CHANGES IN THE LUMEN OF VISCERAL ARTERIOVENOUS ANASTOMOSES DURING PRESSOR REFLEXES

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Changes in the diameter of visceral arteriovenous anastomoses and the microsphere shunting index during pressor reflexes were studied by injection of microspheres in acute experiments on cats. A decrease in the throughput of the arteriovenous anastomoses was found in the small intestine, spleen, kidney, and gastrocnemius muscle during the carotid sinus pressor reflex and electrical stimulation of afferent fibers of the sciatic nerve or brachial plexus.

KEY WORDS: arteriovenous anastomoses; microspheres; pressor reflexes.

The presence of arteriovenous anastomoses (AVAs) in the organs of the splanchnic region and in the skeletal musculature, their size, and their innervation have received comparatively little attention in the literature [1-3, 6-9, 11]. So far as the character of changes in the diameter of AVAs under neurogenic influences and, in particular, during pressor reflexes is concerned no information whatever is to be found.

The object of this investigation was to study changes in the diameter of AVAs in various organs during pressor reflexes.

EXPERIMENTAL METHOD

Experiments were carried out on cats anesthetized with urethane (1 g/kg) and heparinized (1000 units/kg). Changes in the diameter of AVAs during the reflexes were determined by injection of microspheres into the afferent artery of the organ and detecting them in the outflowing venous blood [4]. The microsphere shunting index, the ratio between the fraction of microspheres more than 20 μ in diameter passing through the vascular system of the organ and the fraction of microspheres of a smaller diameter, also was calculated [4, 5]. Changes in the diameter of AVAs in the small intestine, spleen, kidney, and gastrocnemius muscle were recorded during the carotid sinus pressor reflex and also during electrical stimulation of afferent fibers of the sciatic nerve or brachial plexus (10-15 V, 5 msec, 30 Hz).

EXPERIMENTAL RESULTS AND DISCUSSION

The capillaries of the small intestine, spleen, kidneys, and gastrocnemius muscle are known to vary in diameter from 2 to 20 μ [3, 10, 13]. The fact that in the present experiments microspheres over 20 μ in diameter passed through the vascular system of the organs studied (Table 1) could be evidence that the organs contain AVAs with a maximal diameter corresponding to that of the microspheres which passed through. The diameter of AVAs in dogs and rabbits, determined by the microsphere-injection method, is 20-40 μ in the intestine [7, 13], 160 μ in the spleen [12], 15-60 μ in the kidney [8, 9], and 20-40 μ in the skeletal muscle [11].

During the carotid sinus pressor reflex the maximal diameter of AVA was virtually unchanged ($P > 0.1$), but as Fig. 1 shows, the number of microspheres from 24 to 48 μ in diameter passing through them was considerably reduced. The microsphere shunting index fell correspondingly, possible evidence of a decrease in the total throughput of the AVAs.

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TABLE 1. Changes in Lumen of AVAs and in Systemic Arterial Pressure during Pressor Reflexes (M ± m)

Organ studied	Original state		Carotid sinus pressor reflex	
	maximal diameter of AVA (in μ)	shunting index	maximal diameter of AVA (in μ)	shunting index
Small intestine	45,6±1,3	0,5±0,05	51,2±3,5	0,3±0,1
Spleen	52,0±3,1	0,6±0,04	33,6±7,2	0,2±0,05
Kidney	54,5±3,1	0,3±0,1	46,4±6,8	0,2±0,08
Gastrocnemius muscle	29,2±1,7	0,4±0,06	24,0±3,9	0,3±0,07

Organ studied	Carotid sinus pressor reflex	Electrical stimulation of afferent fibers of somatic nerves		
	increase in arterial pressure (in % of initial level	maximal diameter of AVA (in μ)	shunting index	increase in arterial pressure (in % of initial level
Small intestine	31,0±1,7	54,7±1,9	0,25±0,08	25,5±5,1
Spleen	26,2±3,8	39,8±4,5	0,3±0,1	26,8±3,2
Kidney	25,0±5,4	43,2±5,9	0,3±0,1	29,7±4,3
Gastrocnemius muscle	24,1±2,9	22,7±3,6	0,15±0,06	22,0±4,3

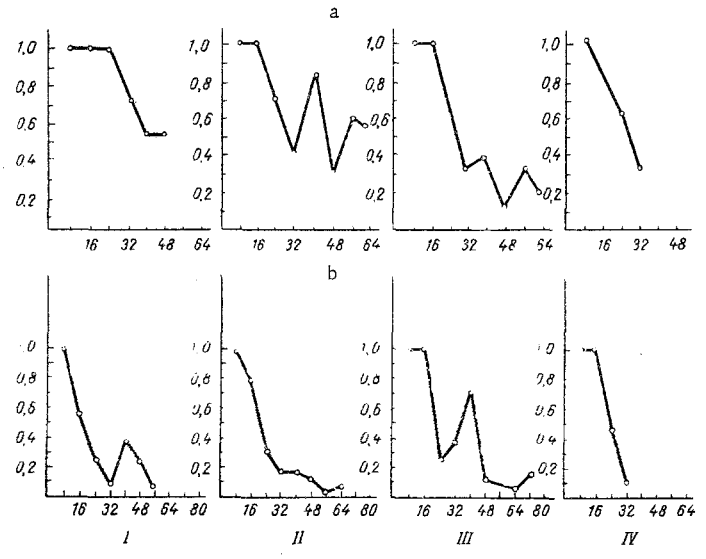

Fig. 1. Distribution by diameters of microspheres passing through vessels of small intestine (I), spleen (II), kidney (III), and gastrocnemius muscle (IV) in initial state (a) and during carotid sinus pressor reflex (b). Abscissa, diameter of microspheres (in μ); ordinate, fraction of microspheres of each diameter.

Microspheres with diameters of up to 64 and 72 μ respectively passed through the AVAs of the spleen and kidney during the carotid sinus pressor reflex, but most of them were between 24 and 48 μ in diameter (Fig. 1). The numbers of microspheres of all diameters shunted through the AVAs also were much smaller than in the initial state. The mean maximal diameter of the AVAs in these organs and the microsphere shunting index were reduced under these conditions (Table 1).

During the carotid sinus pressor reflex microspheres up to 32 μ in diameter passed through the blood vessels of the gastrocnemius muscle, but the number of shunted microspheres from 24 to 32 μ in diameter, like the microsphere shunting index, was considerably reduced. The maximal diameter of AVAs of the gastrocnemius muscle in these experiments was reduced only slightly ($P > 0.1$).

Similar changes in patency of the AVAs of these organs also were observed during pressor reflexes evoked by electrical stimulation of afferent fibers of the somatic nerves (Table 1).

During pressor reflexes the greatest decrease in the maximal diameter of the AVAs took place in the spleen, the decrease was smaller in the kidney and gastrocnemius muscle, and in the small intestine there was a small increase. Meanwhile the microsphere shunting indices were reduced in all organs, possibly indicating a change in the total throughput of the AVAs of these organs during excitation of the sympathetic nervous system.

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