

CONTENT OF PHOSPHORUS COMPOUNDS
IN TISSUES OF THE RIGHT AND LEFT VENTRICLES
OF DOGS AFTER VAGOTOMY

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Division of the left vagus nerve caused the accumulation of creatine phosphate and a decrease in the content of creatine in both ventricles but had no effect on components of the adenylic system. Division of the right vagus nerve was followed by a decrease in the content of creatine phosphate and an increase in the components of the adenylic system in the left ventricle.

Blocking of central parasympathetic influences on the heart causes the development of degenerative changes in the heart tissue [10], accompanied by changes in protein, nuclear, and energy metabolism [2,5,9].

In the present investigation the content of high-energy phosphorus compounds and enzymes participating in the accumulation and liberation of energy of phosphate bonds was studied in the tissues of the right and left ventricles at various times after division of the vagus nerves.

EXPERIMENTAL METHOD

The heart tissues were investigated in dogs 3 and 30 days after division of the vago-sympathetic nerve below the ganglion nodosum.

In tissues of the left and right ventricles frozen in liquid nitrogen, the creatine phosphate content was determined by Alekseeva's method [1], the content of creatine and inorganic phosphorus by Meshkova's method [6], the components of the adenylic system by Carter's method as modified by Tseitlin [8], the ATPase activity of the tissue was determined by Zubenko's method [4], and creatine kinase activity by Meshkova's method [6]. Protein and inorganic phosphorus were determined by Lowry's method [13,14].

EXPERIMENTAL RESULTS

The creatine phosphate in the tissues of the left ventricle of healthy dogs was higher than in the right ventricle (Table 1). This is in agreement with results obtained by other workers [11,12]. The content of total creatine, inorganic phosphorus, and components of the adenylic system, and the creatine kinase and ATPase activity of the tissues of the left and right ventricles were identical. Contradictory data for these indices are to be found in the literature [11,12,15].

On the 3rd day after division of the left vagus nerve the content of creatine phosphate in the left and right ventricles was increased by 19 and 56%, respectively. The creatine content was reduced and the creatine kinase activity increased. The content of components of the adenylic system and the ATPase activity of the tissue were unchanged. These changes showed a further increase 30 days after the operation.

Division of the right vagus nerve alone produced the same changes in phosphorus compounds in the right ventricle as division of the left nerve. No decrease in the creatine phosphate content was observed in the tissues of the left ventricle. The content of components of the adenylic system was increased. The ATP/ADP ratio was reduced on account of an increase in ADP.

After simultaneous division of the right and left vagus nerves the creatine phosphate content remained high, especially in the tissue of the right ventricle. The creatine content was reduced. The creatine kinase and ATPase activity was increased. The ATP/ADP ratio was reduced in the left ventricle on account of an increase of 42% in the ADP content.

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TABLE 1. Content of Phosphorus Compounds (in μ moles/g tissue) in the Myocardium of Dogs After Vagotomy

	Time after operation (in days)	Statistical index	ventricle										Number of dogs						
			Creatine phosphate		Creatine	Inorganic phosphorus		ATP	ADP		AMP	Creatine kinase (in μ moles/5)		ATPase (in mg P/protein nitrogen/5)					
			left	right		left	right		left	right		left		right	left	right			
Normal		M m P	3.0 0.26	3.75 0.24	28.5 1.6	26.8 1.53	11.6	9.9	2.66 0.26	2.52 0.21	0.7 0.05	0.75 0.13	0.38 0.05	0.38 0.06	0.54 0.03	0.53 0.025	0.5 0.09	0.5 0.05	23
	3	M m P	3.93 0.2 <0.01	5.8 0.13 <0.001	23.4 1.5 <0.1	23.5 1.2 <0.1	10.9	9.9	2.59 0.2	2.6 0.25	0.57 0.08	0.64 0.12	0.32	0.33	0.67 0.033 <0.02	0.65 0.02 <0.02	— — —	— — —	5
Division of vagus nerves	Left	M m P	5.2 0.4 <0.001	5.1 0.5 <0.02	21.2 1.4 <0.02	21.8 1.2 <0.05	10.9	10.9	2.76 0.13	2.22 0.3	0.58 0.12	0.57 0.12	0.3 0.12	0.35	0.63 0.02 <0.05	0.62 0.03 <0.02	0.58 0.07 —	0.55 0.06 —	12
	3	M m P	2.8 0.3	5.67 0.28 <0.001	26.2 1.7	23.1 1.5 <0.5	9.4	8.13	2.98 0.14	2.56 0.19	0.83 0.08	0.75 0.14	0.66 0.07 <0.02	0.45	—	—	—	—	5
Right	30	M m P	2.9 0.08 <0.05	4.5 0.15 <0.2	26.8 2.3 0.5	23.4 0.9 <0.5	11.2	10.8	2.99 0.16 <0.5	2.82 0.22 <0.02	0.97 0.03	0.77 0.1	0.53 0.05	0.41 0.04	0.61 0.04	0.56 0.03	0.48 0.06	0.55 0.03	12
	3	M m P	3.42 0.2	5.8 0.28 <0.001	24.7 1.3 <0.02	23.1 0.87 <0.05	13.3	12.3	2.67 0.25 0.2	3.1 0.25 <0.01	1.02 0.05	0.91 0.12	0.51 0.037	0.53 0.044	0.66 0.03 <0.05	0.65 0.025 <0.02	0.52 0.03 <0.02	0.62 0.03 <0.02	12
Left and right simultaneously	3	M m P																	

Summing up the results, it can be concluded that the difference between the effects of division of the left and right vagus nerves on the state of high-energy phosphorus compounds and activity of the enzymes concerned with the liberation and accumulation of energy required for muscle contraction was revealed to a greater degree in the tissues of the left ventricle.

The observed accumulation of a reserve of high-energy bonds in the muscle of the myocardium after removal of its parasympathetic influences can be regarded as the result of disturbance of the utilization of this reserve for muscle contraction. The observed decrease in the ATP/ADP ratio on account of an increase in the ADP content may be the result of stimulation of glycolysis [3].

Division of the right and left vagus nerves separately is thus reflected in the energy metabolism of the tissues of the right and left ventricles.

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