Cardiac multi-marker strategy for effective diagnosis of acute myocardial infarction

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Cardiac multi-marker strategy for effective diagnosis of acute myocardial infarction

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Creatine kinase MB (CK-MB)
Heart-type fatty acid-binding protein (H-FABP)
Multi-marker

Abstract

Background: Heart-type fatty acid-binding protein (H-FABP) is a heart-specific and highly sensitive biomarker for early diagnosis of acute myocardial infarction (AMI). We investigated the effectiveness of H-FABP for diagnosis of AMI in patients with different ethnicity and different time from symptom onset.

Methods: Venous blood was withdrawn from consecutive patients with acute chest pain admitted to the First Affiliated Hospital of Xinjiang Medical University. The blood samples were used for measurement of creatine kinase MB (CK-MB) and cardiac troponin I (cTnI) using Beckman Coulter DC-800 analyzer, and detection of H-FABP using a one-step bedside immunotest.

Results: Two hundred and eighty-nine patients admitted within 12 h after the onset of symptoms were recruited in the study. The H-FABP immunotest was found to have higher diagnostic accuracy than cTnI and CK-MB in patients admitted within 3 h. The combination of H-FABP and cTnI was found to have the highest diagnostic accuracy (91%) among different cardiac markers and the other combinations. It gave the highest sensitivity (96% [95% CI: 91–98%]) and a comparable specificity (84% [95% CI: 76–89%]) to cTnI alone.

Conclusion: A cardiac panel consisting of H-FABP and troponin is recommended.

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1. Introduction

Cardiovascular disease causes a major burden in health care and is the single most costly disease for the health care system. It has been increasing in the past few decades in China, the largest and most populous developing country in the world. Acute myocardial infarction (AMI) is the leading cause of mortality among cardiovascular disease. The high mortality rate can be dramatically reduced by early diagnosis and effective coronary reperfusion.

From the ED perspective, it is important to expeditiously distinguish between AMI and non-AMI patients so as to be able to immediately start proper treatment. Although electrocardiogram (ECG) is a standard test to identify patients with AMI upon ED presentation, it still has relatively low sensitivity for detection of AMI (only 35–50%) [1]. Instead, plasma markers of myocardial injury ultimately show almost 100% sensitivity, dependent on the delay in their release into plasma.

Recently, a one-step bedside H-FABP immunotest so-called Cardiodetect designed to detect H-FABP in whole blood samples has become commercially available [2–6]. The test result is available within 15 min after addition of blood samples. It requires no sample pretreatment and, therefore, is suitable especially for application in an emergency situation. Many studies in the developed countries like Europe and Japan have demonstrated the superior performance of H-FABP for diagnosis of AMI in the early stage [7–12]. However, such information is still relatively insufficient in the developing countries with inconvenient traffic, low educational level, lack of hospital resources and comprehensive facilities. Study about the utility of H-FABP for diagnosis of AMI in China is also limited.

The prevalence of several chronic diseases in Xinjiang including myocardial infarction, diabetes, hypertension, and cancers is difference among different ethnic groups. Therefore, the present study aimed at investigating the effectiveness of the H-FABP immunotest compared to...
current cardiac markers for diagnosis of AMI in patients with different ethnic background, different chronic diseases, different genders and different time from symptom onset in Xinjiang. Also, the diagnostic performance of different combinations of cardiac markers was compared. This study may act as a reference for those developing countries and the results can be compared to those studies conducted in developed countries to assess the universal applicability of the H-FABP immunotest for diagnosis of AMI. This study has been divided into two phases: Phase I has been implementing in Urumqi for 3 y; Phase II will be implemented in the southern, northern and eastern parts of Xinjiang for 4 y.

2. Methods

2.1. Study design and setting

According to the Declaration of Helsinki, the design of this study was to investigate the diagnostic accuracy of the H-FABP immunotest. This study was reviewed and approved by the ethical committee of the First Affiliated Hospital of Xinjiang Medical University in November 2007 with document number: No. 20071108. The First Affiliated Hospital of Xinjiang Medical University is a teaching hospital in the western border of area of Urumqi in Xinjiang. In 2007, there were 2332 visits for cardiovascular diseases to the Emergency Department (ED) of this hospital; 502 of them suffered from chest pain and 158 of these patients ultimately have been diagnosed as acute myocardial infarction (AMI) and 57 as angina pectoris.

