# CHARACTERISTICS OF THE ACETYLCHOLINESTERASE ACTIVITY OF ANTAGONISTIC MUSCLES IN ONTOGENESIS OF DOGS

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P. B. Penchev

Laboratory of Geriatric Physiology and Pathology (Head—Professor I. A. Arshavskii), Institute of Normal and Pathological Physiology (Director—Member of the Academy of Medical Sciences of the USSR, Professor V. V. Parin) Academy of Medical Sciences of the USSR, Moscow
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In the studies of I. A. Arshavskii and his associates, it was established that during the prenatal period and at the early stages of postnatal life, the nerve centers and the antagonistic muscles that they innervate are characterized by well-defined values [1-11, 13-15, 20-22]. These data have made it possible to understand the absence of reciprocal inhibition at the early stages of ontogenesis and the appearance of this inhibition at the age when the animal begins to stand and walk. In dogs the ability to stand begins first at the forelegs (at 10-12 days of age) and then at the hind legs (at 18-20 days of age). The studies of a number of authors [16-18, 23, 24] contain data on the course of the variation of the cholinesterase activity of the muscles during ontogenesis; however, one of them contains materials pertaining to the characteristics of the antagonistic muscles.

In this work we undertook to characterize the changes in the cholinesterase activity of the antagonistic muscles of the fore- and hindlegs of dogs during various age periods.

## EXPERIMENTAL

The true cholinesterase activity (ACE) was determined by a colorimetric micromethod according to Pokrovskii [19]. Puppies of various ages were killed by rapid cutting of the spinal cord beneath the medulla oblongata without narcosis. The m. biceps and m. anconeus, m. semitendinosus and m. rectus femoris were taken for analysis. A weighed sample of each muscle was pulverized, ground in a mortar with distilled water in a dilution of 1 to 20 ml, and placed for 24 h in a refrigerator, after which it was centrifuged and the liquid substrate drawn off and analyzed. Each sample was investigated two to three times. The experimental animals were distributed in the following way according to age: up to 12 days (17), 15 days (4), 19-20 days (3), 30 days (3) 45 days (4) 2-3 months (7), 3-6 months (5).

## RESULTS

The table presents average data of the ACE of all the investigated muscles in dogs during different age periods. The graph (Fig. 1) characterizes the basic principles of the variation of ACE of dog muscles during ontogenesis. From Fig. 1 it is evident that the ACE of the muscles in newborn animals decreased almost sixfold by the age of five to six months. However, this decrease did not begin immediately after birth: by the second day of life the activity increased sharply, then by the fourth day it dropped almost to its level in the newborn puppies, while by the 15th day it dropped to less than one third the latter value ($P < 0.05$). Subsequently, against a background of a gradual decrease in the ACE, there were two slight rises in it at 20-30 days of age and at 60 to 90 days ($P = 0.005$). After three months, constant values of the ACE were established.

Figure 2 presents the nature of the variations of ACE of the antagonistic muscles of the forelimbs (a) and hindlimbs (b).

Cholinesterase Activity of Muscles in Dogs of Various Ages (in micromoles of acteylcholine per g of muscle tissue per min)

| Age (in days) | No. of animals | ACE of muscle | |
|---|---|---|---|
| | | *M* | ±*m* |
| First day | 4 | 3,00 | 0,120 |
| 2 | 4 | 5,90 | 0,140 |
| 4 | 4 | 2,910 | 0,130 |
| 8—12 | 5 | 2,308 | 0,120 |
| 15 | 4 | 0,880 | 0,138 |
| 19—20 | 3 | 1,066 | 0,125 |
| 30 | 3 | 1,271 | 0,160 |
| 45 | 4 | 0,586 | 0,023 |
| 60—90 | 7 | 0,810 | 0,065 |
| 90—180 | 5 | 0,482 | 0,025 |

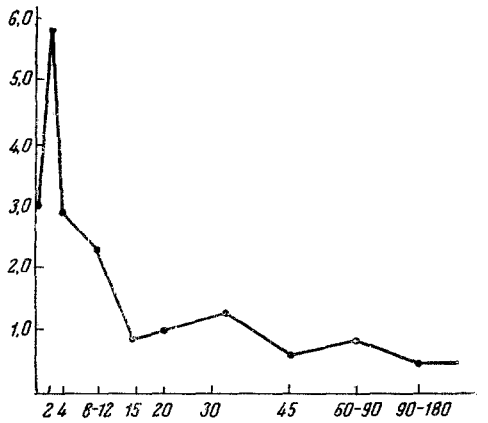


Fig. 1. Changes in the cholinesterase activity of muscles during ontogenesis of dogs. Ordinate) cholinesterase activity in micromoles of acetylcholine per g of muscle tissue per min; abscissa) age (in days).

