

**Production of Cardiac Hypertrophy in Rats.**

GEORGE HERRMANN, GEORGE DECHERD AND PETER ERHARD.

*From the Department of Medicine, University of Texas School of Medicine,  
Galveston*

In this laboratory we have been interested for some years in the problem of the pathogenesis and production of myocardial hypertrophy.<sup>1</sup> We have employed experimental aortic valvular lesions for this purpose, but this method has been unsatisfactory, not only because of individual differences in the response of the heart, but because the individual valvular lesions were inevitably quite different in extent. We also needed a method which was applicable to large series of small animals. For these reasons we have investigated the effect of renal ischemia in the rat, employing several of the methods that have been described for impairing the renal blood supply.

The results of our various studies are shown in Table I. We first employed the technic described by Collins,<sup>2</sup> and used also by Rytand,<sup>3</sup> in which the renal artery is tied over a wire of known gauge. For rats weighing from 150 to 200 g we used a wire of B. & S. gauge No. 26. A few of these animals showed enlarged hearts, but the results were neither striking nor consistent. We also attempted the use of the procedure introduced by Page<sup>4</sup> for yielding a perinephritis by enveloping the kidney in a cellophane capsule. This, too, was unsuccessful in our rats, and in most instances the kidney with the cellophane covering seemed to act as a foreign body, and eroded its way into the stomach, leading shortly to the death of the animal. Deep Roentgen radiation over the kidney as described by Hartman<sup>5</sup> was also employed in a smaller series of animals, but the hearts of none of these rats were hypertrophied. 10,000 unit doses of Vitamin D\* were injected intraperitoneally into each of another series of rats because of the report<sup>6</sup> that such a procedure produced arteriosclerosis and hypertension. However, no cardiac hypertrophy resulted.

The molded gauze-collodion method was attended with uniform success. This method was demonstrated to us by Dr. John Williams

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<sup>1</sup> Herrmann, G., and Decherd, G. M., *Ann. Int. Med.*, 1939, **13**, 794.

<sup>2</sup> Collins, D. A., *Am. J. Physiol.*, 1936, **116**, 616.

<sup>3</sup> Rytand, D. A., *J. Clin. Invest.*, 1938, **17**, 391.

<sup>4</sup> Page, I. H., and Graef, I., *Am. J. Path.*, 1939, **15**, 623 (proc.).

<sup>5</sup> Hartman, F. W., *ibid.*, 1939, **15**, 623 (proc.).

\* Supplied by Upjohn Co.

<sup>6</sup> Ham, A. W., *Arch. Path.*, 1940, **29**, 731 (proc.).

of the Vanderbilt University Medical School. The left kidney, after being exposed and delivered through a posterior lumbar incision, was snugly wrapped with a single layer of ordinary surgical gauze. The gauze was then painted with U.S.P. collodion. As this dried another layer of collodion was applied, so that a firm molded capsule about the kidney resulted. This was not allowed to press on the renal pedicle. About 4 to 7 days after this procedure, the right kidney was removed, again through a lumbar incision. The animals tolerated this procedure well, and in our experience virtually every one that survived the immediate operative mortality of about 20% showed a conspicuous cardiac hypertrophy.

Table I shows the heart weight :body weight ratios, and the statistical constants derived from them, of each series of animals. In Table II there is a further analysis of the rats in whom renal ischemia was produced by the molded gauze-collodion capsule. We have assumed that hypertension resulted after the removal of the normal kidney. Rats sacrificed 10 days after the nephrectomy showed definite cardiac hypertrophy. The data indicate that within 30 days probably the maximum hypertrophy is obtained, although there seems to be a slight tendency towards a further increase up to about the 50th day.

*Summary.* The production of renal ischemia by molded gauze-collodion capsules, as demonstrated to us by Dr. John Williams, appears to be the most satisfactory method of producing cardiac hypertrophy in rats.

TABLE I.  
Heart Weight : Body Weight Ratios of Rats with Various Types of Renal Ischemia.

	No. of HW/BW		P.E. mean	Stand.	
	animals	mean		Dev.	Diff. $\pm$ P.E. Diff.
Normal <sup>1</sup>		3.37	.06	.52	
Renal artery constricted	25	3.81	.09	.67	+ .44 $\pm$ .11
X-ray	14	3.15	.08	.45	- .22 .10
Cellophane	50	3.68	.08	.88	+ .31 .10
Vitamin D	150	3.14	.05	.95	- .23 .08
Gauze-Collodion	54	5.99	.13	1.37	+2.62 .14

TABLE II.  
Percent Hypertrophy of Rat Hearts by Gauze-Collodion Method.

Time after nephrectomy	No. of animals	Range of hypertrophy, %	Avg hypertrophy, %
10-19 days	11	29- 67	46
20-29 "	6	23-106	62
30-39 "	7	61-119	82
40-49 "	10	53-137	92
50-59 "	4	42-155	90
60-69 "	15	23-130	69