This was a double-blind parallel study. Consecutive patients with acute chest pain admitted to the ED of the First Affiliated Hospital of Xinjiang Medical University were diagnosed according to the ESC/ACC guideline and the H-FABP immunotest. Fig. 1 showed the diagnostic pathway in this study.

A comprehensive study design and accurate data collection were relied on a well-organized preliminary study. The preliminary study was implemented from September 2007 to November 2007 and 40 consecutive patients were recruited. The study protocol were revised and finalized after the preliminary study. All the patients in the preliminary study were not included in the current study.

2.2. Inclusion and exclusion criteria

Patients were included in this study if (i) they aged ≥ 18 y, (ii) chest pain suggestive of coronary origin at the discretion of an ED physician’s assessment, (iii) and onset of chest pain < 12 h prior to enrollment. Patients were excluded if (i) they were unable to give consent or unwilling to join the study; (ii) they had chronic renal injury (creatinine in serum > 100 mol/l or > 1.5 mg/dl); (iii) they had intention neuralgia or recent pain related to thoracic trauma within 3 days; (iv) they had severe skeletal muscle injury.

2.3. Patient assessments and investigations

According to the ESC/ACC guideline [13,14], patients were confirmed as AMI patients if they had (i) typical acute chest pain; (ii) abnormal 12-lead ECG defined as pathologic Q waves of > 40 ms, ST-segment elevation or depression of > 1 mm or abnormal T wave morphology; (iii) the cTnI concentration above the 99th percentile cutoff with a CV < 10%.

The onset time of symptoms was critical in this study. The time was based on the subjective reports of the patients about the onset of chest pain. In order to minimize the variation, the medical doctors asked the patients and their relatives twice respectively. The ECG was examined by 2 internal medicine specialists and the final result was reported by the Vice Director at the ED.

2.4. Laboratory analysis

Venous blood was withdrawn from patients suspected of AMI at admission. The blood samples were used for detection of CK-MB, cTnI and H-FABP. The concentrations of CK-MB and cTnI were determined by using Beckman Coulter DC-800 chemistry analyzer. The cut-off values for CK-MB and cTnI were set at 25 U/l and 0.03 μg/l respectively. The final report was approved by a senior medical doctor in the Department of Laboratory Medicine. The measurement of all the cardiac markers using the analyzer in each sample was completed within 30–50 min. The final diagnosis was made by the Director at CCU and the Director at ED who were blinded to the H-FABP results.

All patients were also tested with CardioDetect® H-FABP immunotest (Fig. 2). It is a rapid chromatographic immunoassay designed for...
qualitative determination of H-FABP in blood samples with a cut-off value of 7 μg/l. The working principle of the H-FABP immunotest was based on a sandwich immunoassay using a pair of monoclonal antibodies with the detector labeled with colloidal gold. The test required 100–120 μl of sample and the result was interpreted within 15 min after sample application. The test result was positive if two red lines were visible (one at the area of the test zone and one at the control zone). This indicated that the concentration of H-FABP in the sample was above the threshold value of 7 μg/l and that an AMI had occurred. The result was negative if only 1 red line was visible at the control zone. This reading indicated that the concentration of H-FABP in the sample was below the threshold value and that an AMI had not occurred. The test was invalid if no line was visible or if a line only at the test zone was visible. In such a case, the measurement was repeated immediately.

The result of the H-FABP immunotest was judged by two independent master students at CCU. They had no information about the final diagnosis. The results and the final diagnosis were summarized in a cross table for analysis by a doctoral student who did not participate in any measurement. The study database was setup and organized by two statisticians by using double data entry and double checking method to ensure data accuracy.

2.5. Clinical trial registration

The World Health Organization (WHO) officially announced the expansion of its clinical trial registry platform to include trial registers from China in July 2007. This study was registered under the Chinese Clinical Trial Register (http://www.ctrini.org) in November 2007. The clinical trial registration number was ChiCTR-DT-00000040.

