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# Study on predictive function of TEG on blood coagulation changes in patients with cerebral traumatic hemorrhage.

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## Abstract

**Objective: To analyse predictive function of TEG on blood coagulation changes in patients with cerebral traumatic hemorrhage.**

**Methods: Fifty-four patients with traumatic hemorrhage in ICU of our hospital from August, 2013 to October, 2014 were recruited, which included 42 patients with cerebral traumatic hemorrhage and 12 with other types of traumatic hemorrhage, all patients were given TEG in 1 d, 2 d, 7 d after trauma, and blood coagulation parameter of R value, K value, α value and Ma value were monitored, the regularity at time points were analysed.**

**Results: Blood coagulation parameters of recruited patients in each group were compared, there were significant statistical differences in K value, α value and Ma (P<0.05 whereas R value did not show significant differences (P>0.05). However, the difference between different time points of the same group was significant (P<0.05). There was interaction function between them (P<0.05). Compared with patients with other kinds of traumatic hemorrhage, changes of R value and K value in patients with cerebral traumatic hemorrhage were lowest in 1 d after trauma (P<0.05), but highest in 3 d after trauma (P<0.05), there were no statistical differences in 7 d after trauma between two groups (P>0.05). Changes of α value and Ma value were highest in 1 d after trauma (P<0.05), lowest in 3 d after trauma (P<0.05), and there were no significant statistical differences in 7 d after trauma (P>0.05).**

**Conclusion: Patients with cerebral traumatic hemorrhage have certain differences with patients with other kinds of traumatic hemorrhage in blood coagulation. The former is more severe. And its coagulation function changes have certain regularity. In 1 d after trauma, there is hypercoagulability. In 3 d after trauma, there is hypocoagulability. In 7 d after trauma, all blood coagulation functions are normal.**

**Keywords:** TEG, Cerebral traumatic hemorrhage, Blood coagulation function, Predictive function.

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## Introduction

After cerebral traumatic hemorrhage, blood coagulation of patients is disorder. Namely, blood coagulation system was activated abnormally, then producing hypercoagulability [1]. Then fibrinolysis is occurred. Blood will get thick when it is in hypercoagulability. At the same time, blood flow become slow, which can induce thrombus [2]. Clinics need a rapid, efficient and strong specificity detection method to predict blood coagulation changes of patients with traumatic hemorrhage and to guide clinical treatment [3]. TEG is a technology for recording blood coagulation process, which mainly is applied to study of blood coagulation and fibrinolysis process [4], also used for detecting function of blood platelet [5-7]. This study is to analyse predictive function of TEG on blood coagulation changes in patients with cerebral traumatic hemorrhage, which can provide practical basis for clinical guidance. The reports of study results are as follow.

## Materials and Methods

### *General data*

Fifty-four patients with traumatic hemorrhage in ICU of our hospital from August, 2013 to October, 2014 were selected as study object, which included 42 patients with cerebral traumatic hemorrhage and 12 with other kinds of traumatic hemorrhage, and 40 were male cases and 14 were female cases (Age range: 23-62 y, mean ± sd=35.6 ± 5.8 y). Patients with cerebral traumatic hemorrhage were regarded as A group, consisting of 29 male cases, 13 female cases (Age range: 24 to 61 y, mean ± sd= 36.8 ± 5.3 y). GCS score was not over 8 when admitted into hospital: 15 cases were 3 to 5 grade, and 27 cases from 6 to 8 grades (21 cases from car accident, 9 from crashing injury and 7 from bruise, 5 from other types of injuries). CT examination confirmed all were with simple cerebral injury: 7 cases with cerebral laceration, 17 with cerebral laceration combined with diffuse axonal injury, and 4 with epidural hematoma. PT, APTT and CT all are normal.

Other patients with traumatic injury were regarded as B group, consisting of 8 male cases and 4 female cases (Age range: 23-62 y, mean ± sd=36.6 ± 5.6 y). Six of them were from car, 3 from crashing injury, 2 from bruise, and one from other type of injury. CT scan indicated that 6 cases were with limb fracture, 4 with rib fracture and pulmonary laceration, and 2 with crushing injury of lower limb. PT, APTT and CT all are normal. The control group recruited 10 healthy volunteers without coagulation disorder or blood disease. There were 8 male cases, 2 female cases (Age range: 23 to 72 y, mean ± sd=31.7 ± 6.14 y). There were no significant differences in general data of subjects in three groups (P>0.05 suggesting the comparability and operability of this study.

