THE IMPORTANCE OF THE TYPE OF THE NERVOUS SYSTEM IN THE BODY'S RESPONSE TO INJURIOUS FACTORS

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The experience of the Pavlov Laboratories has shown that the method of exposing the nervous system to functional stress of different character reveals to the fullest extent the features characterizing the type of the higher nervous activity of the experimental animals. From this point of view studied concerning the character of the response to one or the other injurious factor and the course of various pathological processes will also enhance a more profound understanding of the type of nervous system. We studied in our laboratory the inflammatory reaction of the skin evoked by cantharidin in dogs belonging to different types of nervous system and obtained data [5] which showed that differences related to the type of nervous system occur in the local manifestations of that reaction.

In the present investigation we set outselves the task to study the features characterizing a number of general reactions in dogs belonging to different types of the nervous system in response to a factor producing inflammation.

METHOD

Five dogs of approximately equal age were selected for experiments from the Koltuzi Farm which dogs corresponded with regard to their typological features to the four basic types according to the classification of Pavlov. The type of the nervous system was established in the dogs with the aid of the classical method of Pavlov based on the secretion of saliva; the lesser standard recommended by M. S. Kolesnikov and V. P. Troshikhin [2] was used for the test. In the period preceding the experiments the selected dogs were allowed to rest for a prolonged period (not less than three months). The experiments were carried out in one and the same season (summer 1958). Details concerning the dogs are given in Table 1.

The inflammation was produced by subcutaneous injection of 0.1 ml turpentine in the right subscapular region. The size of the inflammatory edema, the body temperature (in four dogs out of five), the erythrocyte sedimentation rate, the total number of white cells and the differential count of the white cells recorded. The haematological indices (total white cell count, differential count of the white cells and erythrocyte sedimentation rate) were established at least five times before the administration of turpentine. Blood was taken in the morning on an empty stomach from an incision made on the edge of the ear. The films were stained with Giemsa-Romanovsky stain. We counted 200 cells.

After the injection of turpentine the blood was investigated between the third and the twelfth hours every hour (in one dog: Orsita-between the third and the ninth hour) and then every second day and daily until the local inflammatory symptoms subsided. The body temperature (in the rectum) was measured before the administration of turpentine, then three hours after the administration and every further hour up to the thirteenth hour; later it

*Deceased.

TABLE 1

Features Characterizing the Experimental Dogs in the First Group

Name of dog	Sex	Age (in yrs)	Weight (in kg)	Type of higher nervous activity
Riza	Female	7	20.5	Strong, balanced inert type
Orsita	same	6	24.0	Strong, balanced mobile type
Charlie	Male	6	19.0	Strong, unbalanced mobile type
Dick	same	6	14.0	Weak type (strong variant)
Chasik	same	7	19.0	Weak type

was measured once a day until the inflammatory symptoms subsided. The size of the inflammatory edema was measured daily. In two dogs (one of which belonged to the strong type and the other to the weak type of nervous system) control investigations of white cell differential count were carried out at the same periods as after administration of turpentine into the other dogs.

RESULTS

The greatest differences in relation to the type became manifest in the dogs in the character of changes in the body temperature, the erythrocyte sedimentation rate, and the differential count of the white cells; but we were unable to establish an influence exerted by the type of the nervous system upon the size of the inflammatory edema or upon the changes in the total white cell count.

With regard to the body temperature all animals responded to the injection of turpentine with temperature changes of different degree within the first three-nine hours after the injection and a subsequent gradual increase in the temperature up to a maximum at the 11th-13th hour. It was particularly in that period that differences in the temperature response related to the type became manifest most of all. Later after one day and yet later during the formation and regression of the abscess the changes in the body temperature did not show any particular features which could have been related to the type of nervous system. In the first hours (between the third and 13th hour) after administration of turpentine, however, the temperature response was as judged by the range of variation between the minimum and maximum temperature in the period stated above, much more intensive in dogs belonging to the weak type of the nervous system than in dogs of the strong type.

An acceleration of the erythrocyte sedimentation rate could be observed in all animals but the highest values were obtained in various dogs at different periods independently of the type of the nervous system. The acceleration of the erythrocyte sedimentation rate proved to be most marked in dogs belonging to the weak type of the nervous system (Table 2).

Changes in the white cell differential count became manifest in a decrease in the number of eosinophiles and lymphocytes, an increase in the number of neutrophiles and a nuclear shift to the left. These changes were most marked between the fourth and ninth hour after the administration of turpentine; at this stage the differences in the degree of reactive eosinopenia and lymphopenia in the dogs proved to be related to the type of their nervous system (Fig. 1).