2.6. Statistical analysis

Data are presented as medians and interquartile ranges (IQR). Sensitivities with 95% confidence intervals (95% CI), specificities with 95% CI, negative and positive predictive values (NPV and PPV), negative and positive likelihood ratios (LR- and LR+) of each cardiac marker and different combinations in 2 groups with different onset of symptoms (0–6 vs. 6–12 h) and in different ethnic groups were calculated by using SPSS13.0 (Chicago, IL) and MedCalc ver 7.0 (MedCalc Software, Mariakerke, Belgium). Diagnostic accuracy was defined as a proportion of correctly classified subjects (TP + TN) among all subjects (TP + TN + FP + FN). The level of significance was set at p<0.05 (Table 1).

### Table 1
Demographic characteristics and risk factors of study subjects.

<table>
<thead>
<tr>
<th>Age, year [M (P25, P75)]</th>
<th>n</th>
<th>AMI</th>
<th>Non-AMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, year [M (P25, P75)]</td>
<td>61 (50, 69)</td>
<td>61 (50, 70)</td>
<td>60 (46, 69)</td>
</tr>
<tr>
<td>Sex (%)</td>
<td>274</td>
<td>157 (57)</td>
<td>117</td>
</tr>
<tr>
<td>Male</td>
<td>196</td>
<td>121 (62%)</td>
<td>75</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>36 (46%)</td>
<td>42</td>
</tr>
<tr>
<td>Ethnic group (%)</td>
<td>180</td>
<td>98 (54%)</td>
<td>82</td>
</tr>
<tr>
<td>Han</td>
<td>66</td>
<td>43 (65%)</td>
<td>23</td>
</tr>
<tr>
<td>Uygur</td>
<td>17</td>
<td>9 (53%)</td>
<td>8</td>
</tr>
<tr>
<td>Xibo</td>
<td>9</td>
<td>5 (56%)</td>
<td>4</td>
</tr>
<tr>
<td>Hui</td>
<td>2</td>
<td>2 (100%)</td>
<td>0</td>
</tr>
<tr>
<td>Risk factors (%)</td>
<td>133</td>
<td>51 (38%)</td>
<td>82</td>
</tr>
<tr>
<td>Diabetes</td>
<td>109</td>
<td>37 (34%)</td>
<td>72</td>
</tr>
<tr>
<td>Hypertension</td>
<td>165</td>
<td>91 (53%)</td>
<td>74</td>
</tr>
<tr>
<td>History of ischemic heart disease</td>
<td>26</td>
<td>12 (46%)</td>
<td>14</td>
</tr>
</tbody>
</table>

3. Results

Between 19 November 2007 and 15 February 2009, 289 patients were recruited to the study (Fig. 3). Three patients without consent and 12 patients’ diagnosis not based on the ESC/ACC guideline were excluded. Therefore, 15 patients were excluded leaving 274 patients (median age: 61 y; IQR: 50–70 y; 28.5% female) for analysis. Among the 274 patients, there were 180 Han patients (65.8%), 66 Uygur patients (24%), 17 Hui patients (6.2%), 9 Kazak patients (3.3%) and 2 Xibo patients (0.7%). The median time from symptom onset to the first blood sample was 5 h (IQR: 3–6 h).

3.1. Diagnostic performance of H-FABP immunotest

The diagnostic performance of different cardiac markers and the combinations in patients suspected of AMI admitted to the hospital within 12 h after the onset of symptoms is summarized in Table 2. The sensitivity and specificity of the H-FABP immunotest were 87% (95% CI: 81–92%) and 84% (95% CI: 76–89%) respectively. The PPV and NPV were 88% and 83% respectively. The LR+ and LR− were 5.37 and 0.15 respectively. The false negative ratio was 13% while the false positive ratio was 16%. There were 19 patients with false positive results including 4 patients with cerebrovascular accident, 4 unstable angina patients, 3 patients with old myocardial infarction, 2 patients with cardiac arrhythmia, 2 patients with essential hypertension (grade III), 1 patient with pulmonary embolism, 1 patient with acute pancreatitis, 1 patient with left ventricular failure and 1 patient with stable angina.

