

STRUCTURAL CHANGES IN EPITHELIUM OF THE RENAL TUBULES OF ALBINO RATS IN
THE EARLY PERIOD OF MERCURIC CHLORIDE NECROSIS

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Morphological disturbances in the kidneys in lesions produced by salts of heavy metals and, in particular, mercuric chloride, have been investigated many times [1-7]. However, the general pattern of repair taking place in the kidneys after lesions of this kind has not yet been discovered.

The aim of this investigation was to study relations between intracellular regenerative processes and repair processes at the cellular level in the epithelium of the renal tubules of the rat kidney in the early period of mercuric chloride necrotizing nephrosis.

EXPERIMENTAL METHOD

Experiments were carried out on 20 male Wistar rats weighing 170-210 g. The animals were divided into two groups: four animals of group 1 served as the control; rats of group 2 received a single subcutaneous injection of mercuric chloride in a dose of 0.6 mg/100 g body weight, dissolved in physiological saline. Pieces of kidneys were removed 6, 12, 24, and 48 h after injection of mercuric chloride from animals anesthetized with ether, and fixed in Carnoy's fluid and also in a 4% solution of paraformaldehyde and a 1% solution of

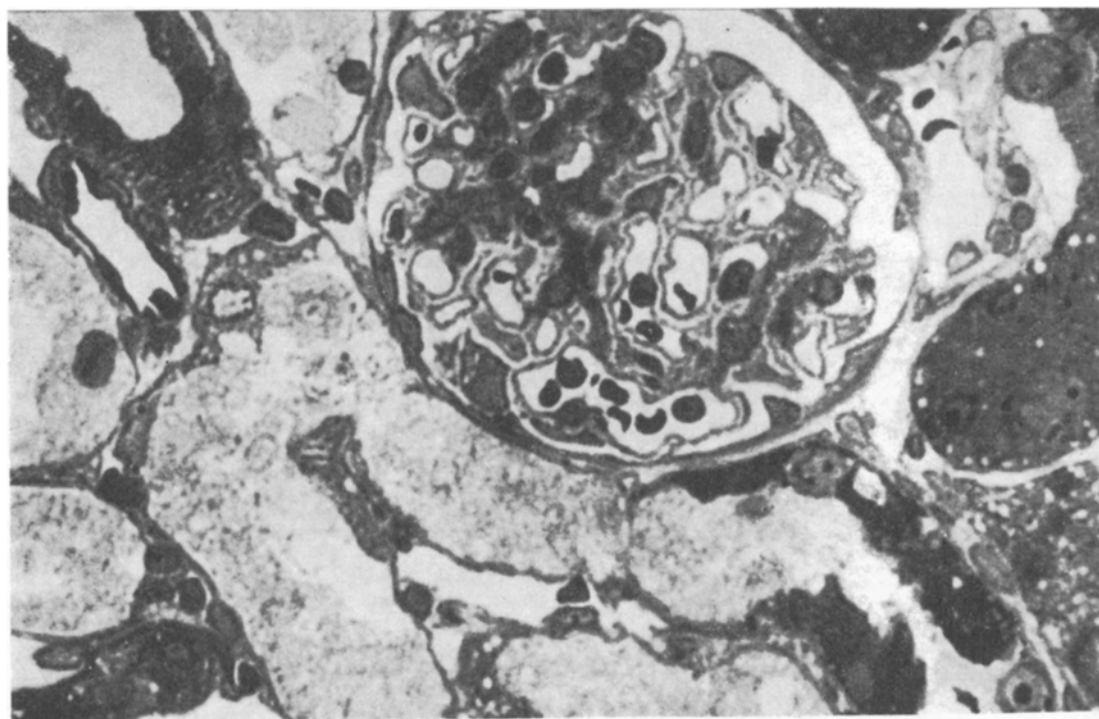


Fig. 1. Microscopic picture of renal cortex of rat 24 h after subcutaneous injection of mercuric chloride. Fragment of convoluted tubule of proximal part of nephron, showing desquamation and destruction of nephrocytes to finely granular material, lies next to renal corpuscle. 1500 \times .

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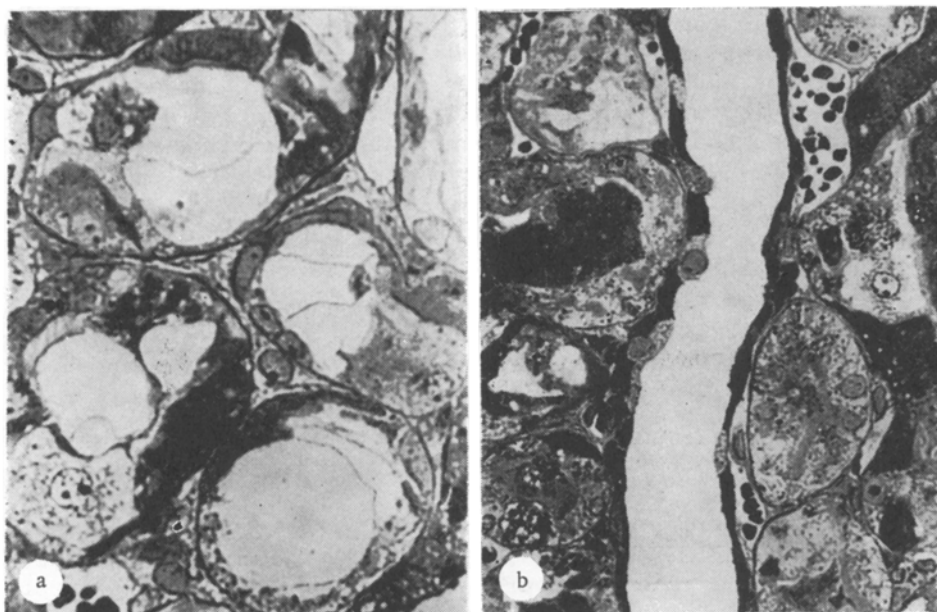


