

EFFECT OF LYMPH WITHDRAWAL DURING DRAINAGE OF THE THORACIC
DUCT ON DEVELOPMENT OF THE DISSEMINATED INTRAVASCULAR
COAGULATION SYNDROME

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The development of a disseminated intravascular coagulation (DIC) syndrome in several pathological states is due to the entry of large quantities of substances with thromboplastic activity from destroyed tissues into the blood stream [2]. The method of treatment with heparin, usually employed in this case, does not prevent its development, and this is evidently the reason why heparin is ineffective [11]. These substances with thromboplastic activity are proteins and enter the blood stream mainly via the lymphatic system [12]. Lymph withdrawal, by interrupting their entry into the blood, ought to weaken the development of the DIC syndrome significantly.

In the investigation described below interruption of access of thromboplastically active substances into the blood stream by lymph withdrawal on development of the DIC syndrome was studied.

EXPERIMENTAL METHOD

Experiments were carried out on 25 mature mongrel dogs of both sexes weighing 10-17 kg, under pentobarbital anesthesia (30 mg/kg body weight). The DIC syndrome was induced by administering vinegar essence (2 ml/kg) by gastric tube to 10 intact dogs and 15 dogs subjected to preliminary drainage of the thoracic duct and lymph withdrawal in a volume of 6 ml/kg body weight. Preliminary experiments showed that lymph withdrawal on this scale has no significant effect on blood clotting in anesthetized animals. Blood for investigation was taken from the femoral vein and mixed with sodium oxalate in a dilution of 1:5 in the initial state and 15, 60, 120, and 180 min after the beginning of the experiments. The recalcification [5], prothrombin [9], and thrombin times [8], concentrations of fibrinogen [7], of soluble fibrin [10], fibrin degradation product (FDP) [1], antithrombin III (AT III) [3], and heparin [6], fibrinolytic activity (FA), plasmin activity, and the plasminogen activator level [4] were determined.

EXPERIMENTAL RESULTS

Administration of vinegar essence to the animals caused a decrease in the recalcification and thrombin times and concentration of the factors of the prothrombin complex, but an increase in concentrations of soluble fibrin and FDP, in FA, and the plasminogen activator level after 15 min (Table 1). These disturbances were more marked after 180 min. The fibrinogen concentration also was sharply reduced, which corresponded to stage I-II of the DIC syndrome.

Lymph withdrawal significantly reduced the severity of the blood coagulation disturbances (Table 2). The recalcification time showed a smaller decrease (especially after 120 min). After 15 min the concentrations of factors of the prothrombin complex and of soluble fibrin were unchanged, but the FDP level was lowered. By the 180th minute the concentrations of factors of the prothrombin complex were reduced but the heparin and FA levels, plasmin activity, and the concentration of plasminogen activator were increased significantly less than in animals without lymph withdrawal. The thrombin time and concentrations of fibrinogen and soluble fibrin after lymph withdrawal were not significantly different from those in animals in the initial state. The FDP concentration was lowered.

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TABLE 1. Parameters of Clotting and Anticlotting Systems of the Blood in Dogs Poisoned with Vinegar Essence ($M \pm m$)

