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EXPERIMENTAL HETEROTRANSFUSIONAL SHOCK IN WHITE RATS ACCOMPANIED BY ACUTE PULMONARY EDEMA

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In the practice of medicine, cases are observed of death of patients after transfusion of incompatible blood as a result of acute edema of the lungs [2, 3, 7].

The pathological findings show that pulmonary edema in patients dying from blood transfusional shock [4] or other forms of shock [8] is very common. However, until our report [5] we could not find any reference in the literature to a study of the pathogenesis of pulmonary edema due to transfusion of blood from another species of animal. Accordingly we transfused foreign blood into various animals. In particular we injected white rats with blood from cattle, dogs, rabbits, sheep, goats, geese, pigeons and man. Preliminary experiments showed that blood from oxen, cows and calves causes shock which is accompanied by acute pulmonary edema.

EXPERIMENTAL METHOD

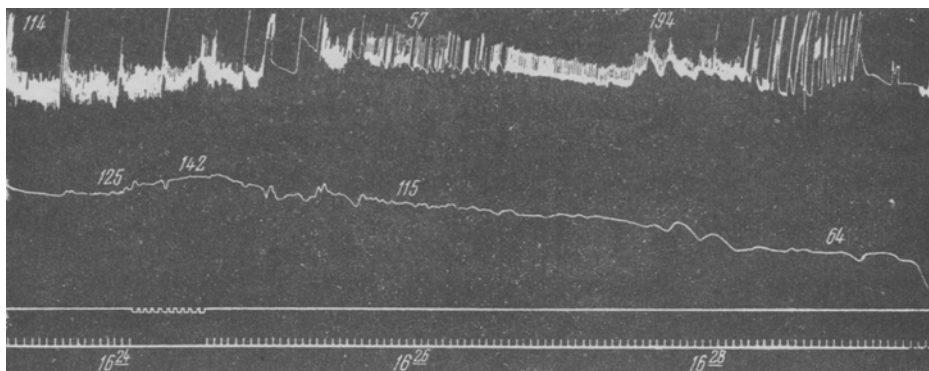
In the experiment we used white rats of both sexes, weighing from 52 to 329 g. Ox**blood was obtained from a slaughter house of the meat combine, observing aseptic precautions. Sodium citrate was used as an anticoagulant (0.3-0.5 g per 100 ml blood). As a rule the blood was used the day it was taken, after filtration through 6-8 layers of gauze. The blood was injected into the femoral vein of unanesthetized rats in a period of 30 sec. In some investigations we obtained tracings of the blood pressure in the carotid artery and of respiration. In a number of experiments we investigated variations in the size of the kidneys. The dead animals were examined post mortem and histological examinations were performed.

EXPERIMENTAL RESULTS

The first series of investigations consisted of 238 experiments in which rats were injected with ox blood in a dose of from 10 to 25 ml/kg; 223 of these experiments did not include kymographic recording. In 11 of these

* In Russian.

** In future, blood from bulls, cows and calves will be called ox blood.



Changes in respiration and arterial pressure during injection of a white rat with ox blood. Interpretation of the curves (from above downwards): respiratory movements (the figures indicate the number of respirations in one minute); arterial pressure (the figures indicate the height of the arterial pressure in mm Hg); zero line and marker of transfusion of ox blood in a dose of 15 ml/kg; time marker (3 sec). After death the lungs of the rat weighed 22.4 g.

223 experiments the rats had been injected 12-13 days earlier with ox blood; in 7 experiments heterogenous blood was injected (20 ml/kg) after preliminary bleeding (from 14.6 to 22.6 ml/kg); in 2 experiments the infusion was made into the femoral artery against the blood-flow; in 4 experiments the rats were injected with ox plasma instead of blood; in 7 experiments serum was injected.

Under the conditions of the experiments these variants did not show any essential difference from the typical picture of shock.

Fatal shock developed in 160 of the 238 animals. The animals survived for 1.4 min to 24 hrs after the infusion, the majority dying between 3 and 13.5 min afterwards.

The experiments showed that in order to produce fatal shock it was sufficient to inject the white rat with 10-25 ml/kg of ox blood, plasma or serum in a period of 30 sec.

As the experiments showed (Fig. 1), at the very beginning of the infusion of ox blood a rise in the blood pressure was observed by 16-32 mm Hg. Later, after .5 to 3.5 min, it fell in a fluctuating manner.

The marked rise in the arterial pressure during blood transfusion depends on the specific action of ox blood as a pathogenic stimulus and not on a nonspecific cold or volume effect of the fluid injected. This is shown by control experiments in which rats were injected with the same and larger doses of a 0.85% saline solution.

At necropsy of the rats which died from shock, in addition to slight congestive changes in the abdominal organs, severe lesions were observed in the lungs; they did not collapse and had the appearance of marble. The bronchi and trachea were filled with transudate containing from 4.78 to 7.32% of protein. If the so-called weight index of the lungs of normal rats, in our experience, varied from 4.2 to 10.4 (with an average of 6.4 in 28 animals), in the rats dying from shock the corresponding variations were from 10.2 to 38.2 (with an average of 23.7 in 96 animals). We may mention that there was pulmonary edema also in rats killed after development of a nonlethal shock.

Histological examinations of the experimental rats confirmed the presence of acute edema of the lungs and of certain dystrophic changes in the liver and kidneys.

It should be pointed out that workers [1, 6] who injected white rats with rabbits' blood found no significant pulmonary edema after death, but constantly observed changes in the form of subperitoneal pinpoint hemorrhages on the intestine [1]. We rarely found this feature, but constantly observed an intensive edema of the lungs.

SUMMARY

Intravenous injection to white rats of blood, plasma or serum of bulls, cows and calves (in the dose of 10-25 ml/kg body weight within 30 sec) brings about hemotransfusional shock which causes rapid death of animals. Development of acute hemorrhagic edema of the lungs is the characteristic sign of this shock.

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