Clinical significance of coagulation function and plasma cTnI, HCY, PCT levels in the severity and prognosis in patients with acute craniocerebral injury

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ABSTRACT

Objective: To investigate the relationship between changes of coagulation function and plasma cTnI, HCY, PCT levels and cerebral trauma severity and prognosis in patients with acute craniocerebral injury. Method: A total of 80 patients with acute craniocerebral injury treated in our hospital from May 2014 to May 2017 were selected as the observation group and divided into 3 groups according to the admission GCS score: mild (27 cases), moderate (28 cases) and severe group (25 cases). 40 healthy volunteers were selected as the control group. The index of blood coagulation (APTT, PT, Fib, TT, DD) and the levels of cTnI, HCY, PCT in observation group after injury and in control group were detected and analysed comparatively. After 1 months of treatment, 80 patients were divided into the good prognosis group (54 cases) and poor prognosis group (26 cases) according to the GOS score and the levels of the parameters above were detected. Results: (1) The PT, APTT, TT and DD levels of mild, moderate and severe acute craniocerebral injury groups were higher than those of the control group, but the level of Fib was lower than that of the control group, and there was also a significant difference between any two groups respectively. (2) The cTnI, HCY and PCT levels of mild, moderate and severe acute craniocerebral injury groups were higher than those of the control group, and there was also a significant difference between any two groups respectively. (3) The indexes of PT, APTT and DD in the good prognosis group were lower than those in the poor prognosis group, while the Fib level was higher significantly. (4) The levels of cTnI, HCY and PCT in the good prognosis group were significantly lower than those in the poor prognosis group. Conclusion: The levels of coagulation function and plasma cTnI, HCY, PCT in acute craniocerebral injury patients were correlated positively with the severity and prognosis of patients with craniocerebral injury.

1. Introduction

Cranio cerebral injuries are caused by accidents, which is one of the most severe Department of Neurosurgery diseases, with high morbidity and mortality[1]. Abnormal coagulation function is a common complication of acute craniocerebral injury. It is beneficial to improve the prognosis of patients with timely correction of coagulation function[2,3]. Acute brain injury may lead to myocardial damage and cause abnormal changes in cTnI levels; HCY is an independent risk factor for secondary brain injury; PCT is a procalcitonin precursor and an early marker of severe inflammation[4–6]. This study of patients with acute craniocerebral injury were analyzed to observe the early coagulation index and cTnI, HCY, PCT index, analysis of the relationship between the severity and prognosis of traumatic brain injury and the index, in order to provide the basis for diagnosis and prognosis evaluation.
2. Data and methods

2.1. General information

A total of 80 patients with acute cranioencebral injury treated in Dongguan Shiqiao hospital from May 2014 to May 2017 were selected as the research object. The dynamic Glasgow Coma Scale (GCS) was performed on all patients within 72 h, and the lowest score of GCS was used as the statistical score. According to the GCS score, the 80 patients with cranioencebral injury were divided into three groups: 27 cases in the heavy group (GCS score 9-12 points), 28 cases in the medium-sized group (GCS score 13-15 points). Among them, the severe group male 17 cases, female 10 cases, aged 20-58 years, 13 cases were caused by traffic accidents, injuries, falls in 9 cases, combat injuries in 5 cases; medium group male 16 cases, female 12 cases, aged from 24 to 64 years, 18 cases were caused by traffic accidents, injuries, falling injury in 6 cases. Combat injuries in 4 cases; light group male 17 cases, female 8 cases, aged from 21 to 68 years, 9 cases were caused by traffic accidents, injuries, fall injury in 9 cases, combat injuries in 7 cases. Another 40 healthy volunteers at the same period were enrolled in this study, and they were included in the healthy control group. There was no significant difference between the four groups in general data (P>0.05), which was comparable. After 1 month of treatment, according to the Glasgow Outcome Scale (GOS) standard for evaluation, the 80 cases of cranioencebral injury were divided into good prognosis group of 54 cases (GOS score 4-5) and poor prognosis group of 26 cases (GOS score 1-3).

This study was unanimously approved by the medical ethics committee of our hospital, and the patients and their relatives signed informed consent. Inclusion criteria: meet the diagnostic criteria of acute cranioencebral injury, cranial CT examination revealed cerebral contusion, after the combination of X-ray examination and MRI scan, no severe compound injury (concise wound outside the head were below 3 points). Exclusion criteria: Patients with chronic diseases may affect the blood coagulation function such as coronary heart disease, hemophilia; tumor, severe cerebrovascular disease or abnormal clotting mechanism; nearly 3 months of anticoagulant treatment history, such as the use of clopidogrel and aspirin on platelet function influence; combined with other parts of the injury and blood loss shock treatment; lack of time 7 d or death from the hospital; menstrual period, pregnancy or lactating women.

