ADRENERGIC INNERVATION OF MESENTERIC PRECAPILLARY SPHINCTERS

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Precapillary sphincters and similar specialized effector apparatuses in the region of the microcirculation are nowadays attracting increasing attention of research workers. This is reflected clearly in the proceedings of an International Symposium devoted to precapillary sphincters from the standpoint of the microcirculation problem [10, 11]. The structure of precapillary sphincters has been described at light-optical and electron-microscopic levels in a number of morphological publications [2-4, 7, 12]. Intravital observations have been undertaken and have demonstrated the important role of sphincters in the distribution of the terminal blood flow and regulation of transcapillary exchange [4, 6, 8]. The results of physiological and pharmacological investigations testified to the high degree of reactivity and sensitivity of precapillary sphincters to various stimulating influences [5, 6, 8, 13]. In existing views the activity of precapillary sphincters is due, on the one hand, to the metabolic activity of the tissue substrate and, on the other hand, to hormonal and neuromediator influences [1, 5, 6]. Despite the presence of convincing proof of the nervous regulation of the contractile function of precapillary sphincters the question of the morphological substrate of their innervation is not yet clear. Information so far obtained is very scanty and contradictory: As well as evidence of the intensive vasomotor innervation of precapillary sphincters [4, 7], there are also indications which essentially reject any appreciable concentration of nervous structures near the sphincters [9].

The object of this investigation was a histochemical fluorescence-microscopic study of the adrenergic (sympathetic) innervation of precapillary sphincters.

EXPERIMENTAL METHOD

Total preparations of the mesentery of the small and large intestines of noninbred rats weighing 180-220 g were studied. Adrenergic nerves were detected by a modified Falck–Hillarp method. The animal was decapitated under ether anesthesia, the mesentery quickly removed and divided into separate pieces, which were stretched out on slides and dried in a current of air from a room fan (for 3-5 min). The preparations were then placed in a chamber containing paraform (water content 50-51%) for up to 3 h at 37°C. The material was examined and photographed in the ML-2 luminescence microscope. Some preparations were counterstained during microscopy with an aqueous solution of acridine orange to reveal the cell composition of the vascular walls. Other preparations, after examination in the luminescence microscope, were postfixed with formalin and counterstained with nuclear dyes so that the pattern of adrenergic innervation of the mesenteric vessels could be compared with the structure of their walls.

EXPERIMENTAL RESULTS

Microscopic study of total preparations of the mesentery stained by the Falck–Hillarp method for catecholamines revealed, besides the usual pattern of adrenergic innervation of vessels of the microcirculation, individual areas with an exceptionally high concentration of adrenergic nerve fibers along the course of the terminal microvessels. They were characterized not only by an abundance of brightly luminescent axons, but also by a unique architectonics of the corresponding fragments of the perivascular plexuses. In some cases they appeared like sinusoidal expansions, in others as sudden bends, helices, or coils. Compara-

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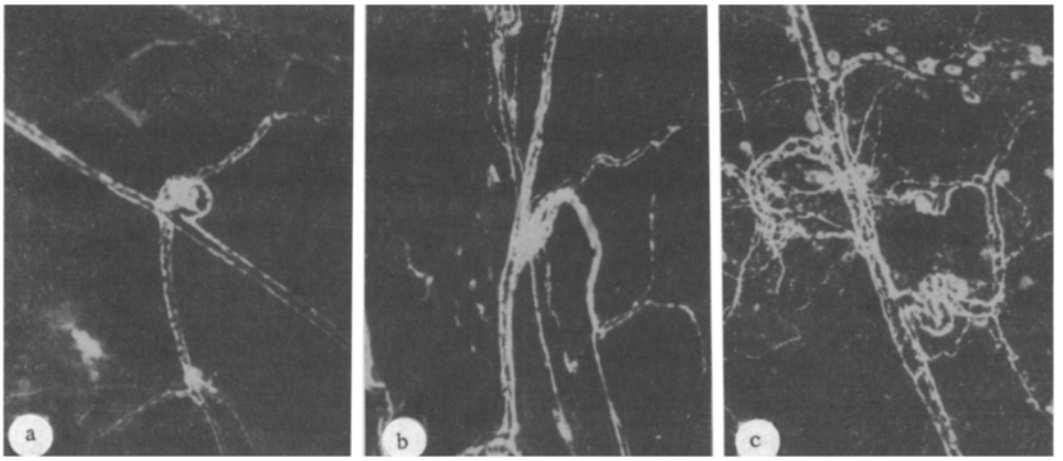

