SPECIES AND SEASONAL CHANGES IN THE ADRENERGIC INNERVATION OF THE RAT KIDNEY

D. S. Gordon, V. I. Smirnova, and E. A. Nuzhnenko

UDC 611.611-018.8-019:599.323.4

The adrenergic innervation of the rat kidney was studied by Krokhina's modification of the method of Falck and Hillarp. Clusters of dull orange granules were found in the wall of the blood vessels of the renal parenchyma and on the malpighian corpuscles during the autumn, but no adrenergic fibers were seen. The tubules of the cortex and medulla in the rats contained dark orange granules in the autumn, and in spring these were replaced by bright whitish-green granules, by contrast with the picture observed in cats. Adrenergic fibers are vessels of the parenchyma in spring, but the malpighian corpuscles are surrounded by adrenergic plexuses.

A survey and an extensive factual record on innervation of the kidney have been published by Shvalev [3]. The present writers have previously described a system of adrenergic nerve fibers of the cat kidney, localized mainly in the adventitia of the renal vessels, and also the innervation of the malpighian corpuscle of the kidney.

In the investigation described below the adrenergic innervation of the kidneys of 12 albino rats in the autumn and winter and of 15 rats in the spring was studied.

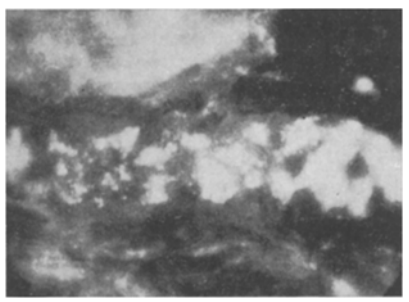

Fig. 1. Numerous clusters of dull orange granules along the course of a cortical vessel of the kidney. Falck–Hillarp method, ML-2 microscope, 630×.

EXPERIMENTAL METHOD AND RESULTS

The material was stained by Krokhina's modification [1] of the luminescence-histochemical method of Falck and Hillarp [4]. The adrenergic innervation of the rat kidney was found to exhibit a number of special features.

Adrenergic fibers in the rat kidney were found in very small numbers in the adventitia of the large blood vessels in the hilar region. The external appearance of the interlobular vessels of the medulla, the afferent and efferent arteries, and also the malpighian corpuscles attracted attention. Along the course of all these structures there were numerous clusters of dull orange granules (Fig. 1). In the cat a few granules of this type were found only in the region of Bowman's capsule.

In the tubules of the renal cortex in rats orange-brown granules were found. In cats in this region a homogeneous, pale yellow luminescence was observed. Whereas the medullary tubules in the

Departments of Histology and Pharmacology, I. N. Ul'yanov Chuvash University. (Presented by Academician of the Academy of Medical Sciences of the USSR A. P. Avtsyn.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 74, No. 12, pp. 105-106, December, 1972. Original article submitted November 26, 1971.

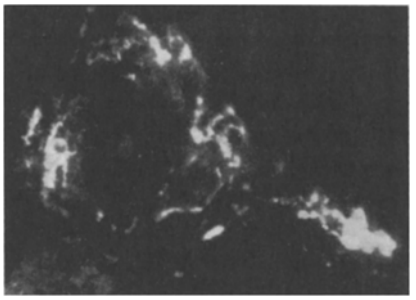

Fig. 2. Malpighian corpuscle with surrounding plexusis of adrenergic nerve fibers. Falck–Hillarp method, Ml-2 microscope, 280×.

cat kidney are not luminescent but give only a dark gray glow, in rats a few solitary brown granules are observed in this region. Since the experiments of series I were performed between October and December, another series (II) was performed in February and March to determine the character of the seasonal changes. As spring approached the character of luminescence of the tubules in the renal cortex was found to change. Besides the dull orange-brown granules, bright white, followed by whitish-green granules began to appear in them and to increase steadily in size and number. The brown granules also began to disappear from the medullary tubules, but these were not replaced by granules of a different type.

In the spring months, the number of dull orange granules in the renal vessels of the rats at first began to decrease, and later they disappeared. Their place was taken by single adrenergic fibers, which later were replaced by complete plexuses. Something similar also took place in the malpighian corpuscles. Whereas in the autumn and winter months clusters of orange granules were visible in this part, in spring the whole corpuscle appeared surrounded by a plexusis of adrenergic nerve fibers, coming in from the afferent and efferent arteries (Fig. 2).

In a parallel study of the innervation of the cat kidney no marked seasonal changes could be detected in its adrenergic innervation or in the luminescence of the parenchyma.

The adrenergic innervation of the rat kidney in spring, it will be noted, is very similar to the adrenergic innervation of the cat kidney. However, there are differences in the luminescence of the parenchyma and these must evidently be regarded as species differences. Luminescence of the cortical tubules, although it has become lighter and brighter, remains homogeneous in the cat whereas in the rat it is localized in granules.

It can be postulated on the basis of the facts described above that in the winter months catecholamine metabolism follows a different pathway so that these substances are deposited as reserve, but reversible forms. One such substance on the quinoid pathway of adrenalin conversion may be dihydroadrenalin [2]. This could be the mechanism which lies at the basis of the radical reorganization of metabolism in the hybernating organism.

LITERATURE CITED

1. E. M. Krokhina and P. N. Aleksandrov, Kardiologiya, No. 3, 97 (1969).
2. A. M. Utevskii, M. Yu. Gaisinskaya, V. M. Demnov, et al., in: Collected Scientific Transactions of Khar'kov Medical Institute [in Russian], No. 87, Khar'kov (1969), p. 33.
3. V. N. Shvalev, The Innervation of the Kidneys [in Russian], Moscow-Leningrad (1965).
4. B. N. Falck, A. Hillarp, G. Tieme, et al., J. Histochem. Cytochem., 10, 348 (1962).