The most marked decrease in the number of eosinophiles and lymphocytes could be observed, as shown by Fig. 1, in the dogs belonging to the weak type of the nervous system: the dogs Dich and Chasik. They showed correspondingly the greatest relative increase in the number of neutrophiles (not shown on Fig. 1). The shift to the left was in one case particularly marked and was observed incidentally in the weakest dog. In the second dog belonging to the weak type: Dick – the shift to the left proved to the least marked of all but in this particular dog a relatively high per cent of immature forms within the neutrophile group of white cells had been observed already before the administration of turpentine. In the group of animals belonging to the strong type the smallest decrease in the number of eosinophiles and simultaneously even a certain increase in the number of lymphocytes was found in the dog Riza which was distinguished from the other dog belonging to the strong type by the inertia of her nervous processes.

In view of the fact that the described picture of changes in the white cell count: the decrease in the number of eosinophiles and lymphocytes is regarded as characteristic for the activation of the adnohypophysis-adreno-

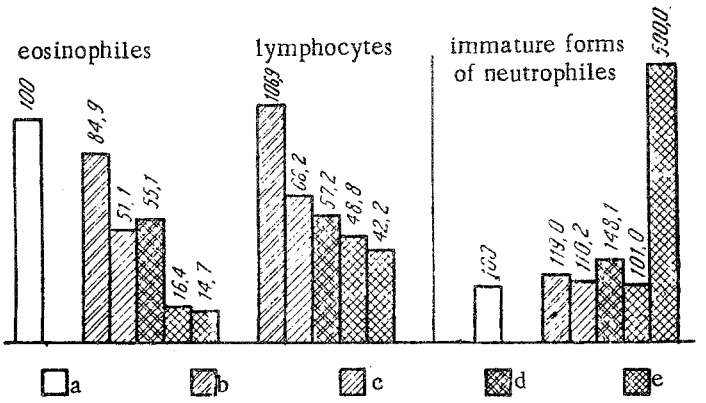

Fig. 1. Changes in the indices characterizing the white cell count after subcutaneous injection of turpentine in dogs belonging to different types of the nervous system. a – Original cell count before the administration of turpentine accepted as 100%; b – changes in the dog Riza, belonging to the strong balanced inert type; c – in the dog Orsita beloning to the strong balanced mobile type; d – in the dog Charlie belonging to the strong unbalanced mobile type; e – in the dog Dick and Chasik belonging to the weak type.

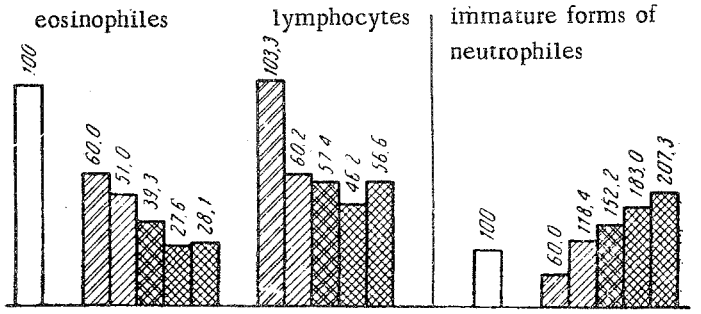

Fig. 2. Changes in the haematological indices after intramuscular injection of 20 units of ACTH in dogs belonging to different types of the nervous system. Captions the same as in Fig. 1. The white columns indicate cell count observed before the administration of ACTH.

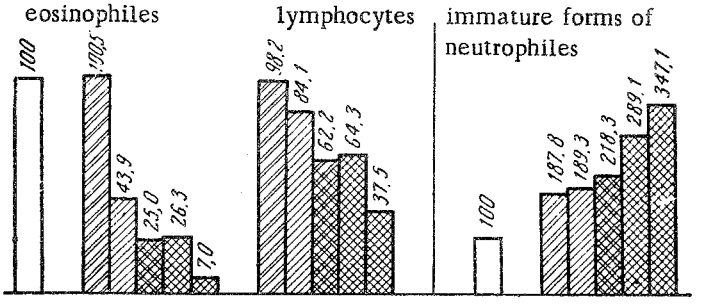

Fig. 3. The same as in Fig. 2, with regard to dogs of the second group. Captions the same as in Figs. 1 and 2.

TABLE 2

The Intensity of the General Temperature Reaction and of Changes in the Erythrocyte Sedimentation Rate in Response to Subcutaneous Injections of 0.1 ml Turpentine in Dogs Belonging to Different Types of the Nervous System