Fig. 1. Adrenergic innervation of precapillary sphincters of rat mesentery: a, b, c) different forms of neurovascular relations in region of sphincters. Falck–Hillarp method, 350 ×.

tive analysis of the preparations (including those counterstained with nuclear dyes) showed that these foci of increased concentration of adrenergic structures coincided with the distribution of precapillary sphincters and other similar effector formations in the mesenteric microcirculatory system. The particular features of their structure and configuration (local thickenings of the vessel wall, sudden bends and turns at the points where they occurred, corkscrew-like twists, and so on) largely determine the special character of the adrenergic innervation of corresponding segments of the microvessels. Different forms of structural organization of neurovascular relations in the region of the precapillary sphincters of the mesenteric microcirculation are shown in Fig. 1.

The zones of increased density of structures of the adrenergic innervation along the course of the terminal vessels can thus be regarded as the morphological substrate of the adrenergic innervation of the mesenteric precapillary sphincters. In turn, they are evidence of the role of an adrenergic (sympathetic) component of the autonomic vascular innervation in the function of the specialized mechanisms regulating the terminal blood flow mentioned above. The results of this investigation showing the presence of numerous specific contacts of adrenergic nerve structures with the walls of the precapillary sphincters agree fully with experimental results showing that the sympathetic nervous system plays a direct role in the contractile activity of these adaptive and regulatory apparatuses in the microcirculation. It must be pointed out in this connection that it is because of the adrenergic innervation of the precapillary sphincters that a number of effects observed in the microcirculation after intervention on the sympathetic nervous system at different levels can be explained. These include, in particular, the results of the action of drugs with distinct mediator properties [5, 6, 8, 13].

In conclusion, it should be noted that the term "precapillary sphincter" itself is used at the present time not only to describe strictly definite topographic-anatomical formations, but also other sphincters observed in the microcirculatory system not directly belonging to the precapillary arterioles. We refer, in particular, to sphincters of typical structure located along the course of the small arteries and their collaterals. It is that state of affairs which evidently is responsible for disagreement between the results obtained by different workers relating to the presence of precapillary sphincters in particular regions of the microcirculation and conflicting views regarding their innervation. The attempts made by individual workers [10, 11, 14], on the basis of recognition of the leading role of the morphofunctional principle, to define the sphincter mechanisms as regulators of the terminal blood flow, can be understood.

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HISTOENZYMOLOGIC FEATURES OF THE ADRENOCORTICAL RESPONSE IN SOME VERSIONS OF EXPERIMENTAL PANCREATITIS

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The role of the adrenal cortex in the pathogenesis of acute and chronic pancreatitis has not been adequately studied. Clinical, laboratory, biochemical, and experimental investigations have demonstrated changes in adrenal function in acute pancreatitis [1, 2, 5]. The morphofunctional state of the adrenals in acute pancreatitis and the stage of transition to the chronic type of pathological process are virtually unstudied.

It was accordingly decided to study the character of morphofunctional changes in the adrenal cortex during the development of experimental pancreonecrosis, including a study of correlation between structural changes in the pancreas and in the adrenal cortex. To determine the more precise role of structural-metabolic changes in the adrenals in the pathogenesis of pancreatitis, the substance methapyrone, a specific stablizer of steroid production, was used.

EXPERIMENTAL METHOD

Experiments were carried out on 80 noninbred male albino rats weighing 150-180 g, divided into groups: intact (six rats), undergoing a mock operation (20 rats), with experimental pancreonecrosis (30), with pancreonecrosis and receiving methapyrone (24). Experimental pancreonecrosis was produced by the method in [3]. Methapyrone was injected subcutaneously in a dose of 11 mg/100 g body weight 24 h after production of the disease, and thereafter daily for 14 days. The adrenals were studied on the 1st, 3rd, 7th, 14th, and 30th days of the experiment. Activity of NAD- and NADP-diaphorases, glucose-6-phosphate dehydrogenase (G6PDH), and of 3 β-OH-steroid dehydrogenase (3β-OH-SDH) was determined histochemically in frozen sections 10 μ thick. The intensity of the histochemical reactions was assessed by indirect cytophotometry, photographs being taken on the MUF-6 instrument, and the negatives subjected to photometry on the MF-4 instrument. The results of photometry were subjected to statistical analysis on the EC-10-22 computer using a program prepared for functional morphologic analysis of the endocrine system [4].

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