2.2 Test indexes and methods

More than 12 h on an empty stomach, extraction of 5 mL elbow venous blood of observation group patients with cranioencebral injury and healthy controls volunteers. (1) Detection of coagulation function index: the collected cubital vein blood anticoagulant treatment (using sodium citrate anticoagulant tube negative pressure (1:9) treatment), the four channel blood coagulation analyzer blood coagulation function index: activated partial thromboplastin time (APTT), thrombin time (TT), prothrombin time (PT), D- two the dimer (DD) and fibrinogen (Fib). All the indicators are tested by special personnel in strict accordance with the test instrument (Sysmex CA-1500 Automatic Coagulation Analyzer) and kit (Dade Behring products) manual. Detection of cTnI, HCY and PCT levels: shake the collected cubital vein blood injection containing 10% EDTA-2Na 40 L and 40 L aprotinin tubes, at 4 °C for 3 000 r under the condition of /min centrifugal 15 min, cTnI, HCY, and plasma PCT levels on the same day. The method of chemiluminescence immunoassay was adopted, and Shenzhen new industry biomedical engineering Limited by Share Ltd maglumi2000 automatic chemiluminescence immunoassay analyzer and its kit were selected.

2.3 Statistical processing

The data was analyzed by SPSS 19.0 statistical software, and the measurement data was expressed by mean ± standard deviation Mean ± SD followed by t test, in which P < 0.05, indicating that the difference was statistically significant.

3. Result

3.1. Relationship between acute traumatic brain injury and coagulation function

The levels of PT, APTT, TT and DD in the patients of mild, middle and severe groups were higher than that of healthy controls, while the levels of Fib were lower than those of healthy controls, and the differences were statistically significant (P<0.05). With the severity of acute cranioencebral injury, the higher the level of PT, APTT, TT and DD, and the lower the level of Fib, the difference between the 22 groups was statistically significant (P<0.05). Among them, the PT, APTT, TT and DD levels were the highest in the severe patients, respectively (18.94 ± 0.83) s, (48.18 ± 2.14) s, (23.07 ± 1.27) s, (4.76 ± 1.21) mg/L, and the lowest level of Fib was (2.21 ±0.16) g/L. See table 1.

Table 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>PT (s)</th>
<th>APTT (s)</th>
<th>TT (s)</th>
<th>DD (mg/L)</th>
<th>Fib (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy control group</td>
<td>40</td>
<td>9.92 ± 0.54</td>
<td>28.41 ± 1.92</td>
<td>15.83 ± 2.07</td>
<td>1.25 ± 0.12</td>
<td>3.03 ± 0.21</td>
</tr>
<tr>
<td>Light group</td>
<td>25</td>
<td>13.01 ± 1.25</td>
<td>32.54 ± 2.01</td>
<td>16.62 ± 0.92</td>
<td>2.15 ± 1.34</td>
<td>2.58 ± 0.46</td>
</tr>
<tr>
<td>Medium-sized group</td>
<td>28</td>
<td>15.12 ± 1.04*</td>
<td>37.17 ± 1.92*</td>
<td>19.34 ± 1.61*</td>
<td>3.11 ± 0.84*</td>
<td>2.46 ± 0.21*</td>
</tr>
<tr>
<td>Heavy group</td>
<td>27</td>
<td>18.94 ± 0.83**</td>
<td>48.18 ± 2.14**</td>
<td>23.07 ± 1.27**</td>
<td>4.76 ± 1.21**</td>
<td>2.21 ± 0.16**</td>
</tr>
</tbody>
</table>

Note: compared with healthy control group, *P<0.05; Compared with mild injury group, **P<0.05; Compared with the injury group, ***P<0.05.
Table 2.
Levels of cTnI, HCY and PCT in patients with different degrees of acute craniocerebral injury and healthy controls.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>cTnI (ng/mL)</th>
<th>HCY (μmol/L)</th>
<th>PCT (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy control group</td>
<td>40</td>
<td>0.015±0.004</td>
<td>10.02±2.83</td>
<td>0.28±0.09</td>
</tr>
<tr>
<td>Light group</td>
<td>25</td>
<td>0.036±0.005</td>
<td>21.87±10.01</td>
<td>0.72±0.11</td>
</tr>
<tr>
<td>Medium-sized group</td>
<td>28</td>
<td>0.047±0.007*</td>
<td>25.94±11.32*</td>
<td>1.08±0.23*</td>
</tr>
<tr>
<td>Heavy group</td>
<td>27</td>
<td>0.076±0.009*</td>
<td>41.27±12.14*</td>
<td>3.21±0.64*</td>
</tr>
</tbody>
</table>

Note: compared with healthy control group, *P<0.05; Compared with mild injury group, #P<0.05; Compared with the injury group, *P<0.05.

