CHANGES IN ADHESIVENESS AND AGGREGATION OF PLATELETS AFTER PASSAGE OF BLOOD THROUGH THE LUNGS

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During passage of the blood through the lungs the degree of deaggregation of the platelets is increased and the activity of factor XIII is lowered.

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Thrombi develop 5 times less commonly in arteries than in veins [1]. This difference is mainly associated with differences in the velocity of blood flow [12]. No allowance is made for the fact that, as blood passes through the systemic and pulmonary portions of the circulation, the physiological state of the clotting system changes. Pavlov [6], for instance, pointed out that blood which had passed through the lungs loses its ability to clot. Venous blood has been shown to clot more slowly than arterial [5] and the fibrinolytic activity of venous blood is higher than that of arterial blood [10]. Adhesiveness and aggregation of the platelets of arterial and venous blood have received little study. The index of adhesiveness of the platelets is known to be slightly higher in arterial than in venous blood [9].

The object of this investigation was to study changes in adhesiveness and aggregation of platelets due to passage of the blood through the systemic and pulmonary circulations.

EXPERIMENTAL METHOD

Two series of experiments were carried out on 24 dogs of both sexes weighing from 7 to 28 kg. In series I the number, adhesiveness, and aggregation of the platelets, the plasma recalcification time, the activity of factor XIII (fibrin-stabilizing enzyme of Läki and Lorand, fibrinase) and the thrombotest were studied in blood obtained from the femoral artery and vein. In series II the same indices were studied in blood obtained from the right and left sides of the heart. Blood was taken under general anesthesia (10% chloral hydrate solution, 0.4-0.5 g/kg, intraperitoneally). Blood was taken from the femoral vessels by puncture with silicone-treated needles, and from the right and left sides of the heart with silicone-treated catheters. The right heart was catheterized through the jugular vein and the left through the carotid artery. Blood taken simultaneously from arteries and veins was stabilized with 3.8% sodium citrate solution in the ratio of 9:1. Plasma rich in platelets was obtained by centrifugation of the blood at 1000 rpm for 10 min. Plasma poor in platelets was obtained by centrifugation of the blood at 5000 rpm for 25 min.

Adhesiveness of the platelets was determined by the method of Wright and co-workers using Pyatnitskii's capillary tubes, rotated at 30 rpm for 20 min. Aggregation of the platelets was determined by Born's method [8] not later than 1.5-2 h after collection of the blood. Aggregation of the platelets was investigated over a period of 24 min in plasma containing 1×10^5 platelets/mm^3 and ADP in a final concentration of 0.2 mg/ml. The beginning of aggregation (in seconds), the intensity of aggregation (decrease in optical density of the aggregating platelet suspension, expressed in mV), and the percentage of deaggregation were noted. Simultaneous determinations were made of the plasma recalcification time by the method

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TABLE 1. Adhesiveness and Aggregation of Blood Platelets from Femoral Vessels of Dogs

Index	Femoral artery	Femoral vein	P
Platelet count (thousands/mm^3)	392	360	< 0.01
Adhesiveness of platelets (percentage of adherent forms)	27	23	< 0.02
Aggregation of platelets			
Beginning of aggregation (in sec)	20	15	< 0.01
Intensity of aggregation (in mV)	13.8	12.3	> 0.5
Reversible aggregation (in%)	21	3	< 0.05
Activity of factor XIII (in sec)	216	257	< 0.01
Plasma recalcification time (in sec)	101	97	> 0.5
Thrombotest (degree)	4-5	5-6	–

TABLE 2. Changes in Adhesiveness and Aggregation of Platelets During Passage of Blood through Pulmonary Circulation

Index	Right heart	Left heart	P
Platelet count (thousands/mm^3)	261	273	> 0.2
Adhesiveness of platelets (percentage of adherent forms)	28	25	> 0.2
Aggregation of platelets			
Beginning of aggregation (in sec)	24	36	< 0.01
Intensity of aggregation (in mV)	19.3	18.7	> 0.5
Reversible aggregation (in%)	3	18	< 0.02
Activity of factor XIII (in sec)	231	201	< 0.02
Plasma recalcification time (in sec)	112	122	> 0.5
Thrombotest (degree)	4-4	4-4	–

of Baluda and co-workers [2], the activity of factor XIII by the method of Baluda and co-workers [3], and the thrombotest as described by Filatov and Kotovshchikova [7]. Statistical analysis of the results was carried out by the difference method [4].

EXPERIMENTAL RESULTS

As Table 1 shows, blood obtained from the femoral artery contained on the average 9% more platelets than venous blood. The adhesiveness of platelets from venous blood was slightly lower than that from arterial. A significant difference was found between aggregation of the platelets. In venous blood the rate of aggregation was 33% higher on the average, while the degree of deaggregation of the aggregated platelets was 18% lower than in arterial blood. Reduced ability of aggregated platelets of venous blood to undergo deaggregation was observed parallel with higher activity of factor XIII in venous plasma.

As Table 2 shows, during passage of the blood through the pulmonary circulation the rate of aggregation of the platelets fell by 50%, while the degree of deaggregation of aggregated platelets increased sixfold. Activity of factor XIII was lowered in blood which had passed through the pulmonary circulation.

Since blood was taken from the left and right sides of the heart, changes developing in it during passage through the pulmonary circulation must evidently be attributed to some effect of the lungs.

In regard to the important role of platelets in thrombus formation [11], it can be postulated that the lungs reduce the ability of the blood to thrombus formation by stimulating deaggregation of aggregated platelets.

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