Applied research of pediatric pneumonia serum CK, CTnT levels and ECG change characteristics in diagnosis and treatment of disease and prognostic evaluation

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Objective: To study pneumonia infant's serum creatine kinase and troponin T level changes and combined with electrocardiogram analysis to discuss its meaning to pneumonia infant’s clinical diagnosis and treatment. Method: 73 cases of pneumonia infants were selected as study group in our hospital from January 2014 to June 2014, meanwhile select 58 cases of healthy infants as control group, to proceed serum CK and CTnT and electrocardiogram examination of both groups. Results: Before treatment, ordinary pneumonia group's CK level rised, CK-MB and CTnT levels significantly rised, 65.71% of children with pneumonia appeared abnormal electrocardiogram, mainly showed atrial premature beats and sinus tachycardia; severe pneumonia group's CK level significantly rised, CK-MB and CTnT levels highly significantly rised, 86.84% of children with pneumonia appeared abnormal electrocardiogram, mainly showed atrial premature beats, sinus tachycardia, bundle-branch block, P-wave high point and so on. After treatment, ordinary pneumonia group's CK, CK-MB and CTnT levels recovered to normal range, ECG returned to normal mostly; severe pneumonia group's CK level obviously returned to normal range, but CK-MB and CTnT levels still exist significant difference. After treatment, severe pneumonia group's CK, CK-MB and CTnT levels were highly significantly lower than before treatment; Compared with ordinary group after treatment, its CK, CK-MB and CTnT levels were higher, but no significant difference, electrocardiogram also returned to normal, only sinus tachycardia and bundle branch block were difficult to return to normal. Conclusion: Serum CK, CK-MB and CTnT levels of pneumonia infants rise along with the aggravation of disease, and ECG level is abnormal, after treatment, most pneumonia infants are cured. This illustrates infant pneumonia could easily cause multiple organ system damage, especially myocardial injury, monitoring CK, CK-MB and CTnT levels, combined with electrocardiogram data has important reference value to the diagnosis of pneumonia.

1. Introduction

Infantile pneumonia is a common disease, mycoplasma pneumoniae, viruses and bacteria are the common pathogen of pneumonia. Pneumoniae is a kind of inflammation exists in interstitial tissue, alveolar and terminal respiratory, it is a serious disease even could imperil multiple organs[1]. Creatine kinase (CK) mainly exist in myocardium and skeletal muscle, when myocardial damage occurs, CK etc. release, enters into blood, which will lead to its level rise in serum[2-4]. Troponin T (CTnT) exists in ventricular myocytes and atrial muscle, pneumonia inflammation causes myocardial cell apoptosis, which leads to CTnT release from myocardial cell, enters into blood, which will lead to its level rise in serum[5-8]. Through studying pneumonia children's serum creatine kinase and troponin T level changes, compared with control group, and combined with electrocardiogram data, sign and clinical symptoms, this article gets us to know the damage of pneumonia to infant's health. The details are as follows:
2. Information and method

2.1. General Information

Select 73 cases of pneumonia infection infants in our hospital as study group from January 2014 to June 2014, meanwhile select 58 cases of healthy infants as control group. According to the diagnostic criteria, 73 cases were divided into ordinary pneumonia group and severe pneumonia group. Ordinary pneumonia group 35 cases: boy 16 cases, girl 19 cases, age: 3 months-6 years old, average age (2.8 ± 1.2); Severe pneumonia group 38 cases: boy 20 cases, girl 18 cases, age: 2 months-5 years old, average age (2.3 ± 0.9); Control group 58 cases: boy 29 cases, girl 29 cases, age: 2 months-6 years old, average age (2.7 ± 1.4). The gender, age and weight index parameters of both groups do not have significant difference (P>0.05).

2.2. Therapeutic method

According to pneumonia infant's illness state, should take proper therapeutic measures, the measures are as follows: Firstly give infants with oxygen to make them breathe well; secondly give infants different drug therapy according to their illness state, for example viral pneumonia given ribavirin etc., anaerobic pneumonia given metronidazole etc.; after that, according to infant's symptoms, proceed anti-febrile, anti-asthmatic, eliminating phlegm,etc.; finally, supplement vitamin C, enhance myocardial nutrition.

2.3. Test method

The 2nd morning after admission, the 8th morning after hospitalization for all infant patients, within 4 d after physical examination for control group, they need to be tested as follows: fasting blood 2 mL collected; determine myocardial enzymes (CK, creatine kinase isozyme CK-MB, lactate dehydrogenase LDH, aspartate transaminase-AST) and CTrT index and record ECG data accordingly.

2.4. Reagent and instruments

Myocardial enzymes determination adopts enzyme dynamics method, HITACH-7600 (Japan) automatic biochemical analyzer; CTrT determination adopts electrochemiluminescence method, roche COBAS6000 spectrophotometer.

2.5. Statistical method

All data analyzes are performed by SPSS 22.0 statistical software for processing. There into the data obtained accord with normal distribution, use (mean±SD) to indicate measurement data, adopt t to test pair wise comparison adopts one-way analysis of variance; count data adopt chi-square test; correlation analysis adopts spearman. If P<0.05, there is statistical significance between the data.

