# Role of Intraosseous Receptors in Afferent and Motor Reaction Modulation

O. A. Shevelev,* E. L. Sokov, and N. A. Khodorovich*

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 120, № 7, pp. 40-41, July, 1995
Original article submitted March 28, 1994

Acute experiments on cats demonstrated facilitation effects of afferent reactions, and segmentary motor reactions during stimulation of sciatic nerves and inhibition of corticofugal motor reactions induced by electrical stimulation of ilium osteoreceptors.

**Key Words:** *nociception; intraosseous receptors; radicular syndrome*

The osteoreceptor system remains one of the least studied parts of sensory system physiology. This might be due to the fact that so far no holistic concept has yet emerged regarding its role in physiological functions and its participation in the pathogenesis of somatic and visceral diseases [3,4]. Published data suggest that overstimulation of intraosseous receptors (e.g., during increased intraosseous pressure) may cause disturbances in sensorimotor reactions, most clearly manifested in the general segments of spinal innervation [1-4]. Increased intraosseous afferentation is thought to play an essential role in the development of neurologic manifestations of lumbar osteochondrosis, prompting the present study aimed at elucidating the effect of osteoreceptor system stimulation on the formation of evoked potentials (EP) in the cerebral cortex and electromyographic reactions for discrete electrostimulations of the sciatic nerve.

## MATERIALS AND METHODS

EP in the focus of maximum activity of the first sensorimotor area of the cerebral cortex and the electromyogram (EMG) of femoral muscles during sciatic nerve stimulation (pulse duration 0.3 msec, current strength 3-10 μA, frequency 0.1 Hz) were recorded in acute experiments on sexually mature cats (14 animals) under chloralose anesthesia and myorelaxation. Electrostimulation was applied to motor zones of the cortex and the EMG-equivalent of the femoral muscle motor reaction was recorded. Conditioning stimulations were applied to the spongy substance of the ilium by means of two needle electrodes insulated their entire length except for the ends, introduced into the spongy bone at a depth of 3-4 mm and 3-4 mm apart (pulse duration 0.3 msec, strength 3-10 ×mA). Experiments were performed using stereotaxis with Multibasis multipurpose neurophysiological apparatus (Biomedica) for 10 signal presentations. The amplitude fluctuations of the summated phases (from peak to peak) were subjected to statistical processing: 1-2 EP phases and deviations from the EMG response.

The strength of sciatic nerve stimulation was selected at the level of threshold intensity sufficient for forming stable responses. For the sake of convenience the alterations of the indexes obtained for conditioning stimulations of the spongy substance of the ilium were estimated in percentages, taking the initial data as 100%. The interval between conditioning and test stimuli ranged from 100 to 1000 msec.

## RESULTS

Conditioning stimulations of the spongy substance of the ilium markedly affected the amplitude of the test EP and of the EMG response. For example, within the interval from 300 to 700 msec the summated

Department of Pathological Physiology, *Department of Nervous Diseases, Russian University Peoples' Friendship, Moscow (Presented by N. A. Agadzhanyan, Member of the Russian Academy of Medical Sciences)