The H-FABP immunotest was found to have higher sensitivity and NPV than CK-MB while its specificity and PPV were comparable to both cTnI and CK-MB. At the time of ED presentation, the use of both early and late markers rather than the gold standard troponins alone increases the diagnostic performance. The combination of H-FABP and cTnI was found to have the highest diagnostic performance among different cardiac markers and the other combinations. It gave the highest sensitivity and NPV while its specificity and PPV were comparable to cTnI alone (Table 2).

3.2. Diagnostic performance of different cardiac markers in patients with different time from symptom onset

The sensitivity and specificity of H-FABP were 79% (95% CI: 65–89%) and 80% (95% CI: 65–89%) respectively for patients admitted 0–3 h after the onset of symptoms, while the sensitivity and specificity of H-FABP increased to 93% (95% CI: 83%–97%) and 90% (95% CI: 77%–96%) respectively for patients admitted 6–12 h after the onset of symptoms (Table 2).

Among patients admitted 0–3 h after the onset, the H-FABP immunotest was found to have higher sensitivity and specificity than both cTnI and CK-MB. The combination of H-FABP and cTnI was found to have the highest diagnostic accuracy (85%) among different cardiac markers and the other combinations in the early phase of AMI.

Among patients admitted 6–12 h after the onset, both the sensitivities and specificities of all single cardiac markers increased to 90% or above while only the sensitivity of CK-MB was slightly below 90%. The diagnostic performance of cTnI and the combination of cTnI and CK-MB was the best among different cardiac markers and the other combinations in the early phase of AMI.

Among patients admitted 6–12 h after the onset, the combination of H-FABP and cTnI was found to have the highest diagnostic accuracy (91%) among different cardiac markers and the other combinations. It gave the highest sensitivity [96% (95% CI: 91–98%)] and a comparable specificity [84% (95% CI: 76–89%)] to cTnI alone.
3.3. Diagnostic performance of H-FABP immunotest in different ethnic groups

The sensitivity and specificity of H-FABP in the Han patients were 87% (95% CI: 81%–92%) and 85% (95% CI: 76%–91%), while the sensitivity and specificity of H-FABP in the Uygur patients were 88% (95% CI: 76%–95%) and 78% (95% CI: 58%–90%) (Table 3). There was no statistically significant difference in the diagnostic performance of the H-FABP immunotest among the Han and Uygur patients (p > 0.05).

3.4. Diagnostic performance of H-FABP immunotest in patients of different genders

The sensitivity and specificity of H-FABP in males were 90% (95% CI: 83%–94%) and 86% (95% CI: 77%–92%) respectively, while the sensitivity

Table 2
Diagnostic performance of H-FABP immunotest, cTnI and CK-MB for diagnosis of AMI.

