The Influence of Colloidal Plasma Substitutes on Spontaneous and Induced Platelet Aggregation

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Colloidal plasma substitutes, particularly dextrans, are increasingly used for thrombosis prophylaxis (1, 4, 5, 6, 8). Intra- and postoperatively they serve for volume substitution and for thrombosis prophylaxis as well. In internal medicine dextran is used for prophylaxis of myocardial infarction, cerebral vascular accidents and thrombosis of arteriovenous shunts in patients on hemodialysis (7). The effect in thrombosis prophylaxis of dextran seems to be comparable with that of oral anticoagulants.

In the present study it was intended to prove and to compare the influence of dextran 40, hydroxyethyl starch and polypeptidyl gelatin on spontaneous, ADP-, epinephrine- and collagen-induced platelet aggregation.

Patients and Methods

30 male and female patients between 22 and 48 years of age (32 ± 7.5 years; x ± SEM) were included in the study, 15 of them had a normal spontaneous platelet aggregation (PAT III negative; Q : α2 \(> 10 \text{ min}^{-1}\)), 15 showed a pathologically increased spontaneous aggregation (PAT III positive; Q : α2 \(> 10 \text{ min}^{-1}\)). To three different groups consisting of 10 patients each (5 patients PAT III positive and 5 patients PAT III negative) 10% dextran 40, 6% hydroxyethyl starch or 3.5% polypeptidyl gelatin was given. The infusions were applied thrice over 3 consecutive days each within 1 hour. Before and one hour after the end of infusion venous blood was taken, in order to measure spontaneous, ADP-, epinephrine- and collagen-induced platelet aggregation and to determine platelet count. 30-90 minutes after blood was taken platelet aggregation was measured with the Born-aggregometer. Spontaneous platelet aggregation was determined by the platelet aggregation test III (PAT III, Breddin et al. (2)). For inducing platelet aggregation 10^{-6} molar ADP, 5 × 10^{-6} molar epinephrine and 1 μg collagen/ml platelet rich plasma was used.

For interpretation of the spontaneous platelet aggregation the angle α, time reaction Tr and the quotient Q of α and Tr came to estimation. For interpretation of ADP-induced aggregation the maximum amplitude Ma and percent of disaggregation, for interpretation of epinephrine-induced aggregation the maximum amplitude Ma and angle α1 and of collagen-induced aggregation maximum amplitude Ma, angle α1 and time reaction Tr was taken. All these parameters document the platelet reactivity. Statistical analysis of the results was made by Student’s t-test.

Results and Discussion

Dextran and Platelet Aggregation. All 5 patients with primarily positive PAT III showed normalization of the positive PAT III after the first infusion of 500 ml 10% dextran 40. The quo-
tient Q: \( \frac{dQ}{dT} \) fell from \( 16,5 \pm 3,4 \text{ min}^{-1} \) to \( 1,6 \pm 1,3 \text{ min}^{-1} \) after first infusion and to \( 1,6 \pm 1,3 \text{ min}^{-1} \) after third infusion (\( \bar{x} \pm \text{SEM} \); Fig. 1). The decrease of Q was statistically significant (\( p < 0,05 \)). Normalization of pathological spontaneous aggregation of these patients lasted on the average of 7 days. Thereafter Q rose above the limit of 10 min\(^{-1}\). ADP-, epinephrine- and collagen-induced platelet aggregation was also markedly inhibited by dextran 40. Patients, who showed a negative PAT III before infusion, had a marked inhibition of platelet function by application of dextran, too, but less than those with primarily positive PAT III.

**Fig. 1.** Spontaneous platelet aggregation of a 33 year-old patient before infusion (left part of the figure; positive PAT III) and after third infusion of 500 ml dextran 40 10% (right part of the figure; negative PAT III). X-axis shows optical density (620 nm, \( d = 1 \text{ cm} \)), y-axis shows time in minutes

**Hydroxyethyl Starch and Platelet Aggregation.** In contrast to patients treated with dextran 40 the 5 patients having a positive PAT III before infusion of 500 ml 6% hydroxyethyl starch had neither after the first nor after the third application a normal PAT III. ADP-induced platelet aggregation however was inhibited. Disaggregation in these patients rose from \( 2,9 \pm 0,9\% \) to \( 27,5 \pm 7,3\% \), maximum amplitude fell from \( 546 \pm 50,1 \) to \( 450 \pm 7,9 \) (\( \bar{x} \pm \text{SEM} \)) after the third infusion (Table 1). Epinephrine- and collagen-induced platelet aggregation was also inhibited by hydroxyethyl starch in patients with primarily positive PAT III as well as in those with primarily negative PAT III.

**Gelatin and Platelet Aggregation.** Gelatin had no inhibitory influence on platelet function.