MORPHOLOGICAL AND FUNCTIONAL ASYMMETRY OF THE MICROVASCULAR BED OF THE RABBIT EAR

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When studying the dynamics of the rheologic parameters of blood flowing from an ischemic region of the rabbit external ear, our attention was drawn to the opposite direction of changes in the apparent viscosity of blood taken from the internal vein of the right and left ear. There is evidence in the literature of a difference in the parameters of the blood flow in different brain zones, and in the right and left human forearm, on correlation between rheologic parameters and parameters of the microvessels, and on differences in the dynamics of the blood flow during ischemia in microvessels differing in their development and structure [1, 2, 6, 7]. On the assumption that this asymmetrical response to ischemia may be due to differences in the organization of the vascular bed, we decided to make a comparative study of the rheologic and morphometric parameters of the microvessels of the right and left ears of the rabbit before and after ischemia.

EXPERIMENTAL METHOD

Experiments were carried out on 10 chinchilla rabbits weighing 2-2.5 kg, using the transparent chambers method [3]; the rabbits were used in the experiments 8 weeks after implantation of the chambers. Experiments on each animal were carried out at intervals of 8-10 days in random order. Ischemia was induced by flexing the concha auriculae at the boundary between its upper and middle thirds and applying a soft clamp along the line of flexion for 30 min. Blood was taken from the internal vein of ear before ischemia, immediately after removal of the clamp, and 1 h after ischemia. The apparent viscosity of whole blood was estimated by means of a capillary viscometer, with shear stress of 3.68 dynes/cm^2. Electrophoretic mobility (EPM) was determined in blood diluted 1:800 with phosphate buffer on an apparatus with a Goryaev's counting chamber [4]. The red cell concentration per unit volume of blood and also their mean volume were determined with the "Celloscope-101" instrument, with blood diluted 1:80,000. The weight of the red cells was calculated by the equation $W = N \cdot V$. For morphometry of the microvascular bed a Leitz-TAC analyzer [5] was used. The total area of projection of the perfused microvessels, the total length of projection of the microvessels, and their mean diameter were calculated. Differences were assessed by Student's test for tied pairs, and correlation between the parameters of the bed was studied by methods of correlation analysis, significance being estimated by Student's test.

EXPERIMENTAL RESULTS

It will be clear from Fig. 1 that in the resting state the area of projection of the microvessels was 36.6% greater on the left than on the right side. The total length of the vessels was 1.5 times greater on the left than on the right, but the mean diameter (D) and viscosity of the outflowing blood (μ) were 14.6 and 16.8% less respectively on the left than on the right. The ratio L/D was 79% higher on the left than on the right.

After ischemia for 30 min the increase in area of projection of the vessels (by 18.1% on the left, 12.9% on the right) was due to an increase in the number of vessels perfused (by 13.9%) and an increase in their mean diameter (by 9.7%), i.e., to dilatation. The L/D ratio after ischemia rose by 9.5% on the left but fell by 6% on the right. Changes in the apparent viscosity of the blood after ischemia were in opposite directions: it increased by 13.6% on the left but decreased by 7.9% on the right.
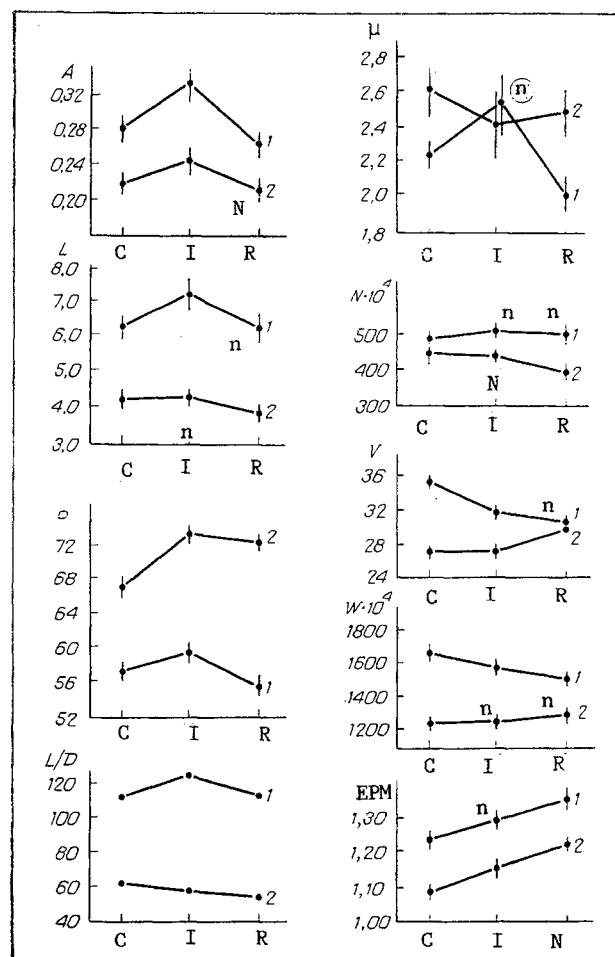

