

CHARACTERISTICS OF PULMONARY EDEMA INDUCED IN RABBITS OF DIFFERENT AGES

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Young rabbits up to the age of 3 weeks are less resistant to chloramine (CA) than adult rabbits. The lethal dose of CA for the young rabbits was 40-50 mg/kg. They died from poisoning manifested as protracted collapse without any evidence of edema. The lethal dose of CA for older rabbits was 60-70 mg/kg. Death occurred from severe acute pulmonary edema. The young rabbits developed atypical pulmonary edema only after receiving very large doses of CA (200-250 mg/kg). Under these circumstances a small quantity of edema fluid was present and the predominant feature was hemorrhage, probably caused by the direct destructive action of CA, excreted through the lungs, on the walls of the arterioles and capillaries of the vascular system of the lungs.

KEY WORDS: age; chloramine; pulmonary edema.

A previous investigation [1] showed that intravenous injection of adrenalin or irritation of the mucous membrane of the trachea and bronchi with acid or alkali evokes pulmonary edema in adult animals. Pulmonary edema does not develop under these conditions in young animals (puppies, rabbits). Young animals do not develop pulmonary edema even if very large doses of adrenalin are injected [6]. However, large doses of diphosgene [5] and chloramine (CA) [8] induce pulmonary edema in young animals also.

The object of the present investigation was to study whether true pulmonary edema develops in young animals after intravenous injection of CA which, like diphosgene, is excreted from the body through the lungs.

EXPERIMENTAL METHOD

Altogether 105 rabbits of different ages, into which various doses of CA (10% aqueous solution) were injected intravenously, were used. The presence and severity of pulmonary edema were judged from the pulmonary coefficient (PC), i.e., the ratio between the weight of the lungs (in g) and the body weight (in kg), and also from the external appearance of the lungs, the presence or otherwise of frothy fluid in them, and their microscopic picture.

EXPERIMENTAL RESULTS AND DISCUSSION

The absolutely lethal dose of CA for rabbits under 3 weeks old was found to be 40-50 mg/kg. Death occurred after 4-5 h from protracted collapse with no evidence of pulmonary edema. The lungs were pink in color and firm. PC was within normal limits for the age. These were very high for the young rabbits: PC was 13-19 for animals under 7-8 days old, 8-10 for rabbits between 10 and 15 days old, and 7-8 at the age of 3-4 weeks. For adult rabbits PC was 3.5-5.4, in agreement with data in the literature [6, 7]. The absolutely lethal dose of CA for rabbits after the age of 1.5 months was 60-70 mg/kg. Pulmonary edema was not detected macroscopically after receiving CA in a dose of 25-30 mg/kg. PC was indistinguishable

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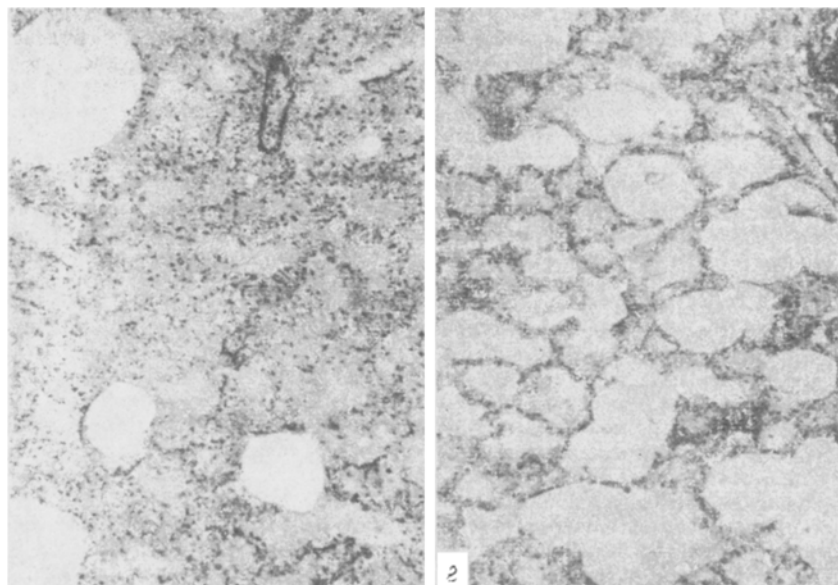


Fig. 1

Fig. 2

Fig. 1. Lung of adult rabbits after injection of 60 mg/kg CA. Edema of third degree. Effusion of fluid into lumen of alveoli. Edema of perivascular cellular tissue.

Fig. 2. Lung of young rabbits aged 6 days after receiving injection of 250 mg/kg CA. Edema of third degree. Edema fluid occupies a small part of the lumen of the alveolar passages and alveoli. None is present around or inside the pulmonary vessels. Capillaries of the interalveolar septa are congested. A collection of blood can be seen in the lumen of the respiratory bronchioles and alveolar passages in some places.

from its value in the control. After injection of CA in a dose of 50-60 mg/kg, however, pulmonary edema of a varied degree of severity developed. PC reached 16. The weight of the lungs exceeded 30 g. In the presence of edema of the second and, in particular, the third degree a large quantity of frothy, blood-stained fluid escaped from an incision in the lungs and trachea.

Attempts were made to produce pulmonary edema in animals under 3 weeks old by increasing the dose of CA. With a dose of 100-150 mg/kg, only one (aged 10 days) of eight rabbits aged 3-10 days developed second degree edema (PC 28.4) and one (aged 5 days) developed first degree edema (PC 21.5). In neither case was frothy fluid present in the lungs. Three rabbits (aged 3, 6, and 10 days) receiving CA in a dose of 200-300 mg/kg developed third degree edema (PC 33.4-4-43). A large quantity of bloodstained frothy fluid flowed from the trachea. The lungs were swollen and emphysematous. The microscopic picture of the lungs, typical of edema in adult rabbits (Fig. 1) and young rabbits (Fig. 2), is illustrated in Figs. 1 and 2. These figures show that pulmonary edema, even of the third degree, differs considerably in young rabbits from the same condition in adult animals. In the young animals a typical pulmonary edema can thus be produced but only after administration of very large doses of CA. With smaller doses the rabbits die from poisoning without any manifestations of edema.

Previous studies in this laboratory showed that the vascular component of the inflammatory reaction does not develop at an early age and the exudation of plasma does not take place, for the innervation mechanisms through which this process is controlled in adults are not yet functioning [2, 4, 9]. High concentrations of chemicals and bacterial toxins [3] injure the walls of the arterioles and capillaries directly, thus causing hemorrhage. The development of so-called pulmonary edema at an early age is evidently another consequence of the direct harmful action of the substance on the vessel wall, increasing its permeability and permitting partial escape of plasma and erythrocytes from the capillaries into the alveoli. The mechanism of the pulmonary edema that arises in young animals under the influence of large doses of diphosgene can be presumed to be analogous to that found during the action of large doses of CA. In the early postnatal period "atypical" pulmonary edema evidently arises only after administration of substances such as diphosgene and CA that are excreted through the vascular system of the lungs and injure it. Adren-

alin, even if given in very large doses, unlike diphosgene and CA, does not damage the walls of the pulmonary vessels and therefore does not cause pulmonary edema in young animals.

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