

EFFECT OF DENERVATION OF THE CAROTID
SINUSES ON TISSUE RESPIRATION OF THE KIDNEY,
SPLEEN, AND BONE MARROW

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In the period of greatest severity of the anemia caused by denervation of the carotid sinuses in rabbits, the oxygen consumption of the kidney and spleen tissue falls, while that of the bone marrow rises. Serum obtained at the time of greatest severity of anemia has the property of lowering the intensity of oxygen utilization by spleen tissue of an intact animal in vitro and of stimulating the oxygen utilization by the bone marrow, but has no effect on oxygen utilization by the kidney. This serum, if injected intravenously into rabbits, causes the recipients to develop anemia.

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During stimulation of receptors of the carotid reflexogenic zones responses are observed in the blood system [1, 2, 4, 7, 8, 14], while after denervation of the carotid sinus, anemia of hemolytic type develops, in the pathogenesis of which an important role is played by inhibitors of hematopoiesis. Some workers consider that the site of formation of these humoral substances is the spleen [3, 5, 12]. It has also been observed that denervation of the carotid sinuses [1, 3], and also an increase of pressure within them [6], produces reflex stimulation of blood destruction and, at the same time, stimulates the liberation of erythropoietin, formed, in the opinion of many workers, in the kidney [3, 6, 10, 11, 13, 15].

Because of the great importance of humoral factors in the regulation of erythropoiesis, and also bearing in mind that formation of erythropoietins is controlled, not by the oxygen tension in the blood, but by the relationship between the oxygen consumed by and supplied to the tissues, it was decided to study the intensity of tissue respiration of various organs in neurogenic anemias.

EXPERIMENTAL METHOD

Experiments were carried out on 31 male rabbits, 14 of which constituted the control group, undergoing a mock operation.

Blood for obtaining serum was taken by cardiac puncture, after which the animals were sacrificed and the spleen, kidney, and bone marrow removed for investigation of the intensity of tissue respiration manometrically in a Warburg's apparatus.

The intensity of tissue respiration was expressed in cubic millimeters of absorbed oxygen per milligram dry weight of tissue per hour, and for bone marrow per milligram fresh weight.

The carotid sinuses were denervated by division of Hering's nerve, removal of the adventitia in the region of bifurcation of the common carotid artery, and painting this region with alcohol. The operation was carried out in two stages separated by an interval of one week. Completeness of denervation of the carotid sinuses was verified by measuring the arterial pressure by the bloodless method described by Grant and Rothschild.

To study the erythropoietic and inhibitory properties, serum was injected intravenously in a dose of 15 ml into healthy recipient rabbits.

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TABLE 1. Changes in Tissue Respiration of the Kidney, Spleen, and Bone Marrow of Rabbits After Denervation of the Carotid Reflexogenic Zone

Organ	No. of animals	In Ringer-Locke solution		In serum of intact animals	
		$M \pm m$	P	$M \pm m$	P
Kidney	31	$-2,2 \pm 0,54$	$<0,01$	$-1,8 \pm 0,48$	$>0,05$
Spleen	31	$-2,5 \pm 0,50$	$<0,01$	$-3,4 \pm 0,55$	$<0,01$
Bone marrow	16	$+3,7 \pm 0,57$	$<0,01$	$+3,5 \pm 0,50$	$>0,01$

TABLE 2. Changes in Tissue Respiration of Kidney, Spleen, and Bone Marrow Under the Influence of Blood Serum Taken at the Height of Anemia Following Denervation of the Carotid Reflexogenic Zone.

Organ	No. of animals	In serum of intact animals	
		$M \pm m$	P
Kidney	28	$0,4 \pm 0,86$	$>0,6$
Spleen	28	$-0,9 \pm 0,40$	$<0,05$
Bone marrow	16	$0,6 \pm 0,18$	$<0,01$

tissue respiration of the spleen and an increase in the oxygen utilization by the bone marrow tissue; the tissue respiration of the kidney remained unchanged (Table 2).

Hence, denervation of the carotid sinus causes significant changes in tissue respiration in all the organs studied. A particularly noteworthy feature is the decrease in oxygen utilization by the spleen, whose role in the pathogenesis of neurogenic anemias consists of the formation of a specific hemolytic substance, capable when injected into recipient animals of reducing the number of erythrocytes but having no inhibitory action on the regenerative and respiratory function of the bone marrow. It can be postulated that the humoral substance causing the development of anemia is a substance which stimulates the hemolytic function of the spleen but does not inhibit erythropoiesis. This view is supported by results obtained from the study of oxygen utilization by the tissues of the organs studied when kept in serum obtained at the period of most severe anemia.

The observed stimulation of bone marrow function can be explained by the accumulation of erythropoietins in the blood, coinciding with a decrease in the intensity of tissue respiration of the kidneys, or by some influence of the nervous system.

EXPERIMENTAL RESULTS

Denervation of the carotid sinuses caused the development of hypochromic anemia with a marked reticulocytosis and an increase in the number of immature reticulocytes and stimulation of erythropoiesis in the bone marrow, in agreement with results obtained by other workers [1, 2, 4, 9].

The mean decrease in the erythrocyte count in the denervated animals was 1,400,000 per mm^3 . The hemoglobin concentration was reduced on the average by 12%, while the reticulocyte count was doubled.

Intravenous injection of serum obtained from the animals in the period of greatest severity of anemia following denervation of the carotid sinuses into recipient rabbits caused a decrease in the erythrocyte count which averaged 1,200,000 per mm^3 of blood, together with the development of reticulocytosis.

In the period of most severe anemia, a decrease in the intensity of tissue respiration of the kidney and spleen and an increase in the intensity of tissue respiration of the bone marrow were discovered (Table 1).

The study of the tissue respiration of the investigated organs in serum taken from rabbits at the height of the anemia caused by denervation of the carotid sinus revealed a decrease in the intensity of

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