ROLE OF AUTOINTOXICATION IN THE CHANGE IN NITROGEN BALANCE IN DOGS AFTER INFLICTION OF THERMAL BURNS

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Burn sickness is accompanied by an intensified decomposition of body proteins, which is apparently caused by autointoxication developing as a result of severe destructive changes in the skin. This hypothesis is based on the fact that the greatest protein decomposition is observed during the first 10-12 days after infliction of the burn, i.e., during the intoxication phase [6].

It has been established [1, 5, 8] that infusion of fresh burns during the autointoxication period with human and animals blood serum taken during the recovery period has a therapeutic effect.

The hemoculture method has been used to show that burn-convalescent serum injected intravenously into dogs during the burn-intoxication period is able specifically to reduce or neutralize the toxicity of their blood serum. This detoxication effect was not observed in experiments involving administration of serum from healthy animals [3].

It has been established [7] that intravenous injection of homologous burn-convalescent serum reduces the rate of protein decomposition in burned dogs, while administration of serum from healthy dogs has a less marked effect in reducing the negative nitrogen balance. In our investigations we detected an attenuation of catabolic processes from the preburn level after repeated infliction of burns. It was hypothesized that there is an active immunity to burn intoxication in animals which have incurred burns in the past. The antitoxins formed in animals $1\frac{1}{2}$-2 months after a burn apparently have the same effect on the rate of tissue-protein decomposition after repeated infiliction of burns as intravenous injection of immune burn convalescent serum. Thus, study of the change in the rate of catabolic processes as a function of the presence or absence of toxic properties in the blood serum of freshly burned animals is of definite interest.

Using this as our basis, in the present work we simultaneously studied the variation in nitrogen balance and the toxicity of the blood serum in burned dogs; for detoxication they were injected intravenously with blood serum from an animal convalescing from burns, as well as serum from healthy animals.

EXPERIMENTAL METHOD

The experiments were conducted on dogs, which were kept on a protein-free diet complete with respect to calorie content and salt and vitamin composition. Each dog daily recieved 150 g of sugar, 50 g of butter, 145 g of potato meal baked into cakes, and 5 g of a salt mixture containing all the necessary anions and cations, vitamins C, B_1, and B_2, nicotinic acid, cod-liver oil, and 1 g of dry brewer's yeast. The dogs were fed this diet for 7-10 days before infliction of the burns, in order to bring their metabolism to a certain level. The burns were flame-inflicted during a 1-min period over an area equal to approximately 10% of the body surface. The nitrogen balance as studied over 5-6 days before the burns were inflicted, on the day of infliction, and for 7-10 days afterward, on administration of immune and normal dog sera, as well as on repeated burning without treatment.

The blood serum of the burned dogs was investigated by the hemoculture method before the burns were inflicted and then daily, before administration of serum. This method consisted in culturing fragments of a leucocyte film

TABLE 1. Change in Nitrogen Balance and Serum Toxicity in Burned Dogs on Treatment with Immune and Normal Sera

Treatment method	Name of dog	N_2 excreted per day (in g)		N_2 intake per day (in g)	N_2 balance per day (in g)		N_2 excreted per kg of body weight (in g)		N_2 intake per kg of body weight (in g)	N_2 balance per kg of body weight (in g)		Change in balance after burn (in % of preburn balance per kg of body weight)	Serum toxicity	Duration of treatment (in days)
		before burn	after burn		before burn	after burn	before burn	after burn		before burn	after burn			
Immune serum	V'yun	2,004	2,295	1,273	—2,004	—1,022	0,130	0,156	0,087	—0,130	0,069	—49 —46,9	+19	6
	Topez	1,659	2,652	1,392	—1,659	—1,260	0,117	0,190	0,099	—0,117	—0,091	—24 —22,2	+13	6
Normal serum	Shustryi	1,992	4,513	1,322	—1,992	—3,191	0,149	0,360	0,105	—0,149	—0,255	+60,2 +71,1	—23	6
	Katok	2,219	4,570	1,69	—2,219	—2,880	0,129	0,287	0,106	—0,129	—0,181	+29,8 +40,3	—18	6
Immune serum + hydrolyzate	Zheltyi	3,572	5,163	4,114	—3,572	—1,049	0,194	0,290	0,231	—0,194	—0,059	—70,6 —69,5	—4	6

