THE SIGNIFICANCE OF COMPLETE DECORTICATION IN THE DEVELOPMENT OF ANAPHYLACTIC SHOCK IN DOGS

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The significance of the functional state of the central nervous system in the mechanism of development of anaphylaxis was first shown by A.M. Bezredka [2]. It was subsequently confirmed by other investigators [1, 6 and others].

At the same time, the results of a number of investigations devoted to the study of the role of various parts of the central nervous system (including its highest levels) in the mechanisms involved in anaphylactic shock [3, 5, 7, 8] carried out by means of surgical intervention at various levels of the CNS do not disclose the role of the nervous system in the process under consideration and do not provide data for a positive solution of this problem.

We decided to investigate the course of anaphylactic shock in dogs under conditions of long-term experiments with unilateral and complete decortication.

EXPERIMENTAL METHOD

The animals were sensitized by subcutaneous injection of normal horse serum (0.1 ml per 1 kg body weight) administered during the course of three days. The resolving dose of the same antigen was given intravenously on the 14th day after the last day of sensitization (control animals received 0.02-0.3 ml per 1 kg body weight, experimental animals 0.02-0.027 ml per 1 kg body weight). Clinical manifestations, changes in pulse, respiration and blood pressure served as indicators of the intensity of shock. Blood pressure was recorded by the bloodless method [4] from the carotid artery which had been exteriorized in a skin flap.

EXPERIMENTAL RESULTS

The clinical picture of anaphylactic shock was studied preliminarily on five control dogs. $1\frac{1}{2}$-$2\frac{1}{2}$ minutes after administration of the resolving dose of antigen the animals showed general motor excitation accompanied by barking, squealing, sometimes involuntary micturition and vomiting lasting 1.5-2 minutes. This was followed by an inhibitory phase: the animal sagged in the stand, the head drooped, the tongue and oral mucosa became pale with a cyanotic tinge, salivation became increased. The blood pressure showed a tendency to rise during the excitatory phase (in some cases this rise could be recorded). It then fell to 60 mm Hg, in some instances so sharply that the carotid artery pulse disappeared from the kymogram record. After three to seven minutes the blood pressure began to rise gradually. The beginning of changes in the pulse coincided with the appearance of the first signs of excitation and found expression in increased rate and rapid diminution of volume; not infrequently, the pulse became "thread-like." Respiration became deeper and more rapid in the first phase but with development of general motor inhibition its depth decreased with the appearance, in some cases, of periodic single respiratory movements of greater depth; this was followed by a gradual return to normal.

As a rule, all the phenomena described developed in the course of 20 minutes at the end of which time they disappeared, which is characteristic for shock of small degree, produced by small doses of horse serum (0.02 ml per 1 kg body weight). Administration of 0.1 ml antigen per 1 kg body weight resulted in extremely severe shock with bloody diarrhea which was still present even after 24 hours; administration of 0.3 ml antigen per 1 kg body weight led to fatal outcome in some cases. Following the injection of the resolving dose a state of transient desensitization supervened, lasting not longer than 48 hours. In the majority of the dogs it was possible to reproduce the shock reaction up to 15 times by means of frequent repeated administration of antigen (at three to five-day intervals); the intensity of anaphylactic shock gradually diminished but not before the sixth-seventh experiment.

Four dogs were used for experiments with unilateral decortication. Two of these were sensitized before decortication (one five months, the other six months before operation). Anaphylactic shock was produced in these animals before decortication. The other two dogs were sensitized after the operation, beginning from the fifth to eighth postoperative day. In all cases the cortex was first removed from the right cerebral hemisphere. On the 22nd-23rd day postoperatively all the animals were given a resolving dose of antigen (0.02 ml per 1 kg body weight) intravenously.

Development of anaphylactic shock was observed in all cases; its intensity was no different from that described in the case of control animals and in one dog (Snezhok) the reaction was more marked than in the controls (Figures 1 and 2). This result agrees with the data reported by V.A. Cherepova [7].

The data of this series indicate that the state of sensitization can be produced in an animal subjected to unilateral decortication by the usual dose of antigen and over the same period of time as in intact animals.

Thirty to thirty-nine days after the first operation these dogs were subjected to extirpation of the cortex of the other (left) hemisphere, under morphine-ether anesthesia. Fifteen days after complete decortication the animals received a resolving dose of antigen.

