PLASMA CYCLIC AMP LEVEL IN DONORS

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The concentration of cyclic adenosine-3',5'-monophosphate (cyclic AMP) in the plasma of blood donors (10 regular, 28 first time) was investigated by the competitive protein binding method on the day before donation and shortly after the removal of 20 ml blood. Two types of responses of the donors to donation were established: with no change and with a change in the cyclic AMP level. In accordance with these responses the donors were conventionally divided into two subgroups – "stable" and "reactive." The cyclic AMP level in the regular donors was higher than in the primary, and at the time of taking the blood it was increased still more, especially among the subjects of "reactive" type. The cyclic AMP concentration in first-time donors of reactive type was either lower or higher than the mean value on the day before donation, and at the time of bleeding it rose or fell respectively to the mean level.

KEY WORDS: Blood loss; stress; cyclic AMP; blood donation.

Cyclic adenosine-3'-5'-monophosphate (cyclic AMP) is a universal mediator of many humoral effects on cells. Its effect has been established on the rates of glycolysis and glycogenolysis, lipolysis, steroidogenesis, and other metabolic processes. The cyclic AMP level depends on the activity of two enzymes: adenyl cyclase, which catalyzes its formation from ATP, and phosphodiesterase, which catalyzes its hydrolysis to 5'-AMP. Adenyl cyclase is activated by several humoral factors, including adrenocorticotropic hormone (ACTH), vasopressin, parathormone, glucagon, and Tβ-adrenergic stimulators which act as stress effectors [9].

The cyclic AMP level in the plasma of clinically healthy blood donors was determined in order to study one aspect of the mechanism of reactions to donation.

EXPERIMENTAL METHOD

Tests were carried out on 38 blood donors (14 males, 24 females) aged from 19 to 44 years, 10 regular donors for a period of 6 to 20 years, the remainder first-timers.

The cyclic AMP concentration was determined in blood plasma taken with EDTA. The plasma was kept until analysis in field ampules in dry ice. Blood for analysis was taken twice: a day before donation and shortly after the removal of 200 ml blood.

The cyclic AMP level was determined by competitive binding with protein [4], using standard sets marketed by the Radiochemical Centre (England). Protein-bound nucleotides were separated from free nucleotides by absorption on activated charcoal. The radioactivity in the supernatant was measured on a Mark II liquid-scintillation counter.

EXPERIMENTAL RESULTS

The results in Table 1 point to a tendency toward an increase in the mean plasma cycle AMP level in the regular donors under the influence of donation. Analysis of individual variation in the cyclic AMP con-

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TABLE 1. Cyclic AMP Concentration in Plasma of Regular Blood Donors (in pmoles/ml)

Cyclic AMP	Normal	Donors		
		whole group (n = 10)	subgroup	
			"stable" (n = 4)	"reactive" (n = 6)
Limits of variations	8—20* 10—25†			
Day before donation		10,0÷26,0	16,0÷24,0	10,0÷26,0
After donation		14,0÷32,0	14,0÷28,0	16,0÷32,0
$M \pm m$	13,0±1,5 ‡			
Day before donation		17,50±1,87	19,67±1,44	15,20±1,92
After donation		22,10±2,28	21,67±2,83	25,50±1,89
P		>0,05	>0,05	<0,01

* Data of Radiochemical Centre, England.
†Data of Kaminskii et al. [5].
‡Data of Patterson et al. [6].

TABLE 2. Cyclic AMP Concentration in Plasma of First-Time Donors (in pmoles/ml)

Cyclic AMP	Normal	Donors			
		whole group (n = 28)	subgroup		
			"stable" (n = 20)	"reactive"	
				1 (n = 4)	2 (n = 4)
Limits of variation	8—20+ 10—25++				
Day before donation		2,5÷34,0	4,0÷18,0	2,5÷8,0	20,0÷34,0
After donation		5,0÷25,0	5,0÷22,0	9,9÷25,0	10,0÷18,0
$M \pm m$	13,0±1,5+++				
Day before donation		12,70±0,78	12,21±0,77	6,18±0.86	24,20±2,41
After donation		13,50±0,55	12,40±0,64	16,50±2,21	12,50±,1,35
P		>0,05	>0,05	<0,01	<0,02

centration revealed two types of reaction to donation, on the basis of which the donors were divided conventionally into two subgroups, described as "stable" and "reactive." Bleeding in subgroup 1 was not accompanied by any change in the cyclic AMP level, but in subgroup 2 the level was increased (Table 1). It will be noted that among donors of the "reactive" type the cyclic AMP concentration fluctuated within wider limits than in the "stable" subgroup.

The initial plasma cyclic AMP level in the first-time donors was lower on the average than in the regulars, and its concentration remained virtually unchanged after donation (Table 2). There was an even wider range of individual variations in the cyclic AMP level. In the "stable" subgroup the mean cyclic AMP level the day before donation was lower than in regular donors of the same subgroup ($P < 0.05$). First-time donors of "reactive" type reacted in two ways to bleeding: in some the cyclic AMP level rose to twice its initial, low concentration, whereas in the others, by contrast, it fell to half its initial, high concentratinn (Table 2).

The chief sources of the plasma cyclic AMP are evidently the kidneys and liver. For instance, nephrectomized patients did not respond with an increased plasma cyclic AMP level to injection of parathormone [5]. No increase was found in the plasma cyclic AMP level in response to injection of glucagon in hepatectomized dogs [3]. In the light of these findings the higher plasma cyclic AMP level in the regular donors both before and after donation must evidently be regarded as the result of activation of renal adenyl cyclase, for according to Rodgers et al. [7], the synthesis of renal erythropoietic factor is mediated through cyclic AMP. The kidneys of the regular donors probably produced more cyclic AMP, in consequence of their regular donations, and this led to a higher plasma concentration of this substance than in the first-time donors.

Changes in the plasma cyclic AMP level in "reactive" first-time donors must probably reflect emotional-hormonal stress changes, including general excitation of the CNS and an increased output of adren-

alin and corticosteroids [1, 2, 8]. Blood loss also activates the secretion of vasopressin, which again raises the cyclic AMP level in the kidneys. All these factors may be responsible for the increase in the plasma cyclic AMP concentration associated with blood donation.

It is more difficult to interpret the response of the remainder of the "reactive" first-time donors, in whom the cyclic AMP level was high on the day before donation and fell after donation. However, some donors have been found to have a higher adrenalin concentration before donation, but not after it [8]; in this group it may be that the parasympathetic background is predominant and that at the moment of stress the cyclic AMP level falls. The absence of such a group among the regular donors could be the result of the smallness of the sample.

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