Table 3.
Patients with acute craniocerebral injury, good prognosis and poor prognosis group, APTT, PT, TT, DD, Fib levels.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>PT (s)</th>
<th>APTT (s)</th>
<th>DD (mg/L)</th>
<th>Fib (g/L)</th>
<th>TT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good prognosis group</td>
<td>54</td>
<td>12.16±0.84</td>
<td>30.62±4.02</td>
<td>2.15±0.32</td>
<td>2.43±0.61</td>
<td>18.62±1.43</td>
</tr>
<tr>
<td>Poor prognosis group</td>
<td>26</td>
<td>15.79±1.32</td>
<td>41.32±3.14</td>
<td>4.19±0.62</td>
<td>2.21±0.32</td>
<td>24.47±2.29</td>
</tr>
</tbody>
</table>

Note: compared with the poor prognosis group, *P<0.05.

3.2 The relationship between plasma cTnI, HCY and PCT in patients with acute craniocerebral injury

The levels of cTnI, HCY and PCT in the patients of mild, middle and severe groups were higher than those of healthy controls, and the differences were statistically significant (P<0.05). With the severity of acute craniocerebral injury, the higher the level of cTnI, HCY and PCT, the difference between the 22 groups was statistically significant (P<0.05). Among them, the cTnI, HCY and PCT levels were the highest in the heavy group, respectively (0.076 ± 0.009) ng/mL, (41.27 ±12.14) mol/L, (3.21 ± 0.64) ng/mL. See table 2.

3.3 Comparison of coagulation function in patients with acute craniocerebral injury after different prognosis

The good prognosis group PT, APTT, DD, TT respectively (12.16 ± 0.84) s, (30.62 ± 4.02) s, (2.15 ± 0.32) mg/L, (18.62 ±1.43) s, was significantly lower than that of the poor prognosis group, and Fib (2.43 ± 0.61) g/L, significantly higher than that of the poor prognosis group, the differences were statistically significant (P<0.05). Among them, the APTT, PT can reflect the abnormal coagulation factor and PCT, the difference was statistically significant (P<0.05). See table 3.

3.4. Comparison of plasma levels of cTnI, HCY and PCT in patients with acute traumatic brain injury

The levels of cTnI, HCY and PCT in the good prognosis group were (0.017 ± 0.006) ng/mL, (13.21 ± 3.27) mol/L, (0.41 ± 0.11) ng/mL, significantly lower than those in the prognosis group, and the difference was statistically significant (P<0.05). See table 4.

Table 4.
Levels of cTnI, HCY and PCT in patients with acute craniocerebral injury and those with good and poor prognosis.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>cTnI (ng/mL)</th>
<th>HCY (μmol/L)</th>
<th>PCT (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good prognosis group</td>
<td>54</td>
<td>0.017±0.006</td>
<td>13.21±3.27</td>
<td>0.41±0.11</td>
</tr>
<tr>
<td>Poor prognosis group</td>
<td>26</td>
<td>0.062±0.008</td>
<td>29.07±13.21</td>
<td>2.72±0.48</td>
</tr>
</tbody>
</table>

Note: compared with the poor prognosis group, *P<0.05.

