PHYSIOLOGY

Fine Electrophysiological Analysis of Impulse Activity of Various Neuron Types in Nodose Ganglion during Intraatrial Injection of Dalargin

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Experiments on narcotized cats showed that intraatrial injection of dalargin in doses crossing and not crossing the blood-brain barrier modifies impulse activity of nodose ganglion neurons.

Key Words: *dalargin; nodose ganglion neurons; myocardial ischemia; atrial fibrillation; bulbar cardiovascular center*

We previously demonstrated a protective effect of dalargin during the development of ischemic cardiac arrhythmias, including ventricular fibrillation [3]. During myocardial ischemia aggravated by ventricular fibrillation local changes in the myocardium are accompanied by important disintegration of neural activity in the bulbar cardiovascular center [1,2,5,6]. The important role in this rearrangement of the activity of bulbar cardiovascular neurons (CVN) is played by changes in impulse activity of nodose ganglion neurons [4]. In light of this, our aim was to study impulse activity of nodose ganglion neurons of various types during intraatrial injection of dalargin.

MATERIALS AND METHODS

Experiments were carried out on 54 cats of both sexes weighing 2.0-4.0 kg. The cats were anesthetized with nembutal (40 mg/kg intraperitoneally) and artificially ventilated. The nodose ganglion was isolated from the connective tissue capsule and placed onto an insulating support, which separated it from the carotid artery.

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Impulse activity of nodose ganglion neurons was recorded extracellularly [7].

ECG was recorded in standard leads II and III. Blood pressure (BP) was measured in the femoral artery.

Dalargin (Peptide Synthesis Laboratory, Russian Cardiology Research-and-Production Complex, Ministry of Health) was administered into the atrium in doses of 10 and 500 μg/kg (1 ml).

The results were analyzed statistically using Student's *t* test.

RESULTS

In control experiments (n=21) intraatrial injections of Ringer solution produced no changes in impulse activity of CVN and integrative neurons (IN), HR and BP were also constant (Table 1).

Dalargin in the low dose not crossing the blood-brain barrier (10 μg/kg, 1 ml) had no effect on HR and BP (Table 1).

The low dose of dalargin (10 μg/kg) modified impulse activity of CVN (n=6) starting from the first or second cardiac cycles: it increased in 33% cases and decreased in 67% cases. Then impulse activity of neurons returned to baseline (Fig. 1).

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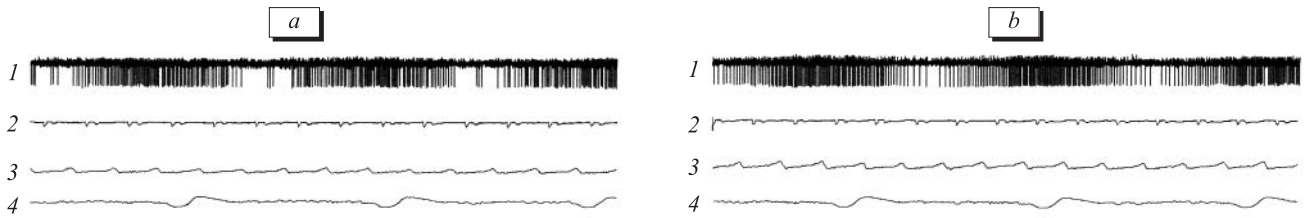

Fig. 1. Effect of low dose of dalargin (10 μg/kg) on impulse activity of cardiovascular neuron. Here and in Fig. 2: *a*) baseline recordings; *b*) response to dalargin. *1*) neurograms; *2*) ECG (deviation from isoline corresponds to the onset of injection); *3*) BP in femoral artery; *4*) pulmogram.

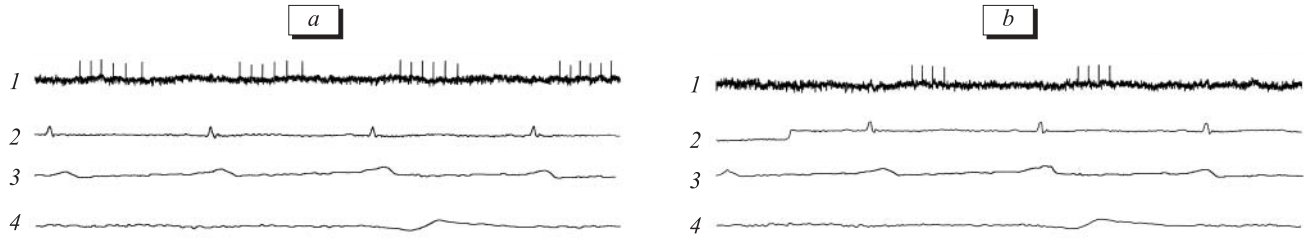

Fig. 2. Effect of low dose of dalargin (10 μg/kg) on impulse activity of cardiopulmonary neuron.

Under the same conditions, activity of IN (n=12), which receive input from cardiovascular and respiratory systems (cardiopulmonary, late inspiratory, inspiratory-expiratory, and rhythmically active neurons with respiratory modulation) increased impulse activity in 77% cases starting from the first-second cardiac cycles (Fig. 2). On minute 5 postinjection, 46% IN continued to increase impulse activity, 46% IN resumed baseline firing, and 8% IN did not change their impulse activity. In the same period, 23% IN moderated their impulse activity.

Intraatrial injection of dalargin in the high dose crossing the blood-brain barrier (500 μg/kg, 1 ml) reduced impulse activity of CVN starting from the first cardiac cycle, and to minute 3 postinjection its activity did not return to baseline. In all cases, impulse activity of IN (n=4) increased starting from cardiac cycles 1-2 and to minute 3 postinjection it remained at the same level. In these experiments HR and BP did not change (Table 1).

Thus, neurons of the nodose ganglion differ in their response to intraatrial injection of dalargin. Cardiopulmonary neurons receiving afferent input not only from cardiovascular, but also from respiratory system increased their activity in most cases. Similar changes were observed during myocardial ischemia not aggravated by ventricular fibrillation under conditions of natural respiration [4]. Probably, dalargin can activate the compensatory reactions induced by respiratory system during cardiac ischemia.

By contrast, in most cases CVN moderated impulse activity. It is known that the afferent input projected to CNS via vagal nerves is increased during myocardial ischemia followed by ventricular fibrillation. Therefore, it can be hypothesized that dalargin inhibits impulse activity of these neurons and thereby impedes disintegration of neuronal activity in the bulbar cardiovascular center. The latter phenomenon is one of major factors leading to ventricular fibrillation during myocardial ischemia [5].

Thus, the protective effect of dalargin during the development of ventricular fibrillation results not only from its action on local mechanisms in the ischemic region, but also from its modulatory action on nodose ganglion neurons [3].

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TABLE 1. Effect of Control Ringer Solution and Dalargin on Impulse Activity of Feline Neurons ($M\pm m$)

Agent		HR, min^{-1}		BP, mm Hg	
		baseline	experiment	baseline	experiment
Ringer solution		169.7±10.8	171.6±11.6	152.7±15.8	153.3±14.7
Dalargin, μg/kg	10	170.4±10.8	170.3±8.9	151.7±15.8	155.6±14.0
	500	170.1±9.2	168.8±7.8	155.4±14.8	156.4±14.2

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