THE EFFECT OF DRUGGED SLEEP ON THE REGENERATION OF THE VOLUME AND MORPHOLOGICAL COMPOSITION OF THE BLOOD IN ANIMALS AFTER BLOOD LOSS

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The present work is dedicated to the study of the effect of drugged sleep on the hematopoietic processes. This question has been little discussed in contemporary literature, and the data available on this subject were evaluated basically, without consideration of the role of the nervous system in the hematopoietic processes. We attempted to decrease the length of time necessary for blood regeneration after blood loss by the action of somnifacients on the central nervous system, without introduction of the various blood substitutes.

EXPERIMENTAL METHOD

Blood loss was produced by two bloodlettings at intervals of 24 hours. This allowed the letting of approximately 40-43% of the blood with minimal trauma and preservation of the animal's lives. The bloodletting was accomplished by means of cardiac puncture and from the vessels in the ear with the aid of a vacuum-pump.

28 rabbits were used in the experiments.

In the first, or control, series (9 rabbits), we studied the regeneration of the volume and morphological composition of the peripheral blood in the absence of drugged sleep. In the second series of experiments (9 rabbits), the animals were drugged 24 hours after the last bloodletting. The sleep was maintained, with daily interruptions of 6-8 hours, until the lost blood was completely regenerated. In the third series (10 rabbits), we studied the regeneration of the blood in animals which had been drugged prior to the bloodletting. The animals were drugged with veronal an hour prior to the bloodletting, which was thus conducted during drugged sleep. The rabbits slept about 15-18 hours, without waking, after the bloodletting. A similar procedure was repeated on the second day, i.e., before the second bloodletting. No somnifacient was employed thereafter.

In order to judge the progress of the regeneration of the blood, the volume of the circulating blood, the hematocrit reading, the red blood count, the hemoglobin content, the absolute and differential blood counts were determined. We used the length of time required for the final return of all of these indicators to normal as the basic criterion of the functional capacity of the hematopoietic mechanisms of the organism.

The hematological indicators were determined before and ten minutes after bloodletting, and every fourth day thereafter, until the values returned to normal. Veronal was the somnifacient used (200 – 220 mg per kg of body weight, in a slightly warmed water solution was introduced into the stomach by means of a thin elastic catheter).

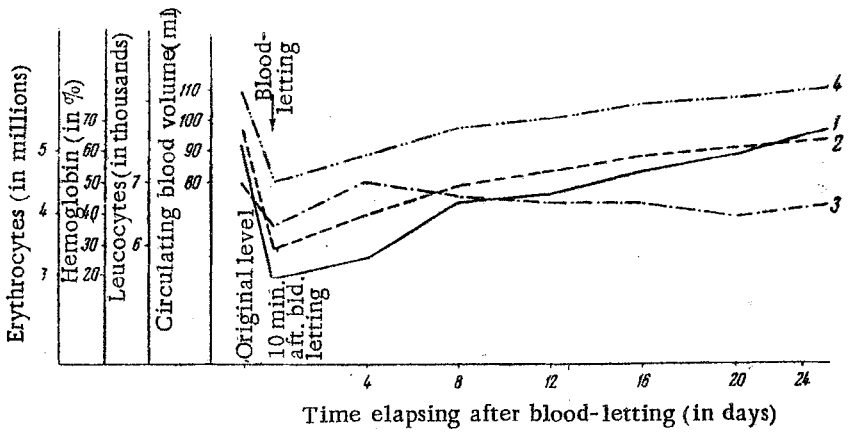

Fig. 1. Regeneration of blood in the control rabbits. 1) Erythrocytes; 2) hemoglobin; 3) leucocytes; 4) volume of circulating blood.

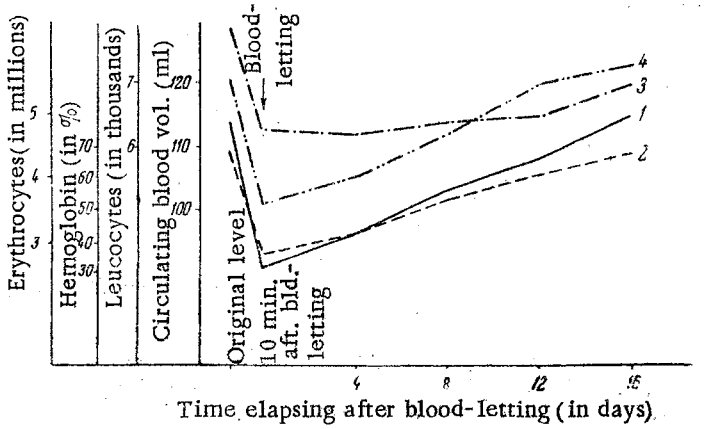

Fig. 2. Blood regeneration under conditions of prolonged sleep due to veronal. Symbols are the same as in Fig. 1.

