# LEVEL OF ADRENALIN-LIKE SUBSTANCES AND ACETYLCHOLINE IN PERFUSATE OF THE SUPERIOR CERVICAL SYMPATHETIC GANGLION IN ADULT CATS AND KITTENS

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In the ontogenetic investigations of a number of authors [2, 6-8, 13-17], carried out on mature and immature animals (guinea pigs, rabbits, and cats), it has been established that the evolution of the functions of the ganglia of the sympathetic nervous system is closely related to the change in the process of development of the nature of the neuro-humoral regulation of stimulation in the synapses of sympathetic ganglia. In early postnatal ontogenesis, the sympathetic ganglia of rabbits and cats naturally possess a high bioelectric activity, which, in contrast to the bioelectric activity of the ganglia of mature rats, rabbits, and guinea pigs in all periods of postnatal development is unchanged after intravenous administration of the cholinolytic hexone and is eliminated after the administration of the adrenalitic sympatholytin. The study of the biological activity of the liquid collected during the perfusion of the superior cervical sympathetic ganglia (SCSG) indicated that in new-born rabbits, after irritation of the preganglionic trunk, adrenalin-like substances appear in the perfusate [15].

In connection with this, it was of interest to determine the nature of the biologically active substances liberated upon the irritation of the preganglionic trunk in the sympathetic ganglia of kittens, since the main principles of the neuro-humoral regulation of excitation of the neurons of the sympathetic ganglia in mature animals have been established, as is well known, in investigations on cats [3, 4, 9-12, 18-21, 23, 25].

## PROCEDURE

The experiments were carried out on 25 adult cats and 20 kittens one to seven days old. The animals were anesthetized with nembutal or hexenal. Perfusion of the ganglia was accomplished according to the method of Bykov and Pavlova [1] and Kibyakov [4]. The ganglia were treated with saturated oxygen and Ringer-Lock solution, warmed to 38° under a pressure of 120 centimeters of water in the experiments with adult cats and 70-80 centimeters of water pressure in the experiments with the kittens. The content of adrenalin-like substances in the liquid flowing out of the ganglia was determined by testing the perfusate on an isolated frog heart and an isolated rat uterus prepared according to the method of de Jalon, Béio and de Jalon in the way described in the work of Gaddum, Peart and Vogt [22]. The acetylcholine content in the perfusate of the ganglia was determined in the experiments by the perfusion of the ganglia with Ringer-Lock solution with eserine at a concentration of $4 \cdot 10^{-6}$ g/ml and testing the perfusate on an isolated frog heart and a denervated leech dorsal muscle, prepared according to the method of Fyumer and Minz [24] in the modification of Rosin [5].

## RESULTS OF THE EXPERIMENTS

The control portions of the SCSG perfusate of adult cats, i.e., the liquid samples collected before irritation of the preganglionic stump, were inactive in most of the experiments in testing on an isolated frog heart.

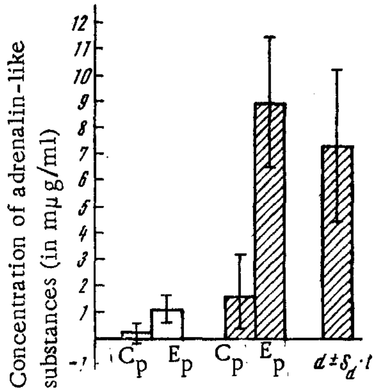


Fig. 1. Concentration of adrenalin-like substances in the SCSG perfusate of adult cats (light columns) and kittens (shaded columns) and the difference between the concentrations of adrenalin-like substances in the experimental ($E_p$) and control ($C_p$) portions of the SCSG perfusate of kittens (average data and their limits of reliability at P = 0.05).

In those cases in which they exerted a stimulating influence on the heart, their action as a rule, did not exceed the effects of solutions of ampoule adrenalin at a concentration of $5 \cdot 10^{-10}$ g/ml. The samples of SCSG perfusate of adult cats collected during irritation of the preganglionic stump exerted a more powerful stimulating influence on the frog heat, although, as in the controls, they did not change the amplitude of the acetylcholine-induced contraction of the isolated rat uterus.

The average concentrations of the adrenalin-like substances in the control and experimental portions of the SCSG perfusate of adult cats were equal to 0.2 ± 0.12 mμg/ml and 1.12 ± 0.24 mμg/ml, respectively.

The fact that the lower limit of reliability of the average concentration of adrenalin-like substances in the control portions of the perfusate is a negative quantity (Fig. 1) is evidence that the detected amounts of adrenalin-like substances in the control portions of the SCSG perfusate of adult cats are statistically unreliable.

The amount of adrenalin-like substances detected in the SCSG perfusate of kittens considerably exceeded their content in the SCSG perfusate of adult cats (see Fig. 1).