Fig. 1.   Dynamics of rheologic and morphologic parameters of microvessels of the rabbit ear after local ischemia. Abscissa: C) before ischemia, I) immediately after ischemia, R) 1 h after ischemia; ordinate: A) area of projection of perfused microvessels (in mm^2), L) length of microvessels (in mm), D) mean diameter (in μ), μ) apparent viscosity of blood (in cp), N) number of red cells per unit volume of blood in $1/mm^3$. V) mean red cell volume (conventional units), W) weight of red cell (in conventional units), EPM)(in $\mu \cdot sec^{-1} \cdot V^{-1} \cdot cm$). 1) Vessels in left chamber, 2) vessels in right chamber.   n) Differences not significant relative to initial level, O) differences not significant between points on curves 1 and 2.

1096

TABLE 1. Correlation Matrices for Rheologic and Morphometric Parameters of Microvascular Bed of the Left (1) and Right (2) Rabbit Ears in Initial State

	1	2	3	4	5	6	7	8	9	10
Bed 1										
1	1.000	0,999	0,917	0,917	0,252	0,364	—0,554	0,084	—0,193	0,980
2	0,999	1,000	0,910	0,909	0,269	0,353	—0,549	0,075	—0,205	0,980
3	0,917	0,910	1,000	1,000	—0,138	0,568	—0,628	0,285	0,093	0,875
4	0,917	0,909	1,000	1,000	—0,138	0,571	—0,625	0,283	0,092	0,873
5	0,252	0,269	—0,138	—0,139	1,000	—0,262	0,346	—0,689	—0,869	0,252
6	0,364	0,353	0,568	0,571	—0,262	1,000	0,182	—0,276	—0,182	0,185
7	—0,554	—0,549	—0,628	—0,625	0,346	0,182	1,000	—0,862	—0,643	—0,672
8	0,084	0,075	0,285	0,283	—0,689	—0,276	—0,862	1,000	0,938	0,212
9	—0,193	—0,205	0,093	0,092	—0,869	—0,182	—0,646	0,938	1,000	—0,096
10	0,980	0,981	0,875	0,873	0,252	0,185	—0,672	0,212	—0,096	1,000
Bed 2										
1	1,000	1,000	0,312	0,308	0,820	0,305	—0,548	—0,752	—0,655	—0,905
2	1,000	1,000	0,311	0,307	0,820	0,305	—0,548	—0,752	—0,655	—0,905
3	0,312	0,312	1,000	1,000	—0,230	—0,708	—0,549	—0,436	—0,493	—0,629
4	0,308	0,308	1,000	1,000	—0,234	—0,710	—0,547	—0,433	—0,491	—0,625
5	0,820	0,820	—0,230	—0,234	1,000	0,794	—0,434	—0,668	—0,558	—0,612
6	0,305	0,305	—0,707	—0,710	0,794	1,000	—0,153	—0,323	—0,245	—0,063
7	—0,548	—0,548	—0,549	—0,547	—0,434	—0,153	1,000	—0,955	0,988	0,801
8	—0,752	—0,752	—0,436	—0,433	—0,668	—0,323	0,955	1,000	0,988	0,893
9	—0,656	—0,656	—0,493	—0,491	—0,558	—0,245	0,988	0,988	1,000	0,854
10	—0,905	—0,905	—0,629	—0,625	—0,611	—0,063	0,801	0,893	0,854	1,000

Legend. Correlations below 0.632 considered to be not significant. 1) A, 2) A/S (percentage of vascularization), 3) L, 4) L/V (specific length), 5) D, 6) μ, 7) N, 8) V, 9) W, 10) EPM.

Thus the vascular network in the chambers of the left and right ears differ in their morphological and functional characteristics.

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