CHANGES IN THE ACTIVITY OF SOME SERUM ENZYMES DURING THE ACTION OF STRONG STIMULI

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Destructive changes in the liver and myocardium are accompanied by increased activity of a number of serum enzymes (transaminase, aldolase, lacticodehydrogenase, etc.). It is not yet known whether this phenomenon is simply the consequence of the movement of enzymes from the affected myocardial or hepatic tissues into the blood stream, or whether it is one of the components of a nonspecific reaction of injury or adaptation developing as a result of the action of any strong stimulus on the organism [1, 2].

The object of the present research was to study the effect of strong stimuli (stressors), capable of eliciting a nonspecific adaptation syndrome [4], on the activity of the serum transaminases and aldolase.

EXPERIMENTAL METHOD

Experiments were conducted on albino rats weighing from 150 to 300 g. The stimuli used included hypoxia, hypothermia, aseptic inflammation, burn shock, convulsions, and septicemia from Escherichia coli (see table).

Experimental Conditions

Experimental series	Stimulus	Mode of application	No. of rats	Time of collection of blood
First	Hypoxia	"Ascent" in a pressure chamber to 4000 m for 2 h	10	Immediately after end of stimulation
Second	Hypoxia	"Ascent" in a pressure chamber to 6000 m for 3 h	7	3 h after end of stimulation
Third	Asphyxia	Rats placed in a hermetically sealed vessel of 12 liter capacity for 20 h	10	Immediately after end of stimulation
Fourth	Hypothermia	Water bath (1°) for a period determined by the ability of the rats to remain in water (10-15 min)	8	3 h after end of stimulation
Fifth	Hypothermia	Water bath (12-15°) for a period determined by the ability of the rats to remain in water (20-90 min)	6	3 h after end of stimulation
Sixth	Hypothermia	Rats placed in a refrigerator (8-10°) for 20 h	8	3 h after end of stimulation
Seventh	Aseptic inflammation	0.2 ml formalin injected subcutaneously into the foot	9	24 h after injection
Eighth	Burn shock	Animals immersed in water (65°) for 10 sec	6	6 h after immersion
Ninth	Convulsions	Injection of bemegride (20 mg/kg)	6	3 h after injection
Tenth	Septicemia	Intraperitoneal injection of a living culture of E. coli (3000 million bacterial cells)	10	24 h after injection
Eleventh	Control	–	41	

For collection of blood from the rats, the blood vessels in the neck were exposed. After it had clotted, the collected blood was centrifuged to separate the serum.

The activity of glutamico-pyruvic (GPT) and glutamico-oxalacetic (GOT) transaminases was determined by Yatzidis's method [5] and the aldolase activity by the micromethod of Anan'ev and Obukhova. The activity of these enzymes was expressed in extinction units.

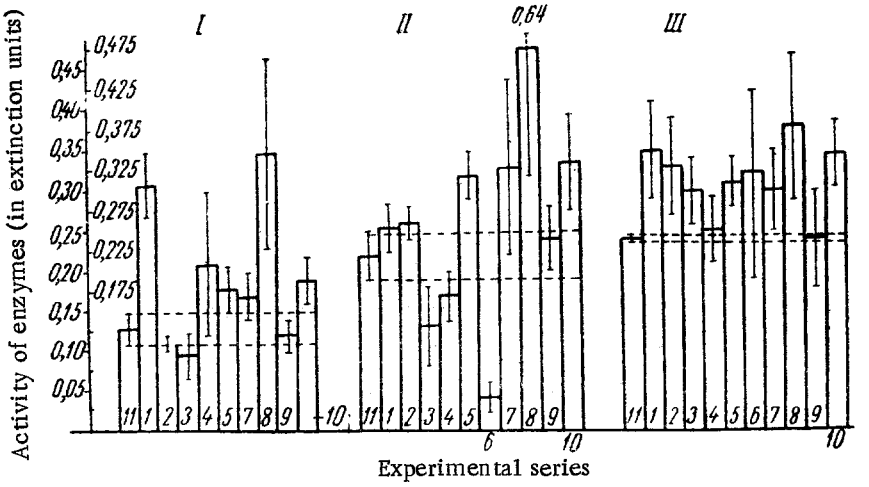
EXPERIMENTAL RESULTS

The figure shows that the activity of all the enzymes studied was increased after an "ascent" in the pressure chamber to an "altitude" of 4000 m for a period of 2 h (first series), during immersion of the animals in a bath at a temperature of 15-20° (fifth series), aseptic inflammation (seventh series), burn shock (eighth series), and septicemia from E. coli (tenth series). Hence, most of the stimuli which were used consistently raised the activity of these serum enzymes. This suggests that an increase in the activity of the serum transaminases and aldolase is one of the components of the nonspecific reaction to injury.

It is interesting to note that asphyxia produced by placing the rats in a hermetically closed vessel (third series) led to a decrease in the activity of the transaminases and to an increase in the activity of the aldolase only. The difference between the results obtained in these experiments and in the experiments with hypoxia may be due to the influence of the high CO_2 concentration. This is supported by the absence of an increase in the enzyme activity in the experiments conducted in hypothermic conditions in a hermetically closed refrigerator, in which the accumulation of CO_2 in the air inspired by the animals undoubtedly supplemented the effect of exposure to cold. In this connection it is interesting to note that when patients with epidemic hepatitis (whose serum transaminase and aldolase activity is usually raised) develop hepatic coma, the activity of these enzymes falls sharply [1, 2].

When the rats were "elevated" in the pressure chamber to an "altitude" of 6000 m (second series), the GOT and aldolase activity also rose, while the GPT activity was not significantly changed. This difference in the results of the first and second series of experiments may perhaps be attributable to the later time of collection of the blood in the latter. The absence of any increase in the enzyme activity in the experiments when the rats were placed in a bath at a temperature of 1° was probably due to the short period of exposure to the stimulus.

An unexpected finding was the absence of changes in the activity of these enzymes during bemegride convulsions (ninth series). We assumed that during the action of strong stimuli such as the convulsant toxins the activity of the enzymes which we were studying would be increased, for they are usually regarded as typical of muscle tissue. The absence of this effect may be explained by acidotic changes resulting from the increased muscular activity. However, after treating psychiatric patients by ECT, Cazzato and Paterno [3] observed an increase in GPT and GOT



Serum GPT (I), GOT (II), and aldolase (III) activity of rats exposed to various stimuli (the numbering of the experimental series corresponds to that in the table). The columns indicate mean values and confidence limits at P=0.05.

activity, although admittedly these changes were only slight and were observed only for the first hour after shock therapy. After intervals corresponding to those when the determinations were made in our experiments, Cazzato and Paterno likewise found no changes in enzyme activity.

SUMMARY

As established in experiments on rats, hypoxia, hypothermia, aseptic inflammation, burn shock, and septicemia caused by E. coli increased the serum glutaminicopyuvic and glutamico-oxalacetic transaminase and aldolase activity. In conditions of acidosis (asphyxia, hypothermia, closed vessel, convulsions) the action of the stimuli did not increase the activity of these two transaminases and aldolase.

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