

THE EFFECT OF CERTAIN TYPES OF NOVOCAINE BLOCK ON CONDITIONED FOOD REFLEXES

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The work of Professor A. V. Vishnevsky is of fundamental importance in the studies of the mechanism of the therapeutic effect of novocaine block; he regards novocaine as a weak nervous system stimulant under whose influence changes in the neurotrophic function of the nervous system may occur. Even prior to discovery of novocaine it had been found that injection of anesthetic substances could give rise not only to analgesic but also therapeutic effects, as mentioned by S. P. Protopopov [13].

However, the mechanism of action of novocaine block on the organism still requires detailed study and explanation in view of its great complexity.

A number of authors [1, 4, 11 and others] have observed that various types of novocaine block give rise not only to local analgesia but often also to drowsiness and even sleep.

In recent times more and more references are encountered in medical and surgical literature [1, 14, 15 and others] to the question of using intravenous novocaine block as prophylaxis for surgical shock. This is based on the hypothesis that novocaine, acting on vascular receptors, interrupts the flow of pain impulses and stimuli to the central nervous system and so protects the organism from development of shock. In favor of this view are M. A. Bubnov's [2] data which showed that preoperative intravenous injection of novocaine led to enhancement of inhibitory processes in the CNS and to lowering of its functional lability. The influence of novocaine on the reflex function of the nervous system has been studied by many authors. Most of them [5, 6, 7, 8, 9, 12 and others] maintain that novocaine causes depression and even complete abolition of both exteroceptive and interoceptive unconditioned and conditioned reflexes. According to E. I. Shur [16] and E. I. Shur, L. A. Baraz, R. S. Vinnitskaya and V. I. Popov [18], who studied interoceptive reflexes following lumbar novocaine block by Vishnevsky's method, the transient depression was followed by enhancement of reflexes to blood pressure and respiration on stimulation of intestinal chemoreceptors and large intestine and urinary bladder mechanoreceptors. Moreover, E. I. Shur [17] reports that more marked enhancement of reflexes from the interoceptors mentioned above was noted against the background of aseptic inflammation of a region of the small intestine.

It is thus seen that opinions concerning the effect of novocaine on the reflex function of the nervous system are to some extent contradictory.

We undertook the study of the effect of various types of novocaine block on the cerebral cortex using conditioned salivating reflex technique in this investigation.

METHODS

Experiments were performed during 1954-1955 in a conditioned reflex chamber; three dogs (Bars, Silva and Galka) with salivary fistulas of the parotid glands were used. Conditioned salivating reflexes were established

to a bell in the case of Silva and Bars; 29 combinations were required for the former and 101 combinations for the latter; in the case of Galka a conditioned reflex was obtained to metronome clicks at the rate of 100 per minute after 20 combinations. The conditioned stimulus was applied for 20 seconds. Rusk powder (3 g) served as unconditioned stimulus. Following establishment of the conditioned reflexes in Bars and Silva differentiation to a bell of lower tone (bell B) was obtained, in Silva's case after 23 trials and in the case of Bars after 56 trials; differentiation to M_{40} was obtained in Galka after 96 trials. On this background of these conditioned reflexes and differentiations the action of spinal, intraperitoneal and paranephritic block was investigated.

On the day before administration of novocaine the magnitude of the conditioned reflex and differentiations was determined using the stimuli referred to above. The next day local anesthesia was induced and the conditioned reflexes tested anew. 24 hours later a control experiment was carried out to compare the magnitude of the conditioned reflexes with data obtained in the preceding experiment. Quite often changes in conditioned reflexes were checked for 2-4 days after the use of novocaine block.

A total of 172 series experiments were performed on Galka, 245 on Silva and 252 on Bars. This includes 49 experiments with investigation of various types of novocaine block.

RESULTS AND DISCUSSION

For spinal (sacral and lumbo-sacral) anesthesia, warmed 1.5% solution of novocaine was used; it was introduced in amounts of 6-12 ml between coccygeal vertebrae I and II or between the last lumbar and first sacral vertebra with evidence of marked depression and even complete abolition of conditioned reflexes after only 10-15 minutes (Fig. 1).

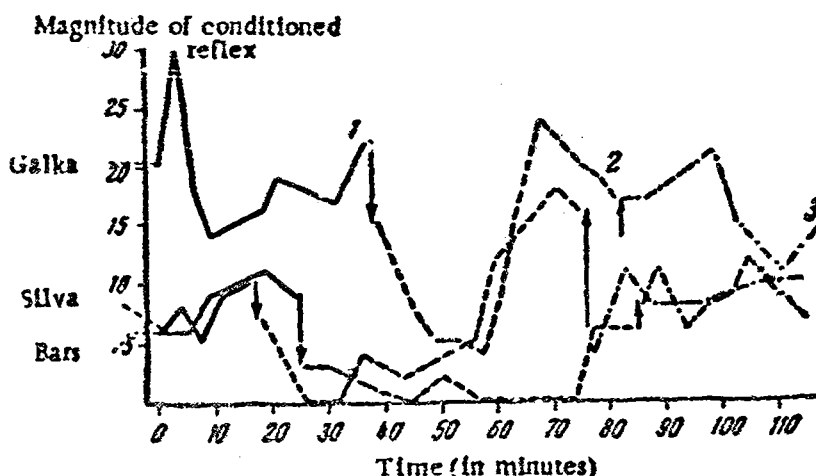


Fig. 1. Changes in magnitude of conditioned reflexes with epidural anesthesia.
1) Day before administration of novocaine; 2) day of experiment with novocaine;
3) 24 hours after administration of novocaine.

