PATHOMORPHOLOGICAL CHARACTERISTICS OF REGIONAL LYMPH GLANDS IN HYDRONEPHROSIS

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Pathomorphological changes in the regional lymph glands of the dog kidney are shown to depend on the duration of experimental hydronephrosis. The appearance of zones of necrosis in some of them is indirect evidence that the lymphatic system of the kidney participates in the removal of stagnant urine saturated with toxic products. Dilation of the intermediate and medullary sinuses, developing as the period of observation increases, is connected with the continuing inflow of lymph, contributing to its stasis, and later it leads to a retrograde flow. A mechanical obstacle appears in the path of flow of the lymph, so that the mechanical failure of the lymphatic circulation is intensified. At the same time, this is a special case of lymphogenic sclerosis, induced by the accumulation of products of disturbed metabolism, brought by the lymph, in the interstitial tissue.

KEY WORDS: experimental hydronephrosis; lymph glands of the kidney; lymphogenic sclerosis.

On account of the disturbance of the excretion of urine in hydronephrosis, the increase in toxemia is accompanied by marked disturbances of metabolism in the kidneys themselves. The lymphatic system of the kidneys plays an active role in the removal of products of disturbed metabolism, with the result that changes take place in the regional lymph glands, whose responses to endogenous toxic substances have been insufficiently studied. With an increase in the outflow of lymph from organs, the plasticity and adaptability of the lymphatic vessels to the new conditions of function are strengthened [1, 2]. Existing lymph glands are modified and new ones are formed [9, 10]. There are indications that in hydronephrosis the number and localization of the lymph glands are usually unchanged, and only in the case of giant hydronephrosis have certain topographic displacements been observed [8]. In response to obstruction of the lymphatic drainage or a change in the circulation in any organ, adaptive reorganization of the microcirculation of the regional lymph glands takes place [3-7, 11].

The object of this investigation was to study the dynamics of transformations taking place in the regional lymph glands of the kidney in experimental hydronephrosis.

EXPERIMENTAL METHOD

Hydronephrosis was produced by ligation of one or two ureters in 25 adult mongrel dogs. Ten intact animals served as the control. The period of observation varied from 1 to 72 days. The lymphatic system was injected with Gerota's mass post mortem and clarified preparations were made and studied with the MBS-1 stereoscopic microscope. Histological sections of kidney tissue fixed in 10% neutral formalin were stained with hematoxylin–eosin, with azocarmine by Heidenhain's method, for elastic fibers with resorcin–fuchselin by Weigert's method, and the reticulin stroma was impregnated by Gomori's method.

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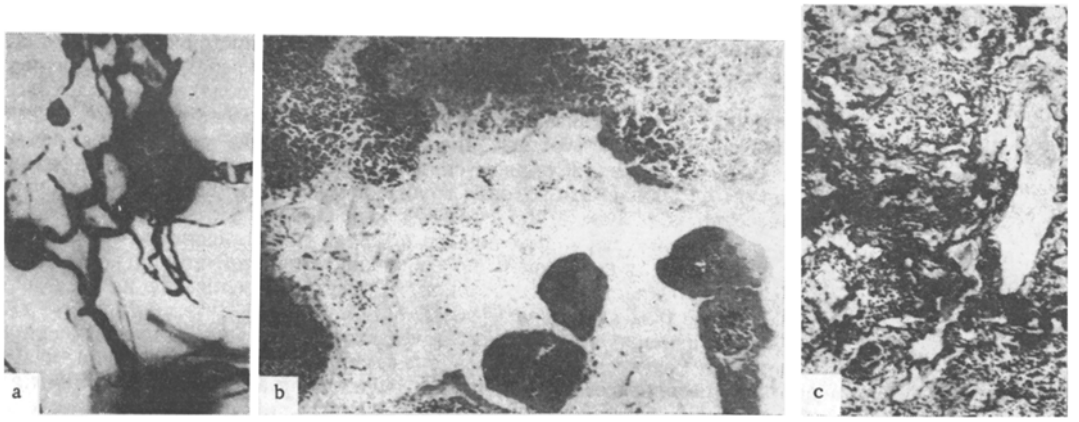

Fig. 1. Regional lymph glands of kidney in experimental hydronephrosis: a) dilation of extramural lymphatics of kidney, accessory lymph glands (MBS-1, objective 0.6, ocular 8); b) coagulated proteins in dilated medullary sinus in hydronephrosis lasting 40 days (hematoxylin–eosin, 120 ×); c) replacement of lymphoid tissue by connective tissue (progression of sclerosis). Bilateral incomplete ligation of ureters, 72 days after operation (Heidenhain's azan, 240 ×).

