

6. T. Hökfelt, L. G. Elfvin, R. Elde, et al., Proc. Natl. Acad. Sci. USA, 74, 3587 (1977).
7. I. M. D. Jackson, R. Saperstein, and S. Reichlin, Endocrinology, 100, 97 (1977).
8. F. Kardon, R. J. Marcus, A. Winokur, et al., Endocrinology, 100, 1604 (1977).
9. J. C. Marshall, R. A. Shakespear, and W. D. Odell, Clin. Endocrinol. (London), 5, 671 (1976).
10. E. Okon and Y. Koch, Nature, 268, 445 (1977).
11. J. M. Schaeffer, M. J. Brownstein, and J. Axelrod, Proc. Natl. Acad. Sci. USA, 74, 3579 (1977).
12. T. Takahashi, M. Yoshikawa, S. Honda, et al., Pharmacometrics, 8, 1319 (1974).
13. W. Vale, P. Brazeau, C. Rivier, et al., Rec. Prog. Hormone Res., 31, 365 (1975).
14. W. F. White, M. T. Hedlund, G. F. Weber, et al., Endocrinology, 94, 1422 (1974).

# CHANGES IN PLATELET AGGREGATION AND FIBRINOLYTIC ACTIVITY OF THE BLOOD IN HEALTHY SUBJECTS DURING A 23-DAY PHYSICAL CYCLE

V. P. Baluda, V. F. Kirichuk,  
L. M. Kolesnikova, and S. I. Chekalina

UDC 612.115"5"

It is shown that thrombocyte aggregation and the fibrinolytic activity of the blood of healthy individuals change over the 23-day physical cycle: In the negative phase of the cycle the quantity of thrombocytes, their aggregation, the process of deaggregation of thrombocyte aggregates, and the fibrinolytic activity of the blood are higher than in the positive phase.

KEY WORDS: biological rhythms; platelets; aggregation; fibrinolytic activity of the blood.

The rhythmic character of biological functions and of the main biophysical, biochemical, and physiological processes forming the basis of vital activity is one of the conditions of existence of animals and plants. From unicellular organisms to man, from processes in the cell to the function of organs and systems — everything is oriented in time, so that the rhythm of activity of the organism is determined by its own "living clock." The system of hemostasis and its various components have their own biorhythm of function (circadian [3, 4], polydian [5, 8], and seasonal [1], and changes in the activity of the hemostasis system depending on solar activity [1, 6-7]).

According to one theory [10, 11], the life of every person, starting from birth, proceeds in accordance with three separate cycles: physical (duration 23 days), emotional (duration 28 days), and intellectual (duration 33 days). Each cycle has its positive and negative phases, which are characterized by a definite difference in the functional state of the systems of the body.

In this paper, data are given on the functional state of the platelets and fibrolytic system of the blood of healthy persons during different phases of the physical, emotional, and intellectual cycles.

## MATERIALS AND METHODS

Observations were made on 100 healthy persons (men and women aged 18-40 years). The number of platelets and their aggregation under the influence of ADP [2] were determined and the fibrinolytic activity of the blood was estimated according to lysis of fibrin on slides [9] in different phases of the physical, emotional, and intellectual cycles. The tests were carried out in the morning under standard conditions.

---

Department of Radiation Pathophysiology, Research Institute of Medical Radiology, Academy of Medical Sciences of the USSR, Moscow. Department of Human Physiology, Saratov Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR N. A. Fedorov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 87, No. 5, pp. 478-480, May, 1979. Original article submitted July 11, 1978.

TABLE 1. Number of Platelets, Their Aggregating Power, and Activity of the Fibrinolytic System of the Blood (M) in the Positive and Negative Phases of the Physical, Emotional, and Intellectual Cycles in Healthy Subjects

Index	Cycle					
	physical		emotional		intellectual	
	phase					
	positive	negative	positive	negative	positive	negative
Platelet count, thousands/ $\mu$ l	185	220*	191	219	204	204
Degree of aggregation of platelets in first minute, %	17,6	53,4*	38,1	35,5	44,3	30,6
Maximal aggregation, %	48,5	60,7	56,6	53,3	57,2	53,3
Degree of deaggregation, %	17,2	23,5*	20,1	21,0	17,9	22,8
Total fibrinolytic activity of blood, mm <sup>2</sup>	46	63*				
Plasmin activity, mm <sup>2</sup>	44	57				
Activity of plasminogen activators, mm <sup>2</sup>	5	9*				

\*P < 0.05.

