

# CHANGES IN BLOOD PROTEIN FRACTIONS IN DOGS AFTER AUTOTRANSPLANTATION OF THE KIDNEYS AND SPLEEN

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Experimental results [1] have shown that antibodies reacting with antigen obtained by extraction of the ground kidneys of other dogs with water may be found in the blood of dogs with an autotransplanted kidney. These results may be explained as follows: the kidney, modified as a result of autotransplantation, may be antigenic in relation to the body itself.

In the present investigation this problem was studied again, and the protein fractions of the blood were determined by an electrophoretic method. During the investigation of the blood protein fractions over a period of time in dogs following autotransplantation of organs, attention was concentrated mainly on the changes in the  $\gamma$ -globulin fraction of the blood as an index of the immunological changes taking place in the organism.

## METHOD

The investigation was carried out on 5 dogs. In three of these animals the right kidney was autotransplanted into the cervical region by means of a vascular anastomosis between the common carotid artery and the renal artery, and between the external jugular vein and the renal vein. In addition, the innervation of the transplanted kidney was restored by anastomosis between the central end of the vagus nerve and the renal nerves. In the 4th dog autotransplantation of the spleen was carried out, and the organ was re-innervated by the central segment of the vagus nerve by a method developed previously [2]. A control operation was performed on the 5th dog, in the course of which the skin of the neck and the anterior abdominal wall was incised in the same way as during the kidney transplantation operation, but the kidney was not transplanted. In all the animals the autotransplanted organs functioned, as was confirmed by special tests. The blood protein fractions were determined by the method of electrophoresis on paper before the operation of transplantation, and during the 3-4 months thereafter, and in the case of the dog with the autotransplanted spleen—for a period of 8 months.

## RESULTS

The changes in the blood protein fractions of the dogs after autotransplantation of the kidney are shown in Table 1. During the first month after the operation of transplantation of the kidney in all 3 animals a decrease was observed in the albumin fraction: in the dog Druzhok from 35.8 to 24.8%, in the dog Pal'ma from 37.5 to 27.7%, and in the dog Raketa from 41.5 to 29.9%. During the month after the operation an increase was found in the albumin fraction in all 3 experimental animals.

The changes in the  $\alpha_1$ -,  $\alpha_2$ -, and  $\beta$ -globulin fractions in the postoperative period revealed no particular regular pattern: the variations in these values differed in character and magnitude in all three dogs.

A definite pattern was observed in the changes in the  $\gamma$ -globulin fraction. In the dog Druzhok during the first month after the operation it rose considerably (from 14.7 to 22.7%), during the second month it fell to 19%, and during the 4th month—to 13.2%. In the dog Pal'ma the  $\gamma$ -globulin content also rose from 10.7% in the control to

TABLE 1. Blood Protein Fractions in Dogs in Control Experiment and After Operation of Transplantation of the Right Kidney into the Neck (in %)

Dog's name	Index	Cont.	After operation				
			1st month	2nd month	3rd month	4th month	
Druzhok	Albumins	35,8	24,8	31,1	—	42,2	
	Globulins:	12,9	9,6	11,9	—	9,8	
	$\alpha_1$	13,7	14,0	12,1	—	11,4	
	$\alpha_2$	22,8	28,8	25,8	—	23,2	
	$\beta$	14,7	22,7	19,0	—	13,2	
	$\gamma$						
Pal'ma	Albumins	37,5	27,7	31,0	32,0	30,8	
	Globulins:	6,6	13,3	9,1	9,5	9,2	
	$\alpha_1$	11,9	14,1	11,6	14,5	15,4	
	$\alpha_2$	33,2	27,7	30,4	23,5	31,0	
	$\beta$	10,7	17,2	17,8	20,5	13,6	
	$\gamma$						
Raketa	Albumins	41,5	29,9	—	48,6	—	
	Globulins:	6,0	11,2	—	7,7	—	
	$\alpha_1$	6,5	12,6	—	13,9	—	
	$\alpha_2$	16,8	12,8	—	15,3	—	
	$\beta$	29,2	33,3	—	14,5	—	
	$\gamma$						

