Catecholamine-induced injury to the endothelium may perhaps be linked with simultaneous activation of both alpha- and beta-adrenoreceptors. Selective adrenoreceptor antagonists block simultaneous activation of receptors by catecholamines, thus preventing injury to the endothelium. Lithium is able to inhibit adenylate cyclase in certain cells [6]. It can be tentatively suggested that adenylate cyclase inhibition lies at the basis of the protective action of beta-antagonists and lithium hydroxybutyrate against catecholamine-induced injury to the aortic endothelium.

LITERATURE CITED

1. V. V. Dolgov, S. N. Preobrazhenskii, O. I. Stenina, et al., Byull. Éksp. Biol. Med., No. 11, 122 (1982).
2. V. V. Dolgov, S. N. Preobrazhenskii, T. A. Voino-Yasenetskaya, et al., Arkh. Patol., No. 11, 51 (1982).
3. G. N. Kryzhanovskii, I. S. Zavodskaya, and E. V. Moreva, Byull. Éksp. Biol. Med., No. 6, 653 (1984).
4. R. M. Makhmudov, V. V. Dolgov, T. A. Voino-Yasenetskaya, et al., Kardiologiya, No. 8, 96 (1984).
5. F. Z. Meerson, Pathogenesis and Prevention of Stress-Induced and Ischemic Heart Damage [in Russian], Moscow (1984), p. 79.
6. E. W. Gelfand, H. M. Dosch, D. Pastings, et al., Science, 203, 365 (1979).
7. R. Ross and L. Harker, Science, 193, 1094 (1976).
8. T. M. Scotti, in: Pathology, W. A. D. Anderson and J. M. Kissane, eds., Vol. 1, St. Louis (1977) p. 737.

PLASMA PHOSPHOLIPASE IN BURN SHOCK

T. L. Zaets, V. K. Sologub, V. I. Nikulin, V. A. Lavrov, and B. Dakova

UDC 617-001.17-06:616-001.36-07:616.153.1:577.152.311

KEY WORDS: phospholipases; burn shock; free radical reactions.

A cardinal syndrome of burns is a disturbance of the structural and functional state of the cellular and intracellular membranes in various organs and tissues [4], associated with a change in their phospholipid composition [2].

This change may be brought about by a change in activity of lipid peroxidation (LPO) or endogenous phospholipase activity.

There are data in the literature on intensification of LPO in burns, but all that is known about phospholipases is that their high activity is observed in the blood, urine, and wound exudate of patients with severe burns during the first weeks [3].

To assess the role of phospholipases in the formation of the basic burn syndromes and, in particular, the syndrome of generalized damage to biomembranes, it is useful to study phospholipase activity in the earliest period of burns.

The aim of this investigation was to study plasma phospholipase activity in patients with burn shock and also in rats during the first hours and minutes after an experimental burn.

Phospholipase activity was compared with plasma trypsin activity and with the intensity of LPO, in view of data indicating conversion of the inactive precursor of phospholipase A into the active form of the enzyme through the action of plasma trypsin on the precursor [12] and on activation of phospholipase by factors initiating LPO [9].

Burn Center A. V. Vishnevskii Institute of Surgery, Academy of Medical Sciences of the USSR, Moscow.

(Presented by Academician of the Academy of Medical Sciences of the USSR D. S. Sarkisov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 103, No. 4, pp. 403-404, April, 1987. Original article submitted August 12, 1986.

0007-4888/87/0004-0452$12.50

TABLE 1. Plasma Phospholipase Activity of Patients with Burns during Burn Shock (M ± m)

Experimental conditions	Number of subjects tested	Phospholipase activity, conventional units	
		A	C
Control	15	0	0
Burns	15	7.1±1.5	10.3±2.4

TABLE 2. Changes in Plasma Phospholipase Activity of Rats After Burns

Experimental conditions	Number of rats	Phospholipase activity, conventional units	
		A	C
Control	18	2.3±0.57	12,1±1,0
Burns:			
15 min	10	7.4±0.6*	15.6±1.1*
30 min	10	8.4±0.3*	16.3±0.3*
60 min	10	10.0±1.5*	20.7±2.7*
120 min	10	7.2	17.6±0.7*
24 h	10	3.8±0.6*	16.0±0.9*

Legend. *$p < 0.05$ compared with control.

