238 (2198)

A study of the pulmonary circulation by the transillumination method.

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Method: The lungs of a pithed cat are aerated by Meltzer's method of intra-tracheal insufflation, temporarily interrupted once per minute. A constantly inflated lobe is carefully elevated from the open thorax and its margin fixed by two serrated clips. If an area near the margin is transilluminated by a suitable optical system the alveoli with their related blood vessels can be directly observed and studied by means of a horizontally arranged microscope magnifying 50 to 100 diameters.

Owing to the wall-thickness of the intra-lobular arteries and veins and their immediate branches, the circulating blood is only visible in the smaller vessels, *i. e.,* (a) in the pre-arterioles and arterioles passing between the alveoli, (b) in the capillary network formed on the surface of the alveoli and embracing the air cells and (c) in the smaller venules before they merge into the efferent intra-lobular veins.

Circulation in Vessels of Different Size: In the *pre-arterioles* the blood stream is often clearly visible. The cellular elements are in densely packed mass formation, the flow is pulsating with a rapid systolic forward movement and a diastolic decrease in velocity, amounting occasionally to a total stoppage of the flow in diastole. Expansion and relaxation of the walls is not observed. In the arterioles the stream is no longer pulsating, the individual blood cells are distinguishable and travel in ranks of two to six. In the capillaries, the blood corpuscles travel in single file, and in a continuous stream, but the rate of flow varies in different capillaries even in the network surrounding the same alveolus. In the smaller venules the stream is constant and a little more rapid than in the capillaries. Individual cells are distinguishable and eddies often occur at the junctions. In still larger venules and the smallest veins the stream is no longer constant, but a definite pulsation occurs, the onward flow tending to be reduced during systole and increased during diastole.

Although many patient observations have been made on a large number of cats no change in caliber either of the pre-arterioles, the arterioles, capillaries or venules has been seen, nor has the appearance or disappearance of patent capillaries been observed as long as the degree of lung inflation or heart rate remain unchanged. There is therefore no evidence in this research of an active change in the size of the smaller pulmonary vessels.

Effect of Stimulating the Peripheral Vagi Nerves after previous injection of, or painting of Cardiac base with Nicotine. Upon stimulation of the peripheral vagi nerves in animals where no change in heart rate occurred, a curious effect is generally observed. With the focus unchanged and a constant lung inflation the vessels appear to pass out of focus, the alveolar air cells appear to bulge, to become more globular and to assume a more glistening appearance. On refocusing, the vessels appear to have sunk deeper into valleys between alveoli. The possibility that these changes may result from stimulation of bronchomotor nerves suggest itself.

This change in appearance during stimulation of the vagi nerve makes it difficult to be quite certain in regard to changes in the size of individual vessels but observation on 24 different experiments failed to yield any evidence that could be safely interpreted as indicating a change in caliber of any vessel, or an alteration of the blood flow therein. Evidence of vasomotor activity which it was hoped might be revealed by the use of this method could not be adduced.

Effect of Cardiac Slowing: When stimulation of the peripheral vagus nerves in un-nicotinized animals causes a marked cardiac slowing, an unanticipated effect on the blood flow in the visible pre-arterioles and arterioles is noted. During diastole the blood actually flows backward, out of the capillaries and smaller arterioles and toward the larger arteries; during systole, this is momentarily checked. This reverse flow continues for a few beats only, however, becoming less and less with each heart beat until the flow becomes stationary. Then if slowing is maintained a gradual onward movement during systole becomes reëstablished. This obviously indicates that the pressure in the pulmonary artery and its immediate branches is lower than in the smaller vessels until sufficient time has elapsed to produce a stabilized effect.

Effect of Epinephrin: In spite of a cardiac acceleration, produced by the injection of 1-3 c.c. of a 1:50,000 epinephrin solution, a definite decrease in the size of the visible pre-arterioles and arterioles is noted. At times this amounts to a complete cessation of flow in certain vessels. This supplies visible corroborative evidence that epinephrin effects the smaller pulmonary vessels.

239 (2199)

The respiratory exchange and blood sugar curves of normal and diabetic subjects after epinephrin and insulin.

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This communication is based on a series of experiments conducted on 5 normal men and 8 diabetics. The method of determining the respiratory exchange was carried out by the open-circuit Tissot spirometer, with gas analyses by a modified Henderson-Haldane apparatus and calculations of the indirect calorimetry by the method of Zuntz and Schumburg, as recently described by McCann and Hannon.[1] At varying intervals during the experiments samples of blood were taken and blood-sugar determinations were made according to the method of Folin and Wu.[2] Coincident pulse and blood pressure charts were also kept in most instances.

The 5 normal men showed a similar reaction to 0.5 c.c. adrenalin given subcutaneously. There was a prompt rise of the R. Q., which was most marked about 10 minutes after the adrenalin. The quotient rose to a different extent, varying with the individual. A distinct increase of heat-production occurred with its maximum degree about 30 minutes after injection, remaining above the basal figure for over an hour. There appeared an immediate and marked rise in carbohydrate metabolism

1 McCann and Hannon, Johns Hopkins Hospital Bull., March, 1923, xxiv, 73.

2 Folin and Wu, *Jour. Biol. Chem.*, 1920, xli, 367.