No shock reaction occurred in the case of the dog Tsyganka. There was no change in pulse and respiration, while the blood pressure even showed a rise amounting to 30 mm Hg and only towards the end of the experiment (after 20 minutes) returned to normal. The dogs Norka and Snezhok showed no clinical manifestations of shock apart from slight motor reaction lasting throughout the experiment and quite uncharacteristic for shock. Pulse volume was unchanged and pulse rate tended to slow towards the end of the experiment (Norka's pulse rate changed from 36 per minute to 52, Snezhok's from 72 to 64). The blood pressure in both dogs showed a gradual fall (maximal drop was only noted by the 12th-13th minute) Norka's blood pressure decreased by 48 mm, Snezhok's by 19 mm Hg. Respiratory changes were slight (Figure 3).

Finally, marked clinical shock reaction with characteristic changes in pulse, respiration and fall of blood pressure by 62 mm Hg without complete return to the initial level at the end of the experiment (180 mm Hg before the injection and 160 at the end of experiment) was observed in the dog Chernaia after administration of a resolving dose of antigen.

Thirty days after complete decortication the same animals again received a resolving injection of antigen (with the exception of Snezhok). No change in behavior and no signs of shock with respect to pulse and respiration were noted in Tsyganka and Norka. There was some rise of blood pressure: in Norka's case by 24 and in Tsyganka's by 14 mm Hg. Shock reaction occurred in Chernaia but it was much less marked than in the previous experiment; the blood pressure fell by 38 mm Hg.

Bilateral decortication is thus seen to lead to lowered reactivity of the body to antigen stimulus. Change of reactivity evidently occurs gradually and takes longer in some animals than others. This may perhaps explain the negative results obtained by Schurer and Strasmann [8], V.N. Nekliudov [5] and I.M. Britvan [3] who showed that under conditions of short-term experiments decortication or decerebration did not affect the course of anaphylactic shock to any great extent.

The next series of experiments was performed on two dogs sensitized six months after bilateral decortication. Administration of the resolving dose of antigen was made on the 14th day after the last day of sensitization. External manifestations characteristic for shock were absent, the pulse rate and volume were unchanged, and there was only some increase in the depth and frequency of respiratory movements. In repeat experiments on the same dogs the antigen dose was increased 2.5-fold (0.05 ml per 1 kg body weight). The pulse was un-

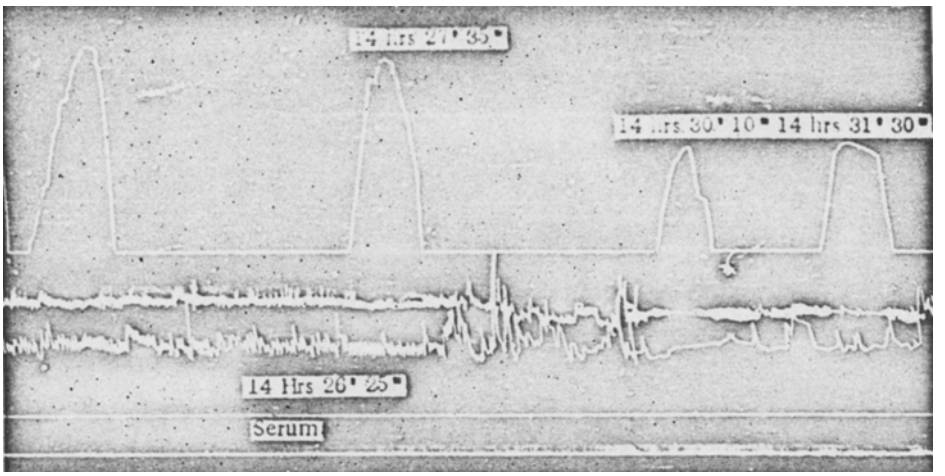

Fig. 1. Change in blood pressure and respiration in the dog Snezhok during anaphylactic shock before decortication. Records from above down: blood pressure (mercury manometer), carotid artery pulsation, respiration, stimulus marker (administration of horse serum 0.02 ml per 1 kg body weight), time marker (one second).

