

DISTURBANCES OF THE CLOTTING AND ANTICLOTTING  
SYSTEM OF THE BLOOD AND CEREBROSPINAL FLUID  
IN EXPERIMENTAL BRAIN TRAUMA

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In cats with a mild degree of brain trauma disturbances of blood coagulability take the form of hypercoagulemia, which is most marked during the first 3 days after infliction of the trauma and disappears by the 12th day. Components of the clotting and ant clotting system, absent in intact animals, appear in the cerebrospinal fluid after brain trauma.

In the course of an experimental study of the effect of brain trauma on the structure of the vascular system of the choroid plexuses, the writer noted that, besides a disturbance of the coagulability of the blood, components of the clotting and ant clotting systems appear in the cerebrospinal fluid (CSF). After brain trauma, the chemical composition of the CSF is known to be changed [1, 2, 4-6, 7, 11]. Considerable attention has been paid to investigation of the clotting and ant clotting systems of the blood in brain trauma [3, 5, 8, 12], but some aspects of this problem have still been inadequately studied.

The object of the present investigation was to examine the clotting and ant clotting system of the blood and CSF in cats with brain trauma.

EXPERIMENTAL METHOD

Experiments were carried out on 42 cats weighing from 2 to 3.5 kg. A mild, measured degree of brain trauma was inflicted. Blood was taken from the internal jugular vein and CSF by suboccipital puncture. Blood and CSF samples were taken 12 and 24 h and 3, 6, and 12 days after trauma. The following tests were carried out on the blood and CSF: recalcification time and fibrinogen concentration by Rutberg's method; heparin tolerance by Poller's method; fibrinase activity by the method of Baluda, Zhukova, and Rudenkova; the thrombotest by Ito's method in Kotovshchikova's modification; fibrinogen B by the method of Kumain and Lyon; fibrinolytic activity by the method of Kowalski, Kopec, and Niewiarowski; and free heparin by Sirmal's method in the modification of the Central Blood Transfusion Institute.

EXPERIMENTAL RESULTS

The indices of the state of the blood clotting and ant clotting systems in the control group of animals are given in Table 1 and agree with those published in the literature [9, 10]. No components of the clotting and ant clotting systems could be found in the CSF of the normal cats.

A disturbance of the blood clotting system was observed 12 h after brain trauma (Table 1): the plasma recalcification time was shortened, the fibrinogen concentration, plasma heparin tolerance, and fibrinase activity were increased; the test for fibrinogen B was strongly positive, and the thrombotest was positive to the 6th-7th degree. The prothrombin concentration was reduced. The indices of the ant clotting system remained within normal limits. Meanwhile, certain components of the clotting system, namely fibrinase,

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TABLE 1. Changes in the Clotting and Anticlotting Systems of the Blood and CSF after Brain Trauma

