mal state of cells of the gastric and duodenal mucosa. Consequently, in the late stages the function of the apudocytes studied was normalized at a level adequate to compensate for the loss of the stimulating effect of acetylcholine due to vagotomy.

Evidently in cases when function of the endocrine cells was disturbed, and they were to some degree or other incapable of participating, together with other factors, in compensation of the changes after vagotomy, the conditions are created for postvagotomy complications of different kinds (dumping syndrome, diarrhea, gastro- and duodenostasis, disturbances of function of esophagogastric and gastroduodenal passage, of gastric and intestinal movement, atony, acid formation, etc.).

The histochemical and electron-microscopic investigations thus revealed a series of successive stages in changes in gastric and duodenal G-, ECL-, and EC-cells in response to selective proximal vagotomy, and shed light on the mechanisms of the corresponding changes at the different stages. The general principles of response of the apudocytes of the gastrointestinal tract to SPV, revealed by the investigation, allow a differential pathogenetic approach to be made for influence to be brought to bear in a specific direction on G-, ECL-, and EC-cells, and they enable the most physiological conditions to be created for the normal course of postvagotomy states, and should complications arise after vagotomy, they can indicate optimal methods of treatment by activation of the hormonal factor in combination with therapeutic measures stimulating or inhibiting it.

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CLOSED CHEST METHOD OF INTRAVITAL STUDY OF THE PULMONARY MICROCIRCULATION IN CATS

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KEY WORDS: lungs; microcirculation; capillaries; alveoli; biomicroscopy.

New data indicating significant disturbances of the microcirculatory compartment of the systemic and pulmonary circulations in lung diseases have recently been published [1, 2, 6]. The functional principles of the capillary circulation of the lungs have hitherto been insufficiently studied. This is largely because of technical difficulties arising during intravital study of the microcirculatory bed of the lungs [4]. The most informative of the methods used to study the pulmonary microcirculation is biomicroscopy [3-5].

The aim of this investigation was to modify existing methods of biomicroscopy of the lungs [4, 7] in order to study the pulmonary microcirculation in closed-chest cats breathing naturally. The following problems were solved in the course of the investigation: creation of an apparatus for studying the pulmonary microcirculation the closed chest, choice of optimal conditions of observation and photographic recording of the capillary system of the lungs.

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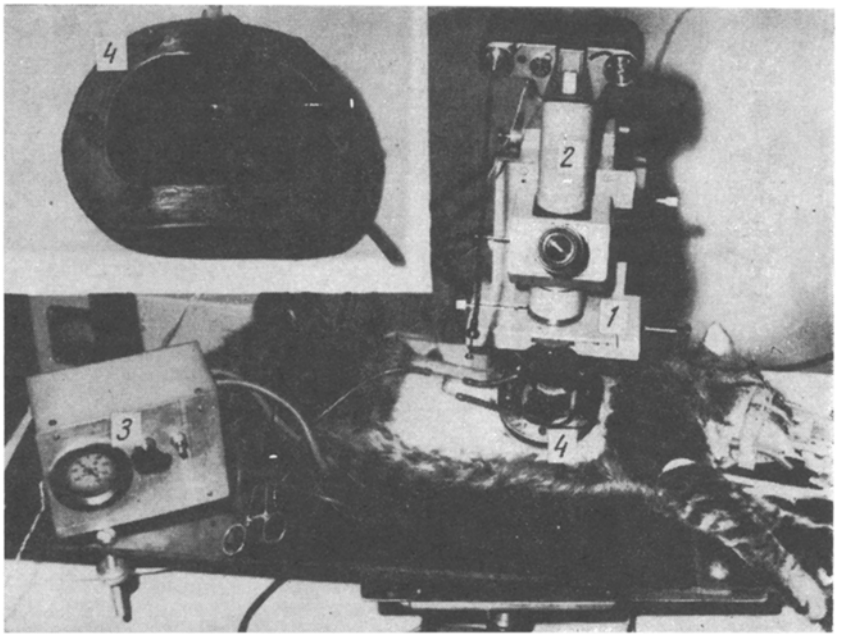

Fig. 1. Apparatus for intravital study of pulmonary microcirculation. 1) MBI-15 microscope; 2) OLK-2; 3) apparatus for creating negative intrathoracic pressure; 4) airtight chamber.