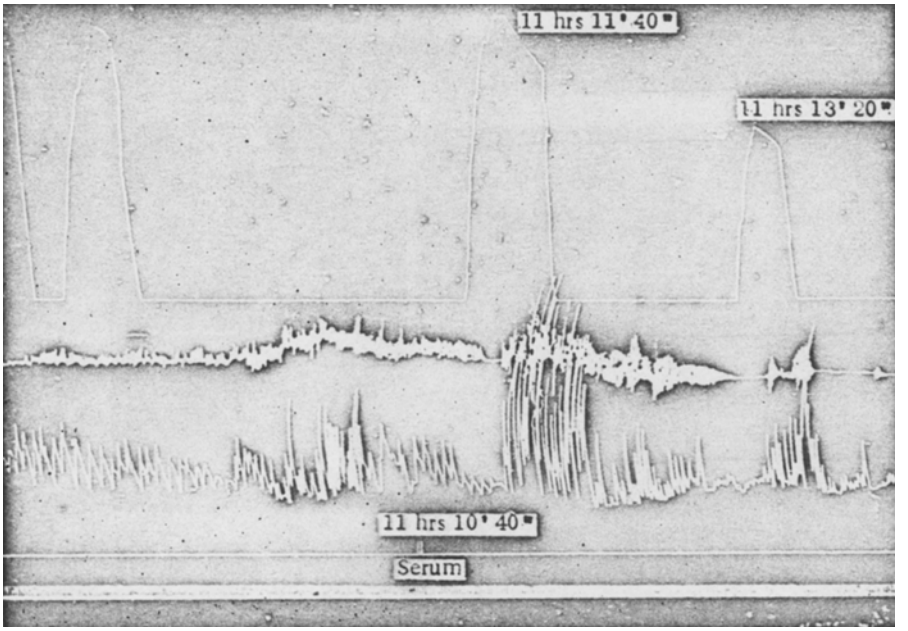

Fig. 2. Change in blood pressure and respiration in the dog Snezhok during anaphylactic shock 25 days after unilateral decortication. Records from above down as in Fig. 1.

changed in one dog; in the other the rate increased by 20 per minute without change in volume. There was some increase in depth and rate of respiration compared with the first experiment. Clinical manifestations of shock were absent.

The results of this series and the data obtained in the previous series of experiments suggest that decortication is accompanied by lowering of the body's reactivity, the degree of lowering increasing with the length of postoperative period.

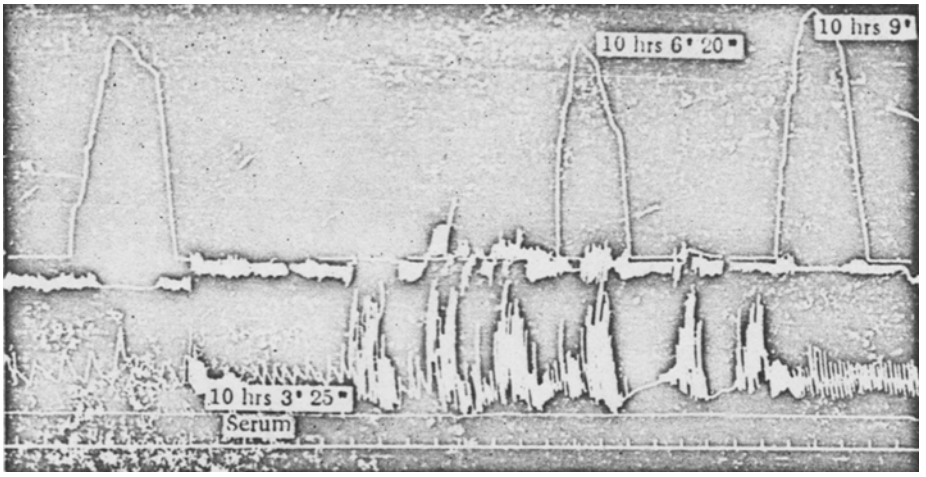

Fig. 3. Change in blood pressure and respiration in the dog Snezhok during anaphylactic shock 15 days after complete decortication. Records the same as in Figure 1. Time marker (10 seconds).

Dynamic observations, carried out in long-term experiments on dogs, and concerned with the character and intensity of anaphylactic shock after two-stage decortication suggest that sensitization and anaphylactic shock develop in hemidecorticated animals in the usual way and to the same extent as in control animals. Following bilateral decortication sensitization develops but manifestation of shock reaction is markedly diminished, which may be explained tentatively by lowering of the general reactivity of the body including its reactivity to antigen stimulus. The lowering of reactivity proved to be progressively greater the longer the postoperative period.

SUMMARY

Following unilateral decortication, the condition of sensitization and anaphylactic shock develops in dogs with the same doses of antigen (horse serum) as in intact animals. Fifteen days after removal of the second hemisphere the intensity of the shock reaction, appearing as a result of introduction of the same dose of the antigen was greatly decreased. One month after complete decortication the manifestations of anaphylaxis were even less pronounced. The intensity of anaphylactic shock was especially low six months after bilateral decortication. This demonstrates that bilateral decortication decreases the reactivity of the animal organism to the antigenic stimulus.

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