| Index                          | Material | Normal       | Time after brain trauma   |                           |                           |                          |
|--------------------------------|----------|--------------|---------------------------|---------------------------|---------------------------|--------------------------|
|                                |          |              | 12 h                      | 24 h                      | 3 days                    | 6 days                   |
| Recalcification time (in sec)  | Blood    | 70.8 ± 2.2   | 53.0 ± 1.2 <sup>1</sup>   | 35.3 ± 2.2 <sup>1</sup>   | 51.3 ± 2.0 <sup>1</sup>   | 66.3 ± 1.8               |
|                                | CSF      | —            | 515.0 ± 14.6              | 347.5 ± 13.7              | 436.6 ± 41.7              | —                        |
| Fibrinogen (in mg %)           | Blood    | 299.4 ± 6.7  | 447.8 ± 13.2 <sup>2</sup> | 623.3 ± 12.5 <sup>2</sup> | 480.8 ± 19.3 <sup>2</sup> | 351.5 ± 8.2 <sup>1</sup> |
|                                | CSF      | —            | —                         | 87.1 ± 6.9                | —                         | —                        |
| Heparin tolerance (in sec)     | Blood    | 153.2 ± 10.2 | 112.5 ± 5.0 <sup>2</sup>  | 39.6 ± 2.5 <sup>2</sup>   | 40.6 ± 3.5                | 86.8 ± 4.2 <sup>2</sup>  |
|                                | CSF      | —            | 853.7 ± 20.9              | 691.5 ± 27.3              | 938.3 ± 13.6              | —                        |
| Fibrinase (in sec)             | Blood    | 60.4 ± 1.6   | 144.0 ± 5.1 <sup>2</sup>  | 213.6 ± 5.0 <sup>2</sup>  | 111.5 ± 5.2 <sup>2</sup>  | 85.0 ± 1.9 <sup>2</sup>  |
|                                | CSF      | —            | 17.5 ± 0.6                | 32.6 ± 2.3 <sup>2</sup>   | 15.0 ± 1.1 <sup>2</sup>   | 9.1 ± 0.4 <sup>1</sup>   |
| Fibrinogen B (+)               | Blood    | +            | +++                       | ++++                      | +++                       | ++                       |
|                                | CSF      | —            | ++++                      | +++                       | +++                       | ++                       |
| Prothrombin (in %)             | Blood    | 96.0 ± 1.0   | 72.1 ± 2.6 <sup>2</sup>   | 118.5 ± 2.4 <sup>1</sup>  | 111.5 ± 5.29              | 102.3 ± 1.2 <sup>1</sup> |
|                                | CSF      | —            | 35.8 ± 1.5                | 50.8 ± 1.4 <sup>2</sup>   | 38.3 ± 1.0 <sup>1</sup>   | 18.3 ± 2.0 <sup>2</sup>  |
| Thrombotest (degree)           | Blood    | 5-6          | 6-7                       | 7                         | 7                         | 6-7                      |
|                                | CSF      | —            | —                         | 1                         | —                         | —                        |
| Fibrinolytic activity (in min) | Blood    | 175.0 ± 13.6 | 176.6 ± 13.6              | 292.5 ± 5.4 <sup>2</sup>  | 228.3 ± 17.2 <sup>3</sup> | 207.5 ± 2.7 <sup>3</sup> |
|                                | CSF      | —            | 40.0 ± 2.8                | 72.5 ± 3.8 <sup>2</sup>   | 30.8 ± 3.0 <sup>2</sup>   | 15.0 ± 1.8 <sup>2</sup>  |
| Free heparin (in sec)          | Blood    | 11.7 ± 0.6   | 10.3 ± 0.6                | 5.8 ± 0.5 <sup>1</sup>    | 9.0 ± 0.9 <sup>1</sup>    | 11.8 ± 0.4               |
|                                | CSF      | —            | —                         | —                         | —                         | —                        |

Note. <sup>1</sup>P < 0.01, <sup>2</sup>P < 0.001, <sup>3</sup>P < 0.05.

fibrinogen B, and prothrombin, appeared in the CSF. The recalcification time and heparin tolerance of the CSF could be determined in 4 of the 6 cats. Examination of the CSF revealed small traces of fibrinogen which could not be determined quantitatively. The disturbance of the blood clotting system (hypercoagulemia) reached a maximum 24 h after trauma. At the same time changes were observed in the anticlotting system of the blood, in the form of a decrease in fibrolytic activity and in the free heparin content. The prothrombin content at this time was higher than normal. All components of the clotting and anticlotting systems were detectable in the CSF (Table 1). Only free heparin could not be determined by the method used.

After 3 days the indices of the clotting and anticlotting systems of the blood were slightly reduced, although they still remained above the normal level. A decrease in the indices of the clotting and anticlotting systems likewise was observed in the CSF (Table 1).

By the end of the 6th day the recalcification time and free heparin content were back to normal. The remaining indices remained a little higher than normal. Only some of the components of the clotting and anticlotting systems (fibrinase, fibrinogen B, prothrombin) could be detected in the CSF at this time. Fibrinolytic activity was still present in the CSF (Table 1).

By the 12th day the indices of the state of the clotting and anticlotting systems of the blood were completely back to normal. None of the components of these systems could be detected in the CSF.

In cats with brain trauma, a severe disturbance of blood coagulation (hypercoagulemia) thus develops and is most marked during the first 3 days after trauma, disappearing by the end of the 12th day. After brain trauma the components of the clotting and anticlotting systems, which cannot be detected in intact animals, appear in the CSF.

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