Diagnostic value of combined detection of myocardial markers, white blood cell count and platelet distribution width in patients with positive myocardial injury markers

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ABSTRACT

Objective: To explore the diagnostic value of combined detection of myocardial markers, white blood cell (WBC) counts and platelet distribution width (PDW) in patients with positive myocardial injury markers. Methods: From January 2017 to January 2018, 100 patients with positive markers of myocardial injury in our hospital were selected as observation group, and 100 healthy people were selected as control group. Serum myocardial markers troponin I (cTnI), creatine kinase isoenzyme (CK-MB), myoglobin (MYO), WBC count, and PDW levels were measured at admission, and analyzed for individual indicators. And individual and combined detections of these indicators in early diagnosis of acute myocardial infarction (AMI) were analysed. Results: Serum cTnI, CK-MB, MYO, WBC count and PDW level were higher in the observation group than those in the control group, and the difference between the groups was statistically significant. Of the 100 patients with positive myocardial injury markers, 48 (48.00%) were diagnosed with AMI by final clinical diagnosis. Compared with the control group, the positive rate of serum index and the combined detection of five indicators in the observation group were significantly increased. The sensitivity and specificity of the five indicators combined detection and diagnosis of AMI were 95.83% and 94.23%, respectively, which were higher than the individual detection of each index, and the difference was statistically significant. Conclusions: The combined detection of serum cTnI, CK-MB, MYO, WBC count and PDW is helpful for early diagnosis of AMI and can improve the sensitivity and specificity of diagnosis.

1. Introduction

Acute myocardial infarction (AMI) is a critical cardiovascular disease that occurs in the middle-aged and elderly population. AMI refers to the rapid reduction or interruption of coronary blood supply caused by myocardial necrosis caused by severe and persistent ischemia of the corresponding myocardial. The rupture of coronary atherosclerotic plaque, platelet adhesion, aggregation and thrombosis are the basic pathogenesis. And severe post-sterial pain is the main clinical manifestation[1]. In recent years, the incidence of AMI has been increasing year by year, and tends to be younger. AMI has the characteristics of acute onset and high mortality. The sooner the patient is treated with thrombolytic therapy, the higher the success rate of rescue[2]; for patients with large myocardial infarction, the treatment will not pose a serious threat to the patient’s life. At present, clinical manifestations, electrocardiogram and biochemical indicators are the main basis for clinical diagnosis of AMI[3]. With the continuous advancement of testing technology, myocardial markers and blood routine tests play an increasingly important role in the early diagnosis of AMI, which is characterized by rapid, easy access, and economy. Serological diagnosis plays an important role in the diagnosis of AMI due to its sensitivity and specificity, but early application of myocardial injury markers such as aspartate aminotransferase (AST) and lactate dehydrogenase (LH) has lower specificity. As a result, its clinical application is limited, and the diagnosis achieved by single indicator detection
is not satisfactory[4]. Most studies have shown that the combined detection of multiple markers can make up for the deficiency, improve the sensitivity and specificity of the diagnosis, and achieve the purpose of accurate diagnosis[5]. This study examined and compared the serum cTnI, CK-MB, MYO, WBC counts and PDW levels in patients with positive myocardial injury markers and healthy subjects, and analyzed the value of separate detection and combined detection of these indicators for early diagnosis of AMI.

2. Materials and methods

2.1. General information

From January 2017 to January 2018, 100 patients with positive markers of myocardial injury were selected as observation group, and 100 healthy people without history of cardiovascular and endocrine diseases were selected as control group. There were 60 males and 40 females in the observation group, aged 36-78 years, with an average age of (58.3±4.6) years. There were 64 males and 36 females, aged 37-80 years, with an average age of (57.9±4.7) years. There was no significant difference in gender and age between the two groups (P>0.05), which was comparable. The study was approved by the hospital ethics committee.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) All of patients were positive for myocardial injury markers for the first time; (2) At least one of the markers of myocardial injury markers (cTnI, CK-MB, MYO) was positive for positive detection, positive criteria[6]: cTnI>0.5 μg/L, CK-MB>5 μg/L, MYO>80 μg/L, 3 indicators were detected simultaneously; (3) The patients were informed and signed the relevant consent form. Exclusion criteria: (1) History of vascular disease; (2) Malignant tumor, severe trauma, severe infection; (3) Liver and kidney dysfunction, myocarditis and ventilator; (4) Chronic respiratory diseases, blood system diseases and autoimmune diseases.

2.3. Methods

All patients were collected 3 mL of elbow venous blood in the early morning after admission, placed in EDTA-K2 anticoagulation tube, and the upper serum samples were taken after centrifugation and stored at -80 °C for testing. The serum cTnI and MYO levels were measured by immunoturbidimetric assay. The instrument used was Toshiba TBA-40FR automatic biochemical analyzer and supporting reagents. The level of serum CK-MB was detected by enzyme method. The cTnI and Mb were determined by immunoturbidimetry. The instrument was Olympus Au2700 automatic biochemical analyzer and supporting reagents. The operation was carried out in strict accordance with the kit instructions. The WBC count and PDW were detected using a Sysmex XT-1800i automatic cell analyzer (produced by Sysmex, Japan). The normal range of parameters was: WBC count <10×10^9/L, PDW is 10.0-15.0 fL. The above indicators were tested within 2 h after the collection of serum samples.

