Correlation study of serum Lp-PLA2 and NSE levels with nerve injury degree and lipid metabolism change in patients with acute cerebral infarction

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ARTICLE INFO

Article history:
Received 7 Sep 2016
Received in revised form 17 Sep 2016
Accepted 12 Sep 2016
Available online 24 Sep 2016

Keywords:
Acute cerebral infarction
Lipoprotein-associated phospholipase A2
Neuron-specific enolase
Lipid metabolism

ABSTRACT

Objective: To study the correlation of serum Lp-PLA2 and NSE levels with nerve injury degree and lipid metabolism change in patients with acute cerebral infarction. Methods: Patients diagnosed with acute cerebral infarction in our hospital between March 2014 and October 2016 were selected as the cerebral infarction group of the study, and healthy subjects receiving physical examination during the same period were selected as control group. Serum was collected to determine the levels of Lp-PLA2 and NSE as well as the content of nerve injury molecules and lipid metabolism molecules. Results: Serum Lp-PLA2, NSE, NO, MDA, LPO, 8-OHdG, ox-LDL, LDL-C and ApoB levels of cerebral infarction group were significantly higher than those of control group while HDL-C and ApoA1 content were significantly lower than those of control group; serum NO, MDA, LPO and 8-OHdG content of patients with NSE > Q3 were significantly higher than those of patients with < Q1, Q1-Q2 and Q2-Q3, serum NO, MDA, LPO and 8-OHdG content of patients with Q2-Q3 were significantly higher than those of patients with < Q1 and Q1-Q2, and serum NO, MDA, LPO and 8-OHdG content of patients with Q1-Q2 were significantly higher than those of patients with < Q1; serum ox-LDL, LDL-C and ApoB content of patients with Lp-PLA2 > Q3 were significantly higher than those of patients with < Q1, Q1-Q2 and Q2-Q3 while HDL-C and ApoA1 content were significantly lower than those of patients with < Q1, Q1-Q2 and Q2-Q3; serum ox-LDL, LDL-C and ApoB content of patients with Q2-Q3 were significantly higher than those of patients with < Q1 and Q1-Q2 while HDL-C and ApoA1 content were significantly lower than those of patients with < Q1 and Q1-Q2; serum ox-LDL, LDL-C and ApoB content of patients with Q1-Q2 were significantly lower than those of patients with < Q1. Conclusion: Serum Lp-PLA2 and NSE levels increase significantly in patients with acute cerebral infarction, the increase of Lp-PLA2 is associated with abnormal lipid metabolism, and the increase of NSE is associated with neural oxidative damage.

1. Introduction

Acute cerebral infarction is a common clinical cerebrovascular disease, atherosclerosis is the pathological physiological basis of the disease, and the atheromatous plaque rupture and intracerebral thrombosis can cause blood flow interruption and ischemic-hypoxic brain tissue injury[1,2]. The key molecules that affect the carotid atherosclerosis and ischemic-hypoxic brain tissue injury during the change of acute cerebral infarction are not clear at present. Lipoprotein-associated phospholipase A2 (Lp-PLA2) is a member of the PLA2 family, has regulatory effect on lipid metabolism and inflammation in the atherosclerosis process, and is an important molecule involved in atheromatous plaque formation and nature change[3]; neuron-specific enolase (NSE) is a catalyzing enzyme in neurons and neuroendocrine cells that has neuroprotective and neurotrophic effect, and it is an important molecule participating in ischemic-hypoxic cerebral injury[4]. In the following study, the correlation of serum Lp-PLA2 and NSE levels
with nerve injury degree and lipid metabolism change in patients with acute cerebral infarction was analyzed.

2. Subjects and methods

2.1 Research subjects

Patients diagnosed with acute cerebral infarction in our hospital between March 2014 and October 2016 were selected as the cerebral infarction group of the study, all patients were diagnosed with acute cerebral infarction by cranial MRI and CT, the onset time was <72 h, and the NIHSS score 25 points on admission. Patients with cardioembolism caused by atrial fibrillation, heart valve disease and bacterial endocarditis as well as the patients complicated with cerebral hemorrhage were ruled out. Total 85 patients were included, including 56 male cases and 29 female cases that were 58 years old. 70 healthy volunteers receiving physical examination in our hospital during the same period were selected as control group and excluded of cardiovascular and cerebrovascular diseases by physical examination, including 48 male cases and 22 female cases that were 59 years old. The two groups of subjects were not significantly different in general information (P<0.05).

2.2 Serum sample collection and detection methods

5 mL of peripheral blood was collected from cerebral infarction group after admission, 5 mL of peripheral blood was collected from control group during physical examination, including 48 male cases and 22 female cases that were 58 years old. 70 healthy volunteers receiving physical examination in our hospital during the same period were selected as control group and excluded of cardiovascular and cerebrovascular diseases by physical examination, including 48 male cases and 22 female cases that were 59 years old. The two groups of subjects were not significantly different in general information (P<0.05).