TABLE 2. Changes in Platelet Count and Functional Properties Depending on Phase of the Physical Cycle in Healthy Subjects

Index	Day of physical cycle																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	positive phase											negative phase											
Platelet count, thousands/ $\mu$ l	276	276	99	125	187	147	160	120	187	235	213	91	215	240	235	315	320	209	240	235	204	184	165
Degree of aggregation after 1 min, %	40	22	28	23	19	16	12	16	14	24	15	56	50	63	52	44	59	59	63	61	65	70	37
Maximal aggregation, %	47	60	56	49	37	32	29	40	41	53	78	56	61	63	74	44	54	60	55	59	65	70	37
Degree of deaggregation at time of its beginning, %	28	40	20	15	12	10	6	17	16	13	8	21	34	29	4	3	10	33	39	45	42	41	13

## EXPERIMENTAL RESULTS AND DISCUSSION

As Tables 1 and 2 show, aggregation of platelets determined 1 min after the addition of ADP to the blood and the number of platelets differed in the positive and negative phases of the physical cycle. In the negative phase the mean platelet count in the blood was 19% higher than in the positive phase, and the degree of aggregation of the platelets during the first minute of aggregation was at least three times higher on average in the negative phase than in the positive. In the positive phase, starting from the first minute of the test, aggregation increased gradually to reach a maximum after 6-10 min. In the negative phase, aggregation took place more intensively in the first minute and rose only slightly during subsequent minutes. A considerable increase in aggregation of the platelets was observed on the day after transition from the positive phase of the physical cycle to the negative. The degree of deaggregation of the aggregated platelets in the negative phase was on average 20% higher than in the positive phase. In the negative phase of the physical cycle the total fibrinolytic activity of the blood and the activity of the plasminogen activators increased as compared with the positive phase.

No significant differences were found in platelet aggregation or in fibrinolytic activity of the blood in the positive and negative phases of the emotional and intellectual cycles.

The number of platelets and their power of aggregation thus change not only during the 24-h period (circadian rhythm), but also during the 23-day physical cycle. The presence of a polydian biological rhythm of platelet function and of the function of the fibrinolytic system of the blood must be taken into account during the distinction between the "normal" and pathological, i.e., a single determination of platelet aggregation is not sufficient to judge the true functional state of the platelets, for depending on the day of the physical cycle on which the platelet aggregation is determined, it may be depressed (in the positive phase), normal, or increased (in the negative phase). This must be borne in mind when operative treatment of patients is considered involving the use of substances affecting the aggregating power of the platelets or the fibrinolytic activity of the blood.

# LITERATURE CITED

1. A. S. Adamchik, "Effect of seasonal and heliogeographic factors on the composition of the peripheral blood and blood coagulation in healthy subjects under the conditions of the Northern Urals." Candidate's Dissertation, Sverdlovsk (1974).
2. V. P. Baluda, S. I. Chekalina, G. N. Sushkevich, et al., Lab. Delo, No. 11, 653 (1976).
3. R. M. Zaslavskaya, E. G. Perepelkin, and N. M. Sazonova, Fiziol. Zh. SSSR, No. 1, 95 (1973).
4. M. S. Klimova, Trudy Saratov. Med. Inst., 1, Part 4, 127 (1936).
5. L. A. Medvedeva, "Mechanisms of changes in the functional state of the fibrinolytic system of the blood of healthy subjects and patients with atherosclerosis," Author's Abstract of Candidate's Dissertation, Sverdlovsk (1969).
6. A. T. Platonova, V. V. Bubliss, and V. I. Marchenko, in: Adaptation of the Organism during Exposure to Physical Factors [in Russian], Vilnius (1969), p. 240.
7. E. D. Rozhdestvenskaya and K. F. Novikova, Klin. Med., No. 7, 65 (1969).
8. E. D. Rozhdestvenskaya and G. P. Siliverstova, in: Circadian Rhythm in Man and Animals [in Russian], Frunze (1975), p. 47.
9. T. Astrup and S. Müllertz, Arch. Biochem., 40, 346 (1952).
10. W. Fliess, Der Ablauf des Lebens, Leipzig (1925).
11. H. Swoboda, Die Perioden des menschlichen Organismus in ihrer psychologischer und biologischer Bedeutung, Leipzig (1904).