The above results do not show an increase in permeability due to the addition of capillary active substances. The membranes were unaffected by the substance added except for a marked decrease in measured permeability in the case of 0.1 per cent saponine.

Membranes of the thickness used in this work and having an alcoholic index (Brown) of 98 were found to be very permeable to hemoglobin, those of 94 somewhat permeable and 90 impermeable to this substance. We did not succeed in increasing the permeability of a 94 membrane, or in rendering a 90 membrane permeable to hemoglobin by the use of sodium oleate, bile salts, saponine, peptone, or the blood plasma, pleural fluid, or water solution of the alcoholic extract of the residue from evaporated urine of nephrosis cases.

This is a preliminary report.

[1] Brinkman, R., and Szent-Györgyi, A. V., *Biochem. Z.*, 1923, cxxxix, 261.
[2] Brinkman, R., and Szent-Györgyi, A. V., *Ibid.*, 270.
[3] Rosenthal, S. M., *J. Pharmacol.*, 1925, xxv, 449.
[4] Clausen, S. W., *Am. J. Dis. Child.*, 1925, xxix, 594.
[5] Clausen, S. W., *J. Biol. Chem.*, 1924, lix, Proc. p. xlv.
[6] Grollman, A., *J. Gen. Physiol.*, 1926, ix, 813.
[7] Brown, W., *Biochem. J.*, 1915, ix, 591; 1917, xi, 40.

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Cough as a Factor in Chronicity of Experimental Lung Abscess.

C. M. VAN ALLEN, R. A. FOX AND H. G. COLLE.

From the Department of Surgery, State University of Iowa.

In a study of the nature of lung abscess produced experimentally in dogs by various means[1] two characteristics of the disease were found in contrast to that in man. In the first place, the animals did not cough appreciably, even at the height of the infection, and, secondly, the abscess cavities, although in some instances of very large size, healed spontaneously and rapidly. It was felt that the absence of cough had direct bearing upon the obliteration of the cavities, and experiments were planned to test this relationship. Preliminary report of these is given, comparing the course of lung abscess in dogs as it occurred without cough, with that of cases in which cough was stimulated. Here the pulmonary lesions were induced by infected emboli, according to the method of Cutler.[2, 3]

In each of 16 dogs a 1.0 cm. segment of femoral vein was resected

and used as container for a lead pellet and a fragment of agar bearing a growth of virulent *Staphylococcus aureus,* both ends of the segment being ligated. This capsule was then introduced into the venous stream and allowed to be carried as an embolus to the lung, where it lodged in one of the lower lobes. X-ray examination of the chest was made immediately after embolus, again at about the 16th day, and in most cases before necropsy, usually 30 to 37 days.

Ten of the dogs served as controls. Of these, 7 received no other interference, and 3 were used as operated controls, tracheotomy being performed in addition to the embolus. Six of the dogs were made to cough from the 2nd week on by one means or another, as follows: In 2, tracheotomy was done and through this opening powdered soap bark (Quillaja), an intense irritant to the respiratory mucous membranes, was insufflated into the trachea three times a day. Each insufflation produced an attack of coughing for 5 to 10 minutes, and at other times the dogs coughed occasionally. One dog was induced to cough more continuously by means of a lead pellet suspended in the trachea. The remaining 3 contracted distemper after being given the embolus, and coughed considerably as result of the bronchitis of that disease.

X-ray plates on the 16th day demonstrated cavitation in 5 of the controls, the other 5 presenting only some induration in the region of the pellet marker. Four of the coughing dogs, *i. e.,* 1 with soap-bark insufflations, 1 with the tracheal pellet, and 2 with distemper, showed cavities in the lung field, all greater than those of the controls, The first two being of very considerable size. The other 2 dogs which coughed showed local induration only.

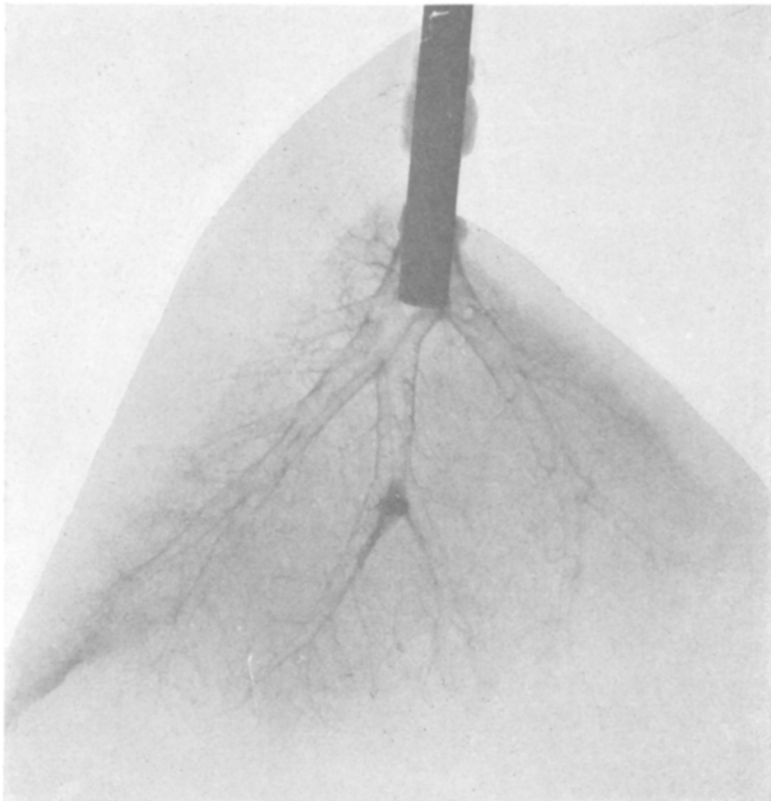
At necropsy, 30 to 35 days, 7 of the controls were found with abscess cavities of size no greater than the pellet which they held. In the other 3 the embolus was still contained entirely within the walls of the pulmonary artery, and the adjacent tissues were intact. Here it was apparent that the infection had been overcome without necrosis of the lung parenchyma. Of the dogs which coughed, the 4 mentioned above had well-defined abscess cavities at necropsy, after 20, 31, 36 and 37 days. They ranged in greatest diameter from 0.9 to 2.2 cm.; 2 were multilocular. Their sizes occurred roughly in proportion to the amounts of coughing taken place. The remaining 2 coughing dogs were found to have the embolus retained within the artery and no cavitation. One of these had died from distemper.

