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LIVER FUNCTION AFTER MASSIVE TRANSFUSIONS OF PACKED RED CELLS

R. V. Nedoshivina

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The liver function was studied in 16 dogs after experimental transfusion of massive doses of packed red cells in order to identify which component of the blood influences the liver function. Transfusion of massive doses of packed red cells was found not to cause any significant changes in the excretory, assimilative, and protein-forming functions or in the content of transaminases. In the control group receiving transfusions of massive doses of whole homologous blood considerable disturbances of liver function were found. The results confirm the view that one cause of disturbances of liver function in the "massive blood transfusion syndrome" is incompatibility of the plasma proteins of the donor and recipient. KEY WORDS: blood transfusion; liver function.

It was shown previously that the "massive transfusion syndrome" is characterized by disturbances of various functions of the body. Changes have been found in the blood [3, 6], circulatory [4, 11], and hemostatic [2] systems, in kidney function [9], and immunologic reactivity, signs of toxemia have been found [8], and changes observed in the composition of the blood proteins [5]. The liver is very sensitive to the action of massive transfusions of homologous blood after acute blood loss [1, 7, 10-12].

To determine which component of blood – plasma or red cells – affects liver function, experiments were carried out in which massive transfusions of these components were given separately. This paper describes the results of an investigation of the liver function after transfusion of massive doses of packed red cells.

EXPERIMENTAL METHOD

Experiments were carried out on 16 dogs. In the experiments of series I (control) repeated losses of small volumes of blood were replaced by an excess of homologous blood to the extent of 150% (seven dogs); in series II massive doses of packed red cells were transfused (nine dogs).

The animals were chosen so that the recipients and donors had identical blood groups for red cell antigens. To exclude the effect of acute blood loss on the liver function, transfusion of fresh homologous blood stabilized with TsOLIPK 12A solution was carried out without any previous acute blood loss in accordance with the following scheme: 50 ml blood was removed and quickly replaced by transfusion of homologous blood in a volume equal to that of the blood loss, and this was repeated until 50% of the circulating blood volume of the recipient dog had been replaced by the adequate volume of homologous blood. An excess of homologous blood was then transfused (at the rate of 25 ml/kg). Packed red cells were obtained from various donors. The blood of donors and recipients was tested for compatibility for red cell group antigens. Packed red cells freed from plasma and suspended in saline were transfused by the same scheme as that used for transfusion of homologous blood. The dogs were investigated in the initial state on the 1st, 2nd, 6th, 9th, and 11th days of the posttransfusion period. The following liver functions were studied: excretion and assimilation by the bromsulphalein test (BSP), protein-formation (Weltmann's test for colloidal stability of proteins), serum transaminase activi-

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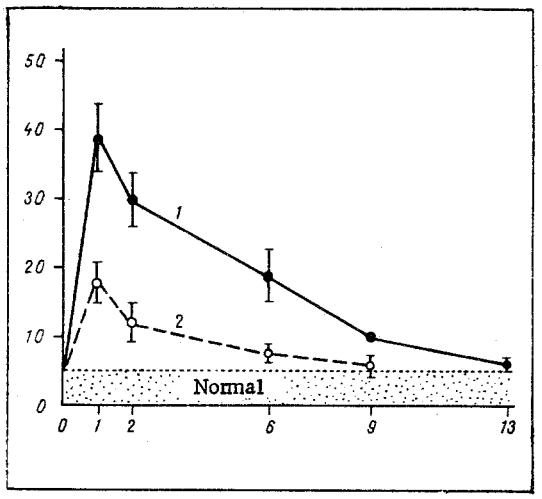

Fig. 1. Dynamics of retention of BSP in blood stream of dogs after massive transfusions of homologous blood (1) and packed red cells (2). Abscissa, days of observation; ordinate, retention of BSP in blood stream (in %).