| Parameter | Initial state | Time interval, min | | | |
|--|------------------|--------------------|--------------------|--------------------|--------------------|
| | | 15 | 60 | 120 | 180 |
| Recalcification time, sec | 92,8 \pm 4,0 | 51,1 \pm 2,7** | 46,7 \pm 6,5** | 47,3 \pm 6,1** | 67,0 \pm 10,0* |
| Prothrombin time, sec | 15,5 \pm 0,5 | 24,5 \pm 2,8* | 32,6 \pm 7,4* | 35,5 \pm 8,4* | 33,5 \pm 7,8* |
| Thrombin time, sec | 27,6 \pm 1,5 | 18,6 \pm 2,9** | 32,8 \pm 9,1** | 47,8 \pm 10,3** | 83,4 \pm 21,8** |
| Fibrinogen, mg % | 408,1 \pm 33,4 | 335,0 \pm 76,0 | 358,1 \pm 58,1** | 100,0 \pm 14,7** | 75,2 \pm 11,2** |
| Soluble fibrin, mg % | 19,3 \pm 1,9 | 33,2 \pm 3,9* | 53,5 \pm 9,2** | 103,0 \pm 13,4** | 156,1 \pm 31,5** |
| FDP, mg % | 17,3 \pm 1,1 | 26,7 \pm 3,6* | 34,7 \pm 3,8** | 23,5 \pm 3,7 | 19,1 \pm 1,9 |
| AT III | 78,4 \pm 18,6 | 81,3 \pm 9,9 | 126,4 \pm 6,1* | 155,0 \pm 8,3* | 110,6 \pm 30,4* |
| Heparin time, sec | 14,8 \pm 0,4 | 16,0 \pm 1,3 | 17,8 \pm 1,2* | 24,6 \pm 1,4** | 30,5 \pm 2,6** |
| FA, mm ² | 31,0 \pm 1,9 | 52,6 \pm 3,3* | 83,8 \pm 11,0** | 130,5 \pm 17,1** | 161,5 \pm 25,2** |
| Plasmin activity, mm ² | 5,0 \pm 1,1 | 9,5 \pm 2,6 | 14,8 \pm 1,2** | 18,3 \pm 1,2** | 23,6 \pm 3,5** |
| Plasminogen activator, mm ² | 26,5 \pm 2,6 | 43,1 \pm 4,4** | 69,4 \pm 11,4** | 112,2 \pm 17,7** | 137,9 \pm 18,4** |

Legend. Here and in Table 2, P is compared to the initial state. * $P < 0.05$; ** $P < 0.01$.

TABLE 2. Parameters of Clotting and Anticlotting Systems of the Blood in Dogs Poisoned with Vinegar Essence Preceded by Lymph Withdrawal ($M \pm m$)

| Parameter | Initial state | Time interval, min | | | |
|--|------------------|--------------------|------------------|------------------|------------------|
| | | 15 | 60 | 120 | 180 |
| Recalcification time, sec | 99,0 \pm 7,4 | 63,1 \pm 4,3 | 72,5 \pm 7,3 | 66,3 \pm 11,1 | 75,8 \pm 10,3 |
| Prothrombin time, sec | 16,0 \pm 0,5 | 15,8 \pm 0,8 | 19,0 \pm 1,0 | 20,4 \pm 0,6 | 22,8 \pm 0,7 |
| Thrombin time, sec | 28,0 \pm 1,1 | 22,7 \pm 1,7 | 23,6 \pm 0,9 | 21,7 \pm 0,9 | 25,0 \pm 4,6 |
| Fibrinogen, mg % | 329,5 \pm 40,1 | 406,2 \pm 19,3 | 420,0 \pm 13,2 | 329,3 \pm 19,8 | 229,3 \pm 42,3 |
| Soluble fibrin, mg % | 13,2 \pm 0,6 | 13,2 \pm 0,6 | 11,2 \pm 0,6 | 12,0 \pm 0,3 | 11,2 \pm 0,3 |
| FDP, mg % | 19,7 \pm 2,2 | 10,3 \pm 3,4 | 10,6 \pm 2,1 | 12,4 \pm 1,9 | 7,3 \pm 0,5 |
| AT III | 52,6 \pm 10,6 | 55,2 \pm 4,8 | 76,5 \pm 9,8 | 121,1 \pm 5,7 | 133,7 \pm 6,6 |
| Heparin time, sec | 15,8 \pm 0,5 | 13,5 \pm 0,7 | 18,0 \pm 0,6 | 20,0 \pm 0,5 | 19,2 \pm 2,7 |
| FA, mm ² | 34,1 \pm 4,2 | 50,5 \pm 4,5 | 48,2 \pm 4,0 | 59,5 \pm 2,5 | 66,8 \pm 3,6 |
| Plasmin activity, mm ² | 18,2 \pm 4,8 | 19,2 \pm 3,7 | 3,6 \pm 1,3 | 7,4 \pm 1,4 | 10,8 \pm 3,1 |
| Plasminogen activator, mm ² | 25,9 \pm 3,9 | 41,3 \pm 4,7 | 39,2 \pm 4,6 | 52,5 \pm 2,5 | 55,1 \pm 4,8 |

Legend. P₁) Compared with values for animals without lymph withdrawal.

Thus by removing large quantities of thromboplastically active substances from the tissues lymph withdrawal reduces the consumption of clotting system factors and the intensity of the DIC syndrome.

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