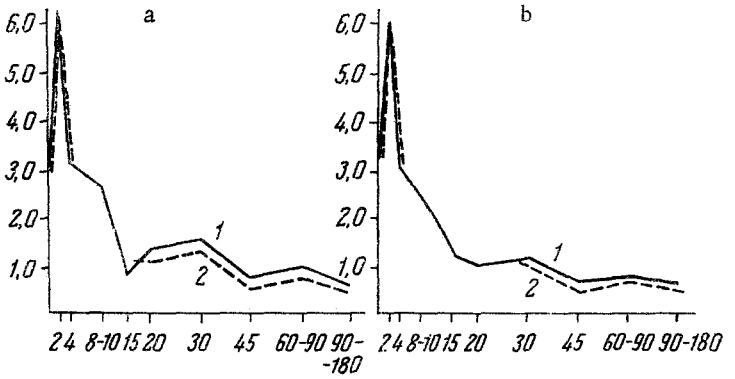


Fig. 2. Variations of the cholinesterase activity of the antagonistic muscles of the forelimbs (a) and hindlimbs (b). 1) Flexors (m. biceps, a; semitendinosus, b); 2) extensors (m. anconeus, a; m. rectus femoris, b). Ordinate) cholinesterase activity in micromoles of acetylcholine per g of muscle tistue per min; abscissa) age (in days).

The curves shown in Fig. 2 basically repeat the shape of the curve depicted in Fig. 1. The only difference is the fact that at an age of 8-10 days the ACE of the flexors of the forelimbs is higher than the ACE of the flexors of the hindlimbs. In addition, the second rise in the curve for the forelimbs comes earlier (on the 20th day) than for the hindlimbs (on the 30th day). It may be assumed that this difference is due to the fact that the ability to stand on the forelimbs comes earlier than the ability to stand on the hindlimbs. From Fig. 2 it is evident that there are no differences in the ACE of antagonistic muscles in puppies 0-4 days old, either for the forelimbs or for the hindlimbs. A constant difference for the muscles of the forelimbs is manifested at an age of 20 days ($P = 0.04$), and for the muscles of the hindlimbs at an age of 30 days ($P = 0.01$).

In the opinion of A. G. Ginetsinskii and associates [12], the general shape of the curve of the decrease in ACE during ontogenesis is explained by the interaction of two opposed factors: the decrease in the relative mass of the receptive substance and the increase in the cholinesterase concentration per unit mass. The peculiarities of the ontogenetic changes in the ACE of the muscles that we found cannot be entirely explained from this viewpoint. In spite of the general tendency for the ACE to decrease by adulthood, there are two rises in its level—on the 20th to 30th day and on the second to third month of life, i.e., during those age periods when there is a substantial functional transformation of the skeletal muscles and the centers that innervate them.

We explain the absence of differences in the ACE of the antagonistic muscles during the first days after birth by the fact that the muscles and the centers that innervate them are characterized by well-defined values during this period (chronaxy, refractory phase and lability, summation time). The earlier appearance of a difference in the ACE of the antagonistic muscles of the forelimbs is due to the fact that the extensor tone is manifested earlier on them than on the hindlimbs. At an age of 1.5-2 months, the absolute and relative refractory phases are shortened, the lability is increased (reaching the level observed in adult animals) and an exaltation phase, trace hyperpolarization and posttetanic activation appear [1-3, 7, 8]. It may be assumed that precisely at this age all the components of the mediator transmission of the nerve impulses acquire the perfection that is characteristic of adult animals.

The results that we obtained permit us to believe that the curve of the variations of muscle ACE during ontogenesis reflects complex transformations of the neuromuscular apparatus, in connection with a reorganization of the functions of the centers that innervate them, and not only the quantitative ratio of the size of the receptive substance and its cholinesterase concentration. Our data permit us to assume that the cholinesterase activity in the muscles is a quantity regulated by the nerve centers.

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