DYNAMICS OF HEMATOLOGIC INDICATORS DURING ACUTE EXPERIMENTAL BLOOD LOSS

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The aim of our work was elucidation of the reasons for the different reactions of sick persons to acute blood loss.

METHODS AND RESULTS

The experiments were carried out on female rabbits. Six series of experiments, 70 experiments in all, were set up. During the examination of the blood we took into account the difference in hemoglobin percent, if it was not less than 5, in estimating the erythrocyte count (over 200,000) and leukocyte count (over 400 formed elements).

In the first preliminary series of experiments we investigated whether there is a difference in the blood picture of blood taken from normal animals, in the vessels of the internal organs and the ear, and how laparotomy affects the composition of the blood.

Ten experiments were set up. Before the operation we took blood from the animal's ear for investigation of the percent hemoglobin and the red and white counts.

We carried out the laparotomies under local anesthesia (0.25% novocaine solution), after which we took blood simultaneously from the ear, the uterus, and the mesentery of the small intestine. Laparotomy did not produce any change in the condition of the blood. We examined all the blood taken for percent hemoglobin and numbers of erythrocytes and leukocytes.

The distribution of the formed elements of the blood in the vessels of the internal organs and the peripheral portions of the body proved to be the same. Differences were within the limits of possible error and had no practical significance.

Laparotomy did not produce any change in the composition of the blood.

In the second series of experiments we investigated the amount of blood loss for fatal hemorrhage in rabbits.

We carried out experiments on 6 female rabbits. We defined the total amount of blood as 1/20 of the animal's weight. Then we isolated the carotid artery and from an incision in it we allowed a thin stream of blood to run out through a cannula into a graduated cylinder until such time as the rabbit died.

For female rabbits of average weight a blood loss of 53.5% of the total mass of blood proved fatal, which confirms the data of D. O. Ott [2] and Sh. M. Leites [1].

The object of the third series of experiments was to investigate the blood picture in the peripheral vessels

and the vessels of the internal organs after acute hemorrhage.

Nineteen experiments were set up. After a preliminary analysis of the peripheral blood we conducted a blood letting from the carotid artery of 30% of the total mass of blood.

We allowed the necessary quantity of blood to run through a cannula into a graduated cylinder, after which we tied the carotid with a catgut ligature. About half an hour after the blood letting we carried out, under local anesthesia, a laparotomy and investigated blood from the peripheral blood vessels of the ear and at the same time from the vessels of internal organs – uterus and the mesentery of the small intestine.

In all 19 of the rabbits, after acute hemorrhage the percent of hemoglobin and the number of erythrocytes decreased, both in the peripheral vessels and in the vessels of the internal organs. However the decrease in percent hemoglobin and erythrocyte count, in 15 out of 19 experiments, proceeded unequally in different local circulatory channels. In 10 rabbits the greatest decrease in hemoglobin percent and erythrocyte count was observed in blood from the vessels of the ear. In the vessels of the uterus and the mesentery of the small intestine, the blood, after acute hemorrhage, contained more hemoglobin and erythrocytes.

All 10 rabbits stood the blood letting and laparotomy well and their condition soon became normal.

In 5 rabbits the opposite relation of the blood indicators was observed: the hemoglobin percent and red count in the ear vessels was higher than in the vessels of the internal organs. All rabbits with similar blood differences died in a few hours immediately after the experiment.

In 4 rabbits the hemoglobin percent and the number of erythrocytes were the same in all parts of the circulation. Two of these died soon after the experiment, but 2 rabbits recovered.

In 14 hour of 19 experiments the number of leukocytes in the ear vessels after acute hemorrhage was higher than in the vessels of the internal organs, and even occasinally surpassed the prehemorrhage figures.