The reflexes remained depressed for 30 minutes on the average and only in one experiment they remained depressed for up to one hour following which they were completely restored; sometimes the magnitude of the reflexes was even greater than the initial value towards the end of an experiment. 24 hours after epidural anesthesia the conditioned reflexes had returned to preblock values. Characteristically, when this type of local anesthesia was used the orientation reaction to the conditioned stimulus was diminished or disappeared altogether. The animal succumbed to a state of drowsiness. As the action of novocaine wore off the orientation reaction reappeared and a parallel restoration of the conditioned reflex was then observed.

In using intraperitoneal anesthesia a comparison was made of the action of sovcaïne* in dilutions of 1:1000 and 1:500 and of 1% solution of novocaine. The most marked depressive action in this type of anesthesia was produced by the 1:1000 solution of sovcaïne which was given in a dose of 60 ml. Depression of the conditioned reflexes supervened not earlier than 40-45 minutes after administration of novocaine, lasting on

* Russian trade name.

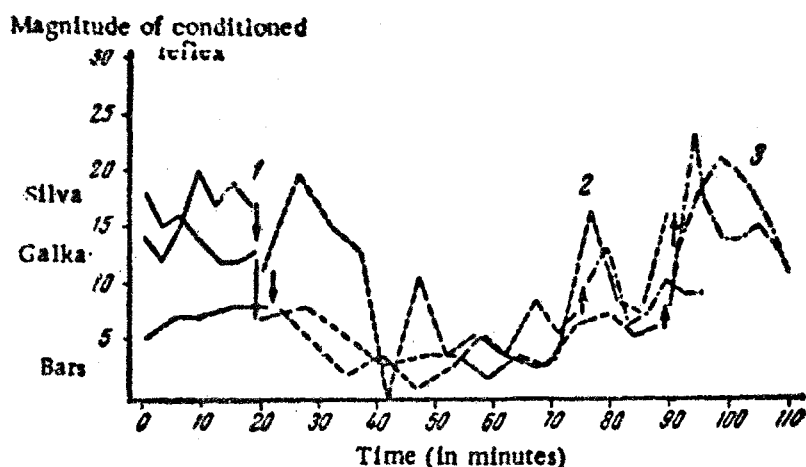


Fig. 2. Changes in the magnitude of conditioned reflexes with intraperitoneal anesthesia. Legend similar to Fig. 1.

the average 30-32 minutes (from 20 to 50 minutes), the value of conditioned reflex falling to zero and then gradually reaching normal levels. Sovcaine in dilution of 1:500 produced depression of reflexes after 5-10 minutes but since its action was accompanied by manifestations of intoxication — vomiting, defecation, extremely copious salivation — its use was rejected.

Depression of reflexes following administration of 1% solution of novocaine given in doses of 30 ml occurred after an average of 29 minutes and lasted from 20 to 45 minutes, an average of 34 minutes (Fig. 2). The extent of depression in this case was, however, rather smaller than in the case of sovcaine.

When intraperitoneal anesthesia was used the reflexes were not always restored to initial values by the end of experiment: in a number of cases the reflexes remained diminished and only reached the initial magnitude during the next experiment.

In the absolute majority of cases the orientation reaction to the conditioned stimulus was preserved; the animal turned its head towards the stimulus, looked alert, licked its lips, stretched towards the food container, the reflexes remaining depressed or even absent.

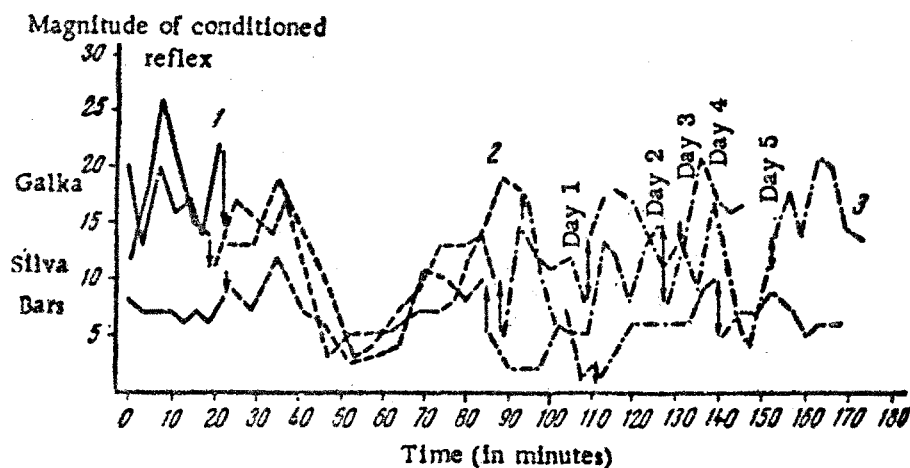


Fig. 3. Changes in the magnitude of conditioned reflexes with paranephritic block. 1) Day before administration of novocaine; 2) day of experiment with administration of novocaine; 3) 24-72 hours after administration of novocaine.