<table>
<thead>
<tr>
<th>Onset time</th>
<th>n</th>
<th>TP</th>
<th>FP</th>
<th>FN</th>
<th>TN</th>
<th>Diagnostic accuracy</th>
<th>Sen 95%CI</th>
<th>Spe 95%CI</th>
<th>LR+</th>
<th>LR-</th>
<th>PV+</th>
<th>PV-</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–3 h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-FABP</td>
<td>95</td>
<td>51</td>
<td>3</td>
<td>39</td>
<td>99</td>
<td>0.95 (0.85–0.98)</td>
<td>0.95 (0.85–0.98)</td>
<td>98 (0.87–1.00)</td>
<td>37.82</td>
<td>0.06</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>cTnI</td>
<td>95</td>
<td>52</td>
<td>3</td>
<td>39</td>
<td>99</td>
<td>0.95 (0.85–0.98)</td>
<td>0.95 (0.85–0.98)</td>
<td>98 (0.87–1.00)</td>
<td>37.82</td>
<td>0.06</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>CK-MB</td>
<td>95</td>
<td>49</td>
<td>6</td>
<td>37</td>
<td>98</td>
<td>0.89 (0.78–0.95)</td>
<td>0.93 (0.80–0.97)</td>
<td>11.88</td>
<td>0.12</td>
<td>0.94</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>H-FABP+cTnI</td>
<td>95</td>
<td>52</td>
<td>3</td>
<td>39</td>
<td>99</td>
<td>0.95 (0.85–0.98)</td>
<td>0.95 (0.85–0.98)</td>
<td>98 (0.87–1.00)</td>
<td>37.82</td>
<td>0.06</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>cTnI+CK-MB</td>
<td>95</td>
<td>52</td>
<td>3</td>
<td>39</td>
<td>99</td>
<td>0.95 (0.85–0.98)</td>
<td>0.95 (0.85–0.98)</td>
<td>98 (0.87–1.00)</td>
<td>37.82</td>
<td>0.06</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>H-FABP+CK-MB</td>
<td>95</td>
<td>52</td>
<td>3</td>
<td>39</td>
<td>99</td>
<td>0.95 (0.85–0.98)</td>
<td>0.95 (0.85–0.98)</td>
<td>98 (0.87–1.00)</td>
<td>37.82</td>
<td>0.06</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>Overall</td>
<td>237</td>
<td>177</td>
<td>14</td>
<td>120</td>
<td>103</td>
<td>0.87 (0.81–0.92)</td>
<td>0.84 (0.76–0.91)</td>
<td>5.37</td>
<td>0.15</td>
<td>0.88</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>cTnI</td>
<td>240</td>
<td>141</td>
<td>18</td>
<td>110</td>
<td>102</td>
<td>0.89 (0.83–0.93)</td>
<td>0.89 (0.82–0.93)</td>
<td>8.03</td>
<td>0.12</td>
<td>0.92</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>CK-MB</td>
<td>240</td>
<td>110</td>
<td>47</td>
<td>92</td>
<td>102</td>
<td>0.70 (0.62–0.77)</td>
<td>0.87 (0.79–0.95)</td>
<td>5.46</td>
<td>0.34</td>
<td>0.88</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>H-FABP+cTnI</td>
<td>240</td>
<td>140</td>
<td>17</td>
<td>110</td>
<td>102</td>
<td>0.87 (0.81–0.92)</td>
<td>0.79 (0.70–0.85)</td>
<td>4.08</td>
<td>0.16</td>
<td>0.85</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>cTnI+CK-MB</td>
<td>240</td>
<td>140</td>
<td>17</td>
<td>110</td>
<td>102</td>
<td>0.89 (0.83–0.93)</td>
<td>0.81 (0.73–0.87)</td>
<td>4.74</td>
<td>0.13</td>
<td>0.86</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>H-FABP+CK-MB</td>
<td>240</td>
<td>140</td>
<td>17</td>
<td>110</td>
<td>102</td>
<td>0.88 (0.95–0.98)</td>
<td>0.79 (0.70–0.85)</td>
<td>4.47</td>
<td>0.06</td>
<td>0.88</td>
<td>0.93</td>
<td></td>
</tr>
</tbody>
</table>

TP: true positive; FP: false positive; FN: false negative; TN: true negative; Sen: sensitivity; Spe: specificity; LR+: positive likelihood ratio; LR-: negative likelihood ratio; PV+: positive predictive value; PV-: negative predictive value.
and specificity of H-FABP in females were 80% (95% CI: 65–90) and 79% (95% CI: 64–92) respectively (Table 3). There was no statistically significant difference in the diagnostic performance of the H-FABP immunotest among males and females (p > 0.05). The diagnostic performance of H-FABP was higher in males than in females.

3.5. Diagnostic performance of H-FABP immunotest in patients with different chronic diseases

The diagnostic performances of H-FABP in patients with and without diabetes and hypertension were shown in Table 3. Patients without both diabetes and hypertension gave the highest sensitivity [94% (95% CI: 85–98%) but the lowest specificity [40% (95% CI: 12–77%)]. Patients with only hypertension gave the optimal sensitivity [84% (95% CI: 72–91%)] and specificity [91% (95% CI: 82–96%)].

4. Discussion

4.1. Diagnostic performance of H-FABP immunotest

The appropriate handling of patients with suspected AMI depends on the availability of results from simple, sensitive and specific diagnostic tests. In patients with typical early ECG changes of ST-segment elevation, the diagnosis of AMI is easily and rapidly established. However, at least 40% of patients with AMI show no diagnostic ECG changes, especially at the early phase of AMI [5,6,12,25,26]. In this study, we found that the sensitivities of H-FABP and cTnI were comparable. This may be explained by the utilization of different cutoff values for cTnI in various studies. In this study, the cutoff value for cTnI was 0.03 μg/l and thus enhanced its sensitivity.

