

THE EFFECT OF THE SUPERIOR CERVICAL SYMPATHETIC GANGLIA ON THE BLOOD PRESSURE OF RABBITS IN THE ABSENCE OF THE THYROID AND SEX HORMONES

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It is known that impulses originating from the superior cervical sympathetic ganglia cause an elevation in the blood pressure [7, 8, 9, 12].

We made it our goal to study this influence on a long term experimental basis.

In addition, we considered it important to investigate the influence of the superior cervical ganglia on a previously altered blood pressure.

We know that a lasting elevation in the blood pressure may be caused by sex hormone insufficiency. A model of this type of high blood pressure is seen in postcastration hypertension. According to the data of B. A. Vartapetov [6, 7], the blood pressure in castrated rabbits is markedly elevated, and remains high over the course of several months (in certain cases, up to 2-3 years).

TABLE 1. The Effect of Castration and Thyroidectomy on the Arterial Pressure of Rabbits

Date	Control	Castrated rabbits			Thyroidectomized rabbits		
	pressure						
	in mm Hg	in mm Hg	in % of the original level	in % of the control level	in mm Hg	in % of the original level	in % of the control level
29/I (original level)	59.7	56.7			55.6		
30/I	Operation						
13/II	62.7	68.7	121.2	109.5	58	104.4	92.6
7/III	66	75.7	133.5	115	55.2	99.3	83.6
15/III	63.7	75.7	133.5	119	52.4	94.2	82.3
22/III	63.7	76.7	135.3	120.5	47.6	85.6	74.7
30/III	62.3	79.3	140.0	127.3	49.6	89.2	79.6

On the other hand, it was important to elucidate how an action applied to the superior cervical ganglia effects the blood pressure of animals with hypotension. For this purpose, we used animals whose thyroid glands were preliminarily removed. From clinical practice, it has long been known that decreasing the function of the thyroid gland causes a reduction in the blood pressure, the more striking in the case of thyroidectomy.

EXPERIMENTAL METHOD

In the experiment, we used 24 sexually mature male rabbits, weighing 1900-2500 grams. The animals were divided into three groups: a control group of rabbits, a group undergoing castration, and a group undergoing total thyroidectomy.

Two months after castration or thyroidectomy, the experimental animals underwent a second operation; stimulation or disconnection of the superior cervical ganglia. The same operation was carried out in a portion of the control animals. Stimulation of the ganglia was accomplished by wrapping them in silver wire; disconnection was realized by their extirpation. In order to exclude the effect of surgical trauma on the blood pressure, in the second portion of the control animals a false operation was performed on the neck: the superior cervical ganglia were exposed, but no further procedure was performed on them and the wound was closed.

For two weeks prior to the beginning of the experiment, the blood pressure of all the rabbits was measured in the central artery of the ear by the bloodless method of Grant and Rothschild [11], and its base level established. The pressure indices after the operation were compared with the starting level of the arterial pressure in the same animals, as well as with the level of pressure in the control animals.

TABLE 2. The Influence of the Superior Cervical Sympathetic Ganglia on the Arterial Pressure of Normal, Castrated, and Thyroidectomized Rabbits

Control	Normal				Castrated				Thyroidectomized			
Pressure												
in mm Hg	in mm Hg	in % of the original	in mm Hg	in % of the original	in mm Hg	in % of the original	in mm Hg	in % of the original	in mm Hg	in % of the original	in mm Hg	in % of the original
63	62.7		62		78.5		80		48		46	
False opera- tion	Stimulation of the ganglia		Extirpation of the ganglia		Stimulation of the ganglia		Extirpation of the ganglia		Stimulation of the ganglia		Extirpation of the ganglia	
63	78.7	125.5	67.6	109	86	109.5	75.8	94.8	68.7	143	82.7	180
62.5	80.7	128.8	62.4	100.6	89.5	113.3	73.1	91.4	64	133	85.3	185
60	82	130.8	61.6	99.3	89.5	113.3	78.6	98.3	64	133	83.3	181
61	81.3	129.6	60.4	97.4	89	113.2	70	87.5	63	131.2	78.7	171

The arterial pressure indices obtained by this method are lower than the pressure indices in the main arteries. However, this has no essential significance, since we were not interested in the absolute figures for the blood pressure, but in the dynamics of changes in the pressure of the experimental animals as compared with the controls.

EXPERIMENTAL RESULTS

After castration, even as early as 2 weeks later, a portion of the rabbits showed an elevation in the arterial pressure; after 3-4 weeks, postcastration hypertension developed in all the animals, and subsequently became even more manifest. The pressure reached 135-140% of the original level, and 125-127% of the pressure in the control animals.

After total thyroidectomy, hypotension developed. The first signs of lowering of the pressure in the thyroidectomized rabbits appeared after 2-3 weeks. In the course of two months, the level of the arterial pressure fell to 74-79% of the pressure in the control animals, and to 85-89% of the original level.