EXPERIMENTAL METHOD

Experiments were carried out on noninbred albino rats weighing 170-200 g on which a burn of the IIIB degree, covering 20% of the body surface was inflicted by the flame of a spirit lamp with an exposure of 50 sec. Blood samples were taken on decapitation 15, 30, 60, and 120 min and 24 h after burning. Activity of phospholipases A and C in the plasma was determined by the method in [11] with modifications in [8], trypsin activity by the method in [1], and the malonic dialdehyde (MDA) concentration by the reaction with 2-thiobarbituric acid [7]. Phospholipase activity also was determined in the blood of 15 patients with burns affecting between 20 and 60% of the body surface in the period of burn shock, and in a group of healthy blood donors.

EXPERIMENTAL RESULTS

Activity of phospholipases A and C is known to be absent or at the trace level in normal human plasma. Investigation of patients with burn shock showed the presence of considerable activity of both phospholipases in the plasma of virtually all who were severely burned (Table 1). Since the determinations during shock were carried out over a wide range of time after burning (from a few hours to 2 days), in the experiment attention was concentrated on the earliest times after trauma. High activity of phospholipases A and C was found in normal rat plasma, in agreement with data in the literature [12] (Table 2). The most marked changes after burning were discovered in phospholipase A activity. An increase in its activity by 220% took place as early as 15 min after burning, but the highest values were found after 1 h. Virtually the same pattern was observed with respect to changes in phospholipase C activity, although they were less marked.

No significant changes were found in plasma trypsin activity in the course of the experiment.

The concentration of MDA, an end product of LPO, rose by 50% 15 min and by 75% 30 min after burning, evidence of the early intensification of free-radical processes inducing LPO.

The most likely cause of the appearance or of an increase of phospholipase activity so early after burning is evidently migration of phospholipases into the blood from destroyed cells and subcellular structures, including from lysosomes, and in rats from hemolyzed erythrocytes [13]. Activation of phospholipases by trypsin in this case is unlikely because of the absence of any significant changes in plasma trypsin activity after burning. There is a sounder basis for the suggestion that phospholipases were activated by products of free-radical

reactions, assuming that they can activate not only membrane-bound phospholipase, but also that circulating in the bloodstream.

The increase in plasma phospholipase activity immediately after burning makes it possible for the biomembranes to be damaged as a result of enzymic hydrolysis of their phospholipid layer. This second mechanism may play a no less essential role in the syndrome of generalized injury to biomembranes than the first mechanism — intensification of LPO. Increased phospholipase activity creates the conditions for very early disturbance of the barrier and enzymic function of biomembranes, for arachidonic acid release, and for the formation of an excess of prostaglandins, which is characteristic of burns [6, 5], i.e., for the formation of the key mechanisms of disturbances of homeostasis in burns, and it also raises the question of the need to look for ways and means of protecting cells against the damaging action of these enzymes.

LITERATURE CITED

1. L. P. Alekseenko, Modern Methods in Biochemistry [in Russian] Vol. 2, Moscow (1968), pp. 301-326.
2. E. B. Burlakova, T. L. Zaets, N. I. Dudinskaya, et al., Patol. Fiziol., No. 5, 13 (1984).
3. S. I. Vozdvizhenskii, V. S. Okat'ev, and É. A. Yur'eva, Pediatriya, No. 8, 48 (1981).
4. T. L. Zaets, Byull. Éksp. Biol. Med., No. 10, 43 (1983).
5. M. I. Kuzin, V. K. Sologub, N. A. Raben and T. L. Zaets, Prostaglandins in Experimental and Clinical Medicine [in Russian], Moscow (1978), pp. 19-20.
6. V. K. Sologub, N. A. Olyunina, D. M. Lisitsyn, et al., Byull. Éksp. Biol. Med., No. 9, 308 (1985).
7. I. D. Stal'naya and T. G. Garishvili, Modern Methods in Biochemistry [in Russian], Moscow (1977), pp. 66-68.
8. É. A. Yur'eva, M. A. Musaev, and O. A. Malashina, Biochemical Identification of Pathological Processes Under Clinical and Experimental Conditions [in Russian], Moscow (1983), pp. 73-74.
9. G. Arturson, Ann. Chir. Gynec. (Finland), 69, 178 (1980).
10. E. Frei and P. Zahler, Biochim. Biophys. Acta, 550 450 (1979).
11. E. Habermann and H. Hardt, Anal. Biochem., 50, 163 (1972).
12. M. Paysant, M. Bitran, J. Etienne, and Y. Polonovsky, Bull. Soc. Chem. Biol., 51, 866 (1969).
13. M. Paysant, M. Bitran, R. Wald, and Y. Polonovsky, Bull. Soc. Chem. Biol., 52, 1257 (1970).