EXPERIMENTAL METHOD

The intravital study of the pulmonary microcirculation was carried out with an original system (Fig. 1). The MBI-15 microscope, the OLK-2 device for investigation by contact microscopy, and contact objectives 20 × 0.60 and 25 × 0.75 LK were used. Mikrat 200 and UT-23 film was used for photomicrography.

An important part of the system was an airtight chamber of our own design (Fig. 2). Tight contact between the base of the chamber and the skin around the operation wound in the chest was achieved with the aid of two metal rings. The latex dome of the chamber was fixed hermetically to the microscope objective by means of a "nest" made from transparent plastic. The edges of the "nest" were carefully polished and they formed what appeared to be a continuation of the sleketon of the chest. In the dome there were channels for connecting the device creating a measured negative pressure. The tension of the latex wall of the chamber was chosen so that it would not be drawn in during inspiration. The negative intrathoracic pressure (corresponding to the physiological level) and forces of surface tension of the pleural fluid ensured contact between the contact lens of the objective and the lung surface. Consequently there was no need to use a suction chamber or other methods of fixation of the lung. Fixation of the chamber to the animal's skin and the extensibility of its rubber dome enabled the objective of the microscope to be moved by sliding with the contact glass over the surface of the visceral pleura. In this way the lung tissue could be studied over an area of 4 cm^2. The design of the airtight chamber permitted control of the projection of the contact lens outside the "nest" of the objective. The smooth surface and oval shape of the contact lens enabled trauma to the lungs during the investigation to be avoided. If it was necessary to work with contact objectives with different magnifications the "nest" for the lung objective was removed from the chamber and replaced by another, corresponding to the new objective. The airtight chamber, unlike the suction chambers used previously [4, 7], did not completely immobilize the part of the lung to be tested. As a result, a physiological state of the capillary blood flow of the lungs was preserved, during successive phases of the respiratory cycle. Accuracy of focusing under these conditions was guaranteed by the great depth of definition of the contract objectives and the use of the OLK-2 system for investigation by contact microscopy. Recording of the pneumogram showed that the use of the airtight chamber did not impair the respiratory excursions of the chest wall.

A no less important stage of the work was improvement of the illumination of the part of the lung to be photographed. For this purpose the lighting system of the microscope was

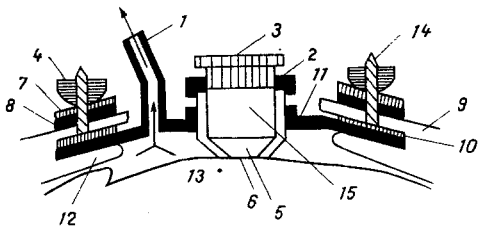

Fig. 2

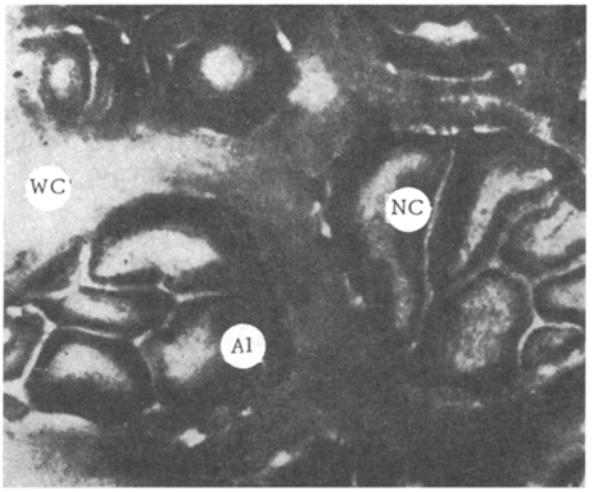

Fig. 3

Fig. 2. Diagram of thoracic airtight chamber. 1) Air pipe for connecting apparatus creating negative pressure; 2) airtight ring between "nest" and microscope objective; 3) microscope objective; 4) oval compression nuts; 5) "nest" for microscope objective; 6) place of contact of contact objective with lung; 7) upper ring of chamber; 8) latex washer; 9) skin around operation wound; 10) base ring of chamber; 11) latex dome of chamber; 12) rib; 13) lung; 14) threaded pins.

