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Observations on Coronary Occlusion III: Chemical and Histologic Changes.*

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(Introduced by R. Hussey.)

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A series of experiments was made to study the chemical changes with reference to lactic acid and glycogen in the myocardium following ligation of the anterior descending branch of the left coronary artery of dogs and to correlate these with the anatomic and electrocardiographic changes observed.

Sixteen dogs were used. Essentially similar operative techniques were employed as in the experiments previously reported.^{1, 2} The tissues for chemical studies were excised from the heart *in situ* in the living animal under amytal anesthesia and immediately plunged into liquid air. Lactic acid was determined by the method of Friedemann and Graeser³ and the glycogen by the modified Pflüger procedure as outlined by Yannet and Darrow.⁴

In the first group of experiments 10 dogs were used. After ligation of the coronary vessels the animals were sacrificed at intervals varying from ½ hour to 24 hours. The lactic acid content of the muscle tissue from the zone supplied by the ligated vessels was increased 100-200% over that of the control zone (right ventricle) while the glycogen content of similar zones was decreased below that of the control zone. These changes were noted in every instance irrespective of the duration of the period of ligation. Control animals subjected to the same operative procedure except that the sutures were passed about the vessels and then removed, showed no significant variation in the content of lactic acid or glycogen from the two sides of the heart.

In the second group of experiments the coronary vessels were ligated for varying periods up to 8 hours. At the end of these in-

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¹ Sutherland, F. A., Dial, D. L., and Harris, B. R., *PROC. SOC. EXP. BIOL. AND MED.*, 1933, **30**, 1430.

² Harris, B. R., Sutherland, F. A., Ramsey, E. M., and Gaiser, D. W., *PROC. SOC. EXP. BIOL. AND MED.*, 1933, **31**, 222.

³ Friedemann, T. E., and Graeser, J. B., *J. Biol. Chem.*, 1933, **100**, 291.

⁴ Yannet, H., and Darrow, D. C., *J. Clin. Invest.*, 1933, **12**, 779.

tervals the ligatures were removed and the animals were sacrificed 2 hours afterward. Six dogs were used in this series. In all instances the lactic acid content of the heart muscle from the zone supplied by the previously ligated vessels was decreased below that of the muscle from the control zone. The glycogen content of the affected zones, as in the first group, was also decreased below that of the control zone.

In the first group of experiments the anatomic changes were similar to those previously reported.¹ No demonstrable characteristic alteration was observed in the myocardium of animals surviving for 10 hours or less. In contrast to these findings the second group showed striking gross and microscopic changes in every case except in the instance when the vessels were tied for only $\frac{1}{2}$ hour. In all the other hearts a sharply delimited zone, extending from the apex for a distance of 3 cm. up the anterior surface of the left ventricle was seen. The myocardium here was soft, dark red and sharply delineated from the adjoining red-brown myocardium. The dark red discoloration extended through the entire thickness of the wall with the most intense involvement in the inner half. The anterior one-third of the interventricular septum was also involved by this process. The histologic changes were the same in all. They consisted of edema, extensive hemorrhage and a slight polymorphonuclear cellular exudate distributed diffusely throughout the interstitial tissue of the involved zone. In the region where the exudate and hemorrhage was most marked the myocardial fibers stained intensely pink and their striations were lost. Fat droplets were not present in any of the muscle fibers.

The electrocardiographic changes in this series are similar to those previously reported,² except that following the removal of the ligatures the development of ectopic ventricular premature beats and tachycardia was observed.