4. Discussion

Acute craniocerebral injury is a common disease in clinical department of Neurosurgery, which leads to abnormal coagulation and fibrinolysis, which may lead to serious diseases such as cerebral infarction, intracranial delayed bleeding and malignant brain edema[7]. Severe traumatic brain injury can lead to coagulopathy, which can lead to progressive intracranial hemorrhage, which can cause two brain injuries and affect the prognosis of the patients to a great extent[8,9]. At present, it is thought that the cause of abnormal coagulation mechanism caused by severe craniocerebral injury may be: (1) In brain injury, a large number of exogenous coagulation factors (tissue factor III) are released into the blood, enter the blood circulation and activate the exogenous coagulation system[10]. (2) Human brain vascular endothelial cell damage will consume a large number of coagulation factors, so that in the low coagulation state of the organism caused the activation of endogenous coagulation pathway, resulting in fibrin deposition, plasma Fib levels dropped sharply[11,12]. (3) The risk factors of coagulation dysfunction are ischemia reperfusion injury after traumatic brain injury[13]. Coagulation index, APTT is a comprehensive examination of the intrinsic coagulation system, monitoring prothrombin and fibrinogen deficiency, to reflect the clotting factor Ⅱ, Ⅶ, Ⅸ and ⅩⅢ levels and PT can reflect the abnormal coagulation factor and tissue factor[14]. Fib, a thrombin substrate, is an important index for detection of thrombosis. TT is a common pathway of internal and external coagulation systems, which can reflect whether Fib is sufficient in plasma, and the prolongation of time reflects the presence of fibrinolysis. DD is a specific fibrinolytic marker, which can reflect the thrombus activation and fibrinolysis activity in the blood vessels[15]. Research shows that the hypercoagulable state caused by blood clots by fibrinolysis and removal of dissolved, fibrinolytic and can cause disseminated intravascular coagulation or cerebral hemorrhage, and acute brain injury after the change of the
The results of this study showed that the levels of PT, APTT, TT and DD in patients with mild, moderate and severe acute craniocerebral injury were higher than that of healthy controls, while Fib levels were lower than that of healthy controls (P<0.05). With the severity of acute craniocerebral injury, the higher the level of PT, APTT, TT and DD, and the lower the level of Fib, the difference between the 22 groups was statistically significant (P<0.05). Reasons for the brain injury, a large number of tissue factor was released, the exogenous blood coagulation activation, intensify the conversion of prothrombin to thrombin, the thrombin mediated enzymatic reaction of Fib into fibrin. Therefore fibrinogen depletion, caused by Fib in patients with acute craniocerebral injury were significantly reduced, and with the degree of brain the more serious the injury, the lower the level of Fib. At the same time, anticoagulant mechanism can also be activated by blood coagulation mechanism starts, causing secondary hyperfibrinolysis, within a short period of time to consume a large amount of blood coagulation factor, which is the extension of APTT, PT and TT, and the DD content increased sharply. In addition, the levels of PT, APTT, DD and TT in the prognosis group were significantly lower than those in the poor prognosis group, while the level of Fib was significantly higher than that in the poor prognosis group (P<0.05). The results showed that the higher the abnormal degree of coagulation function in patients with acute craniocerebral injury, the greater the possibility of intracranial hematoma, the worse the prognosis. The reason may be that hypercoagulability caused by acute brain injury slows down the blood flow at the end of cerebral blood vessels. Even without thrombosis, it can impede the recovery of damaged brain tissue and even aggravate brain damage.

Research shows that cTnI is a specific and sensitive detection of myocardial injury markers of the blood. When the myocardial cells from ischemia and hypoxia and other factors were damaged, free cTnI first rapidly released by the cells into the blood, then combined with the cTnI protein in myocardial structure gradually decomposes and is slowly released into the blood. So cTnI in circulation the blood appeared earlier and can last for a long time[7]. HCY, a sulfur-containing amino acid. Its elevated levels can cause endoplasmic reticulum stress, vascular smooth muscle cell proliferation, lead to damage of vascular endothelial cells, lipid peroxidation, and destroy the balance between blood coagulation and fibrinolysis[18].

PCT is a procalcitonin precursor produced by thyroid follicular cells and is one of the early markers of severe inflammation. Under physiological condition, the stability is good, but under the inflammatory factors and bacterial endotoxin, the level increases rapidly, and the level of plasma PCT increases with the aggravation of infection[20,21]. The results showed that the levels of cTnI, HCY and PCT in the light, middle and heavy groups were significantly higher than those in the healthy control group (P<0.05). With the severity of acute craniocerebral injury, the higher the level of cTnI, HCY and PCT in patients, the difference between the 22 groups was statistically significant (P<0.05). The level of cTnI in patients with traumatic brain injury is significantly higher, which may be due to stress reaction in the patients with acute craniocerebral injury, and myocardial oxidative stress, which leads to myocardial ischemia. At the same time, platelet aggregation aggravates the obstruction of small myocardial vessels and aggravates the symptoms of myocardial ischemia. In addition, the brain stem injury or displacement of craniocerebral injury can change the regulatory function of the cardiovascular nerve center, produce arrhythmia and other symptoms, and further aggravate myocardial damage, and even myocardial necrosis. Increased HCY level may be due to abnormal metabolism of methionine in patients with acute craniocerebral injury, leading to HCY excretion blocked, and the high level of HCY can produce superoxide and peroxide, resulting in the injury of vascular endothelial cells, endothelial edema and fibrous tissue accumulation, elastic membrane rupture. Which results in vascular disorders, smooth muscle cell hypertrophy and hyperplasia, and increases the likelihood of micro thrombosis and hemorrhage[19].

The level of PCT is obviously higher, the reason may be that with the aggravation of the infection degree of the patients with acute craniocerebral injury, the inflammatory reaction is more serious, so the level of plasma PCT is increasing. At the same time, the good prognosis group of plasma cTnI, HCY and PCT levels were significantly lower than those of the poor prognosis group showed that cTnI, HCY, and PCT index is helpful to predict the prognosis of the craniocerebral injury, and assess the risk of recurrence of acute craniocerebral injury.

To sum up, the detection of coagulation function indexes and plasma levels of cTnI, HCY and PCT in patients with acute craniocerebral injury may be of high value in reflecting the degree of injury of brain tissue. And it is helpful for clinicians to judge the severity and prognosis of patients with craniocerebral injury at early stage.

Reference


