

significant. 3. The original implants of sarcomas E-2 and E-5, when implanted into pregnant animals, showed a significantly lower growth rate than those implanted into controls. No significant differences were observed, however, in the recurrent tumors.

9846 P

Phosphorus Fractions in Human Heart Muscle.

GEORGE M. DECHERD, JR., AND J. E. BLUM, JR.

From the Department of Medicine, School of Medicine, Louisiana State University, New Orleans, La.

In pursuance of our studies of the myocardial chemical changes that accompany congestive heart failure, we have attempted to determine the various phosphorus compounds in the left ventricles of hearts obtained at autopsy. These have been divided into two groups, those with and those without myocardial failure. It is well known that many hearts that have failed give no hint of their lack of functional capacity when examined histologically and previous studies¹ indicate that changes in the chemical compounds participating in the energy exchanges of muscular contraction accompany, and may play a causative rôle in the precipitation of congestive failure.

The total myocardial phosphorus is composed of that present in those compounds which are soluble in 5% trichloroacetic acid, namely, phosphocreatine, hexose phosphates, nucleotid phosphoric acid, and inorganic or orthophosphate, plus that residual portion which is not acid-soluble. The residual phosphorus has been identified with the phospholipid fraction by Sorg² and Wassermeyer.³

It has been previously shown that a decrease in total phosphorus accompanies myocardial failure.⁴ The hypothesis has been advanced that the endurance of a muscle parallels its phospholipid content,⁵ and in agreement with this idea, Kutchera-Aichenberger⁶ reported phospholipid decreases in the heart in congestive failure and in ex-

¹ Herrmann, G., and Decherd, G., *Trans. Assn. Am. Phys.*, 1936, **51**, 295.

² Sorg, K., *Z. f. physiol. Chem.*, 1929, **182**, 97.

³ Wassermeyer, H., *Deut. Arch. klin. Med.*, 1934, **177**, 573.

⁴ Wilkins, W. E., and Cullen, G. E., *J. Clin. Invest.*, 1933, **12**, 1063.

⁵ Lehnartz, E., *Erg. Physiol.*, 1933, **35**, 874.

⁶ Kutchera-Aichenberger, H., *Wien. Arch. f. inn. Med.*, 1929, **18**, 209.

perimental myocardial injury by chloroform. However, Wassermeyer and Rohrbach⁷ found no changes in the lipoids of the heart in experimental valvular lesions, with or without hypertrophy, in myocarditis produced by caffeine and adrenaline, or in beri-beri. Furthermore, Ludewig and Chanutin⁸ could detect no change in the lipid phosphorus of hearts hypertrophied secondarily to hypertension in partially nephrectomized rats.

It is to be emphasized that the abrasive used in grinding the muscle for extraction must be devoid of any adsorptive properties, else the determined acid-soluble phosphorus will be too low and, by difference, the residual (or lipid) phosphorus, too high. Detection of this source of error in our preliminary determinations⁹ necessitated this study now reported.

Methods. Duplicate weighed portions of heart muscle, obtained within 48 hours after death, were taken for (a) digestion with sulphuric acid and superoxol for estimation of the total phosphorus; (b) ground with washed sea sand, which was shown to adsorb none of the soluble phosphorus compounds, and extracted with a calculated volume of 5% trichloroacetic acid, so that 20 cc. of extract represented 1 gm. of muscle, assuming the muscle to contain 80% water; portions of this extract were digested to determine the total acid-soluble phosphorus, and in addition were fractionated according to the technique of Pollack, *et al.*,¹⁰ (c) dried at 105°C. to constant weight. Phosphorus determinations were done by the method of Fiske and Subarrow,¹¹ and all values are given in terms of 100 gm. fresh muscle, being corrected to a standard of 20% content of solids for purposes of comparison.

Results. We have confirmed in a larger series the drop in total phosphorus in the muscle of hearts that have failed, observed by Wilkins and Cullen. This decrease is due entirely to a decrease in the acid-soluble fraction. There is no change in the residual phosphorus. The mean of each series, expressed as milligrams of phosphorus per 100 gm. of fresh muscle, with the probable error of the mean, as well as the standard deviation, have been calculated and assembled in Table I; the lower line gives the difference between the means of the 2 large groups, namely, hearts with and without failure, and the probable error of this difference.

⁷ Wassermeyer, H., and Rohrbach, A., *Arch. f. exp. Path. u. Pharm.*, 1932, **166**, 375.

⁸ Ludewig, S., and Chanutin, A., *J. Biol. Chem.*, 1936, **115**, 327.

⁹ Herrmann, G., and Decherd, G., unpublished data.

¹⁰ Pollack, H., Flock, E., and Bollman, J. L., *Am. J. Physiol.*, 1934, **110**, 105.

¹¹ Fiske, C. H., and Subarrow, Y., *J. Biol. Chem.*, 1925, **66**, 375.

TABLE I.
Phosphorus Values in Human Heart Muscle.
Mg. per 100 gm. Fresh Muscle.

		Total P		Acid-soluble P		Residual P	
		Mean \pm PE	σ^*	Mean \pm PE	σ^*	Mean \pm PE	σ^*
No Failure	36	180.3 \pm 0.90	8.0	88.8 \pm 0.99	8.4	91.0 \pm 1.04	9.3
Failure	33	161.4 \pm 1.15	9.8	72.3 \pm 0.96	8.2	89.0 \pm .91	7.7
Difference		18.9 \pm 1.46		16.5 \pm 1.38		2.0 \pm 1.38	

*of the whole series.

The attempts to fractionate the acid-soluble fraction were unsuccessful. As might be anticipated, these labile compounds had hydrolyzed before we obtained the muscle; the estimation of the changes in this group must await the experimental production of heart failure. In a few instances, traces of soluble barium salts were obtained (phosphocreatine or hexosephosphate), but these were too small to measure. No pyrophosphate could be identified.¹² The orthophosphate was consistently 5 to 15 mg. % lower than the total acid-soluble phosphorus; this difference possibly is a measure of a portion of the nucleotid phosphorus which is either difficult to hydrolyze or is as yet unidentified.

Summary. The decrease in total myocardial phosphorus which accompanies heart failure is due to a decrease in the acid-soluble phosphorus compounds.

9847 P

Use of Mice for Testing Toxicity of Rabbit Therapeutic Antipneumococcic Serum.

KENNETH L. BURDON AND EDWARD L. BURNS.

From the Department of Pathology and Bacteriology, Louisiana State University School of Medicine, New Orleans, La.

Since the newly developed *rabbit* therapeutic (unconcentrated) antipneumococcic sera, now being used with favorable clinical results,^{1, 2, 3} even after processing of the raw serum by heating at 56°C.

¹² Lohmann, K., *Biochem. Z.*, 1928, **202**, 466.

¹ Horsfall, F. L., Jr., Goodner, K., and MacLeod, C. M., *Science*, 1937, **84**, 579.

² Horsfall, F. L., Jr., Goodner, K., MacLeod, C. M., and Harris, A. H., 2nd, *J. Am. Med. Assn.*, 1937, **108**, 1463.

³ Horsfall, F. L., Jr., Goodner, K., and MacLeod, C. M., *N. Y. State J. Med.*, 1938, **38**, 246.