2.3 Statistical methods

SPSS 18.0 software was used to input and analyze data, the quartiles Q1, Q2 and Q3 of Lp-PLA2 and NSE content of cerebral infarction group were calculated, measurement data analysis between two groups was by t test and measurement data analysis among groups was by variance analysis. P<0.05 meant statistical significance in differences.

3. Results

3.1 Serum Lp–PLA2 and NSE levels

Analysis of serum Lp-PLA2 and NSE between two groups of subjects was shown in Table 1: serum Lp-PLA2 and NSE levels of cerebral infarction group were significantly higher than those of control group, and differences in serum Lp-PLA2 and NSE levels were statistically significant between two groups of subjects (P<0.05). According to the quartiles Q1, Q2 and Q3 of serum Lp-PLA2 and NSE content, the cerebral infarction group were divided into <Q1, Q1-Q2, Q2-Q3 and >Q3.

3.2 Serum nerve injury molecule levels

Analysis of serum nerve injury molecules NO, MDA, LPO and 8-OHG between two groups of subjects was shown in Table 2: serum NO, MDA, LPO and 8-OHG content of cerebral infarction group were significantly higher than those of control group. Differences in serum NO, MDA, LPO and 8-OHG content were statistically significant between two groups of subjects (P<0.05); analysis of serum nerve injury molecules NO, MDA, LPO and 8-OHG among patients with NSE<Q1, Q1-Q2, Q2-Q3 and >Q3 within cerebral infarction group was shown in Table 3: serum NO, MDA, LPO and 8-OHdG content of patients with >Q3 were significantly higher than those of patients with <Q1, Q1-Q2 and Q2-Q3, serum NO, MDA, LPO and 8-OHdG content of patients with Q2-Q3 were significantly higher than those of patients with <Q1 and Q1-Q2, and serum NO, MDA, LPO and 8-OHdG content of patients with Q1-Q2 were significantly higher than those of patients with Q1. Differences in pair-wise comparison of serum NO, MDA, LPO and 8-OHG levels were statistically significant among cerebral infarction patients with NSE<Q1, Q1-Q2, Q2-Q3 and >Q3 (P<0.05).

3.3 Serum lipid metabolism molecule levels

Analysis of serum lipid metabolism molecules ox-LDL, LDL-C, ApoB, HDL-C and ApoA1 between two groups of subjects was shown in Table 4: serum ox-LDL, LDL-C and ApoB content of cerebral infarction group were significantly higher than those of control group while HDL-C and ApoA1 content were significantly lower than those of control group. Differences in serum ox-LDL, LDL-C, ApoB, HDL-C and ApoA1 levels were statistically
Comparison of serum lipid metabolism molecule levels among cerebral infarction patients with different Lp-PLA2 levels.

Table 4.

Comparison of serum lipid metabolism molecule levels between two groups of subjects.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>ox-LDL (ng/mL)</th>
<th>LDL-C (mmol/L)</th>
<th>HDL-C (mmol/L)</th>
<th>ApoA1 (g/L)</th>
<th>ApoB (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>70</td>
<td>3.57±0.56</td>
<td>4.15±0.55</td>
<td>0.89±0.10</td>
<td>0.77±0.09</td>
<td>1.83±0.22</td>
</tr>
<tr>
<td>T</td>
<td>32</td>
<td>4.92±0.67</td>
<td>5.21±0.68</td>
<td>6.14±0.79</td>
<td>13.15±1.68</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Comparison of serum nerve injury molecule levels among cerebral infarction patients with different NSE levels.

Table 3.

Comparison of serum nerve injury molecule levels among cerebral infarction patients with different NSE levels.

Table 5.

Comparison of serum lipid metabolism molecule levels among cerebral infarction patients with different Lp-PLA2 levels.

Table 6.

Comparison of serum nerve injury molecule levels among cerebral infarction patients with different NSE levels.

Comparison of serum lipid metabolism molecule levels among cerebral infarction patients with different Lp-PLA2 levels.

<table>
<thead>
<tr>
<th>Lp-PLA2 quartiles</th>
<th>n</th>
<th>ox-LDL (ng/mL)</th>
<th>LDL-C (mmol/L)</th>
<th>HDL-C (mmol/L)</th>
<th>ApoA1 (g/L)</th>
<th>ApoB (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Q1</td>
<td>22</td>
<td>33.91±4.85</td>
<td>2.52±0.31</td>
<td>3.63±0.48</td>
<td>6.23±0.78</td>
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<tr>
<td>Q1-Q2</td>
<td>21</td>
<td>42.17±5.97</td>
<td>3.47±0.42</td>
<td>4.92±0.67</td>
<td>9.31±1.03</td>
<td></td>
</tr>
<tr>
<td>Q2-Q3</td>
<td>21</td>
<td>48.72±6.34</td>
<td>5.21±0.68</td>
<td>6.14±0.79</td>
<td>13.15±1.68</td>
<td></td>
</tr>
<tr>
<td>&gt;Q3</td>
<td>21</td>
<td>59.61±7.85</td>
<td>7.12±0.89</td>
<td>7.86±0.93</td>
<td>19.32±2.36</td>
<td></td>
</tr>
</tbody>
</table>