Name of dog	Body temperature before the injection of turpentine	after 3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	24 hours	Intensity of temperature reaction (judged by diff. between min. and max. temp. between 3rd-13th hr after turpentine injection)	Degree of acceleration in erythrocyte sed. rate (% of mean level of erythrocyte sed. rate observed for 5 days before turpentine injection)
		After the injection of turpentine													
Riza	37,9°	37,6°	37,9°	37,8°	37,7°	37,9°	37,9°	37,7°	38,0°	38,1°	38,1°	38,2°	38,0°	0,6	270
Orsita	Not measured													—	200
Charlie	38,2°	38,4°	38,1°	38,3°	38,6°	38,4°	38,4°	38,6°	38,6°	38,8°	38,9°	39,1°	38,8°	1,0	320
Dick	38,1°	38,2°	38,2°	38,1°	38,3°	38,5°	38,9°	39,1°	39,5°	39,9°	40,0°	40,0°	38,3°	1,9	430
Chasik	38,9°	38,2°	36,0°	37,6°	37,9°	36,4°	36,5°	38,7°	38,6°	39,1°	39,2°	39,1°	38,7°	3,2	420

cortical system ("Stress Syndrome", Selye [6, 7]) and in view of the fact that the degree of these changes proved to be different in dogs belonging to different types of the nervous system it could be assumed that the above differences are based on a reaction on behalf of the pituitary-adrenal system of different intensity in response to the injurious factors: administration of turpentine.

To check this assumption we carried out the Thorn test on the same dogs [8]. Adrenocorticotropic hormone (ACTH) was administered by intramuscular injection in a dose of 20 units. The blood (films) was taken every hour after the injection of ACTH for nine hours. The blood was investigated at least five times before the injection of ACTH.

The results of investigations concerning the white cell count between the fourth and ninth hour after the injection of ACTH are set forth in Fig. 2. They are on the whole very similar to the results obtained after injection of turpentine: in the dogs belonging to the weak type (Dick and Chasik) the number of eosinophiles decreased after injection of ACTH also to a greater degree than in the dogs belonging to the strong type of the nervous system and among the latter the smallest decrease in the number of eosinophiles could be observed in the strong inert dog Riza. This dog was the only animal in which both after the administration of turpentine as well as after the injection of ACTH a certain increase in the number of lymphocytes instead of a decrease could be observed and instead of an increase in the number of immature forms in the neutrophile group of leucocytes a decrease in their number could be observed after injection of ACTH. Among the other dogs the greatest changes could be observed in the dogs belonging to the weak type of nervous system.

To check our results on a larger material we repeated the experiment with ACTH on yet another group of dogs belonging to well defined types of the nervous system which with regard to the features characterizing that type were as far as possible selected corresponding to the animals of the first group (Table 3). The hormone was injected in the same dose and under similar conditions as into the dogs of the first group but hormone of a different batch was used.

In this group too the greatest decrease in the number of eosinophiles lymphocytes and the greatest shift to the left could be observed in a dog belonging to the weak type: Mol' and the smallest decrease (or rather complete absence of a response on behalf of the eosinophiles and lymphocytes) could be observed in the strong inert dog Malysh (Fig. 3).

A reaction of approximately equal intensity could be observed in the dog belonging to the strong variant

TABLE 3

Features Characterizing the Dogs of the Second Group

Name of dog	Sex	Age (in yrs)	Weight (in kg)	Type of higher nervous activity
Malysh	Male	7	21.7	strong, not completely balanced, inert type
Ors	same	6	24.8	strong balanced mobile type
Octar	same	5½	21.7	strong unbalanced mobile type
Marsik	same	~9	23.0	weak type (strong variant)
Mol'	same	7	16.0	weak type

of the weak type Marsik and in the excitable dog Octar. It must be emphasized that in the group of strong dogs animals of the excitable type: Charlie and Octar occupied with regard to the degree of changes in the differential count of leucocytes as well as with regard to the degree of changes in the body temperature and the erythrocyte sedimentation rate an intermediate place between animals belonging to the strong balanced type of nervous system on the one hand and animals belonging to the weak type of the nervous system on the other hand.

Differences in the character of the inflammatory process (as judged by the cytogram of the aseptic wound) as well as differences in the functional features of the adrenal cortex depending on the type of nervous system have also been established by other authors [1, 5].

Our findings show that the intensity of a number of protective-adaptory reactions produced by the body in response to injurious factors causing inflammation, in particular the intensity of those reactions which are based on the activation of the pituitary-adrenocortical system is closely related to the type of nervous system. Further investigations in this direction might extend our conceptions concerning the type of the nervous system to a large extent and might bring us nearer to an understanding of the actual mechanisms on which the cortical regulation of the internal body systems is based.

SUMMARY

The experiment was performed on 5 dogs – 3 with a strong and 2 with a weak type of nervous system. A number of general reactions of the organism during inflammation caused by subcutaneous administration of turpentine (0.1 ml) were studied. A greater degree of hyperthermia, a higher ESR and changes in the leucocytic formula (eosino- and leukopenia) were noted in the dogs of the weak type in comparison with those of the strong, especially of the strong and inert type of nervous system. In ACTH administration (20 units) to the same dogs and to 5 other animals – 3 with a strong nervous system type and 2 with a weak type – eosino- and lymphopenia were also most pronounced in dogs with a weak type of nervous system, and least marked in strong, inert animals. A shift to the left in the neutrophilic group of leucocytes was also most pronounced in weak dogs. The data obtained indicate a different degree of activity exercised by various physiological systems, including the endocrine system, in animals with different types of nervous system.

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