0007-4888/95/0007-0685$12.50 

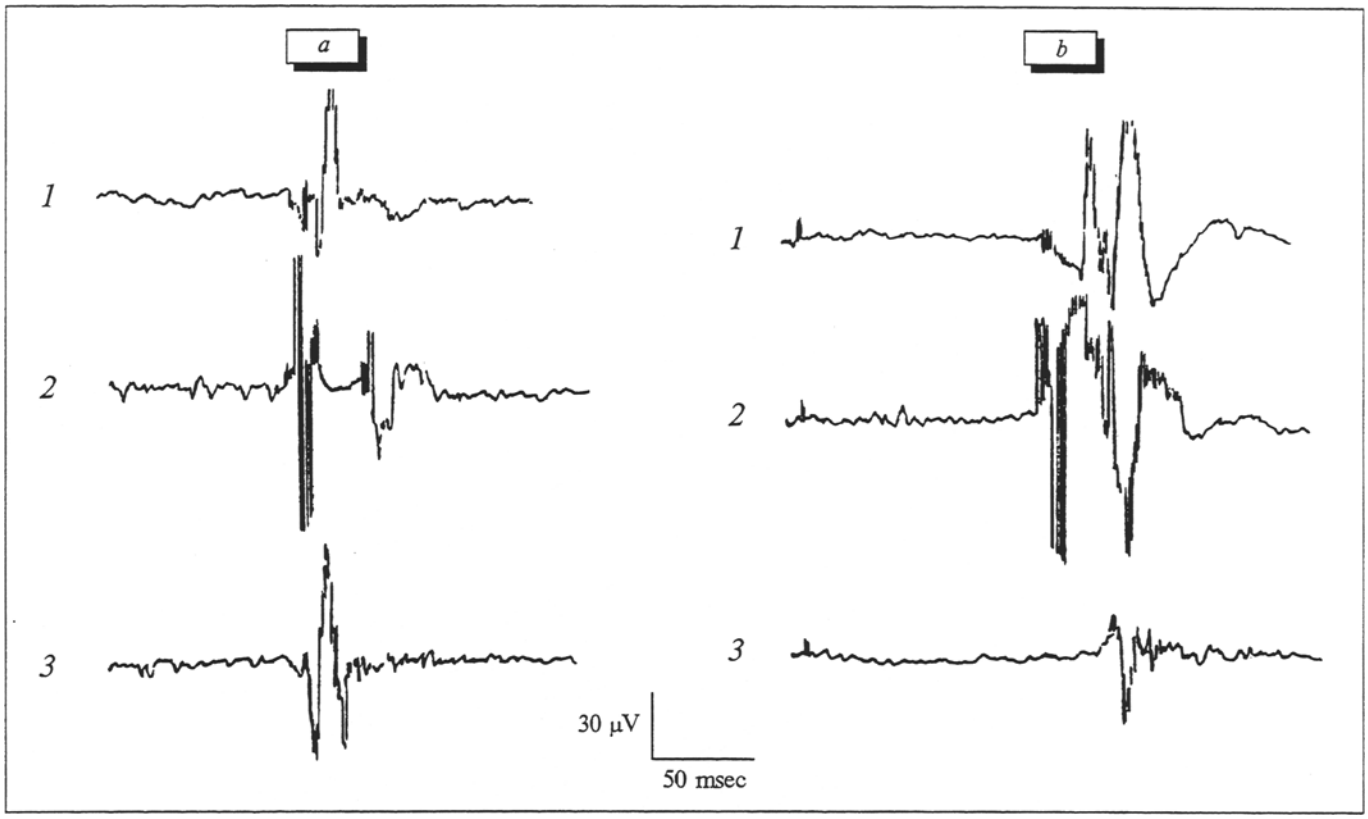


**Fig. 1.** Alterations in EP (*1*) and in the EMG response (*2*) during sciatic nerve stimulation, and in the EMG reaction (*3*) during stimulation of the motor zones of the cortex at the end of the experiment (*a*) and during conditioning stimulation of intraosseous receptors of the ilium (*b*).

amplitude of initial EP phases increased by 40%, whereas the maximum deviations in EMG responses increased by 45%. The facilitation effect of conditioning stimuli of osteoreceptors of the ilium spongy substance on the formation of afferent and motor reactions was statistically significant and persisted for an interpulse interval up to 800 msec and then gradually declined. The facilitation effect in the reactions tested disappeared when the interpulse interval was less than 150 msec. Other regularities were observed in the experiments where a motor response was induced by electrostimulation of motor zones of the cortex. For instance, osteoreceptor stimulation of the ilium in an interval of 100-500 msec between the conditioning and the test stimulus led to a marked suppression of the EMG. Conditioning stimulations had no effect on the recorded motor response induced by electrostimulation of the motor cortex zones when the interpulse interval increased by more than 600 msec (Fig. 1).