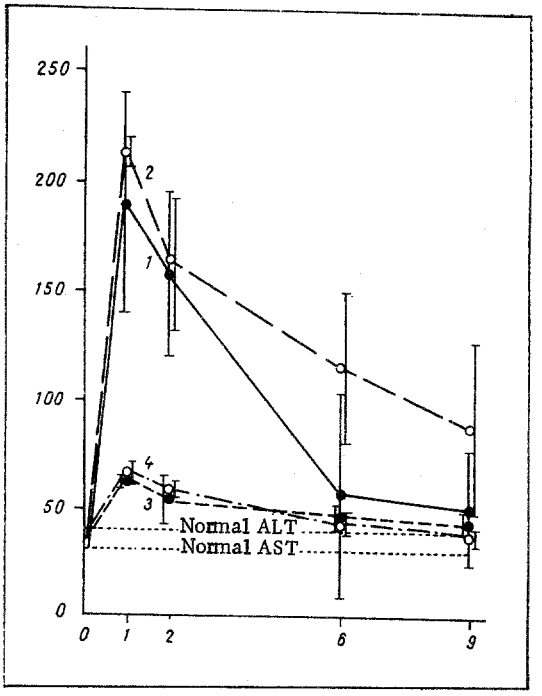

Fig. 2. Dynamics of AST (1, 3) and ALT (2, 4) activity after massive transfusions of homologous blood (1, 2) and packed red cells (3, 4). Abscissa, days of observation; ordinate, enzyme activity (in units).

ty – determination of activity of aspartate-aminotransferase (AST) and alanine-aminotransferase (ALT) activity by the method of Reitman and Frankel.

EXPERIMENTAL RESULTS AND DISCUSSION

In the experiments of series I with transfusion of massive doses of homologous blood without previous acute blood loss (hypervolemic transfusion) a significant disturbance of the various liver functions studied was observed. In all the experimental animals the excretory and assimilative function of the liver was depressed, as shown by delayed excretion of BSP and an increase in its initial concentration in the blood stream. Compared with the initial data, the percentage retention of BSP in the blood stream was increased (Fig. 1, curve 1). Improvement of the excretory functions was observed on the sixth day after transfusion. Elimination of the dye from the blood stream at these times was accelerated and its retention amounted to 19%. On the 11th-13th day the retention of BSP was back to its initial level. To determine intracellular functions and, in particular, functions of the cytoplasm of the hepatocyte, the activity of the transaminases (AST and ALT), which belong to the group of indicator enzymes, was investigated. Increased blood enzyme activity is known to be connected with the state of the cell membrane: with a fall in energy metabolism in the cell the permeability of its membrane increases and enzymes enter the blood stream. A marked increase in transaminase activity was observed in the blood serum of the experimental dogs 2 h after massive transfusions of homologous blood (Fig. 2). ALT activity was increased much more than AST activity. An increase in serum ALT activity is a more specific test for damage to the liver cells. Increased transaminase activity also was observed on the second day after transfusion. On the sixth day AST activity was back to its initial level, whereas the increase in ALT activity persisted until the ninth day. Normalization of transaminase activity is one of the most reliable criteria of restoration of function of the liver cells.

Studies of the colloidal stability of the blood serum proteins showed lengthening of the coagulation band or a shift to the right as far as the ninth tube inclusive in all dogs after massive transfusion. Lengthening of the coagulation band was observed until the ninth day after transfusion. In intact dogs Weltmann's test gave flocculation only in the first six tubes. Lengthening of the coagulation band is evidence of marked liver damage.

In the experiments of series II with transfusion of massive doses of packed red cells, the changes in liver

function were less substantial than after massive transfusions of homologous blood. Delay in the excretion of BSP and an increase in its initial blood concentration on the first day were observed (Fig. 1, curve 2). On the second day the excretory and assimilative functions were appreciably improved and the uptake of BSP from the blood took place more rapidly. Changes in the serum enzyme activity after transfusion of packed red cells were very small compared with the control. On the first day, for instance, AST and ALT activity was doubled in the experiments of series I and increased fivefold in series II (Fig. 2). On the sixth day after transfusion the activity of these enzymes was back to normal.

The study of the colloidal stability of the blood serum proteins showed that lengthening of the coagulation band lasted until the third day.

The results thus indicate that transfusion of massive doses of packed red cells causes no significant changes in the excretory, assimilative, and protein-forming functions of the liver or in its content of transaminases. On the fifth to sixth days after transfusion all the parameters mentioned above were back to their initial values. In the control group receiving transfusion of massive doses of whole blood considerable disturbances of liver function were observed, but the normal values were restored by the 9th-13th days. The results of the investigation confirmed the view that one cause of disturbances of liver function after massive transfusion of homologous blood is incompatibility of the plasma proteins of the donor and recipient; the possibility of an incompatibility factor relating to platelets and leukocytes cannot be ruled out.

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