

EFFECT OF INCREASED ATMOSPHERIC PRESSURE ON COAGULABILITY OF THE BLOOD

E. I. Chinchenko and A. A. Mel'nik

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Changes in the thromboelastogram indicative of hypercoagulation were observed after decompression of rabbits exposed to a pressure of 3 atm for 24 h, and 24 h later they were superseded by hypocoagulation. By the 3rd day after decompression, lasting and more marked signs of hypercoagulation reappeared, to disappear gradually by the 6th-9th day.

With the introduction of barotherapy into clinical practice for the treatment of a number of pathological conditions it is essential to study the character of the effect of increased pressure on physiological functions of the body.

The effect of prolonged increased atmospheric pressure on coagulability of the blood has been studied.

EXPERIMENTAL METHOD

Experiments were carried out on 15 male rabbits weighing 2.5-3 kg and aged from 1 to 2 years.

To create a raised atmospheric pressure the animals were placed in a pressure chamber with a capacity of 95 liters, modified from the AG-1 autoclave. The chamber was equipped with an inspection lamp, an illuminating system, and a moisture-absorbing filter. The pressure inside the chamber was raised by means of a type MK-1 medical diaphragm compressor. The chamber was ventilated at a controlled rate of 3 liters/min by means of a rotary disometer fitted to the outlet. The assigned pressure in the chamber was maintained within an accuracy of 0.2 atm by means of a type ÉKM-1 contact manometer and an automatic relay of the authors' own design. Each rabbit remained in the pressure chamber for 24 h under a pressure of 3 atm, and compression lasted for 10 min. The scheme of decompression was as follows: 20 min at 0.9 atm, 45 min at 0.6 atm, 50 min at 0.3 atm. This time schedule of decompression was taken from a manual of special physiological techniques [1]. Before the beginning of the experiment and during their stay in the chamber the animals were given food and water ad lib.

The state of the clotting and anticlotting systems of the blood was assessed by means of the thromboelastogram (TEG), recorded on the "Tromb-1" apparatus, with a paper winding speed of 10 mm/min and calibration pulse 0.5 mA.

Blood for testing was taken from a vein of the rabbit's ear before the animal was placed in the chamber, immediately after decompression, and 1, 2, 3, 6, and 9 days after removal of the animal from the chamber.

Interpretation of the TEG was based on the instructions given in [2, 3].

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TABLE 1. TEG Indices of Rabbits before and at Various Times after Their Stay in the Pressure Chamber ($M \pm m$)

TEG index	Time of investigation						
	before com- pression	immed. after decompr.	1st day	2nd day	3rd day	4th day	5th day
R (min)	6.2±0.3 —	5.5±0.3 $P < 0.1$	7.2±0.5 $P < 0.1$	4.8±0.2 $P < 0.001$	5.3±0.3 $P < 0.1$	5.7±0.3 $P < 0.1$	5.9±0.2 $P < 0.1$
K (min)	4.2±0.2	3.8±0.2 $P < 0.1$	4.9±0.3 $P < 0.05$	3.5±0.2 $P < 0.02$	3.7±0.2 $P < 0.1$	4.1±0.2 $P < 0.1$	4.0±0.2 $P < 0.1$
ma (mm)	54.0±2.7	59.0±3.6 $P < 0.2$	60.0±4.2 $P < 0.2$	61.0±3.1 $P < 0.1$	61.0±3.8 $P < 0.2$	56.0±3.3 $P < 0.5$	55.0±2.9 $P < 0.1$
t (mm)	179.0±9.1	170.0±9.3 $P < 0.5$	181.0±12.7 $P < 0.5$	152.0±9.8 $P < 0.5$	165.0±10.1 $P < 0.1$	177.0±8.5 $P < 0.5$	185.0±9.6 $P < 0.1$
E	117.0±5.7	144.0±8.6 $P < 0.02$	150.0±10.6 $P < 0.01$	155.0±8.0 $P < 0.001$	156.0±9.6 $P < 0.01$	127.0±5.9 $P < 0.2$	122.0±6.3 $P < 0.01$
I	22.6±1.1	24.0±0.1 $P < 0.2$	16.8±1.2 $P < 0.01$	19.7±1.2 $P < 0.1$	21.1±1.2 $P < 0.2$	24.7±1.4 $P < 0.2$	23.8±1.4 $P < 0.1$

EXPERIMENTAL RESULTS

The results of a statistical analysis of the experimental findings are given in Table 1.

It can be concluded from the results given in Table 1 that keeping the animal for 24 h under a pressure of 3 atm causes definite changes in the blood clotting system. These changes differed depending on the time after decompression. During the first minutes after removal of the animal from the chamber, there was a marked tendency for the coagulability of the blood to increase. This is shown by a decrease in the index R, which characterizes the first and second phases of blood clotting, a decrease in the value of K (the beginning of the third phase of clotting), and a decrease in the time of clot formation (t). Increased coagulability of the blood is also shown by an increase in the ma index, which has been shown to indicate a decrease in fibrinolytic activity and in the fibrinogen content. Further evidence in support of this conclusion is given by the increase in the dynamic constant E, characterizing the density of the blood clot.

During a stay of 24 h under increased pressure there is evidently an increase in the rate of fibrin formation, for the general coagulation index I was increased, although only by a small amount.

The character of the TEG again changed 24 h after decompression, and this time it indicated a decrease in coagulability of the blood. The invisible phase of blood clotting (R), for instance, was prolonged from 6.2 to 7.2 min. Evidence of a decrease in coagulability of the blood was given by increases in the indices K and t. The general index of coagulation also fell from 22.6 to 16.8.

Another indication that hypocoagulation had developed was the very long duration of feeding from the sight where blood was taken from the vein, which was not observed on other days of the investigation.

On the second day after decompression, changes clearly opposite to those described above took place in the blood clotting system of the animals. For instance, the reaction time R was reduced to 4.8 min, the time of thrombus formation K also was reduced to 3.5 min, and the time of clot formation t was reduced from 179 to 158. Increases in the constants ma and E also indicated increased coagulability of the blood at this period. It must be emphasized here that in individual cases the vein had to be punctured more than once in order to obtain blood because of rapid clotting inside the lumen of the needle. This fact also is evidence of hypercoagulation.

The results given in Table 1 show that starting with the 3rd day after removal of the animal from the pressure chamber the TEG indices gradually returned to their original levels, which they reached by the 6th-9th day.

These experiments showed that after exposure of rabbits to an atmosphere of air under a pressure of 3 atm regular changes develop in the blood clotting system. These changes consist in an increase in coagulability during the first few hours after decompression. Distinct changes of hypocoagulation arise after 24 h, and on the 3rd day coagulability is again increased, but unlike in the initial period, it is relatively stable, for the TEG indices do not return to their original levels until 6-9 days after the animal's removal from the pressure chamber.

LITERATURE CITED

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