Xinjiang is a multi-ethnic region. This study only included patients from Han, Uyghur, Hui, Kazakh and Xibe, which occupy 98.2% of the population in Xinjiang. The Uyghur and Han patients were dominated in this study as the Uygurs is the largest ethnic group (45%) and the Han is the second (41%). In this study, we found that there was no statistically significant difference in the diagnostic performance of the H-FABP immunotest among the Han and Uygur patients.

The prevalence rate of AMI case in the recruited cases not only depends on the inclusion and exclusion criteria, but also depends on the recruiting site. In this study, the prevalence rate of AMI case recruited was 5% which was similar to the studies reported by Alhashemi et al. [5] and Ecolan et al. [6]. This study also demonstrated that there was no statistically significant difference in the diagnostic performance of the H-FABP immunotest among males and females. On the other hand, patients without both diabetes and hypertension showed the highest sensitivity but the lowest specificity. The low specificity could be explained by the small number of non-AMI cases in this group. Therefore, the diagnostic performance of H-FABP immunotest in patients with different chronic diseases should be further investigated.
4.4. Impact on clinical practice

The re-measurement of H-FABP negative samples after 1 h can improve the diagnostic accuracy and was thus the most effective diagnostic tool for diagnosis of AMI. Mion et al. [28] also demonstrated that the combination of Ctnl and H-FABP gave the greatest diagnostic efficacy in AMI diagnosis in northern Italy. A rapid bedside immunotest allows H-FABP to be used in clinical settings, together with other clinical tools such as troponin test, to diagnose and treat cardiac patients as soon as possible so that mortality and morbidity can be decreased. This strategy may allow the complete detection of cardiac injury and may improve the diagnosis of AMI on the initial sample. Further investigation should be conducted to confirm the efficiency of this strategy.

4.3. Limitations of the study

This study was limited by the number of patients and a continuous measurement of H-FABP was omitted after confirmation as a negative case, Chan et al proved that the sensitivity and the negative predictive value of H-FABP reached to 100% in 1 h after admission [16]. Whether the re-measurement of H-FABP negative samples after 1 h can improve the diagnostic accuracy should be further investigated.

4.4. Impact on clinical practice

As the therapeutic window for AMI is within the first 6 h, and an earlier intervention has a better success rate, the availability of an early rapid test is important. In order to decrease the risk of falsely excluded patients with ongoing AMI, a combined measurement of two cardiac markers, an early one such as H-FABP and a later marker such as troponins may provide the optimum diagnostic performance. In this study, a 1-step H-FABP immunotest based on a sandwich principle was evaluated. Apart from its high diagnostic accuracy the H-FABP immunotest is very easy to be operated and thus favorable to be used in ambulance, emergency department and any emergency situation. Its simplicity in operation makes it a user-friendly test for application by chronic patients with high risk in AMI at home.

Recent studies about the application of the H-FABP immunotest for diagnosis of AMI were mainly reported in some developed countries like Europe and Japan [7–12]. Due to unfair distribution of medical resources across the world, the need of the H-FABP immunotest is always higher in the developing countries than the developed countries, especially for hospitals located at the countryside. The Xinjiang Uyugur Autonomous Region is located in the North West corner of China. Its characteristics like low population density, poor transportation system, relatively poor economic and educational development, and lack of infrastructure improvements to promote hygiene reflects the key characteristics of the developing countries, and thus there is an urgent need to have a rapid system for early diagnosis of AMI.

This study can act as a model to demonstrate the utility of the H-FABP immunotest in the developing countries. In the second phase of this study, we will conduct a cost-effectiveness analysis on the utility of this test in the routine clinical practice and investigate whether this test can improve the clinical outcome and shorten the time of diagnosis compared to the original protocol.

The potential of this rapid and sensitive H-FABP immunotest in the detection of myocardial infarction is considerable. It may help physicians to diagnose AMI more accurately and earlier, leading to improved treatment that will reduce patient morbidity and mortality and prevent unnecessary hospital stays for non-AMI patients. This sophisticated and effective diagnostic tool could enable both physicians and patients to control diseases that now cause extensive disability and loss of life worldwide.

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