CHANGES IN THE CHOLINESTERASE ACTIVITY OF THE BLOOD OF DOGS IN ONTOGENESIS

(UDC 612.751.1.015.14:577.153.9]:612.66-019)

V. D. Rozanova and Li Hsu-ts'en

Laboratory of Age Physiology and Pathology (Head, Professor I. A. Arshavskii), Institute of Normal and Pathological Physiology, USSR Academy of Medical Sciences (Director, Active Member AMN SSSR, Professor V. V. Parin), Moscow
(Presented by Active Member AMN SSSR, V. V. Parin)
Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 61, No. 2, pp. 14-16, February, 1966
Original article submitted July 13, 1964

Investigations undertaken in this laboratory have shown that the animal organism at an early age possesses a high level of metabolism and activity of the cardiovascular and respiratory systems, maintained mainly by sympathetic and adrenergic factors of regulation. In the process of development (in dogs, after the 18th-20th day), as a result of the appearance of mechanisms of inhibition, and especially of vagus inhibition on the heart, the level of activity of these systems and the oxygen consumption fall in a resting state. In connection with the appearance of the cholinergic factors of regulation, the reserve powers (potential lability) of the cardiovascular and respiratory systems are increased during activity, and during the action of stress stimuli [1-15, 19-24].

The object of the present investigation was to study the changes in the cholinesterase activity of the blood in dogs during ontogenesis as one of the indices of the cholinergic system of regulation of homeostasis of importance to the assessment of the reactions of the organism at different ages.

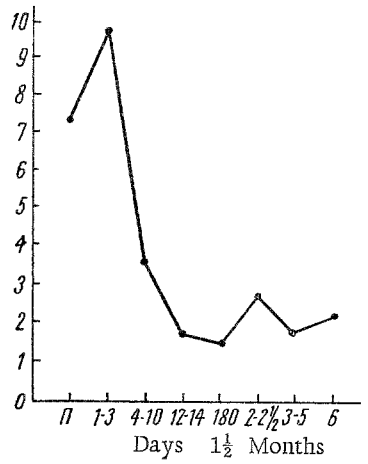
EXPERIMENTAL METHOD

The total cholinesterase activity of whole hemolyzed blood was determined by A. A. Pokrovskii's colorimetric micromethod [18], suitable for investigation of animals at early age periods, when little blood can be taken. The reaction of enzymic hydrolysis of acetylcholine by drop samples of blood took place in a plastic thermostatically controlled comparator. The cholinesterase activity was determined from the time required to hydrolyze 50% of the acetylcholine taken in the reaction (at 37-38°), obtained by comparing the color of the sample with a colorimetric standard (the color became the same). The buffered indicator solutions of the colorimetric standard and of the acetylcholine were prepared by the method described by A. A. Pokrovskii. Mixed capillary blood (0.02 ml) was taken with a pipette from an incision on the ear of the dogs at various ages, starting with the end of the antenatal period. The blood was immediately blown out into a test tube with 0.4 ml distilled water for hemolysis. Each blood sample was analyzed twice or three times, and in each analysis the accuracy of measurement of the drop of blood and of the buffered indicator solution was verified. The results of the investigation were treated by the method of variance analysis.

EXPERIMENTAL RESULTS AND DISCUSSION

The cholinesterase activity of the blood was investigated in 76 dogs. Comparison of the results of the analyses enabled the animals to be divided into age groups: fetuses aged 50-55 days (5 animals), puppies aged 1-3 days (10), 4-10 days (16), 12-14 days (5), 18 days to 1.5 months (12), 2-2.5 months (10), 3-5 months (10), puppies over 6 months and adult dogs (8).

It was found that the cholinesterase activity of the dogs' blood fell with age. In the fetuses it was almost 3.3 times higher than in the adult dogs, and in the puppies aged 1-3 days, 4-5 times higher. Arithmetical mean values (M) and their standard deviation (m) for the dogs of each of the above age groups are given in the table.