Thus the decrease in the indicators of the blood following hemorrhage proceeded unequally in different parts of the circulation. Those animals in which the blood of the internal organs was richer in hemoglobin and erythrocytes than the periphery bore the experiment well. Those rabbits, in which investigation of the blood showed a higher hemoglobin and erythrocyte content in the peripheral regions of the body died. In a moderate numbers of cases (4 experiments), uneven distribution of morphological elements of the blood after hemorrhage was not observed.

Leukocytosis after hemorrhage appeared essentially only peripherally.

In the fourth and fifth series of experiments we investigated the causes of similar unequal distributions.

In the fourth series 10 experiments were conducted. Under general ether anesthesia we allowed blood to be lost to the amount of 30% of the total blood and about half an hour later performed a laparotomy. General anesthesia was employed to exclude the influence of the central nervous system.

After blood loss under ether anesthesia the hemoglobin and erythrocyte levels were the same in all parts of the circulation. After hemorrhage 8 rabbits died and only 2 survived it comparatively well.

It is evident that the unfavorable outcome of the loss of blood depended on the exclusion of the central nervous system. The rabbits did not tolerate the same loss of blood as the animals in the third series of experiments under the usual conditions. The number of leukocytes was the same in all parts of the circulation.

In the fifth series (15 experiments) we performed the blood letting about half an hour after the intravenous injection of benzedrine, which we introduced in the amount of 0.6 mg/kg, purposing to stimulate the central nervous system. About half an hour after the blood letting we performed a laparotomy under local novocaine anesthesia.

Under these conditions in 13 of 15 rabbits the blood after hemorrhage was significantly richer in hemoglobin and erythrocytes in the internal organs than the blood of the peripheral vessels of the ear. All 13 rabbits tolerated the experiment well.

In 2 rabbits after blood letting there was observed in the peripheral vessels a higher level of hemoglobin and erythrocytes than in the internal organs. Both rabbits died immediately after the experiment. Investigations

of the white cells in the blood of the animals of this series after blood loss showed the posthemorrhagic leukocytosis established by us earlier.

In the sixth series of experiments we investigated the morphological composition of the blood in the vessels of the cerebrum after acute hemorrhage.

Ten experiments were set up. About half an hour after the blood letting from the carotid we performed a laparotomy and immediately took blood from the ear, uterus, mesentery, small intestine and from the cerebral vessels (branches of the middle cerebral artery).

In 8 out of 10 rabbits the blood from the cerebral vessels, uterus and mesentery contained more hemoglobin and erythrocytes than blood from the peripheral vessels. In 1 experiment there was the reverse relationship, i.e., the peripheral blood was richer in hemoglobin and erythrocytes than the blood from the brain and other internal organs.

In 1 rabbit we did not establish any difference between blood from differentparts of the circulation.

Leukocytosis after blood loss was also on the whole peripheral.

Thus rabbits bore acute hemorrhage differently. To a certain extent this depends on the conditions of the experiments. Those animals stand acute hemorrhage best, in the internal organs of which the blood after hemorrhage is richer in hemoglobin and erythrocytes than in the peripheral vessels of the body. Evidently this is a protective reaction of the body which may be called a compensatory redistribution of the morphological elements of the blood. In the establishment of this the central nervous system plays a big role. In those cases where there was a reverse redistribution of the blood and the peripheral network of vessels proved to better supplied with blood, all the animals succumbed. Such a redistribution of the morphological elements of the blood following blood loss we may call pathological.

SUMMARY

Experiments on female rabbits showed that those of them survive acute blood loss whose blood in the internal organs and cerebral vessels is richer in hemoglobin and erythrocytes than is the blood of the peripheral vessels. Anesthesia diminishes these differences and reduces the number of animals surviving. The reverse effect is produced by benzedrine.

LITERATURE CITED

[1] Leites Sh., Arkh. Biol. Nauk SSSR, 1936, 41, No. 3, 133-145.

[2] Ott D. O. On the Effect on an Exanguinated Organism of the Infusion of Salt Solution and a Comparison of Its ActionWith Other Liquids Used for Transfusion,* St. Petersburg, 1884.

* In Russian.