TABLE 2. Blood Protein Fractions in the Dog Aida after the Operation of Transplantation of the Spleen into the Neck

Index	Control	After operation			
		1st mon.	2nd mon.	3rd mon.	4th mon.
Albumins	35,9	30,1	30,2	42,8	42,6
Globulins:					
$\alpha_1$	8,5	8,4	8,9	4,2	6,4
$\alpha_2$	13,0	12,6	11,4	11,8	11,1
$\beta_1$	15,3	14,0	12,8	11,3	12,4
$\beta_2$	19,0	18,9	20,4	18,7	16,9
$\gamma$	8,3	15,9	16,3	11,2	10,6

TABLE 3. Blood Protein Fractions of the Dog Mushka in Control Experiments and after Incisions without Autotransplantation of the Kidney (in %)

Index	Cont.	After operation (30th day)
Albumins	31,5	21,7
Globulins:		
$\alpha_1$	16,0	12,1
$\alpha_2$	15,4	8,9
$\beta$	23,6	45,0
$\gamma$	14,2	10,9

17.2% during the first month, and during the 2nd and 3rd month it remained high (17.8 and 20.5% respectively, while during the 4th month it fell (13.6%). In the dog Raketa the level of this fraction also rose from 29.2% in the controls to 33.3% during the first month after the operation, while during the 4th month its content was 14.5%. The comparatively small increase in the  $\gamma$ -globulin fraction in this dog in the early periods after the operation and the considerable fall in its level in the late periods after transplantation may possibly be explained by the high initial level of the  $\gamma$ -globulin. In fact, such a high percentage of  $\gamma$ -globulin was not observed in any of the experimental dogs in the period of the control experiments. In this dog some form of reaction of immunity was evidently present even before the operation of transplantation of the kidney.

The results of experiments on the dog Aida, undergoing autotransplantation of the spleen are given in Table 2. These results show that after autotransplantation of the spleen, the level of the  $\gamma$ -globulins again showed the most marked changes. During the first 2 months its content rose to 15.9 and 16.7% respectively compared with 8.3% in the controls. At the same period the albumin fraction showed a decrease.

Hence, it may be concluded from these results that autotransplantation of the kidney and spleen in all the experimental animals caused a fall in the level of the albumins and a rise in the level of the  $\gamma$ -globulins.

The results of the determination of the blood protein fractions in the dog Mushka, on which the control operation was performed but the organs were not transplanted, are shown in Table 3.

It follows from Table 3 that after the control operation the pattern observed was completely different from that in the experiments on the dogs with the transplanted kidney. Whereas after the control operation the level of the  $\beta$ -globulins rose, after the operations of transplantation of the kidney and spleen the content of  $\gamma$ -globulins rose. Evidently, the increase in the  $\gamma$ -globulin fraction of the blood was connected with autotransplantation of the kidney and spleen, and not with the operation itself.

Hence, in these experiments on dogs, after autotransplantation of the kidney and spleen the level of the  $\gamma$ -globulins rose and the level of the albumins fell. Reports in the literature show that this change in the blood protein fractions results from the "immunological reorganization" of the organism. For instance, similar changes in the blood protein fractions have been observed in experimental nephritis of the Lindemann-Mazuga type [4]; the authors cited state that  $\gamma$ -globulinemia with a decrease in the albumin content is an expression of the "immune" reaction of the organism to foreign protein. After homotransplantation of the kidney, i.e., after introduction of foreign protein into the organism, an increase in the  $\gamma$ -globulin fraction of the blood was also observed [5].

The reaction of immunity in the present investigations may be explained by autoimmunization against the proteins of the autotransplanted kidney. The facts of autoimmunization have frequently been observed by many investigators; a survey of the literature on this subject is given in one of their papers [3]. This may perhaps not be the only explanation, but the results of the present investigation show that autotransplantation must not be regarded as the simple moving of an organ; even in these conditions, immune reactions of the organism are found.

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