KIDNEY FUNCTION IN EXPERIMENTAL PNEUMONIA

E. S. Filinova

UDC 616.24-002:092.9-07:616.61-008.1-072.7

A connection between the respiratory organs and the digestive system in both normal and pathological conditions has been demonstrated experimentally [1-3].

The results of the author's investigations have shown that in a pathological process produced artificially in the lungs of animals, the kidneys and various other organs are implicated.

Because of this fact, an investigation was carried out to study disturbances of kidney function in dogs with experimental pneumonia in chronic experimental conditions.

EXPERIMENTAL METHOD

The investigations were carried out on 7 adult dogs with ureters exteriorized separately on to the abdominal wall by the Orbeli-Tsitovich method. Pneumonia was induced by injecting a living virulent culture of pneumococcus type II into the pleural cavity under manometric control. As a preliminary step the animals were cooled in water at 10° for 10-12 min.

The state of the inflammatory process in the lungs was judged by percussion, auscultation, fluoroscopy, and roentgenography. Analysis of the blood and urine were made regularly (by the usual methods

The state of the protein metabolism was judged from the composition of the serum proteins and the nonprotein nitrogen concentration.

The kidney function was studied before and after the disease by quantitative determination of the diuresis of the right and left kidneys separately every 15 min for a period of 3.5 h.

After determination of the "spontaneous" diuresis, the animals were given a load of water and milk in a dose of 5% of body weight.

The filtration-reabsorption capacity of the kidneys was determined by intravenous injection of a 2% solution of inulin at the rate of 90-100 drops per minute. Thirty minutes after the beginning of infusion of the inulin solution, two 15-minute samples of urine were collected, and in the middle of each 15-minute period blood was taken from the jugular vein for analysis.

The excretory function of the tubules was studied by the phenol red method, the dye being determined colorimetrically. The sodium concentration in the urine and blood plasma was determined by the method of flame photometry.

The experimental results were expressed per square meter of body surface of the animal and were subjected to statistical analysis.

EXPERIMENTAL RESULTS

The condition of the dogs worsened from the 2nd day after injection of the pneumococci into the pleural cavity. The body temperature rose to 39.40°, the pulse was irregular — 110-120 per min, the heart sounds were muffled, and the respiration rate rose to 40-45 per min. The hemoglobin concentration fell from 71±5.1 to 60.5±3.5 units ($P < 0.01$), the ESR rose from 11±2.7 to 39±4.7 mm in the first hour ($P < 0.001$), and the leukocytes count rose from 10,000±1226 to 17,000±2181 per mm^3 ($P < 0.05$).

At the height of the disease, the blood prothrombin level fell from 86.7±3.28 to 76.0±2.72% ($P < 0.05$). In all the experimental animals the nonprotein nitrogen of the blood showed an increase from 25.4±1.84 to 50.5±2.38 mg% ($P < 0.001$).

Department of Pharmacology, Ivanovo Medical Institute (Presented by Active Member of the Academy of Medical Sciences of the USSR, S. R. Mardashev). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 64, No. 7, pp. 43-45, July, 1967. Original article submitted December 15, 1965.

In the course of development of the disease, during the first 5-7 days, the phagocytic activity of the leukocytes in the investigated dogs fell from 1.68 to 1.01 ($P < 0.02$).

Changes were also found in the protein composition of the blood. In the first days of the disease hypoproteinemia was observed (the blood protein concentration fell from 6.56 to 5.94 g %), associated with hypoalbuminemia, hyperglobulinemia, and a decrease in the protein coefficient by 50-67%.

Despite the decrease in the volume of urine, the specific gravity was not increased (1.001-1.002). Protein appeared in the urine (in some animals on the 10th-12th day of the disease), and reached a concentration of 0.3%; by the 18th-20th day no protein was found in the urine. Lysed and fresh erythrocytes and many leukocytes were found in the residue of the urine. The results indicated that experimental pneumonia produced marked disturbances throughout the body.

In all the experimental animals the water diuresis was reduced in the course of the disease. On the 2nd-3rd day of the disease, the diuresis fell from 2.49 ± 0.12 to 1.31 ± 0.12 ml/min/m^2 ($P < 0.001$), while on the 10th-12 day, it increased to 1.53 ± 0.35 ml/min/m^2 ($P < 0.05$). The normal diuresis was restored on the 18th-23rd day from the beginning of the disease.

The filtration capacity of the kidneys fell during the first days of the disease from 50.95 ± 4.88 to 34.97 ± 37 ml/min/m^2 ($P < 0.02$), but by the 18th-20th day, it returned to its original level. In the animals with experimental pneumonia a decrease in the phenol red clearance was observed, an index of the renal plasma flow. On the 3rd-5th day of the disease the renal plasma flow fell from 81.73 ± 9.23 to 52.06 ± 10.7 ml/min/m^2. This index returned to normal at the same time as the filtration index. Changes were also observed in the secretion of phenol red. Active excretion of the dye was reduced in the first days of the disease from 1.14 ± 0.12 to 0.8 ± 0.15 mg/min/m^2. The inulin concentration index, reflecting the reabsorption of water, was also studied in these experiments. During the disease the concentration index rose from 11.13 ± 0.92 to 19.10 ± 1.91 ($P < 0.01$), and correspondingly, the reabsorption of water was increased from 90.61 ± 1.38 to 94.02 ± 0.75% ($P < 0.05$), which was evidently responsible for the decrease in the diuresis.

During the disease the blood sodium concentration fell from 186 ± 11.5 to 137.8 ± 11.1 meq/liter and its reabsorption increased from 97.38 ± 0.72 to 98.51 ± 0.18%; by the 18th-20th day of the disease these indices had returned to their original level.

The results obtained may be regarded as reflecting neurohumoral influences on renal function from the pathologically changed lungs. The disturbances were observed throughout the length of the nephron, so that filtration and the plasma flow were diminished for a long time, indicating the presence of hemodynamic disturbances of the vascular apparatus of the kidneys. The increase in the inulin concentration index and the reabsorption of the water and sodium may be due to an increase in secretion of antidiuretic hormones by the pituitary, and of aldosterone by the adrenals, and a corresponding increase in the tubular reabsorption of sodium and water, limiting their excretion.

LITERATURE CITED

1. S. A. Konokotina, Gastric Function in Experimental Diseases of the Lungs and Pleura, Author's abstract of doctorate dissertation, Leningrad (1962).
2. S. S. Poltyrev, Problems in the Pathogenesis and Treatment of Certain Diseases of the Internal Organs in the Light of Experimental Data [in Russian], Moscow (1962).
3. N. M. Skovorodin, Disturbance and Recovery of Certain Autonomic Functions in Dogs with Experimental Diseases of the Respiratory Organs, Author's abstract of candidate dissertation, Moscow (1958).