3. Results

3.1. Comparison of myocardial enzyme, CTrT levels of all groups before treatment

CK: ordinary pneumonia group, severe pneumonia group is higher than control group, severe pneumonia group is higher than ordinary group, ordinary pneumonia group has no significant difference (P>0.05), severe pneumonia group difference has statistical significance (P<0.01).

CK-MB: ordinary pneumonia group, severe pneumonia group is higher than control group, severe pneumonia group is higher than ordinary group, ordinary pneumonia group has significant difference (P<0.05), severe pneumonia group difference has statistical significance (P<0.01).

LDH: ordinary pneumonia group, severe pneumonia group is higher than control group, severe pneumonia group is higher than ordinary group, ordinary pneumonia group has significant difference (P<0.05), severe pneumonia group difference is highly statistical significant (P<0.01).

AST: ordinary pneumonia group, severe pneumonia group is higher than control group, severe pneumonia group is higher than ordinary group, ordinary pneumonia group difference has no statistical significance (P>0.05), severe pneumonia group difference is highly statistical significant (P<0.01).

CTnT: ordinary pneumonia group, severe pneumonia group is higher than control group, severe pneumonia group is higher than ordinary group, ordinary pneumonia group has significant difference (P<0.05), severe pneumonia group difference is highly statistical significant (P<0.01).

Details see Table 1 as follows.

These data show that pneumonia infants’ serum’s myocardial enzyme and CTrT levels are higher than common infants, and the heavier the disease is, the higher the myocardial enzyme and CTrT levels are.

Table 1.
Comparison of myocardial enzyme, CTrT levels change of both groups before treatment.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>CK (μL)</th>
<th>CK-MB (μL)</th>
<th>LDH (μL)</th>
<th>AST (μL)</th>
<th>CTrT (μg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary pneumonia</td>
<td>35</td>
<td>249 ± 183*</td>
<td>21 ± 13**</td>
<td>251 ± 161*</td>
<td>149 ± 67*</td>
<td>0.34 ± 0.15*</td>
</tr>
<tr>
<td>Severe pneumonia</td>
<td>38</td>
<td>432 ± 256**</td>
<td>73 ± 46**</td>
<td>592 ± 231**</td>
<td>213 ± 87**</td>
<td>1.09 ± 0.59**</td>
</tr>
<tr>
<td>Control</td>
<td>58</td>
<td>123 ± 49</td>
<td>14 ± 9</td>
<td>141 ± 76</td>
<td>81 ± 13</td>
<td>0.08 ± 0.01</td>
</tr>
</tbody>
</table>

Compare with control group, *P<0.05, **P>0.05; compare with ordinary group,**P<0.01.
3.2. Comparison of CK, CK-MB and CTnT levels change of all groups before and after treatment

Before treatment, CK level of ordinary pneumonia group is higher than control group, but has no significant difference \((P>0.05)\), CK-MB and CTnT level is higher than control group, all has significant difference \((P<0.05)\); CK level of severe pneumonia group is higher than control group, has significant difference \((P<0.05)\), CK-MB and CTnT level is higher than control group, all has high significant difference \((P<0.01)\). Data show that the heavier the disease is, the higher the CK, CK-MB and CTnT level in the serum is.

After treatment, compared with control group, CK, CK-MB and CTnT level of ordinary pneumonia group is close to control group, recover to range of normal value \((P>0.05)\); CK level of severe pneumonia group recover obviously \((P>0.05)\), but CK-MB and CTnT level has significant difference \((P<0.05)\). CK, CK-MB and CTnT level of severe pneumonia group after treatment is obviously lower than before treatment \((P<0.01)\), compared with ordinary group after treatment, CK, CK-MB and CTnT level rise accordingly, but has no significant difference \((P>0.05)\). Details see Table 2 as follows:

### Table 2.
Comparison of CK, CK-MB and CTnT level change both groups before and after treatment.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>CK (μ/L) before/after treatment</th>
<th>CK-MB (μ/L) before/after treatment</th>
<th>CTnT (μg/mL) before/after treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary pneumonia</td>
<td>35</td>
<td>249 ± 181/155 ± 89</td>
<td>21 ± 13/17 ± 11</td>
<td>0.34 ± 0.15/0.09 ± 0.04</td>
</tr>
<tr>
<td>Severe pneumonia</td>
<td>38</td>
<td>432 ± 256/148 ± 101</td>
<td>73 ± 46/29 ± 16</td>
<td>1.09 ± 0.59/0.17 ± 0.063</td>
</tr>
<tr>
<td>Control</td>
<td>58</td>
<td>123 ± 49</td>
<td>14 ± 9</td>
<td>0.08 ± 0.01</td>
</tr>
</tbody>
</table>

Compare with control group, \(^*P<0.05\), \(^*P>0.05\); compare with ordinary group, \(^**P<0.01\); compare with before treatment, \(^*P<0.01\).

