PERMEABILITY AND BLOOD FILLING OF THE LUNGS IN SOME TYPES OF EXPERIMENTAL PULMONARY EDEMA

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Changes in the state of the pulmonary hemodynamics and in the permeability of the air-blood membrane play a leading role in the mechanism of development of acute pulmonary edema. The importance of each of these factors has been demonstrated by direct or indirect evidence in various types of experimental edema [2].

In experiments on 148 albino rats the author attempted to study the relationship between the intensity of edema and the quantitative indices of the degree of blood filling of the lung and changes in the permeability of their membranes.

EXPERIMENTAL METHOD AND RESULTS

Pulmonary edema was produced by intravenous injection of adrenalin (0.002-0.5 mg/100 g) and chloramine (8-10 mg/100 g), by intracisternal injection of 3-5 mg of fibrinogen, by dynamic poisoning with diphosgene (0.35-0.38 mg/liter over a period of 10-14 min), and by injection of 0.06 ml of a $1:10^5$ solution of aconitine hydrochloride into the preoptic zone of the hypothalamus. The blood hemoglobin concentration was determined [1], the serum proteins were estimated by the biuret reaction, and the blood filling of the lungs was investigated by Meijer's spectrophotometric method [7].

The main results of the experiments are given in the table. As the changes in the lung coefficient and dry residue show, in all the series of experiments the edema attained a considerable degree. It was most marked following administration of diphosgene, adrenalin and aconitine. No complete correlation was found between the two indices, because the lung coefficient increased not only because of an excess of water in the lungs, but also because of their increased blood filling. Hence it follows that to describe the severity of the edema, it was necessary to determine the dry residue of the lungs as well as the lung coefficient, the only index determined by many investigators. The dry residue reflects the degree of excess hydration of the organ more closely.

Injections of aconitine into the hypothalamus increased the blood filling of the lungs by 50%. The increase was still greater after intracisternal injection of fibrogen, and it reached its maximal degree after administration of adrenalin, which strengthened the edemogenic action of the pulmonary hypertension accompanying these types of edema [4, 5, 9]. The blood filling of the lungs was reduced by more than 50% after poisoning with diphosgene, and was slightly reduced in chloramine edema. This confirms the view that the hemodynamic factor does not play an essential role in the pathogenesis of diphosgene and chloramine edemas [3, 6, 8] and the increased intensity of filtration of fluid in the lung tissue may take place in association with an increased or a considerably decreased blood filling.

The protein concentration in the edema fluid, characterizing the increase in permeability of the lung membrane, was high in all forms of edema investigated. This demonstrated a considerable disturbance of the structure and properties of the air-blood membrane during exposure to very different factors, including those which could have a direct injurious action on it (injection of adrenalin, aconitine, fibrinogen).

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Changes in Gravimetric Indices, Blood Filling of the Lungs, and Protein Concentration in Edema Fluid in Some Types of Pulmonary Edema ($M \pm m$)

Series of experiments	No. of rats	Lung coefficient (%)	Dry residue of lungs (in %)	Blood filling of lungs in ml/100 dry tissue	Protein: In blood plasma (in g %)	Protein: In edema fluid (in g %)	Protein: Ratio edema fluid/plasma (in %)
Normal conditions	37	0,63±0,02	20,75±0,19	99,9±2,7	—	—	—
Experiments with adrenalin	6	1,53±0,14	14,60±0,50	117,5±8,8	7,89±0,10	5,10±0,58	64,7
	9	2,21±0,15	13,98±0,42	213,8±12,7	7,89±0,10	5,75±0,50	72,9
with chloramine	16	1,38±0,03	15,46±0,33	79,4±8,5	—	—	—
	7	1,66±0,16	14,24±0,92	—	7,58±0,29	5,28±0,21	67,0
with diphosgene	18	2,07±0,09	13,88±0,41	44,8±2,7	7,55±0,07	7,21±0,28	95,4
with aconitine	13	1,63±0,10	13,80±0,58	151,3±9,7	—	—	—
	20	1,66±0,15	14,12±0,36	—	7,95±0,13	5,31±0,13	67,0
with fibrinogen	8	1,66±0,09	16,63±0,60	162,9±8,5	—	—	—
	14	1,35±0,05	16,10±0,24	—	7,94±0,02	6,61±0,06	83,3

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