The experimental portions of the SCSG perfusate of kittens, together with the stimulating influence on the frog heart, in all cases also exerted an inhibiting influence on the acetylcholine-induced contractions of the isolated rat uterus. In a number of cases the inhibiting influence on the acetylcholine-induced contractions of the rat uterus was also shown by the control portions of the kitten ganglia perfusate. The average concentration of the adrenalin-like substances was equal to 1.6 ± 0.55 mμg/ml in the controls and 8.9 ± 1.2 mμg/ml in the experimental portions of the kitten SCSG perfusate.

The difference between the concentrations of the adrenalin-like substances in the control and experimental portions of the kitten SCSG perfusate ($d \pm S_d t$) was 7.3 (4.48 to 10.12) mμg/ml (see Fig. 1, column at the extreme right).

The adrenalin nature of the substances detected in the SCSG perfusate of adult cats and kittens is confirmed by the fact that their stimulating effect on the isolated frog heart was weakened by preliminary treatment of the heart with dihydroergotamine or simpatholytin, and by the fact that all the experimental portions of perfusate investigated exerted a distinct inhibiting effect on the "spontaneous" contractions of the isolated rat uterus (Fig. 2).

It should be noted that a change in the "spontaneous" contractions of an isolated rat uterus under the influence of various portions of the perfusate is only a qualitative test for the content of adrenalin-like substances in the investigated liquids since the value of the drop in the curve is not proportional to the amount of adrenalin in the test liquid and to a considerable degree was a result of the initial state of the preparation in each individual experiment.

In the experiments studying the acetylcholine content in the SCSG perfusate, the following results were obtained. The control portions of the adult cat SCSG perfusate during the testing on the isolated frog heart either were inactive or exerted an inhibiting influence, compared with the action of standard acetylcholine solutions in concentrations of $1 \cdot 10^{-10}$-$1 \cdot 10^{-9}$ g/ml. The control portions of the kitten SCSG perfusate never exerted an inhibiting influence on the frog heart. Irritation of the preganglionic stump considerably increased the acetylcholine content in the adult cat SCSG perfusate and led to the appearance of small amounts of acetylcholine in the kitten SCSG perfusate. The average value of the concentrations of acetylcholine within the limits of reliability (P = 0.05) in the experimental portions of the adult cat and kitten SCSG perfusate was equal to 14.64 (10.11–19.17) mμ/ml and 0.09 (0.04–0.14) mμg/ml, respectively. The acetylcholine nature of the effects which was observed during testing of the perfusate on an isolated frog heart was corroborated in all cases either by parallel testing of the perfusate on a denervated leech dorsal muscle, or by repeated testing of the perfusate on an atropinized frog heart.

Thus, the results obtained were evidence that among the biologically active metabolites liberated into the SCSG during irritation of the preganglionic stump in kittens, adrenalin-like substances predominate, while in adult cats acetylcholine predominates.

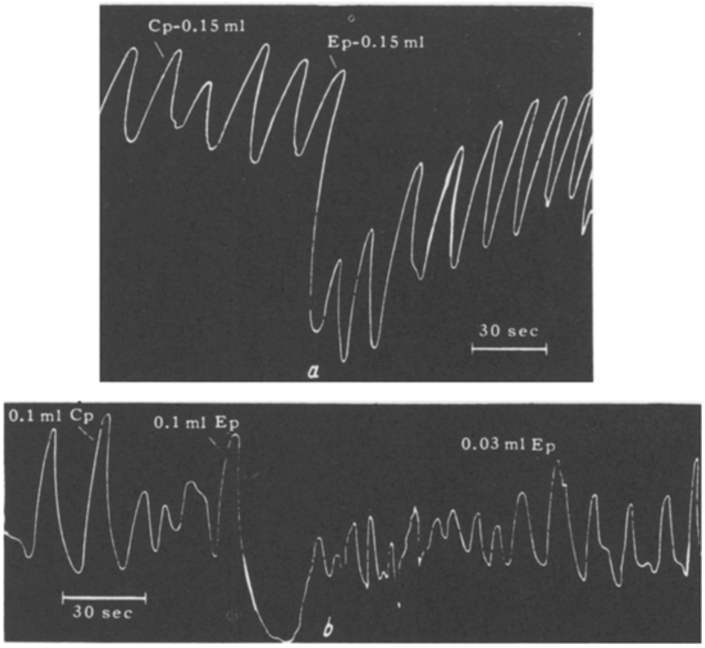


Fig. 2. Inhibiting influence of control ($C_p$) and experimental ($E_p$) portions of adult cat SCSG perfusate (a) and three-day old kittens (b) on "spontaneous" contractions of an isolated rat uterus (Fig. 2).

Consequently, our data are in basic agreement with the results of similar investigations on other representative immature animals—rabbits [15]—and are confirmed by the hypotheses developed by V. S. Sheveleva on the evolution of neuro-humoral regulation of the stimulation of neurons in the synapses of ganglia [13-15] and other regions [16] of the nervous system.

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