3.3. Relationship between myocardial enzymes & ECG change and disease of pneumonia infants

Before treatment, CK, CK-MB and CTnT level in the serum of ordinary pneumonia group rise obviously, ECG featured atrial premature beats and nodal tachycardia, symptoms mainly showed that cough, fever, and shortness of breath etc., after treatment, pneumonia was cured, and ECG returned to normal.

CK, CK-MB and CTnT level in the serum of severe pneumonia group is higher than control group, and is higher obviously than ordinary pneumonia group, CK level is 3.5 times than that in the control group, CK-MB level is 5.2 times than that in the control group, CTnT level is 13.6 times than that in the control group. Abnormal ecg types in severe pneumonia group are more, except for atrial premature beats and nodal tachycardia, still exist bundle branch block and P-wave high point etc. Except for the same clinical symptoms as ordinary pneumonia group in severe pneumonia group, also the performance such as myocarditis, myocardial ischemia and sudden death etc. After treatment, most infants returned to normal, but CK, CK-MB and CTnT level in the serum is obviously higher than that in the control group, myocardial damage abnormality in ECG still exist etc.

4. Discussion

Pneumonia cause serious damage to the physiological and physical health of infants, and pneumonia deaths worldwide each year is about 4 million in infants. According to clinical diagnosis, through definitive therapy, most pneumonia infants could be cured\(^{[9-11]}\). Because of multiple organ system damage, severe pneumonia group tend to cause complication\(^{[12]}\). Clinically, use myocardial enzyme and CTnT index to test myocardial damage\(^{[13-15]}\). Clinical experience finds that most pneumonia infants' myocardial enzyme improves in different extent, especially severe pneumonia infants\(^{[16-18]}\).

Enzyme content in myocardial cell is rich, normally, myocardial cell membrane can prevent myocardial enzyme from extravasation, therefore, myocardial enzyme content in serum is lower, and normal myocardial activities show mainly ecg transmission and normal exchange, ECG shows normal sinus heart rate. After pulmonary infection& inflammation in infants, this will lead to myocardial damage, then myocardial enzyme extravasates, will result in abnormal myocardial enzyme content in serum, meanwhile, ECG will appear abnormal changes, and these changes are related with myocardial damage degree. Therefore, myocardial enzyme and ECG can reflect the condition of pneumonia infants. When taken the treatment such as anti-inflammatory, enhance myocardial nutrition etc., most pneumonia infants will get a remission, myocardial enzyme level returns to normal, ECG shows normal.

The conclusion from this study: before treatment, CK level in ordinary pneumonia group rises \((P>0.05)\), CK-MB and CTnT levels rise obviously \((P<0.05)\); CK level in severe pneumonia group rises obviously \((P<0.05)\), CK-MB and CTnT levels rise obviously \((P<0.01)\). Mainly show that the heavier pneumonia disease is, the higher myocardial enzyme and CTnT levels are, and CK-MB and CTnT are more sensitive than CK. After definitive therapy, CK, CK-MB and CTnT levels in ordinary pneumonia group recover to normal range \((P>0.05)\), CK level in severe pneumonia group recovers obviously \((P>0.05)\), but CK-MB and CTnT levels still exist significant difference \((P<0.05)\). These mainly show that individual severe pneumonia infants myocardial damage is severe, and is difficult to recover. Before treatment, ECG of ordinary pneumonia group mainly features atrial premature beats and nodal tachycardia; in severe pneumonia group, ECG abnormality types is more, besides atrial premature beats and nodal tachycardia, still exist bundle branch block and P-wave high point etc. Not only severe pneumonia group have the same clinical symptoms as the ordinary pneumonia
group’s, but also show myocarditis, myocardial ischemia and sudden death etc. These suggest that severe pneumonia is worse than ordinary pneumonia. After treatment, condition improved, ordinary pneumonia infants could be cured, but as for severe pneumonia infants, some could not be cured.

This paper has discussed deeply the relationship between infant pneumonia and serum CK, CK-MB and CTnT levels. The result shows that before treatment, serum CK, CK-MB and CTnT levels in ordinary pneumonia group rise obviously, ECG mainly features atrial premature beats and nodal tachycardia, symptoms show cough, fever, and shortness of breath etc., after treatment, pneumonia is cured. Serum CK, CK-MB and CTnT levels in severe pneumonia group are higher than control group, and are obviously higher than ordinary group. ECG abnormality besides atrial premature beats and nodal tachycardia, still exists bundle branch block and p-wave high point etc. After treatment, most infants become better than before, but serum CK, CK-MB and CTnT levels are still obviously higher than control group, ECG still exists myocardial damage abnormality etc.

In conclusion, CK, CK-MB and CTnT levels in serum will become higher along with the aggravation of disease in pneumonia infants, and ECG is abnormal, after treatment, most infants could be cured. These suggest that infant pneumonia tend to cause multiple organ system damage, especially myocardial damage, monitoring CK, CK-MB and CTnT levels, combined with ECG data, has important reference value to pneumonia diagnose.

References