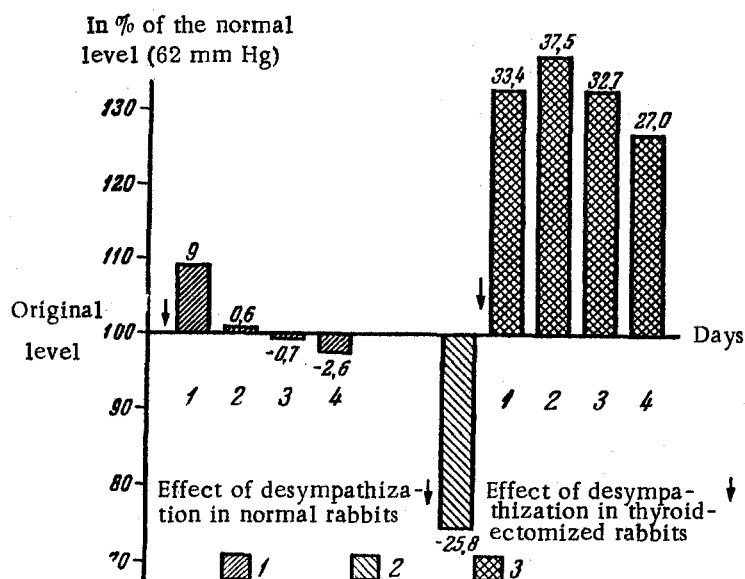
Data on the changes in pressure following castration and thyroidectomy are presented in Table 1.

Data on the changes in pressure following an action being applied to the superior cervical ganglia are presented in Table 2.

Stimulation of the ganglia in normal rabbits leads to an elevation in the pressure of approximately 30% (the pressure held at this level for a month after the operation; the data in Table 2 are for the first 4 days). After desympathization, the arterial pressure either remained generally unchanged, or after a transient elevation (1st day after the operation) returned to the normal level and subsequently showed a tendency toward falling. The rise in pressure on the first day is possibly explained by trauma of the sympathetic ganglia.

In the setting of postcastration hypertension, stimulation of the superior cervical ganglia caused a subsequent elevation in the pressure to 90-92 mm Hg, as compared with a pressure of 78-82 mm Hg in the rabbits that underwent only castration. Desympathization, performed in the castrated animals, initially left the pressure essentially unchanged, but there later appeared a tendency toward its lowering.

In the thyroidectomized rabbits, stimulation and disconnection of the superior cervical ganglia was performed against the background of a lowered arterial pressure. Under these conditions, stimulation of the ganglia caused an average pressure elevation of 30%, i.e., the magnitude of the effect was the same as in the normal rabbits after performance of this operation. Disconnection of the sympathetic impulses by extirpation of the superior cervical ganglia did not lead to lowering, as would be expected, but to an even greater elevation in the pressure than that which was observed after stimulation of these ganglia. The developing, clearly manifested, hypertension was a particularly vivid contrast to the original low level of pressure in the thyroidectomized rabbits: the pressure reached 80-90 mm Hg, when it was equal to 44-48 mm Hg prior to the desympathization.



Inversion of the desympathization effect in thyroidectomized animals. Blood pressure is shown on the ordinate axis.

Thus, under conditions where the organism is deprived of thyroid hormones as a result of thyroidectomy, desympathization causes a clear and lasting elevation in the arterial pressure (see figure). Hence, there occurs an inversion of the effect of desympathization, wherein the tendency toward lowering of the pressure, observed in normal rabbits, is replaced in thyroidectomized rabbits by a marked elevation in the pressure.

The inversion in the desympathization effect which we observed may be compared with a similar inversion in the effects shown by sympathetic impulses on hormonopoiesis in the anterior lobe of the hypophysis. As shown by the experiments of B. V. Aleshin and coworkers [1-5], sympathetic impulses manifest an inhibitory influence on the thyrotropic and follicle stimulating function of the hypophysis in male animals. However, under conditions of thyroidectomy, the effect of these impulses inverts: they do not cause attenuation, but on the contrary, a clear intensification of the production of these hormones. The mechanism of these inversion phenomena is still unclear, but they testify to the influence of thyroid hormone on the reactivity of effector organs to sympathetic impulses.

SUMMARY

In male rabbits chronic irritation of the superior cervical sympathetic ganglia was done by encircling them with a silver wire; in other experiments extirpation of these ganglia was performed in normal rabbits. Irritation of the ganglia provokes a rise in the blood pressure. Desympathization either does not change the blood pressure or decreases it somewhat.

Against the background of postcastrational hypertension stimulation of the ganglia leads to further blood pressure rise whereas desympathization — decreases it.

In thyroidectomized rabbits with reduced blood pressure stimulation of the superior cervical ganglia provokes a blood pressure rise. The effect produced extirpation of these ganglia was quite different from that in normal animals (the blood pressure rise was even more pronounced than after the irritation (1.5-fold). Consequently, in thyroidectomy an inversion of the desympathization effect is observed. This phenomenon testifies to the significance of thyroid hormones in bringing about the influence of sympathetic impulses.

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