4. Discussion

Atherosclerosis is the pathological physiological basis of acute cerebral infarction, and the plaque rupture and thrombosis on the basis of atherosclerosis can lead to cerebral blood flow interruption, resulting in ischemic-hypoxic brain tissue injury[5,6]. In the processes of atheromatous plaque rupture, thrombosis and ischemic-hypoxic brain tissue injury, multiple factors, multiple molecules as well as energy and substance metabolism are involved, and the specific mechanism is not very clear[7]. Neuron-specific enolase (NSE) is the soluble protease in the neurons and neuroendocrine cells, and it can catalyze the mutual transformation between 2-phosphoglyceric acid and phosphoenolpyruvic acid and adjust the glycolysis process in the brain tissue. Under physiological conditions, NSE adjusts the glycolysis process to implement the neurotrophic and neuroprotective effect; in the case of cerebral ischemic-hypoxic damage, the cellular structure ruptures and the NSE in the cytoplasm is released out of the cells and then enters into the blood circulation through the damaged blood brain barrier[8,9]. In the study, the analysis of serum NSE content in patients with cerebral infarction showed that serum NSE content of cerebral infarction group was significantly higher than that of control group. This means that the rise of serum NSE levels in circulating blood of patients with acute cerebral infarction is associated with the occurrence of acute cerebral infarction.

The rise of NSE levels in circulating blood of patients with acute cerebral infarction can not only reflect the degree of cerebral ischemic-hypoxic injury, but can also lead to the reduced NSE content in local brain tissue and the weakened neurotrophic and neuroprotective effect. Thus it was speculated that the rise of serum NSE levels in patients with cerebral infarction was associated with the degree of nerve injury. When the brain tissue is under ischemic hypoxia stimulation, oxygen free radicals are massively produced in local area and increase the expression of NOS, which catalyzes L-arginine to produce NO[10]. Oxygen free radicals, in addition to increasing the generation of NO, can also have oxidizing reaction with the lipid compositions and nucleic acid compositions in the cells, cause cellular damage and also increase the generation of metabolites LPO, MDA and 8-OHdG[11,12]. In the study, analysis
of the content of these nerve injury molecules showed that serum NO, MDA, LPO and 8-OHdG levels of cerebral infarction group were significantly higher than those of control group. Patients with cerebral infarction group were further grouped according to quartiles of serum NSE levels, and comparison of the differences in nerve injury molecule content among groups showed that the higher the serum NSE content in patients with cerebral infarction, the higher the serum NO, MDA, LPO and 8-OHdG content. This means that the rise in serum NSE levels of patients with cerebral infarction is directly related to the degree of nerve injury.

Lp-PLA2, also known as platelet-activating factor acetylhydrolase, has hydrolytic effect on the oxidizing lecithin on platelet-activating factors and low-density lipoprotein, the hydrolysis products lysolecithin and oxidized free fatty acids can deposit in the arterial intima and form foam cells, which promote atheromatous plaque formation and prompt plaque destabilization[13,14]. In the study, analysis of serum Lp-PLA2 levels in patients with cerebral infarction showed that serum Lp-PLA2 content of cerebral infarction group was significantly higher than that of control group. This means that the rise in serum Lp-PLA2 content is associated with the occurrence of acute cerebral infarction. Lp-PLA2 can catalyze and produce oxidized free fatty acids, and can also affect the process of lipid metabolism in the body[15]. HDL-C and the corresponding apolipoprotein ApoA1 are mainly involved in the lipid removal in the body while LDL-C and the corresponding ApoB are mainly involved in lipid transportation and deposition to peripheral tissue in the body[16]. In the study, analysis of the content of these lipid metabolism molecules showed that serum ox-LDL, LDL-C and ApoB content of cerebral infarction group were significantly higher than those of control group while HDL-C and ApoA1 content were significantly lower than those of control group. Patients with cerebral infarction group were further grouped according to quartiles of serum Lp-PLA2 levels, and comparison of the differences in lipid metabolism molecule content among groups showed that the higher the serum Lp-PLA2 content in patients with cerebral infarction, the higher the ox-LDL, LDL-C and ApoB content while the lower the HDL-C and ApoA1 content. This means that the rise in serum Lp-PLA2 levels of patients with cerebral infarction is directly related to the degree of abnormal lipid metabolism.

To sum up, it is believed that serum Lp-PLA2 levels in patients with acute cerebral infarction increase significantly and are associated with abnormal lipid metabolism, and NSE levels increase significantly and are associated with neural oxidative damage.

References