Paraneprhritic block was achieved by administration of 36 ml 0.5% novocaine next to the transverse process of the second lumbar vertebra on the left side. Silva showed depression of conditioned reflexes after 35-45 minutes, lasting up to 40 minutes and on one occasion even an hour. Galka showed very similar effects: depression occurred after 37-40 minutes and lasted about 40 minutes. Depression of reflexes occurred more quickly in Bars - after 20 minutes - and lasted from 25 to 40 minutes. The magnitude of the conditioned reflex dropped to 2-3 divisions of the record scale and in some cases fell to zero (Fig. 3).

Unlike intraperitoneal anesthesia, paraneprhritic block was not, in most cases, followed by restoration of conditioned reflexes to their initial values by the end of experiment.

Worthy of attention is the fact that after paraneprhritic block the conditioned reflexes remained depressed on the second and even third day following the block and only reached initial values on the fourth day. This had been observed earlier by T. S. Miryushchenko [10].

While investigating the various types of novocaine block we wondered whether the animal might not develop a conditioned reflex to the experimental conditions such as needle prick during injection, etc. and the observed depression of conditioned reflexes thus being not a consequence of the effect of novocaine but a result of the action of completely extraneous factors in no way connected with the local anesthesia. It was therefore decided to substitute warmed physiologic solution for novocaine. Such experiments were performed after spinal and intraperitoneal anesthesia. Physiologic solution was administered in the same amounts as novocaine 1-2 days after novocaine block. No changes of the magnitude of conditioned reflexes were noted under the influence of physiologic solution (Fig. 4).

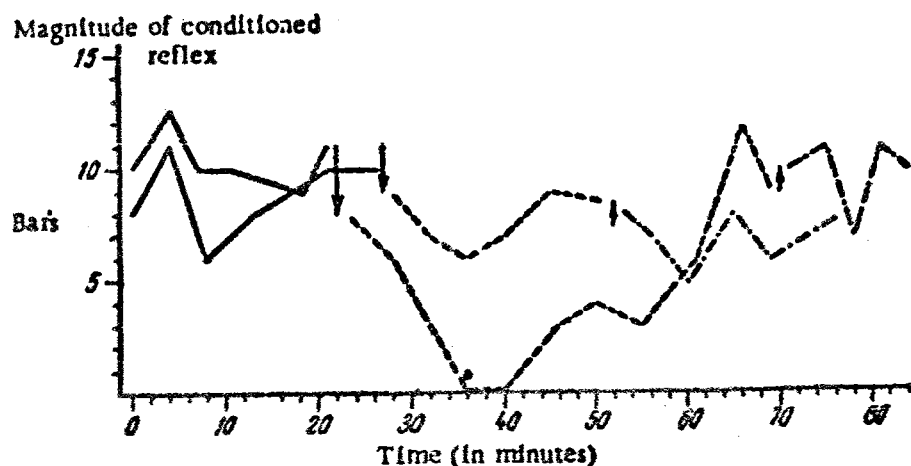


Fig. 4. Control experiment with introduction of physiologic solution.
Legend similar to Fig. 1.

The experiments described thus demonstrated that novocaine block exerted an influence on the magnitude of conditioned reflexes.

As regards the mechanism underlying novocaine block of various types it may be supposed that exclusion of large numbers of interoceptors and exteroceptors by novocaine diminishes the inflow of impulses to the central nervous system and thus alters the functional state of the cerebral cortex.

Under these conditions inhibition can readily develop with consequent depression and even disappearance of conditioned reflexes as has been observed in the present experiments.

This hypothesis is confirmed by the fact that with epidural anesthesia which blocks the greatest number of receptors the effect observed was the most pronounced.

Changes with intraperitoneal and paraneprhritic block were less marked and the effect was seen later than in epidural anesthesia, viz. after 30-40 minutes. This is evidently explained by the heterogeneous character of the receptive fields acted upon by novocaine depending on the mode of its administration.

The data obtained confirm the general action of novocaine which alters the functional state of the central nervous system including that of the cerebral cortex.

SUMMARY

The influence of various types of novocaine block on conditioned food reflexes were studied. Paraneuritic, spinal, and intraperitoneal introduction of novocaine and soveaine was used. Depression of conditioned reflexes was revealed, but orientating reaction was preserved. The degree of this depression and its duration were different in various methods of novocaine introduction. Depression was greatest in epidural introduction. Probably, this effect is connected with extinguishing of afferent impulses by novocaine.

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* In Russian.