2.4. Diagnostic criteria for AMI[7]

AMI was diagnosed on the basis of clinical manifestations, laboratory tests, and changes in electrocardiogram, and in line with the World Health Organization diagnostic criteria for AMI. The diagnostic criteria were: (1) typical ischemic chest pain, lasting more than 1 h, and nitric acid Glycerol can not be relieved after taking it; (2) ECG examination showed that adjacent ECG leads were accompanied by more than two ST-segment elevations, which were arch-back-up and lasted for more than 0.5 h; (3) myocardial injury markers showed dynamic changes, cTnI, or the CK-MB level exceeded the upper limit of the reference range by 2 times. At least 2 of the above criteria can be diagnosed as an AMI.

2.5. Observation indicators

The serum levels of cTnI, CK-MB, MYO, WBC and PDW were compared between the two groups. The positive rate of the five indicators and the combined detection were recorded. The separate detection of each index and the combined detection of five indicators were used to diagnose the sensitivity and specificity of AMI.

2.6. Statistical methods

Statistical analysis and analysis were performed using SPSS 19.0 statistical software. The measurement data were expressed as mean ± standard deviation. The independent sample t-test was used to compare the two groups. The count data were expressed as percentage. The Chi-square test was used to compare the groups. The difference was statistically significant at P<0.05.

3. Results

3.1. Comparison of serum cTnI, CK–MB, MYO, WBC count and PDW level between two groups

Serum cTnI, CK-MB, MYO, WBC count and PDW level were higher in the observation group than those in the control group, and the difference between the groups was statistically significant (P<0.05), as shown in Table 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>cTnI (μg/L)</th>
<th>CK-MB (μg/L)</th>
<th>MYO (μg/L)</th>
<th>WBC count (×10^9/L)</th>
<th>PDW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>100</td>
<td>0.08±0.05</td>
<td>1.88±0.63</td>
<td>37.4±15.71</td>
<td>7.16±3.23</td>
<td>8.06±2.52</td>
</tr>
<tr>
<td>Observation group</td>
<td>100</td>
<td>11.32±4.26</td>
<td>9.36±2.12</td>
<td>218.9±46.27</td>
<td>12.79±4.02</td>
<td>8.06±2.52</td>
</tr>
</tbody>
</table>

Note: Compared with the control group, *P*<0.05.
saving patients’ lives, improving cure rate, prognosis and quality of life. In the diagnosis of acute myocardial infarction, markers of myocardial injury play an important role. At present, the most common myocardial markers for diagnosis and exclusion of AMI are cTnI, CK-MB, MYO. These markers are released into the blood for different times and have different half-lives[8]. Therefore, the diagnostic accuracy of AMI can be improved by detecting these indicators jointly.

cTnI is a myocardial-specific marker present only in the myocardium, which can reflect myocardial damage. Smooth muscle and skeletal muscle do not interfere with it, so it has high specificity[9]. In recent years, cTnI has become more and more widely used in the early diagnosis of cardiovascular diseases. The content of cTnI is lower in normal humans (<0.5 μg/L). When the myocardium undergoes irreversible damage due to continuous ischemia and hypoxia, cTnI will be released into the blood from the damaged cardiomyocytes, and the degree of myocardial damage will be the heavier, the more the release, so the severity of myocardial damage can be judged to some extent by cTnI content[10]. cTnI has a high degree of myocardial specificity and enables accurate diagnosis of AMI with chest pain and ECG changes. cTnI appeared 3 to 6 h after myocardial infarction and reached a peak at 12 h, which lasted for a long time (6 to 10 days), so the diagnostic window was wider[11]. For traditional myocardial enzymes, cTnI has higher sensitivity and specificity, and is an ideal marker of myocardial necrosis for understanding myocardial injury, and gradually becomes the “gold standard” for myocardial injury.

CK-MB is one of the myocardial markers for clinical detection of AMI, mainly in myocardial cells, and is an important indicator for judging myocardial damage. When cardiomyocytes were severely damaged, CK-MB was released into the blood in a large amount. CK-MB increased rapidly after 4 to 8 h of onset, peaked at 12 to 24 h, and returned to normal level at 2 to 3 days[11]. Elevated serum CK-MB has a decisive diagnostic effect on AMI without Q-wave in ECG. A number of studies have shown that CK-MB has a good diagnostic coincidence rate, and its increase is closely related to the degree and area of infarction. The higher the level of CK-MB, the more severe myocardial necrosis and the greater the extent of damage[12]. In the diagnosis of AMI, CK-MB has certain sensitivity and specificity, but because its duration of post-infarction elevation is not long, the diagnosis window is relatively narrow, and there is a certain limitation in the diagnosis of AMI. Late diagnosis and prognosis are unfavorable.