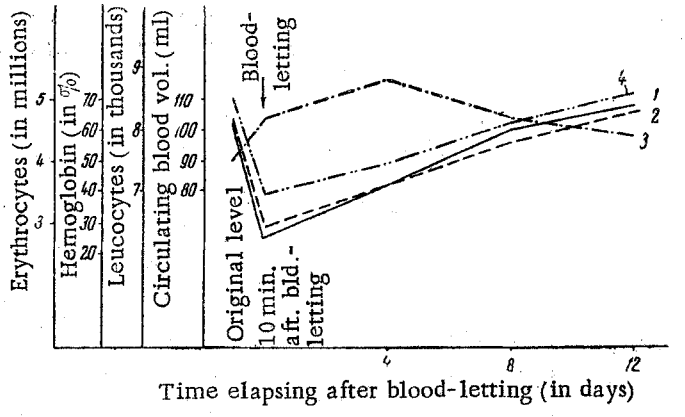

Fig. 3. Blood regeneration in animals which had first been drugged to sleep with veronal. Symbols are the same as in Fig. 1.

EXPERIMENTAL RESULTS

The control animals survived the blood-letting with difficulty. A sharp drop in the amounts of erythrocytes and hemoglobin was noted shortly after this. Four days later, the majority of animals were observed to have somewhat higher red blood cell values. The greatest increase in erythocytes and hemoglobin was observed in the first 8-12 days Then the rates of regeneration slowed, and the red blood cell values returned

to the original level only on the 20-24th day after bloodletting [Fig. 1].

The leucocyte number dropped less sharply than the erythrocyte and hemoglobin values, not only returning to the original level 3-4 days after bloodletting, but even surpassing it.

Before the introduction of veronal, the animals in the second series of experiments reacted poorly to the bloodletting, just as the control animals did: they lay on their sides and refused food. When awakened from sleep, they readily accepted food. In this series, some increase in the rates of regeneration of the volume and morphologic composition of the blood was observed. The increase in the hematologic indicators, established 4 days after the bloodletting, became more noticeable later.

The absence of post-hemorrhagic leucocytosis and persistent leucopenia was characteristic of this series of experiments. All of the blood indicators returned to normal by the 15-16th day after bloodletting (Fig. 2).

The after-effects of blood loss depend on the condition of the organism immediately before bloodletting, as well as on the amount and rapidity of blood loss [1,2,3]. Consequently, in the third series of experiments we drugged the animals to sleep for a short time with veronal prior to each bloodletting. No changes could be observed in the behavior of the animals during the bloodletting. After rousing, they ate their food willingly and did not outwardly differ from healthy animals in any way. Four days after the bloodletting, all of their blood indicators rose markedly, and 8-12 days after the initiation of the experiment they returned not only to the original values, but even surpassed these (Fig.3).

On comparing the results obtained, the most noticeable difference is the marked shortening of the length of time required for final regeneration of the volume and morphological composition of the peripheral blood in the animals which had been drugged prior to the bloodletting. Thus, for example, if complete return of the blood indicators to normal was observed on the 20-24th day in the controls, the return to normal was complete by the 15-16th day in the experiments utilizing prolonged sleep produced with veronal. The greatest acceleration of the reestablishment of the blood indicators was observed in those animals which had been drugged prior to the bloodletting. In these cases, the regeneration of the blood proceeded markedly more rapidly and was complete almost twice as soon as that of the controls.

The reestablishment of the blood indicators in the animals of the various series proceeded almost identically during the first days after the bloodletting. However, beginning with the 8th day after the bloodletting, an increase in the rate of the regeneration (in comparison with the controls) was observed among the rabbits of the second and third series. The increase was especially marked among the animals which had been drugged with veronal prior to the blood letting.

Thus, the process of blood regeneration after extensive blood loss is noticeably speeded by utilization of drugged sleep both before and after bloodletting. In order to explain the stimulating action of drugged sleep on blood formation, it is necessary to take into consideration the fact that acute blood loss and the consequent hypoxia are extreme irritants of the cortical cells; this can lead to their functional exhaustion.

The protective inhibition produced by drugged sleep reestablishes the ability of the brain cortex to function, which is displayed in the positive trophic effect on the hematopoietic system.

The best effect, which was noted when preliminary veronal sleep was employed, can apparently be explained by the early transition of the brain cortex to a condition of protective inhibition. This aids the mobilization of the recuperative powers of the organism to regenerate the lost blood. This problem can only receive a final answer after further experimental investigation.

LITERATURE CITED

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