ROLE OF THE ADRENALS IN DEVELOPMENT OF RAISED BLOOD ENZYME LEVELS IN EXPERIMENTAL MULTIPLE INJURY

V. K. Kulagin*, N. A. Kulikova, and V. N. Kudrin

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Activity of acid phosphatase (AP), lactate dehydrogenase (LDH), and aspartate and alanine aminotransferases (AST and ALT) was studied in the blood serum of intact and adrenalectomized rats after severe multiple injury produced by the method of Noble and Collip. Removal of the adrenals had virtually no effect on the dynamics of LDH and AP activity. Activity of serum AST and, in particular, ALT of adrenalectomized rats increased much less after trauma than in animals with intact adrenals.

KEY WORDS: adrenals; raised blood enzyme level; multiple trauma.

An important role in the development of irreversible states associated with traumatic shock is ascribed to disturbances of enzyme activity [3, 6]. A few reports have been published on the effect of experimental multiple trauma on the activity of certain enzymes [6-9]. The mechanisms of the raised blood enzyme levels developing in shock are of great interest. Hormones of the adrenal medulla and cortex have been assigned an important role in this process [4, 10].

The object of the present investigation was to study the activity of acid phosphatase (AP; 3.1.3.2), lactate dehydrogenase (LDH; 1.1.1.27), and aspartate (AST; 2.6.1.1) and alanine aminotransferases (ALT; 2.6.1.2) in the blood serum of intact and adrenalectomized rats after severe multiple trauma.

EXPERIMENTAL METHOD

Two series of experiments were carried out on adult female albino rats weighing 150-220 g with intact adrenals or adrenalectomized. The animals were used in the experiments on the 12th-14th day after adrenalectomy, which was performed by Kulagin's method [2]. Throughout the postoperative period the rats were given physiological saline instead of water. Trauma was inflicted on the animals by the method of Noble and Collip (300 turns of the drum rotating at a speed of 37 rpm) [11]. To obtain blood the rats were decapitated at once or 3 h after trauma. AP activity was determined by a colorimetric method using a ready-made set of reagents (Boehringer, West Germany) and expressed in milliunits (m. u.) activity in 1 ml blood serum during incubation for 30 min at 37°C. LDH activity was determined by the method of Sevela and Tovarek in the modification of Korovkin et al. [1], and AST and ALT activity by the method of Reitman and Frankel in the modification of Yatzidis [12]. The activity of these enzymes was expressed in μmoles pyruvic acid (PA) per ml serum during incubation for 60 min at 37°C. The experimental results were subjected to statistical analysis with the use of Student's criterion.

EXPERIMENTAL RESULTS

After trauma the animals were apathetic and disinclined to move; their respiration rate was increased, their oxygen demand reduced, and their body temperature slightly lowered. These features were particu-

*Corresponding Member, Academy of Medical Sciences of the USSR.

Department of Pathological Physiology, S. M. Kirov Military Medical Academy, Leningrad.

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TABLE 1. Activity of LDH, AST, ALT (in μmoles PA/ml serum/60 min) and AP (in m. u./ml serum/30 min) after Multiple Trauma in Blood Serum of Intact and Adrenalectomized Rats (M ± m)

Enzyme	Series of experiments	Initial data	After trauma	
			immediately	after 3 h
LDH	Rats with intact adrenals	16,9±0,76 (19)	37,9±0,44 (9)	36,9±1,21 (10)
	Adrenalectomized rats	20,2±2,25 (8)	36,8±0,43 (9)	37,5±0,58 (6)
AP	Rats with intact adrenals	16,9±0,69 (19)	54,7±5,38 (10)	26,1±1,84 (10)
	Adrenalectomized rats	33,7±2,80 (8)	100,2±22,07 (9)	47,1±7,59 (6)
AST	Rats with intact adrenals	3,9±0,79 (19)	21,4±2,47 (10)	44,0±4,77 (9)
	Adrenalectomized rats	4,7±0,12 (8)	23,8±2,17 (7)	28,1±4,92 (6)
ALT	Rats with intact adrenals	1,9±0,09 (19)	39,2±7,27 (8)	56,1±9,42 (7)
	Adrenalectomized rats	1,6±0,08 (8)	15,6±4,12 (7)	24,8±10,96 (6)

Legend. Number of experiments shown in parentheses.

larly sharply defined in the adrenalectomized rats, in whom the mortality on the first day after trauma reached 100% (only 8% in series I).

It will be clear from Table 1 that adrenalectomy had no significant effect on the character of the changes in LDH activity in the blood serum after multiple trauma. Similar results were obtained by the writers previously in shock caused by crushing the soft tissues [5]. Adrenalectomy likewise had virtually no effect on the dynamics of activity of the second enzyme – AP. The raised initial AP activity in the blood serum to twice the control level after adrenalectomy is an interesting fact. It can evidently be connected with the reduced stability of the lysosomal membranes after adrenalectomy and liberation of the enzyme into the blood stream [6]. After trauma the AP activity of the adrenalectomized rats also was about twice as high as the corresponding value in the control.

Adrenalectomy had the greatest effect on the changes in AST and ALT activity after multiple trauma, much as in the crush syndrome [4]. As Table 1 shows, the activity of both these enzymes in the blood serum of the adrenalectomized rats increased much less after trauma than in animals with intact adrenals; the difference was particularly marked in the case of ALT ($P < 0.001$).

It can thus be concluded from the results that the raised blood enzyme level after trauma produced by the method of Nobel and Collip is due primarily to the release of enzymes into the blood stream from the tissues of the internal organs as a result of a change in permeability of cellular and intracellular membranes under the influence of the hypoxia developing during shock. The possibility of direct activation of certain enzymes (AST, ALT) in the blood serum under the influence of adrenal hormones likewise cannot be ruled out. Investigators differ in their opinions on which hormones play the leading role in this process. Some ascribe it to glucocorticoids [9], others to adrenalin, holding the view that corticosterone has merely a "permissive action" in the mechanism of development of the raised blood aminotransferase level [4].

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