Graph of changes in cholinesterase activity of the blood in dogs during ontogenesis. Along the axis of abscissas, age; along the axis of ordinates, cholinesterase activity (in micromoles acetylcholine split per min per ml blood).

Cholinesterase Activity of Blood of Dogs in Ontogenesis (in μmoles/ml blood/min)

Group	Age	No. of animals	M	± m
1-	Fetuses 50 — 55 Days	5	7,3	0,44
2-	Puppies 1 — 3 »	10	9,67	0,71
3-	» 4 — 10 »	16	3,6	0,4
4-	» 12 —14 »	5	1,69	0,12
5-	» 18 Days —1½ months	12	1,5	0,14
6-	» 2 — 2½ months	10	2,73	0,106
7-	» 3 — 5 »	10	1,73	0,097
8-	» 6 » And adult dogs	8	2,2	0,071

The results in the table were used to plot a curve of the changes in cholinesterase activity of the blood of the dogs during ontogenesis (figure). This shows that the already high cholinesterase activity in the fetuses (7.3 μmoles/ml blood/min) rose still higher, to 9.67 μmoles, in puppies in the first days of life (1-3 days). By the 4th-6th day of life, the activity had fallen considerably, by almost 67% compared with the preceding age period. At the age of 12-14 days, a further fall had occurred. The least cholinesterase activity in the blood was found at the age of between 18 days and 1.5 months. In the puppies aged 2-2.5 months, a small and temporary increase in cholinesterase activity was observed, and in animals over 3 months old, its level was 1.73-2.2 μmoles. The figures for adult dogs were close to those obtained by A. A. Pokrovskii by the same method.

Hence, against the background of a general tendency for the cholinesterase activity to fall with age, there are two periods when it rises temporarily, a sharper rise at the age of 1-3 days and a small rise at the age of 2-2.5 months.

The changes in the cholinesterase activity of the blood are similar to the changes described in the muscles of dogs during ontogenesis by P. B. Penchev, working in this laboratory. Against the background of the fall in cholinesterase activity in the muscles with age, Penchev also found a sharp increase at the age of 2-3 days and a less marked increase at 2-2.5 months. Leibson [16] found much the same changes in cholinesterase activity in the muscle of rabbits with age and attributed this irregular pattern of its variation at each age period to a decrease in the quantity of cholinoreceptive substance and an increase in the concentration of cholinesterase at the myoneural synapse.

The similarity between the curves of the changes in cholinesterase activity in the blood and muscles of the dog in ontogenesis suggests that this interpretation is correct, and that some general principle lies at its basis.

What is the physiological interpretation of the high cholinesterase activity of the blood in the early stages of ontogenesis and its decrease with age? It was pointed out at the beginning of this paper that the early stages of ontogenesis are characterized by a high level of metabolism and activity of the cardiovascular and respiratory system, maintained by regulation by the sympathetic nervous system and the adrenergic humoral factors.

No information is yet available regarding differences in the blood adrenalin concentration in dogs at different ages. We know that in adult animals and man the blood contains very little adrenalin and noradrenalin. According to A. V. Nasedkin's findings [17], the blood of newly born rabbits contains up to twice as much adrenalin and adrenalin-like substances as the blood of adult rabbits.

These results suggest that the high level of cholinesterase activity of the blood in the early stages of ontogenesis in dogs, leading to rapid destruction of acetylcholine, contributes to the maximal efficiency of the adrenergic mechanisms of neuro-humoral regulation.

The high cholinesterase activity of the blood in puppies at an early age is an essential factor in the regulation of the homeostasis, maintaining a high level of energy metabolism and activity of the cardiovascular, respiratory, and other systems of the organism. The fall in cholinesterase activity in the blood with age demonstrates the

increasing importance of the cholinergic mechanisms of regulation of homeostasis and of the activity of the various systems and organs, giving rise to an increase in their potential lability.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
