

MECHANISM OF CHANGES IN THE BLOOD PICTURE DURING PROLONGED NOCICEPTIVE STIMULATION

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The author has previously shown [4] that appreciable changes take place in the composition of the peripheral blood of dogs during prolonged nociceptive stimulation. These changes are observed for a period of 6 months or more. Deafferentation of the limb on the side of stimulation restored the normal blood composition within a much shorter time.

The object of the present investigation was to continue the study of the mechanism of the change in the composition of the peripheral blood during prolonged nociceptive stimulation by interrupting the reflex arc at different periods after the production of a focus of stimulation.

METHOD

Three series of experiments were carried out on 10 dogs. After the establishment of a stable initial background of the blood picture, a focus of prolonged nociceptive stimulation was created as described earlier [3, 5]. In the experiments of series I (4 dogs) the sciatic and femoral nerves were blocked with procaine twice daily above the point of stimulation (3-4 ml of a 1% procaine solution) when the changes in the blood indices were at their height (after 10-14 days), in series II (4 dogs) procaine was injected 1.5-2 months after the creation of the focus of stimulation, and in series III (2 dogs) the focus of stimulation was created against the background of injections of procaine which continued for 2 weeks.

RESULTS

The initial erythrocyte count in the individual dogs varied within narrow limits—the amplitude of the diurnal fluctuations did not exceed 200,000-400,000/ml blood. The differences in the hemoglobin concentration in the experiments did not exceed 0.6-0.9 g%, but the changes in the leucocyte count were greater, the fluctuations of this index reaching 300-1200/ml blood.

After the creation of a focus of prolonged stimulation the erythrocyte count rose within the first days on the average by 10-15% of the initial value, and the variations between the individual experiments reached 1,000,000-1,800,000/ml. The hemoglobin level rose by 8-10% and fluctuated within the limits of 15.8 and 18 g%. The leucocyte content in all the dogs rose by 15-30%, varying within wide limits. In individual experiments the leucocyte count reached 17,000-23,000/ml. The results obtained (see table) are in full agreement with those obtained by the author previously [3-5].

Injection of procaine into the region of the nerves led on the following day to a decrease in the blood cell counts and in the hemoglobin level. After 3-5 days the blood indices in all the animals regained the initial level, and the amplitude of the diurnal variations diminished. Discontinuation of procaine administration 14-20 days after the beginning of the injections led to a fresh rise in the blood curves: 4 days after discontinuation of the procaine injections the erythrocyte count rose on the average by 20%, the hemoglobin by 12%, and the leucocytes by 25.5% of the initial level.

Changes in the Blood Picture after Creation of a Focus of Stimulation and Injection of Procaine

Index	Initial background ($M_1 \pm m_1$)	After creation of a focus of stimulation ($M_2 \pm m_2$)	Injection of procaine ($M_3 \pm m_3$)	P
Erythrocytes (in thousands)	$5\,500 \pm 28,0$	$7\,900 \pm 64,8$	$5\,200 \pm 22,0$	380,9
Hemoglobin (in g%)	$14,0 \pm 0,014$	$16,0 \pm 0,08$	$13,6 \pm 0,02$	3,7
Leucocytes	$9\,000 \pm 209,0$	$13\,400 \pm 552,4$	$8\,600 \pm 198,0$	240,4

Procaine blocking of the nerves at a later period after the creation of a focus of stimulation (1.5-2 months) restored the normal blood composition within a shorter time: the blood indices regained their initial level 18-22 days after the beginning of the procaine injections.

When the focus of stimulation was created against the background of two weeks of procaine injections, no significant changes took place in the blood composition.

Analysis of films of the bone marrow before and after the creation of the focus of stimulation and during administration of procaine showed that erythropoiesis and leucopoiesis were stimulated in the marrow of all the animals, and that the erythroblastic and leucoblastic functions of the marrow were manifested to a varied degree. The number of erythroblasts was increased on account of polychromatophilic and, to some extent, of oxyphilic forms, indicating their more intensive proliferation and their accelerated maturation to the stage of the adult erythrocyte. Stimulation of the myeloid branch of hemopoiesis was also observed: the content of promyelocytes and myelocytes increased, and the number of adult forms of leucocytes fell appreciably. The marrow picture was much more normal during procaine administration than when the focus of stimulation was created without procaine injections.

It may be concluded from these findings that the changes in the peripheral blood during prolonged nociceptive stimulation are primarily reflex in character, and that all divisions of the central nervous system are evidently concerned in the formation of these reflexes. The interruption of the flow of impulses from the focus of stimulation causes changes in the state of the nervous centers regulating the composition of the blood, and these are reflected in the state of the blood and the bone marrow. More prolonged irritation from the focus of stimulation creates a stable focus of excitation in the central nervous system, as a number of investigations have confirmed [1, 2, 6]. In this case, time is required after the block for the "static" focus of excitation to disappear, and not until this has occurred can a gradual normalization of the blood composition take place. If the blocking of the impulses begins early, before a "static" focus of excitation has arisen, normalization of the blood takes place during the first days after the block.

Control experiments showed that nerve block in the absence of stimulation, and also stimulation in the presence of a nerve block, produced no changes in the composition of the blood.

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