Thus, 70 per cent of the controls and 66 per cent of those which coughed developed pulmonary cavitation as result of the embolus. None of the controls showed persistence of the cavities except as

containers of the pellets; while all dogs of the coughing group with cavitation showed larger cavities at the 16th day and persistence to the end of the experiment.

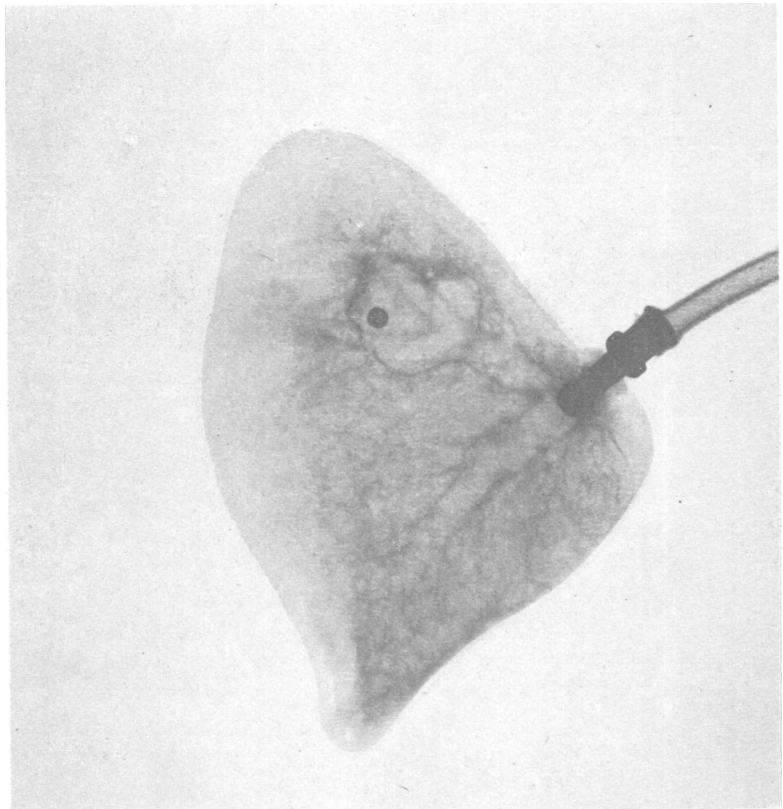
These data indicate, (1) that in dogs an infected embolus in the lung does not always result in abscess, at least where this strain of organism is used, (2) that the disease is characterized by absence of cough and rapid healing, and (3) that when the factor of cough is supplied, the cavities which form may be much larger and persist much longer.

Evidence is not yet at hand as to the means by which the size and chronicity of the abscesses were increased in the presence of coughing. In 2 dogs weakness from distemper doubtless played a part, but that this was a minor rôle is suggested by the fact that another presented a healed lesion, although succumbing from distemper.



Roentgenogram of lung lobe of control dog taken 35 days after embolism, showing healed abscess. Lead pellet indicates position of embolus.

This suggests, also, that merely the jarring and mobilization of the lung by cough was not important. The lesion in this dog, it will be recalled was indurative and not associated with necrosis of the parenchyma; and therein, perhaps, lies the explanation. Where necrosis of the lung parenchyma took place to an appreciable degree, an involvement of at least the finer air passages would be expected, and a communication with the respiratory tract of cavities that formed. In 2 instances gross communication of the cavities with bronchi was demonstrated. The effects of sudden increases of intrathoracic pressure, as in coughing or straining, have been known to lead to rupture of air sacs with the escape of air into the tissues or pleura.[1] Thus, repeated elevations of pressure in coughing transmitted to the abscess cavity from the bronchial tree would probably distend it and impede healing, even make the lesion progressive.



Rontgenogram of lung lobe of coughing dog taken 37 days after embolism, showing abscess cavity containing lead pellet. Cough was stimulated by foreign body suspended in trachea.

For confirmation of these results and study of the mechanism involved, the experiments are being repeated with this embolic type of lung abscess, and also with bronchogenic and interstitially arising types.

This is a preliminary report.

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[1] Van Allen, C. M., unpublished work.

[2] Cutler, E. C., and Schlueter, S. A., *Ann. Surg.*, 1926, lxxxiv, 256.

[3] Holman, E., Weidlein, I. F., and Schlueter, S. A., PROC. SOC. EXP. BIOL. AND MED., 1926, xxiii, 266.

[4] Sauerbruch, F., *Chirurgie der Brustorgane*, Berlin, 1925, Vol. 2, 714.