

NEUROPHYSIOLOGICAL ANALYSIS OF THE ACTION
OF AMIDOPYRINE ON THE THALAMO-CORTICAL
LEVEL OF THE SOMATOSENSORY SYSTEM

M. V. Komendantova, R. A. Durinyan,
V. L. Glants, and G. M. Aleksandrova

UDC 615.212.2015.4:612.826.2+
612.826.2.014.46:615.212.3

Acute experiments on unanesthetized cats showed that amidopyrine (10 or 20 mg/kg, intravenously) lowers the level of spontaneous unit activity in the thalamic nucleus and leads to grouping of unit discharges and a simultaneous increase in amplitude of focal primary electrical responses. It is suggested that, on the one hand, synchronization of evoked unit responses both in the thalamus and in the cortex, and on the other hand, a lowering of excitability of neurons in the somatosensory projection cortex, participating in interzonal connections, may contribute to the mechanism of action of amidopyrine on the thalamo-cortical level of the somatosensory system.

KEY WORDS: amidopyrine; neurons; thalamus; cortex; electrical response.

Acute experiments on unanesthetized cats have shown that amidopyrine (5, 10, 20, 30 mg/kg, intravenously) increases the amplitude of responses in the posterior ventral nucleus of the thalamus (n.VPL) and in the second somatosensory area of the cortex (S2) to electrical stimulation of the superficial radial nerve. Changes in the response in n.VPL affect only that part of the response that is connected with the postsynaptic process, i.e., the interneuronal discharge.

The object of this investigation was to study the action of amidopyrine on the conduction of excitation along specific projection systems.

EXPERIMENTAL METHOD

Acute experiments were carried out on 20 cats. All preliminary manipulations were performed under hexobarbital anesthesia (40 mg/kg, intraperitoneally). The wound surfaces were infiltrated with 0.25% procaine solution. The animal was then immobilized with listhenon and artificially ventilated. Electrodes were inserted into n.VPL by reference to Jasper and Ajmone-Marsan's atlas of the cat brain. The superficial radial nerve and the first somatosensory area of the cortex (S1) were stimulated. In some experiments, evoked potentials were averaged by means of a special ART-1000 computer. The cortex was stimulated through a bipolar surface electrode (interelectrode distance 1.5 mm).

EXPERIMENTAL RESULTS AND DISCUSSION

The effect of amidopyrine (20 mg/kg) was studied on the activity of a single relay neuron in n.VPL. Spontaneous activity of the thalamo-cortical neuron of the unanesthetized animal consisted of aperiodic single discharges. Amidopyrine altered the character of the spontaneous activity of this neuron: grouped high-frequency bursts of discharges, separated by long periods of absence of unit activity appeared.

Department of Pharmacology, Moscow Medical Stomatological Institute. Laboratory of Physiology of Sensomotor Integrations, P. K. Anokhin Institute of Normal Physiology, Academy of Medical Sciences of the USSR, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR A. M. Chernukh.) Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 81, No. 1, pp. 41-42, January, 1976. Original article submitted April 9, 1975.

©1976 Plenum Publishing Corporation, 227 West 17th Street, New York, N.Y. 10011. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission of the publisher. A copy of this article is available from the publisher for \$15.00.

Since the amplitude of the response in the projection cortex evoked by peripheral nerve stimulation reflects not only processes taking place in cortical neuronal systems, but also changes affecting the afferent volley in the preceding stages of transmission, it became necessary to determine the state of the cortical mechanisms themselves under the influence of amidopyrine. The response in cortical area S2 to stimulation of the homologous region of representation in cortical somatosensory area S1 was chosen as the model for such an analysis. After injection of amidopyrine the amplitude of the positive and negative phases of the interzonal response and the number of high-frequency waves increases. Whereas before injection of amidopyrine, three high-frequency waves could be detected in the positive phase of the response, after injection of amidopyrine the number of high-frequency waves rose to five.

In the next series of experiments the interzonal response was investigated in S2 before and after injection of amidopyrine (10, 20 mg/kg) during a change in the strength of the stimulus in S1 from threshold to supramaximal. The response threshold was raised. For instance, whereas an amplitude of the stimulating pulse of 9 V in area S1 before injection of amidopyrine was the threshold level for generation of the initial positive wave and even for the appearance of the first high-frequency wave on it, after the injection of amidopyrine in a dose of 10 mg/kg the same stimulus evoked only a hardly visible positive wave, and after injection of 20 mg/kg the response was virtually absent. These results indicate the marked sensitivity of these particular formations of the CNS to the action of amidopyrine.

The increase in amplitude of the postsynaptic component of the focal response in n.VPL points to an increase in the number of units in that nucleus which participate in the primary response. This is probably because of a change in the properties of the thalamo-cortical neurons. This hypothesis is confirmed by transformation of the character of the spontaneous activity of the thalamic nuclear relay units under the influence of amidopyrine. Since the presynaptic component of the response is virtually not increased, presumably amidopyrine, in the doses used, causes little change in the transmission of afferent impulses at the spinal relay level (the nuclei of the dorsal columns).

Similar electrophysiological manifestations of the action of drugs were observed by the writers previously in experiments with subnarcotic doses of barbiturates [2, 3, 7]. However, there are differences in the action of amidopyrine and barbiturates on the neuronal systems of the projection cortex, chiefly affecting the character of the interzonal response. The appearance of interzonal responses in the somatosensory cortex is due to involvement of direct cortico-cortical connections and it takes place on account of the participation of neuron systems actually in the cortex [4-6, 8, 9]. An important feature of the interzonal responses is the presence of high-frequency waves which accompany the development of the slow wave of the complex. Whereas barbiturates reduce the number of high-frequency waves of the interzonal response, the action of amidopyrine is manifested as an increase in amplitude of the high-frequency waves and in their number. This may be connected with the synchronization of unit discharges in area S2 in response to stimulation of area S1. At the same time amidopyrine causes an increase in the response threshold of units responsible for slow potential generation. This suggests that synchronization of the responses of cortical neurons is accompanied by a general lowering of their excitability.

LITERATURE CITED

1. V. L. Glants, "Analysis of mechanisms of transmission of somatosensory impulses in the thalamic relay nucleus," Author's Abstract of Candidate's Dissertation, Moscow (1969).
2. R. A. Durinyan, V. R. Glants, and A. G. Rabin, *Zh. Vyssh. Nerv. Deyat.*, No. 6, 1256 (1971).
3. A. G. Rabin and V. L. Glants, *Zh. Vyssh. Nerv. Deyat.*, No. 4, 644 (1969).
4. A. G. Rabin, *Byull. Éksperim. Biol. Med.*, No. 3, 3 (1969).
5. A. G. Rabin, *Trudy Inst. Norm. Patol. Fiziol. Akad. Med. Nauk SSSR*, 13, 66 (1970).
6. A. G. Rabin, *Zh. Vyssh. Nerv. Deyat.*, No. 5, 1032 (1971).
7. A. G. Rabin and V. L. Glants, *Byull. Éksperim. Biol. Med.*, No. 8, 63 (1971).
8. E. G. Jones, *Nature*, 216, 704 (1967).
9. H. Nakahama, *J. Neurophysiol.*, 22, 16 (1959).