assessment of the pain in comparison with the effect of destruction of the left cingulum bundle. Interhemispherical asymmetry of the morphological, physiological, and biochemical indices was demonstrated not only at the neocortical level, but also within the limbic structures. Specifically, this asymmetry was documented for the hippocampus,

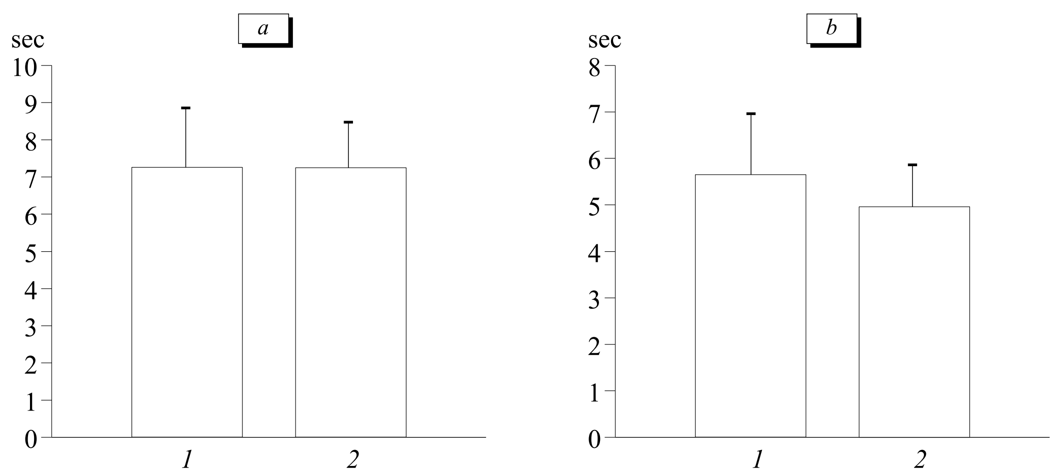

Fig. 1. Mean TFL before (*1*) and after (*2*) coagulation of the left (*a*) and right (*b*) cingulum bundle.

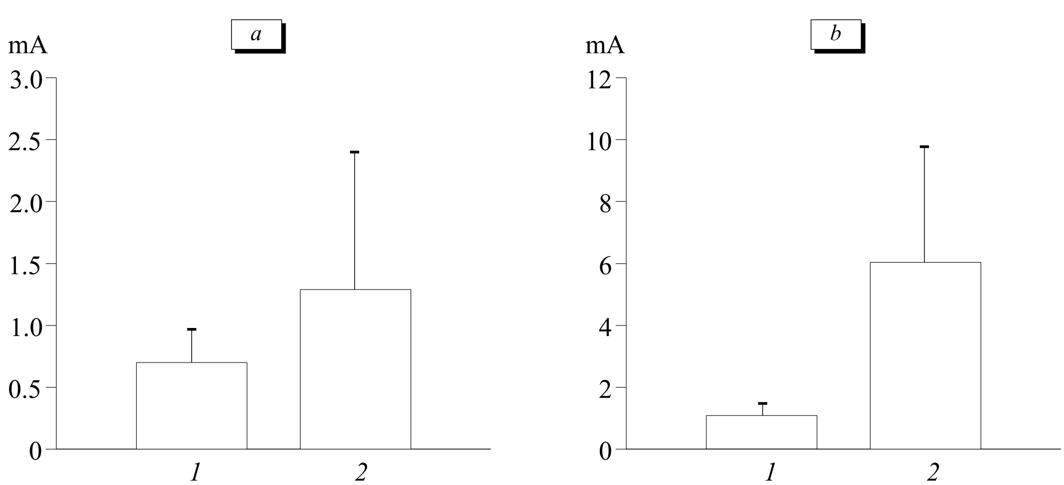

Fig. 2. Mean VT before (*1*) and after (*2*) coagulation of the left (*a*) and right (*b*) cingulum bundle.

amygdale, and hypothalamus [1]. The results of neurophysiological and psychophysiological studies of activity in the right and left areas of the frontal cortex suggest that the left hemisphere is involved in positive emotions, while the right hemisphere is responsible for negative ones [3]. Experiments on dogs demonstrated opposite asymmetry of various degrees of some parameters of electrical activity in amygdale and hippocampus, which depended on the types of the higher nervous activity [2].

Revealing the individual-typological peculiarities in functional symmetry of cingulum bundle in animal nociception is a promising avenue of investigation.

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