EXPERIMENTAL RESULTS

As they approach the lymph gland the lymphatic vessels break up into several branches and are dilated (Fig. 1a).

From 1 to 3 days after bilateral ligation of the ureter, the afferent lymphatics and peripheral sinuses of the lymph glands were dilated; they contained oxyphilic protein masses. Fibrous elements of the capsule were loosened in structure; they stained a delicate blue color with azocarmine as normally, and retained their fibrillary structure, but on impregnation with silver, they were brownish in color. The lumen of the intermediate medullary and, sometimes, the peripheral sinuses were filled with lymph and reticulum cells, together with a number of macrophages.

With an increase in the duration of hydronephrosis (7 days after the beginning of the experiment), the general "pattern" of the lymph gland became less clear and foci of necrosis were found. These were segmental in character and were more frequent after bilateral ligation of the ureters.

Two weeks after the beginning of development of hydronephrosis, the peripheral and medullary sinuses were unequally dilated. The latter had a spongy structure, their argyrophilic fibers did not form a distinct network or syncytium, as found normally or 1-3 days after ligation of the ureter, but they were seen as fragmented threads. The number of reticulum cells was reduced. The lumen of the sinuses contained masses of protein debris, basophilic in their staining properties, especially at the edges of the sinus, presumably on account of the concentration of the lymph and its coagulation taking place there. This phenomenon may be connected with the precipitation of low-molecular-weight proteins. The connective-tissue structures of the capsule of the lymph gland (compared with the picture observed after 7 days) consisted of numerous coarse spiral fibers, running in different directions. The medullary cords and trabeculae were atrophied.

One month and more after the beginning of the experiment the general "pattern" of the lymph gland was obscure. The medullary sinuses were dilated the most. They were filled with delicate fibrils and masses of protein, sharply basophilic in their staining properties, forming protein coagula (Fig. 1b). The number of argyrophilic fibers in the capsule of the lymph gland was reduced. It consisted of coarse fibrous tissue giving a brownish color on silver impregnation, chainging to cinnamon. The fibrous connective tissue of the trabeculae had similar staining properties and was lilac in color when stained with azocarmine. The medullary cords were atrophied and they contained fewer cells and a higher proportion of fibrous argyrophilic structures. However, these fibers were coarser than normal and often brownish in color.

Elastic fibers were somewhat more numerous in the trabeculae of the lymph gland during hydronephrosis, especially on the 14th day or later, compared with normal. A diffuse increase in their number was found in the capsule also (by 2 months of hydronephrosis).

Dilation of the afferent lymphatics and peripheral sinuses in the first week of hydronephrosis indicated that the lymphatic drainage at this stage of the pathological process was accomplished in the usual way. Saturation of the connective-tissue framework of the lymph glands with lymph led to progressive fibrosis and to gross changes in their general architecture (Fig. 1c). The increasing dilatation of the intermediate and medullary sinuses during progressively later observations was due to the continued inflow of lymph, leading to its stasis, followed by a retrograde flow.

Coagulation of the lymph, which started after 2 weeks in the lymphatics and sinuses of the altered lymph glands, increased with an increase in the duration of hydronephrosis and led to a still further reduction in functional capacity of the lymph gland. A mechanical obstruction to the flow of lymph appeared, thus increasing the mechanical insufficiency of the lymphatic circulation.

The increase in number of elastic fibers in the capsule can be interpreted to some extent as a compensatory and adaptive phenomenon, a response of the capsule to stretching as a result of the excessive inflow of fluid to the lymph gland. Meanwhile, this is a special case of lymphogenic sclerosis induced by the accumulation of products of disturbed metabolism, brought by the lymph, in the interstitial tissue. This is shown by changes in the staining properties of the connective-tissue framework of the lymph gland observed after the 7th-14th day of the experiment, and evidently is due to a disturbance of its physicochemical composition as a result of stagnation of the protein metabolites constantly entering the lymph gland.

Hyperplasia of reticulum cells and the presence of macrophages in the first 3 days after ligation of the ureter are the stereotyped response of lymph glands to the action of toxic substances. In hydronephrosis of a week's duration or more the number of reticulum cells was reduced, areas of necrosis appeared, and the argyrophilic fibers in the sinuses decreased considerably in number and almost disappeared. This suggests that during prolonged exposure to toxic substances the tissue anoxia increases.

In lymph glands undergoing severe sclerosis, an almost "complete block" arises, i.e., the lymph glands is quite unable to pass lymph through it. Its function is taken over by another group of lymph glands. The appearance of zones of necrosis in some of them points indirectly to the participation of the lymphatic system of the kidney in the removal of stagnant urine saturated with toxic products.

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