MYO is a kind of heme protein mainly present in myocardium and skeletal muscle tissue. Due to its small molecular weight, MYO can be released into the blood from the cells within a short time after

### Table 2
Comparison of positive rates of individual and combined detection of different indicators in two groups (%).

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>cTnI</th>
<th>CK-MB</th>
<th>MYO</th>
<th>WBC count</th>
<th>PDW</th>
<th>Joint detection of 5 indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>100</td>
<td>4.00</td>
<td>3.00</td>
<td>6.00</td>
<td>4.00</td>
<td>8.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Observation group</td>
<td>100</td>
<td>44.00</td>
<td>41.00</td>
<td>53.00</td>
<td>36.00*</td>
<td>50.00*</td>
<td>49.00*</td>
</tr>
</tbody>
</table>

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

### 3.2. Diagnosis of AMI

After final clinical diagnosis, 48 patients were diagnosed with AMI, accounting for 48.00%. Among them, 28 cases had anterior wall, anterior wall and extensive anterior wall infarction, and 20 cases had inferior wall, anterior posterior wall and right ventricular infarction.

### 3.3. Comparison of positive rates of individual and combined detection of different indicators in two groups

The positive rates of serum cTnI, CK-MB, MYO, WBC count and PDW alone and the combined detection of 5 indicators were higher in the observation group than those in the control group. The difference between the two groups was statistically significant (*P*<0.05), as shown in Table 2.

### 3.4. Comparison of sensitivity and specificity of individual indicators and combined detection for diagnosis of AMI

Compared with the sensitivity and specificity of each index for the diagnosis of AMI alone, the sensitivity and specificity of the combined detection of the five indicators were significantly improved, and the difference was statistically significant (*P*<0.05), as shown in Table 3.

### Table 3
Comparison of sensitivity and specificity of individual indicators and joint detection of each indicator (%).

<table>
<thead>
<tr>
<th>Index</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>cTnI</td>
<td>72.92</td>
<td>82.69</td>
</tr>
<tr>
<td>CK-MB</td>
<td>58.33</td>
<td>75.00</td>
</tr>
<tr>
<td>MYO</td>
<td>66.67</td>
<td>59.62</td>
</tr>
<tr>
<td>WBC count</td>
<td>54.17</td>
<td>80.77</td>
</tr>
<tr>
<td>PDW</td>
<td>62.50</td>
<td>61.54</td>
</tr>
<tr>
<td>Joint detection of 5 indicators</td>
<td>95.83</td>
<td>94.23</td>
</tr>
</tbody>
</table>
mild myocardial damage\cite{13}. Most studies have found that serum MYO levels rise rapidly after 1-3 h of onset of AMI, peak time is 6 to 9 h after onset, and returns to normal after 24 h of onset, so MYO is presumed to be an early sensitive indicator of AMI diagnosis\cite{13}. MYO is elevated in skeletal muscle disease, trauma or renal dysfunction, and thus has poor specificity and needs to be confirmed with other myocardial markers such as cTnI or CK-MB to prevent misdiagnosis.

Coronary atherosclerosis is the pathological basis of AMI, and atherosclerosis is closely related to inflammatory reactions, so AMI patients are often accompanied by elevated levels of inflammatory markers\cite{14}. This study found that the serum WBC count of patients with AMI was significantly higher than that of healthy subjects, suggesting that the increase in inflammatory index WBC count is closely related to AMI, and can be used as an early diagnostic marker for AMI. Adhesion, aggregation, and release of activated platelets play a key role in coronary atherosclerotic thrombosis. Studies have found that the size of platelets determines the activation state of platelets, and the bulk of platelet metabolism and enzyme activities are more active, thereby promoting the formation of thrombosis\cite{14}. An important indicator of changes in platelet volume size is PDW, which can also be used to reflect platelet activity. Platelet function is closely related to the occurrence and development of AMI. During the process of thrombosis, the number of platelets is greatly reduced, resulting in a sudden drop in the number of platelets. The emergency mobilization of the bone marrow releases large new platelets into the blood, resulting in an increase in PDW and a large platelet volume. The increased activity directly involved in the onset of AMI\cite{15}.

This study evaluated the diagnostic value of the combination of the above indicators in the diagnosis of AMI. It was found that serum cTnI, CK-MB, MYO, WBC counts and PDW levels were significantly higher in patients with positive myocardial injury markers compared with healthy controls in the control group, and the positive rate of each index and joint detection was also significantly increased, suggesting that these indicators are ideal indicators for early diagnosis of AMI. The study also analyzed the sensitivity and specificity of the above-mentioned indicators alone and 5 combined detection of AMI. The results showed that the sensitivity and specificity of the combined detection of the five indicators were 95.83% and 94.23%, respectively. Separate detection of indicators, indicating that serum cTnI, CK-MB, MYO, WBC count and PDW combined detection can improve the accuracy of early diagnosis of AMI, reduce the incidence of misdiagnosis and missed diagnosis. Although these indicators play an important role in the diagnosis of AMI, combined detection complement can improve the sensitivity and specificity of the test, and gain valuable time for the treatment of patients.

In conclusion, the combined detection of serum cardiac markers (cTnI, CK-MB, MYO), WBC count and PDW has important clinical value in the diagnosis of AMI, and can improve the diagnostic accuracy.

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\begin{enumerate}
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\end{enumerate}