### *Inclusion criteria*

Patients were diagnosed as simple cerebral injury by cerebral CT and spinal MRI from 18 to 75 years old, who admitted into hospital within 24 h after trauma. They were included in this study. All patients were closed cerebral trauma. And their scores were all below 8 grades. There were no disorders of liver function and blood coagulation function.

### *Exclusive criteria*

This study excluded patients with congenital blood coagulation disorders and liver function disorder. In addition, this study should exclude patients who took anticoagulants, long-term aspirin and patients with antithrombin in 6 months before incidence.

### *Methods*

Venous blood samples under empty stomach were selected in 1 d, 3 d and 7 d after trauma of patients in A and B groups. Subjects with 2 ml were selected only once time [8]. Changes of blood coagulation function were detected by adopting whole blood complex calcium methods [9]. Details were as followed: blood sample was injected into cylinder directly. Liquid blood cannot make cylinder drive cylinder axis. The recorded results were marked with straight line. Blood gradually becomes solidified. Cylinder vibration can send to cylinder axis by fibrin with strong stickiness in blood. Then cylinder and alloy fiber began to move [10]. Electrical signal of actuating signal transformation can be recorded as swing curve after amplification. Namely, it was TEG.

### *Monitor index*

R value was reaction time. The time from blood injected into cylinder to coagulation, this was considered equal to the time for generating fibrin at early stage of blood coagulation. The normal reference ranges were from 2 to 8 min. K value was coagulation time. The time was 20 min from R value terminal point to curve amplitude, which was considered equal to time for generating thrombin. The normal reference ranges were from 1 to 3 min. Elasticity of coagulation clot was 25. α was solidified angle, which indicates the generation speed of fibrin. The normal reference ranges were from 55 to 78°. M value was amplitude peak of thrombus. It represents the biggest firmness of thrombus. The normal reference ranges were from 51 to 69 mm [11]. TEG (type: 5000 Series) of this study was provided by Haemoscope company in America.

### *Statistical methods*

Data in this study were analysed by statistical software SPSS 17.0. Measurement data were represented by ($\bar{x}$ ± S). Age comparison among groups of subjects was analysed by adopting one-way analysis of variance. Comparison between blood coagulation of subjects in different times and different groups were analysed by two-way multi-level analysis of variance. Enumeration data were analysed by using rank-sum test. P<0.05 meant data had significant statistical differences.

## Results

### *Comparison of R value of subjects in three groups*

After statistical analysis of R value of subjects in three groups in different times, there were significant statistical differences (P<0.05). There were no significant statistical differences between two groups (P>0.05). Various groups and measurement time had interaction function (P<0.05). Details were listed in Table 1. Therefore, there were no significant differences in starting process of intrinsic coagulation between different types of trauma.

***Table 1.*** *Variance analysis of R value of subjects in three groups and different time points.*

| Source of variance | SS | df | MS | F value | P value |
|---|---|---|---|---|---|
| Management | 31.420 | 2 | 15.154 | 2.194 | 0.124 |
| Measurement time | 16.007 | 2 | 7.403 | 33.620 | 0.000 |
| Management × measurement time | 15.531 | 4 | 3.050 | 15.441 | 0.000 |
| Intergroup difference | 278.050 | 38 | 6.304 | | |
| Intra-group difference | 18.614 | 77 | 0.142 | | |

### *Comparison of K value of subjects in three groups*

After statistical analysis of K value of subjects in three groups in different times, there were significant statistical differences (P<0.05). There were also significant statistical differences between two groups (P<0.05). Various groups and measurement time had interaction function (P<0.05). Details were listed in Table 2. Therefore, the influences of different trauma on blood coagulation function had significant differences. With time extension, the influences of different trauma on blood coagulation at different time points became differentiated.

***Table 2.*** *Variance analysis of K value of subjects in three groups and different time points.*

| Source of variance | SS | df | MS | F value | P value |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Management | 19.234 | 2 | 15.061 | 272.101 | 0.000 |
| Measurement time | 25.055 | 2 | 12.072 | 48.352 | 0.000 |
| Management × measurement time | 68.153 | 4 | 16.205 | 64.356 | 0.000 |
| Intergroup difference | 343.743 | 38 | 8.088 | | |
| Intra-group difference | 19.520 | 77 | 0.154 | | |

### *Comparison of α value of subjects in three groups*

After statistical analysis of α value of subjects in three groups in different times, there were significant statistical differences (P<0.05). There were also significant statistical differences between two groups (P<0.05). Various groups and measurement time had interaction function (P<0.05). Details were as Table 3. Therefore, generation speed of cerebral trauma and other kinds of blood coagulation clot had changed. After 7 s, they recovered to normal. Compared with the control group, R value and K value decreased in 1d after trauma of patients in A and B groups (P<0.05). Ma value and α value increased (P<0.05), indicating that the blood was hypercoagulated. R value and K value increased obviously after 3 d (P<0.05). However, Ma value and α value decreased obviously (P<0.05). Blood was hypocoagulated. Various indexes recovered to normal state after 7 d (P>0.05).