Fig. 3. Microvascular bed of the cat lung. WC) Wide capillaries; NC) narrow capillaries; Al) alveolus. Magnification 80.

modified. An IFK-2000 lamp was used as a powerful light source. A power unit was designed to supply the lamp. When an equal intensity of illumination had been achieved on all frames of the photographic film, a device stabilizing the working conditions of the IFK-2000 lamp was introduced into the power unit.

Great attention was paid to the creation of the optical system for flash photography and the visual observation system. The design of the optical systems enabled the flash source to be brought as close as possible to the object for study and the light losses during filming to be reduced. The intensity of illumination of the test area which could be achieved enabled filming to be carried out on fine-grain contrast photographic materials of low sensitivity, and the depth of definition could be increased by stopping down the microscope objective considerably. The quality of the resulting photographs was sufficiently good for quantitative parameters of the microcirculatory system of the lungs to be studied on the Leitz ASM semiautomatic image analysis system.

Visual observations were made on the microcirculation of the lungs in light from an OP-12-100 lamp, working on 4 A and 12 V, and using S3S7 and S3S24 heat-protective filters.

The Course of the Experiment. Cats were given an intraperitoneal injection of pentobarbital (40 mg/kg), the pleural cavity was punctured, and the intrapleural pressure measured by means of a manometer. Tracheotomy was carried out and the animal artificially ventilated (200-300 ml/min) on the DAMPM-2 apparatus (Academy of Medical Sciences of the USSR). Thoracotomy was performed in the fifth intercostal space. The operation wound was closed by means of the airtight chamber. The table with the animal was placed on a lifting platform beneath the microscope. The microscope objective was connected to the airtight chamber. A negative intrathoracic pressure equal to that present initially was created. The artificial ventilation apparatus was disconnected. After restoration of spontaneous breathing, different parts of the lung were photographed. The quantitative parameters of the capillary system of the lungs, recorded on the photographs, were studied on the "Leitz ASM" apparatus.

EXPERIMENTAL RESULTS

The optimal program of observation and photography for the determination of quantitative relations between parameters of the capillary bed of the lungs and the respiratory surface of the alveoli is to use 25 × 0.75 LK and 20.0 × 0.60 LK objectives and the OLK-2 system (char-

acteristic magnification 4 times). With this magnification an alveolus with the wide capillaries surrounding it is placed inside the frame of the camera (Fig. 3). The quantitative parameters of the microcirculatory network of the alveoli (n = 68) are given below.

The diameter of the wide capillaries was 34.8 ± 7 μ, the length of the wide capillaries 663 ± 18 μ, and the area of the wide capillaries 22,300 ± 900 μ^2; the length of the narrow capillaries was 600 ± 34 μ and their area 4815 ± 242 μ^2; the area of an alveolus was 17,700 ± 800 μ^2:

$$\frac{S_{nc}+S_{wc}}{S_a} - 1{,}65 \pm 0{,}05, \quad \frac{S_{wc}}{S_a} - 1.36 \pm 0{,}04,$$

$$\frac{S_{nc}}{S_a} - 0.28 \pm 0.01.$$

The method of studying the pulmonary microcirculation described above thus enabled: 1) trauma associated with fixation of the lungs to be abolished; 2) the capillary circulation to be studied in a wide area of the lungs, with the chest closed, and without disturbance of physiological excursions of the chest wall; 3) photographs of sufficiently high quality for studying quantitative parameters of the pulmonary microcirculatory system by the Leitz ASM semiautomatic image analysis system to be obtained, thereby increasing the accuracy of the measurements and speeding up analysis of the experimental results.

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MORPHOLOGICAL HETEROGENEITY AND FUNCTIONAL STATUS OF ALVEOLAR MACROPHAGES OBTAINED BY BRONCHOALVEOLAR LAVAGE DURING DEVELOPMENT OF TUBERCULOUS INFLAMMATION IN GUINEA PIGS

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KEY WORDS: bronchoalveolar washings; alveolar macrophages; electron microscopy; proteinases; tuberculosis.

Alveolar macrophages (AM) are a factor of antimicrobial resistance of animals and man, they determine the development of chronic inflammation, and participate in the maintenance of structural homeostasis of lung tissue in health and disease. It is from this standpoint that in recent years the character of the macrophagal response in several diseases, including tuberculosis, has been assessed, and the possibility of its use for diagnostic and prognostic purposes has been studied [2-5]. Good prospects from this point of view are provided by the method of bronchoalveolar lavage, by means of which a virtually pure population of

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