Fig. 2. Outer zone of renal medulla of rat 24 h after subcutaneous injection of mercuric chloride. a) Disturbance of structure of tubules as a result of total or partial necrosis of nephrocytes. Preserved nuclei of nephrocytes, surrounded by a small rim of cytoplasm, can be seen in lumen of top right tubule; b) fragment of collecting tubule with partially sequestered cytoplasm of epithelium. 1200 \times .

glutaraldehyde in phosphate buffer (pH 7.4), followed by treatment in osmium fixative by Caulfield's method. The tissue was embedded in a mixture of prepolymerized butyl and methyl esters of methacrylic acid in the ratio of 4:1.

Semithin serial sections (300) 0.5 μ thick were cut on an ultramicrotome, and stained with methylene blue and basic fuchsin [8]. The number of mitoses was counted in paraffin sections 8 μ thick, stained with hematoxylin and eosin.

EXPERIMENTAL RESULTS

The results showed that only 6 h after injection of mercuric chloride destruction of a few cells of the epithelium of the renal tubules in the cortex of the kidney was observed. After 12 h destructive changes affecting the renal tubules continued to increase, and after 24 h they were most widespread. The dose of mercuric chloride used, incidentally, produces morphological changes in different parts of the tubular portion of the nephron which differ in severity. In parts of the convoluted tubules lying nearer to the renal corpuscle, as a rule almost total deaths of the nephrocytes was observed. The lumen of these tubules 24 h after injection of mercuric chloride was filled with finely granular, palely stained material (Fig. 1). In parts of the nephron located in the outer zone of the medulla, a distinct mosaic pattern of damage to the renal epithelium was observed.

In sections through the renal tubules oriented in different planes, areas of basement membranes completely without renal epithelium, or covered with epithelial cells with disturbed cytoarchitectonics could be seen. Complete or partial loss of microvilli and of apical areas of cytoplasm of different sizes could be observed in these cells. In some epithelial cells much of the cytoplasm was lost, and in that case the cell nuclei, surrounded by a narrow rim of cytoplasm, remained on the basement membrane (Fig. 2a). A study of serial semithin sections showed that however severe the destructive changes in the epithelium of the renal tubules, total death of the epithelium was not observed. In distal or proximal parts of the tubule, single epithelial cells were always present, whose morphology demonstrated their viability. In such "miraculously" preserved cells, with a small area of cytoplasm, 24 h after injection of mercuric chloride one or more (most frequently two) round or irregularly shaped nucleoli could be seen. The number of nucleoli counted in semithin sections after 24 h in the nuclei of the epithelial cells which remained in the zone of partial necro-

sis of the experimental animals and in the same zone of the control animals was 109 nucleoli per 100 nuclei in the experiment and 76 per 100 in the control. Analysis of serial semithin sections also showed no abrupt absolute increase in the number of nucleoli in the epithelial cells of the rat kidney at this time, but the results can evidently be explained on the grounds that, being increased in size, the nucleoli appeared more frequently in the section. In the thin region of the loop of the nephron, no destructive changes in the nuclei (pycnosis, rhexis), characteristic of the damaged higher regions of the nephron, were found. It was impossible to judge whether the cytoplasm of the cells in the thin part of the loop of the nephron was involved simply on the basis of light-microscopic data.

In the straight part of the distal portion of the nephron and in areas of the collecting tubules passing through the outer zone of the medulla, partial necrosis most frequently was observed, with sequestration of the apical zones of the cytoplasm of the nephrocytes into the lumen of the tubule (Fig. 2b).

It can be concluded from the results of this investigation that 24 h after injection of mercuric chloride in a dose of 0.6 mg/100 g body weight destructive processes in the rat kidneys reach their peak. However, as well as destructive processes, between 12 and 24 h after injection of mercuric chloride intracellular repair processes begin to appear in the partially damaged but still viable nephrocytes, as shown by the increase in size of their nucleoli — organelles linking the genetic apparatus of the nucleus with the protein-synthesizing system of the cytoplasm. Repair processes in the renal tubules on account of cellular renewal are manifested to only a slight degree 24 h after injection of mercuric chloride, as is shown by the solitary mitoses which are rarely seen in the convoluted tubules of the proximal part of the stained sections.

LITERATURE CITED

1. N. K. Permyakov and L. N. Zimina, Acute Renal Failure [in Russian], Moscow (1982), p. 66.
2. N. M. Petrun' and L. A. Khomenko, Patol. Fiziol., No. 5, 69 (1974).
3. V. V. Serov and A. G. Ufimtseva, Arkh. Patol., No. 8, 36 (1967).
4. E. M. McDowell et al., Arch. Pathol. Anat. Zellpath., 22, 173 (1976).
5. R. C. Zalme et al., Arch. Pathol. Anat. Zellpath., 22, 197 (1976).
6. H. Schulte-Wissermann, E. Straub, and P. Funke, Arch. Pathol. Anat. Zellpath., 23, 163 (1977).
7. H. G. Preuss et al., Lab. Invest., 32, 286 (1975).
8. T. Sato and M. Shamoto, Stain Technol., 48, 223 (1973).