PATHOLOGICAL PHYSIOLOGY AND GENERAL PATHOLOGY

INVESTIGATION OF THE MECHANISM UNDERLYING THE PHYSIOLOGIC ACTION OF ARTIFICIAL CLOSED PNEUMOTHORAX

COMMUNICATION II. PULMONARY BIOMECHANICS IN ARTIFICIAL CLOSED PNEUMOTHORAX

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It was shown in the previous communication that artificial closed pneumothorax elicited substantial changes in efferent impulses in the pulmonary branches of the vagus and consequently in the activity of the respiratory center. These data, together with facts described in the literature [1, 4, 6, 9], suggested that an important role in the mechanism of the influence exerted by artificial pneumothorax was played by reflex factors.

This question has not received adequate experimental examination and requires investigation of the concrete mechanisms underlying the functional changes in external respiration during pneumothorax.

The present communication is concerned with the study of pulmonary biomechanics of pneumothorax (by means of investigation and comparison of the distinctive features of respiratory movements of the thorax, intrapleural and intratracheal pressure, magnitude of pulmonary ventilation and arterial blood pressure) at the moment of induction of closed experimental pneumothorax and during adjustment to it.

EXPERIMENTAL METHOD

Two series of experiments were carried out: short-term experiments on 16 cats and prolonged experiments on 2 dogs.

In the experiments on urethane-anesthetized cats (1 g/kg urethane) a study was made of the effect on induced closed pneumothorax and of subsequent aspiration of air from the pleural cavity, on the dynamics of respiratory movements of the thorax, changes in its volume, air pressure in the trachea, intrapleural pressure and arterial blood pressure.

Thoracic respiratory movements were recorded by means of a crimped rubber tube fastened around the thorax and connected with a Marey's tambour. This method of recording respiratory movements permits observation of changes in the mid-position of the thorax and hence relative changes in its volume can be judged.

Fluctuations of air pressure in the trachea during the respiratory phases were recorded by the usual method by means of a tracheal cannula connected to a Marey's tambour. Intrapleural pressure was recorded by means of a system consisting of a hollow needle which was introduced into the pleural cavity, rubber tubes and a water manometer connected to a Marey's tambour. Blood pressure was recorded in the common carotid artery by a mercury manometer and a tonometer. In some experiments the other carotid artery was also exposed. In the course of the experiment a clamp was placed on it for 10-15 seconds from time to time in order to determine the level of reflex excitability of the vasomotor center.

Introduction of air into the pleural cavity and aspiration of air from the latter were achieved by means of a pneumothorax apparatus which was connected by a T-joint to the intrapleural pressure recording system.
Fig. 1. Dynamics of the changes in thoracic volume, intrapleural pressure, respiration and blood pressure during induction of closed pneumothorax and during aspiration of air from the pleural cavity.
Cat weighing 3.1 kg. Data of experiment September 30, 1954. Records (from above down): respiratory movements of the thorax (inspiration—downward deflection), intrapleural pressure and its base line, blood pressure (mercury manometer), respiration (tracheal record), blood pressure (tonometer), mercury manometer base line, signal line (\(\downarrow S_{60}\) - 60 ml air introduced into the left pleural cavity; \(\downarrow S_{50}\) - ditto, 50 ml; asp. \(S_{80}\) - aspiration of 80 ml air from the pleural cavity; \(\uparrow\) - compression of the left carotid artery; figures underneath the signal line - time period during which the kymograph was stopped; time marker (2 seconds).