THE ACTIVITY OF CHOLINESTERASE IN THE WALL OF THE DUCTUS ARTERIOSUS

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The mechanism for the closure of the ductus arteriosus has not been conclusively explained. Setting up a direct physiological experiment, associated with the necessity of manipulating a tiny object within the immediate neighborhood of the very sensitive, reflexogenic zones of the thoracic cavity, makes it impossible to exclude various errors intrinsic to the method. Although morphological methods of investigation disclose the structural changes in the duct, which appear as a result of its obliteration, they yield only indirect knowledge of the mechanism of its closure, and thus permit varying interpretations. Hence, the large number of hypotheses on the reasons and means of closure of the ductus arteriosus. Differing from one another to a greater or lesser degree, they can be divided into two groups. One group of authors [1, 2] acknowledges a neuroreflexive mechanism behind this process, while the other denies it [4, 5].

This report was devoted to studying the activity of cholinesterase in the wall of the ductus arteriosus.

EXPERIMENTAL METHODS

The determination was carried out according to the method of Biggs-Carey-Morrison [3]. Newborn puppies and kittens served as the subject animals. The study involved the ductus arteriosus, the aorta near the mouth of the ductus, and the pulmonary trunk, i.e., the area of the arterial bed including the vessel of interest to us and the neighboring region. Considering the "muscular" character of the ductus arteriosus, as distinct from the aorta and pulmonary trunk, we investigated the cholinesterase activity in the wall of another artery of the muscular type for comparison purposes (the femoral artery). Cholinesterase activity was expressed in arbitrary units (according to Biggs-Carey-Morrison), calculated per unit of weight of the tissue.

EXPERIMENTAL RESULTS

The data obtained are presented in Tables 1 and 2.

Statistical analysis of the data presented in the tables showed that the cholinesterase activity in the wall of the ductus arteriosus was considerably lower than in the walls of the aorta and the pulmonary trunk. Thus, in the kittens, the activity of this enzyme was equal to 35 ± 8.7 arbitrary units, while in the aorta, 75 ± 4, and in the pulmonary trunk, 79 ± 6.2 arbitrary units (significance of the difference in the cholinesterase concentration within the wall of the ductus and the aorta, and the ductus and the pulmonary trunk are expressed as $P < 0.001$, according to the table of Student, i.e., equal to 99.9%).

A similar picture was observed in the puppies: in the wall of the ductus arteriosus we measured 32 ± 7.8 aribitrary units of cholinesterase, in the aorta, 80 ± 10, and in the pulmonary trunk, 74 ± 7.2 arbitrary units (significance of the difference in the cholinesterase activity within the wall of the ductus arteriosus and the aorta, and the ductus and the pulmonary trunk was also equal to 99.9%). This difference can be explained hypothetically by a difference in the histological structure of the vessels: the ductus arteriosus possesses a thick muscular layer, while the aorta and pulmonary artery are vessels of the elastic type. However, investigation of the cholinesterase in the wall of the other muscular type artery – the femoral artery – showed that although the activity of this enzyme was reduced in comparison

TABLE 1. Cholinesterase Activity in the Walls of Different Vessels within Newborn Puppies (in arbitrary units)

Animal number	Ductus arteriosus	Aorta	Pulmonary trunk	Femoral artery
1	17	81	65	57
2	33	97	65	62
3	42	71	73	59
4	31	73	78	54
5	34	78	80	61
6	30	79	77	59
7	36	85	79	61
Mean	32±7.8	80±10	74±7.2	59±2.6
Mean quadratic error (±)	3	3.8	2.7	1

TABLE 2. Cholinesterase Activity in the Walls of Different Vessels within Newborn Kittens (in arbitrary units)

Animal number	Ductus arteriosus	Aorta	Pulmonary trunk	Femoral artery
1	33	74	74	49
2	55	66	97	71
3	18	79	63	54
4	41	79	85	64
5	34	75	77	57
6	29	74	77	48
7	38	77	79	52
8	36	80	81	59
9	31	79	78	55
10	33	74	78	57
11	35	78	81	59
Mean	35±8.7	75±4	79±6.2	57±6.2
Mean quadratic error (±)	2.6	1.2	1.8	2

with the aorta and pulmonary artery (see Tables 1 and 2), it was still far from the level seen in the ductus arteriosus. In the wall of the femoral artery the cholinesterase activity in the newborn kittens was 1.6 times greater, and in the newborn puppies, 1.8 times greater, than in the wall of the ductus arteriosus (significance of the difference between the femoral artery and the ductus expressed as $P < 0.001$).

The low cholinesterase activity in the wall of the ductus arteriosus, as distinct from the neighboring regions of the arterial bed, probably may be regarded as one of the links in the mechanism for postfetal closure of this vessel. As we know, the vagus nerve, which shows an increase in tonus following birth, serves as the vasoconstrictive nerve for the ductus [2]. The low concentration of cholinesterase in the wall of this vessel secures the sufficiently prolonged action of the vagal mediator, acetylcholine, and thus allows a lasting spasm of the ductus. This spasm represents the first (functional) phase of closure of the ductus arteriosus.

SUMMARY

The activity of cholinesterase was determined in the walls of a number of blood vessels (ductus arteriosus, aorta in the vicinity of the ostium of ductus arteriosus, pulmonary trunk and femoral artery). Newborn kittens and

puppies served as experimental animals. The cholinesterase activity was the least in the wall of ductus arteriosus. In the author's opinion, the data obtained are of interest from the viewpoint of a neuro-reflex mechanism of closure of the ductus arteriosus.

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