from a healthy human on a nutritive medium composed of a mixture of human and rabbit plasma. The index of biological activity was the size of the leucocyte-migration zone after 18 h of culturing at 37° in an incubator. The control was cultures in which Ringer's solution rather than the sera under investigation was added to the nutritive medium. The migration of the experimental cultures was calculated with respect to the control, which was taken as 100, and was designated as + or – in relation to 100 [2].

Two of the burned dogs were injected intravenously with burn-convalescent serum (10 ml/kg) for 6 days from the day after the burns were inflicted. Sixty ml of a 40% glucose solution, 1 ml of a 5% vitamin B_1 solution, and 2 ml of a vitamin C solution were added to the ampoule containing the serum. Immune serum was obtained from the dogs' blood 2-3 months after 1-min flame-burning of 10-15% of their body surface. The activity of the serum was checked by the hemoculture method. Sera with antitoxin titres of 1:16, 1:32, or more were selected for the experiments. In the control experiments the same dose of a mixture of blood serum from healthy, unburned dogs with glucose and vitamins was administered at the same times. Each dog received 1.3-1.7 g of nitrogen per day, or 0.1-0.09 g per kg of body weight

EXPERIMENTAL RESULTS

Despite the almost equal quantities of nitrogen administered, the quantity excreted with the urine on administration of immune serum was approximately half that excreted on administration of normal serum. As a result, the negative nitrogen balance in the dogs treated with burn-covalescent serum was considerably reduced in comparison with the preburn period. In the dog V'yun the negative nitrogen balance dropped by 49% in comparison with the preburn period after infliction of the burns, while in the dog Topaz it dropped by 24%. In the control dogs Shustryi and Katok, who were given normal serum over the same period the nitrogen balance not only failed to drop after the burns were inflicted, but, quite the contrary, increased by 30-60% in comparison with the preburn level. The percentage rise was even more substantial when expressed per kg of body weight It must be noted that the protein-metabolism levels of these dogs were approximately the same before the burns were inflicted, while their negative nitrogen balances during the preburn period averaged 0.117-0.149 g of nitrogen (Table 1).

The data cited indicate the effectiveness of immunotherapy during the postburn period. Administration of serum from healthy dogs did not produce this

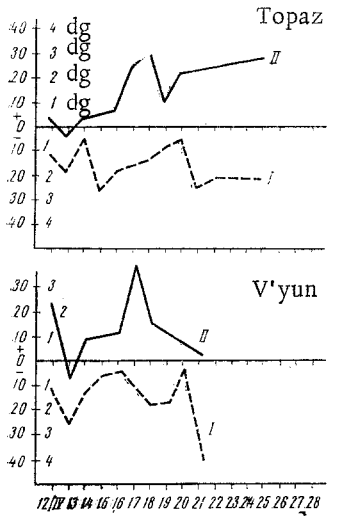

Fig. 1. Change in nitrogen balance (I) and serum toxicity (II) after infliction of burns in dogs treated with burn-convalescent serum.

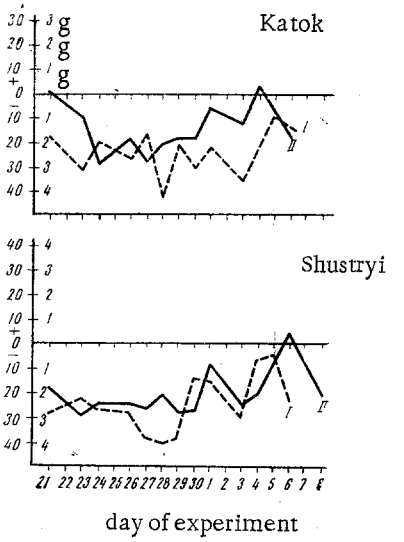

Fig. 2. Changes in nitrogen balance (I) and serum toxicity (II) after infliction of burns in dogs treated with normal serum.

