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Hypertension with Arteriolar and Glomerular Changes in the Albino Rat Following Subtotal Nephrectomy.

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Chanutin and Ferris[1] have already reported hypertension and renal insufficiency in rats following partial nephrectomy. This report describes briefly the histological changes in the kidney stump of rats at intervals after subtotal nephrectomy and records additional blood pressure observations.

In this experiment 184 Wistar strain albino rats were studied. In 157 of these, approximately two-thirds of the left kidney was removed by polar ligation, and the remaining right kidney was excised one week later. Of 27 control animals, each had 2 laparotomies (one week apart) when the kidneys were exposed, handled and replaced intact. After the operative procedures all of the animals were fed on a normal balanced diet containing approximately 20% protein. At intervals varying from one to 281 days after second operation, a direct carotid blood pressure reading was made (ether anesthesia), and autopsy then performed. Infection was not encountered except in rare instances, and did not affect the results reported below. Tissues were fixed variously in formol, mercuric chloride, and Helly's fluid. Frozen and paraffin sections were stained with Scharlach-R, Mallory-Heidenhain, and other usual methods.

The blood pressure in the 27 control rats ranged from 100 to 140 mm. Hg., with an average of 120 mm. Hg. (a figure already fully established by Chanutin and Ferris). Of 157 animals with subtotal nephrectomy, 10 had blood pressures ranging from 70 to 99 mm. Hg.; 57, from 100 to 139 mm. Hg.; 45, from 140 to 169 mm. Hg.; 34, from 170 to 199 mm. Hg.; and 11, from 200 to 230 mm. Hg. In general, the test animals with subnormal blood pressures were acutely ill. The higher blood pressure levels were found in rats with subtotal nephrectomy of 60 days or longer. Of 34 test animals killed from one to 59 days after second operation, only 5 showed blood pressures of 140 mm. Hg. or above, whereas, of 123 animals killed from 60 to 275 days after second operation, 85 (or 69%)

[1] Chanutin, A., and Ferris, E. B., *Arch. Int. Med.*, 1932, **49**, 767.

showed blood pressures of 140 mm. Hg. or above. In each instance of hypertension, degenerative glomerular changes have been present.

Microscopic studies show constant and characteristic changes in the renal stump. During the first 12 days after second operation there is rapid dilatation of the tubules, with marked fatty change and hyperplasia of their epithelium. The glomeruli show no appreciable change, other than increase in size, until about 40 to 70 days after second operation. About this time there is a thickening of the supporting structures of the glomeruli, as well as swelling and fatty change of the glomerular epithelium with formation of capsular adhesions (Fig. 1). One has the general impression that the media

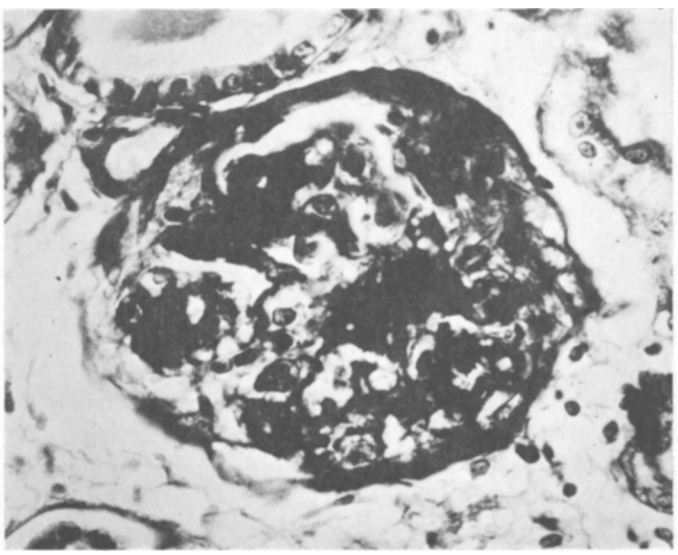

FIG. 1.

Rat 360 B.E. Mallory-Heidenhain Azan Carmine Stain. Showing a moderately advanced glomerular lesion with degeneration, fibrosis and hyalinization. ×470.

of many of the smaller arteries and arterioles is definitely thickened. More striking, however, are focal accumulations of fat within the media of smaller arteries and arterioles, frequently leading to marked diminution in the size of the lumen. The arterial lesions (Figure 2) bear a striking resemblance to those of human renal arteriolosclerosis. Progression of all of these changes leads to complete destruction of many glomeruli with atrophy of their related tubules. The number of completely destroyed renal units increases with the duration of the experiment. The remaining intact

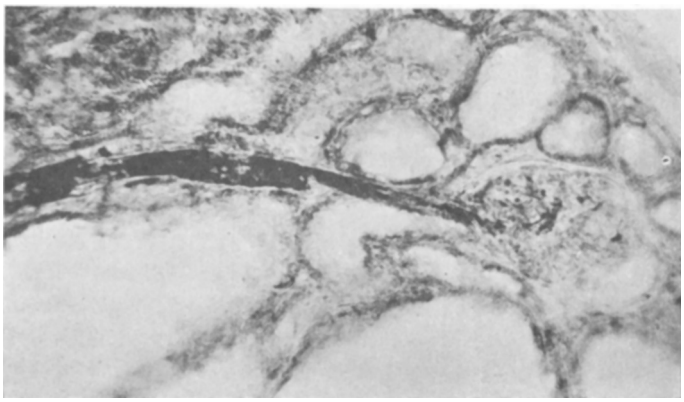

FIG. 2.
Rat 352 B.N. Scharlach-R and Haematoxylin Stain. Fat which photographs black is seen in afferent arteriole and glomerulus. ×95.

renal units show tremendous hypertrophy of both glomeruli and tubules.

None of these pathological changes has been seen in the kidneys of 27 control animals or in the kidneys of 13 animals subjected to unilateral nephrectomy. The resemblance of the hyaline glomerular changes to amyloid formation in some instances caused us to test for this substance with iodine-sulphuric acid, methyl violet, and intravenous injection of congo red.[2] Negative results have been obtained by all methods.

From the preceding data it appears fair to conclude that chronic progressive glomerular and arterial renal lesions, associated with hypertension, have been produced in rats by subtotal nephrectomy. In our opinion these changes may be interpreted as a natural sequence of hypertrophy and degeneration brought about by functional strain.

[2] Smetana, H., *Johns Hopkins Hosp. Bull.*, 1925, **37**, 383.