Thus, two basic regularities have emerged from the findings. First, stimulation of the osteoreceptor apparatus of the ilium spongy substance produces a facilitation effect on the development of afferent reactions and the segmentary motor response during stimulation of the sciatic nerve by pulses of threshold intensity. Second, similar effects on osteoreceptors block centrifugal flows of excitation and sharply lower the amplitude of the EMG-equivalent of the motor reaction caused by the stimulation of the motor zones of the cortex.

These results have some clinical analogies. Intraosseous blockades in patients with marked neurologic manifestations of osteochondrosis have revealed the phenomenon of "recognized" pain accompanying normal irradiations and a short-term (1-3 min) exacerbation of the radicular syndrome [2]. Moreover, facilitation effects of the segmentary motor response may be responsible for disturbances in the muscular tonus in the corresponding segments and the segments connected with the section of the osseous system of interest. At the same time, blockades in centrifugal motor reactions cause more profound disturbances in the muscular tonus, which testify to a decrease in the cortical control of the motor functions in patients with neurologic manifestations of osteochondrosis.

On the whole, the findings demonstrate a significant role of osteoreception in neuromotor disturbances and allow intraosseous receptor blockade to be considered as a pathogenic method of treating radiculitis and neuritis.

## REFERENCES

1. A. R. Varfolomeev, *Intraosseous Infusions in the Complex Treatment of Lumbar Osteochondrosis*, Abstract of Ph. D. Dissertation, Tomsk (1974).
2. E. L. Sokov, *Zh. Nevropatol. Psikhiatr.*, № 4, 57-61 (1988).
3. O. A. Shevelev and E. L. Sokov, *Byull. Eksp. Biol. Med.*, **115**, № 5, 587-589 (1993).
4. G. A. Yankovskii, *Osteoreception* [in Russian], Riga (1982).

# Adaptation to Periodic Hypoxia and a Diet Supplemented with Polyunsaturated Class ω-3 Fatty Acids Enhance the Resistance of $Ca^{2+}$ Transport in the Myocardial Sarcoplasmic Reticulum to Free-Radical Oxidation

**T. G. Sazontova, Yu. V. Arkhipenko, and F. Z. Meerson**

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 120, № 7, pp. 42-45, July, 1995
Original article submitted June 27, 1994

The relationship between the level of accumulation of lipid peroxidation products and the status of the $Ca^{2+}$-transporting system in the sarcoplasmic reticulum of the rat myocardium is studied against the background of two cardioprotective factors, namely adaptation to periodic hypoxia and a diet enriched in polyunsaturated fatty acids of the ω-3 class. It is shown that the diet leads to an increase of level of lipid peroxidation products by 1.8 times in the heart and by 19 times in the liver, whereas a adaptation has no effect on the level of lipid peroxidation products in either of these organs. At the same time, the combined action of both factors considerably enhances the resistance of the myocardial $Ca^{2+}$-transporting system to free radical-induced oxidation. In *in vitro* experiments it is shown that adaptation to periodic hypoxia results in a more than twofold deceleration of $Ca^{2+}$ transport inhibition during the oxidation induction by the $Fe^{2+}$/ascorbate system; the diet causes a 3.5-fold deceleration of such inhibition. The results show that the accumulation of a high level of lipid peroxidation products is not always followed by damage to the $Ca^{2+}$-transporting system in the myocardial sarcoplasmic reticulum.

**Key Words:** *polyunsaturated fatty acids; adaptation; lipid peroxidation; $Ca^{2+}$ transport; myocardium*

The process of lipid peroxidation (LPO) which is constantly going on in the organism carries out a number of important physiological functions [1]. However, the LPO hyperactivation that is a feature of numerous pathological states causes damage to membranes and to membrane-associated enzymatic systems, in particular in the heart. In the last few decades it has come to be thought that LPO activation plays an important role in the pathogenesis of various diseases. LPO inhibition is associated with the protective action of various factors, while LPO activation is thought to be directly related to harmful effects on the membrane structures. In this context the effect of LPO on the

Research Institute of General Pathology and Pathophysiology, Russian Academy of Medical Sciences, Moscow (Presented by G. N. Kryzhanovskii, Member of the Russian Academy of Medical Sciences)

0007-4888/95/0007-0687$12.50 