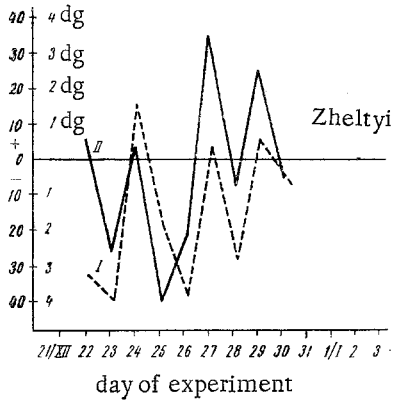

Fig. 3. Changes in nitrogen balance (I) and serum toxicity (II) after infliction of burns in dog treated with convalescent serum and TsOLIPK (Central Order of Lenin Scientific Research Institute of Hematology and Blood Transfusion) hydrolyzate.

effect. Detoxication or, in any case, a decrease in toxemia apparently occurs as a result of immunotherapy and this leads to an attenuation of catabolic processes in dogs with thermal trauma. This was confirmed by the results obtained in determining the toxicity of the blood serum of these dogs by the hemoculture method.

In V'yun and Topaz serum toxicity was completely absent through out the entire immunotherapy period after infliction of the burns.

Serum toxicity was detected in Shustryi and Katok, who were given normal serum; this toxicity persisted throughout the entire experiment and was somewhat reduced only toward the end of the 10-day period of serum administration. At this time the dogs also exhibited a decrease in negative nitrogen balance (Figs. 1 and 2).

Comparison of the results obtained in determining the serum toxicity and nitrogen balance indicates that the changes in these quantities are directly correlated: when toxicity is absent or reduced the negative nitrogen balance is also reduced. This was especially marked in the dog Zheltyi, who was given immune serum and hydrolyzate. The serum toxicity of this dog fluctuated sharply throughout the entire experiment, the negative nitrogen balance varying accordingly (Fig. 3).

An absence of or decrease in serum toxicity in burned dogs consequently leads to an attenuation of catabolic processes in these animals.

Burns were again inflicted on the dogs 3 months after the first trauma, on the same body surfaces and with the same exposure time. The negative nitrogen balance of the dogs subjected to repeated burns was found to be less than that of the animals subjected only to the initial burns. Thus, in the dog Meteor the negative nitrogen balance increased by an average of 123% during the first day after the initial burn in comparison with the preburn period. After repeated infliction of burns the negative nitrogen balance increased by only 67% over its preburn level. In the dogs Tarzan the negative nitrogen balance increased by 54% over its preburn level after infliction of the first burn and by only 24% after infliction of the second burn (Table 2).

TABLE 2. Change in Nitrogen Balance in Dogs after Repeated Infliction of Burns

Name of dog	Burn	Nitrogen balance per day		Nitrogen balance per kg of body weight		Increase in balance (in % of preburn balance)
		before burn	after burn	before burn	after burn	
Meteor	Initial	1,932	4,304	0,120	0,296	+122,8 +147,1
	Repeated	1,34	2,237	0,082	0,150	+66,9 +82,9
Tarzan	Initial	2,385	3,663	0,140	0,235	+53,6 +67,8
	Repeated	1,717	2,134	0,090	0,116	+24,3 +28,9

The results of the investigation indicate that the rise in the negative nitrogen balance in comparison with the preburn period after a repeated burn is only half that after the initial burn. The repeated burn consequently has the same effect on the rate of tissue-protein decomposition as administration of immune burn-convalescent serum.

The toxic properties of the serum of these dogs were not investigated after the repeated burns, but experiments previously conducted on 18 dogs showed that the blood serum always had marked toxic properties for 20-30 days after thermal trauma.

In the investigations performed on Meteor and Tarzan after repeated burns it was established that their sera did not have a toxic effect in hemocultures throughout the entire observation period, a phenomenon noted on administration of immune serum. These data indicate the existence of active immunity with respect to burn intoxication in animals which have incurred burn trauma in the past. The presence of such active antiburn antitoxic immunity leads to a decrease in the rate of protein decomposition after infliction of repeated burns.

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