Increase in the total sulphur eliminated was marked on the day of poisoning but, unlike the total nitrogen, returned to normal on the following day. The neutral sulphur was increased both absolutely and relatively to total sulphur on the poison day and that following. A corresponding decrease in oxidized sulphur was observed.

3 (259)

Pneumothorax and posture.

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The sudden entrance of air into the normal healthy pleura often gives rise to a train of grave symptoms. These symptoms have been studied experimentally in dogs. Most of the animals died from the pneumothorax when a large opening was made. Gluck lost all of the dogs he used; Biondi lost 4 of 5; Block, Marcus, Schmidt, Pourrat and Rodet, Tuffier, Murphy, Quenu and Longet, had similar experiences.

In some recent experimental investigations of open pneumothorax I obtained similar results. Many of the dogs either died suddenly as soon as an opening into the pleura was made, or a violent expiratory dyspnea ensued, soon followed by rupture of the mediastinal septum, double pneumothorax, and death. The method of operating on the dogs was the following: The animal was given a hypodermic injection of morphin, and a few hours later was anesthetized with ether; tracheotomy was performed, a cannula inserted, and the administration of ether continued through the cannula. One or more ribs were resected, the intercostal muscles divided, the pleura exposed, and a small opening carefully made in it and gradually enlarged. In a number of the animals, the pressure of the inspired and expired air was roughly measured by allowing the animal to breathe into a large bottle, the tube leading to it from the tracheal cannula being connected by means of a T-tube with a water manometer.

If a small opening (1–5 mm.) is made in the right or left pleura of a dog which is lying on its back, or on its right or left side, the

animal will in most instances continue to breathe well, although the amount of inspired and expired air will be less than (about two thirds of) the normal. That such an animal is very sensitive to the slightest influence which disturbs the breathing is shown by the fact that if the animal is deeply under the anesthetic, clamping the trachea for part of a minute will bring on the dyspnea; if the dog is not deeply under the anesthetic, the struggling of the animal or irritation of the cornea, mucous membrane, etc., will bring it on.

While most dogs stand a small opening well, sudden heart stoppage or dyspnea and death will follow in some instances. The larger the opening, however, the more likely is an occurrence of serious interference with respiration. In almost all of the animals in which the size of the opening approached to or exceeded that of the diameter of the trachea, dyspnea and death followed. No matter how slowly and cautiously the opening was made, typical expiratory dyspnea ensued, the heart becomes irregular and weak, the mediastinal septum bulged into the opening with each violent expiration, and rupture of the septum and double pneumothorax or sudden stoppage of the heart occurred. Nor did it make any difference in what part of the chest the opening was made, whether on the right or left side, near the apex or base of the lung, near the sternum or vertebral column. When, however, the animal was operated upon while lying flat on its belly, very different and gratifying results were obtained. When the dog is lying on his belly, not only can a small opening be made and the dog continue to breathe like a normal animal, but even a very large opening (2–4 cm.) can be made, and breathing go on regularly and quietly, almost if not quite like the normal. Even one half of one chest wall can be removed and the animal survive. Furthermore, if a dog on its back, with an opening in its chest 1 cm. in diameter and with typical violent dyspnea due to the pneumothorax, is turned on its belly, the breathing will often become regular and quiet again, and the pressure of air breathed in and out will be found to be several times as great as when the animal was on its back. On the other hand, a dog on its belly with a large opening in one pleural cavity and breathing quietly, can be brought into a condition of grave dyspnea and asphyxia by turn-

ing it on its back. Sometimes it is even possible to resuscitate an animal that has stopped breathing by thus turning it on its belly.

A dog on its back will sometimes stand a double pneumothorax when the opening in each pleura is a very small one, not more than 1–2 mm. in diameter and very slowly made. But with the dog on its belly, an opening almost 1 cm. in diameter can sometimes be made in each pleura, if cautiously done, and the animal will often continue to breathe and survive for hours. The amount of inspired and expired air in such an animal is surely small as compared with the normal, but it is apparently sufficient to keep the animal alive.

The explanation for this great difference between an animal on its belly and on its back with an open pneumothorax, is not an easy one. The following considerations and experiments are offered as a preliminary contribution to a solution of the problem.

The two pleural cavities are separated by the layers of the anterior and posterior mediastinal septa. Between the two lies the heart. In the dog, the posterior seems to be somewhat tougher than the anterior, and somewhat more fixed and tense. With violent respiratory movements, it is the anterior septum which more especially flaps to and fro and bulges when an opening in the pleura has been made, and it is the anterior septum which is so apt to rupture and thus cause double pneumothorax and death of the animal. When the dog is on its back, the heart falls backward and the bulging of the anterior mediastinal septum is made more easy. It is different when the animal is on its belly. The heart then falls toward the anterior chest wall and thus supports the anterior septum; hence the flapping of the septum, the interference with the respiration of the lung on the sound side, the bulging on expiration on the open side, cannot so readily occur. The following experiments, which I have repeated several times, are, I think, of importance in this connection.

After several ribs had been resected and before the pleura was opened, with the dog *lying on his back*, the pericardium was attached to the anterior chest wall by a suture, so that the heart was pulled forward. A very large opening could now be made in the pleura, almost as large as when the animal was on its belly, without causing the occurrence of serious symptoms. The

moment, however, that the stitch was cut and the heart allowed to drop backward, the typical pneumothorax symptoms appeared. In a second dog, *lying on his belly*, the pericardium was attached to the posterior chest wall by a stitch before the pleura was widely opened. The heart could therefore not drop toward the anterior chest wall. When an opening was made in the pleura of this animal, the typical pneumothorax symptoms started. They ceased soon after the stitch was cut and the heart allowed to drop toward the sternum. In this way it was often possible to reverse conditions; to put a dog with an open pneumothorax on its belly into the condition of one on its back, and vice versa.

From the above experiments, the conclusion may be drawn that in dogs, at least, pneumothorax is better borne when the animal is on its belly than when in any other posture. The reason therefore is to be found in the change in the position of the heart in the thorax when the animal is on its belly.

I may be permitted to add that I have in Mt. Sinai Hospital and in private practice operated upon a number of patients with empyema, upon a patient with a bronchiectatic cavity, on one with a subphrenic and one with a liver abscess and had the patients lying flat on the abdomen during the operation. In all of the patients the pleura had to be opened. The last three patients in whom an almost normal pleura was opened showed unusually few untoward symptoms when the opening was made and air entered the pleural cavity. In the patients in whom an operation for empyema was done, it was noted that with only one exception the coughing and interference with breathing that is regularly observed when the opening in the pleura is made for this affection, was entirely absent. Of course I am aware that these cases are too few to be conclusive.

At the French Surgical Congress of this year, Depage advised that all operations on the chest should be done with the patient lying on his abdomen; Kocher, in the last edition of his Operative Surgery, which has just appeared, states that in operating on the lung the patient should be on his back, and he adds in parenthesis "possibly also on the abdomen."

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