***Table 3.*** *Variance analysis of* α *value of subjects in three groups and different time point.*

| Source of variance | SS | df | MS | F value | P value |
|---|---|---|---|---|---|
| Management | 58.627 | 2 | 28.758 | 0.100 | 0.000 |
| Measurement time | 424.857 | 2 | 206.873 | 81.268 | 0.000 |
| Management × measurement time | 805.007 | 4 | 203.004 | 76.085 | 0.000 |
| Intergroup difference | 5414.273 | 38 | 130.566 | | |
| Intra-group difference | 205.286 | 77 | 2.535 | | |

### *Comparison of Ma value of subjects in three groups*

After statistical analysis of Ma value of subjects in three groups in different times, there were significant statistical differences (P<0.05). There were also significant statistical differences between two groups (P<0.05). Various groups and measurement time had interaction function (P<0.05). Details were listed in Table 4. Therefore, different trauma can make blood coagulation become abnormal. They recovered to normal after 7 d.

***Table 4.*** *Variance analysis of Ma value of subjects in three groups and different time points.*

| Source of variance | SS | df | MS | F value | P value |
|---|---|---|---|---|---|
| Management | 443.544 | 2 | 216.217 | 1.314 | 0.000 |
| Measurement time | 1202.231 | 2 | 645.560 | 160.001 | 0.000 |
| Management × measurement time | 1451.173 | 4 | 280.460 | 100.067 | 0.000 |
| Intergroup difference | 6108.603 | 38 | 148.370 | | |
| Intra-group difference | 300.090 | 77 | 3.750 | | |

## Discussion

After cerebral trauma, cerebral tissue will release plentiful TF, which can induce exogenous blood coagulation and obvious abnormality of blood coagulation in damage area [12]. Patients with cerebral traumatic hemorrhage, blood coagulation function in different time points were monitored and analysed by using various parameters of TEG. The results show injury of various parts of body can induce disorders of blood coagulation function. Disorders of blood coagulation function in patients with cerebral traumatic hemorrhage are more durable and obvious [13]. We guess that decreased degree of arachidonic acid is more obvious in human cerebral tissue comparing with other trauma. It makes COX and function of blood platelet and decrease more obviously. Then it prolongs coagulation time of patients with traumatic hemorrhage, which can cause disorders of blood coagulation function [14]. Besides, cerebral trauma comparing with other traumas, ADP level of body also has difference. They can recover to normal state after three days. This study shows that various parameters of TEG in patients with cerebral traumatic hemorrhage within 6 h after trauma are abnormal, namely hypercoagulability. It may be caused by injury of cerebral tissue and vascular endothelial tissue after injury. Blood brain barrier was damaged. Cerebral tissues secrete and release a large number of tissue factors and activate coagulation system [15].

This study results show that the blood of patients with cerebral traumatic hemorrhage in 3 d after trauma were hypocoagulated. Ma value and α value in TEG are lower than normal referent values. We can see that, function and number of blood platelet are relatively low. It shows that, generation of fibrin and solidifying speed are lower than these of the control group. When body is injured, excessive bleeding can consume blood platelet sharply. Excessive blood transfusion can dilute original blood. The rate of general infection increases, which prevents megakaryocytes of bone marrow from normal maturation. In addition, the function of this medicine can inhibit normal function of blood platelets [16]. From results of this study, we can see that, coagulation function of patients with cerebral traumatic hemorrhage is from hypercoagulability to hypocoagulability, and then recover to normal state gradually. Therefore, the meaning of TEG in clinics is to monitor coagulation function of patients with trauma, in order to acquire the situation of the patients and take actions properly.

In this study, the blood state of 26 patients in early treatment stage is hypocoagulability. Twelve patients after 1 d become hypocoagulable. Its function and number of blood platelet are relatively low. Patients with cerebral traumatic hemorrhage in early treatment stage need to use anti-fibrinolysis and hemostasis medicine cautiously [17], real-time monitor its various coagulation functions and regulate administration dosage and time accordingly. Above all, the coagulation function disorder fibrinolysis disorder caused by cerebral traumatic hemorrhage deserve profound attention, and TEG is recommended to be applied to diagnose and treat disease as early as possible, which can promote advantages of survival, shorten time of coagulation function disorder to the best extent.

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