Original Article

An analysis of the ischemia grades on admission electrocardiograms in patients with ST-segment elevation myocardial infarction

Xianchun Li, Wenya Shi

The First People’s Hospital of Fuyang, Hangzhou 311400, Zhejiang Province, China

Received May 27, 2020; Accepted August 23, 2020; Epub November 15, 2020; Published November 30, 2020

Abstract: Objective: This study aimed to explore the clinical significance of the ischemia grades on the admission electrocardiograms (ECG) of patients with ST-segment elevation myocardial infarction (SEMI). Methods: A total of 136 patients with myocardial infarction admitted to our hospital from December 2018 to November 2019 were enrolled. According to their myocardial ischemia classifications, 58 patients with grade III ischemia were placed in the control group (the CG, administered 20 mg Lipitor, once daily for 12 weeks) and 78 patients with grade II ischemia were placed in the observation group (the OG, administered 80 mg Lipitor, once daily for 12 weeks). The deviations of the ST-segments and the baseline data as well as cardiac function and any complications after admission were compared. Results: The sum of the ST segment elevations in the CG was significantly higher than it was in the OG at admission ($t=3.376$, $P<0.05$). The TnT and myocardial infarction areas in the CG during the patients’ hospitalization were significantly higher than they were in the OG ($P<0.05$), but the cardiac function indices, such as the left ventricular ejection fraction and the creatine kinase-MB levels in the CG were significantly lower than they were in the OG ($P<0.05$). There were 30 right coronary artery occlusion cases (51.72%) and 28 circumflex coronary artery branch occlusion cases (48.27%) in the CG, but in the OG, there were 29 proximal, mid anterior descending branch occlusion cases (37.17%), 38 right coronary artery occlusion cases (48.71%), and 11 mid, distal anterior descending branch cases (14.10%). The peak cTnI and NT-proBNP levels in the CG were significantly higher than they were in the OG ($P<0.05$). The serum hypersensitive troponin I levels in the CG were significantly higher than they were in the OG ($P<0.05$). Conclusion: Patients with grade III myocardial ischemia have a poorer prognosis than those with grade II, suggesting that ECG analysis and grading have an important diagnostic significance for the admission of patients with myocardial infarction and have a guiding significance for the prognoses of patients and their treatment selection.

Keywords: Myocardial infarction, grade of ischemic, electrocardiogram ST-segment elevation

Introduction

Acute myocardial infarction (AMI), also known a heart attack, is a life-threatening condition that occurs when blood flow to the heart muscle is suddenly interrupted, causing tissue damage. At present, electrocardiogram (ECG) examination is the primary tool for clinical diagnosis of AMI [1]. In the diagnosis of acute ST-segment elevation myocardial infarction (SEMI), fragmented wide QRS wave (fWQRS) of the corresponding lead has not received enough attention [2]. The emergency opening and occlusion of the blood vessels and the restoration of blood flow are the most effective methods to treat AMI. Generally, patients with AMI require percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), or thrombolytic therapy. However, PCI and CABG have not been widely implemented in small local hospitals due to the limitations in surgical facilities and resources. Patients have no time to transfer to technologically advanced hospitals for PCI or CABG treatment. On the basis of QRS, the drug regimen can also effectively open occlusive coronary arteries, significantly reduce the mortality and improve patients' arrhythmia in the early stage [3].

AMI is a sudden reduction or interruption in the coronary blood supply, resulting in irreversible ischemic necrosis caused by insufficient myo-
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Cardiac perfusion, with angina pectoris as the precursor of onset. Clinical symptoms include pain, arrhythmia, hypotension and even shock [4]. Zheng et al. indicated that the prognoses of patients with myocardial infarction are closely related to ischemia grades, and ECGs are thought to play an important role in the diagnosis and evaluation of myocardial infarction [5]. When AMI patients are examined, healthcare providers pay much attention to the ST segment elevation displayed on the ECG and formulate a corresponding treatment plan. The dosing of drugs can be quantified according to the data displayed by the QRS [6]. This study retrospectively analyzed 136 AMI patients who were divided into a control group (the CG) (grade III) and an observation group (the OG) (grade II). The two groups’ clinical prognoses and ECGs were compared to provide a reference for the clinic and to improve patients’ clinical prognoses.

Materials and methods

Baseline data

Altogether 136 patients with AMI admitted to our hospital from December 2018 to November 2019 were recruited for this study. They included 60 males and 76 females 50-78 years old, with an average age of (53.3 ± 10.1) years. The AMI patients with grade III myocardial ischemia were included in the CG (n=58), and the patients with grade II myocardial ischemia were enrolled in the OG (n=78). Inclusion criteria: Ischemic chest pain ≥ 30 mg, which could not be relieved by rest or nitroglycerin, the ECG showed two adjacent leads with ST-segment elevation ≥ 0.1 MV, an onset time in the non-thrombolytic patients of ≤24 hours, and an onset time in the thrombolytic patients of ≤12 hours. Exclusion criteria: Patients who have had a previous myocardial infarction, patients with cardiac insufficiency due to other causes, patients with incomplete ECG data, and patients with bundle branch block. All the patients or their families signed a written informed consent. This study was conducted with the approval of the ethics committee of our hospital.

Diagnostic method

According to the diagnostic criteria for acute myocardial infarction recommended by the American College of Cardiology/American Heart Association in 2004, ischemic grading was performed according to the Sclarovsky-Birnbaum Ischemia Grading (SB-IG) criteria [7, 8]. Grade II ischemia: Elevation of the ST segment in two adjacent leads ≥ 0.1 mV, chest pain ≥ 30 min, changes in the concentration of the serum creatine kinase isozyme (CK-MB). Grade III ischemia: Emergence of the J point ≥ 50% of the R wave in the leads with qR configuration, or the disappearance of the S wave in the leads with a Rs configuration. The patients in the CG were administered 20 mg Lipitor, once daily, with continuous treatment for 12 weeks. The patients in the OG were administered 80 mg Lipitor, once daily, with continuous treatment for 12 weeks.

Outcome measurement

The patients’ ECGs were monitored by a professional physician, and the echocardiography was performed within 4 weeks of admission. The GEVivid7 color ultrasonic diagnostic instrument was used with a probe frequency of 2.5 MHz. The left ventricular ejection fraction (LVEF) was measured using the biplane method, and the movement of the ventricular wall was observed. Cardiac troponin I (cTnI): Fasting venous blood samples (3 ml) from the two groups were collected in the early morning, centrifuged with 15 cm as the centrifugal radius at 2500 r/min for 10 min. The serum was separated and stored at -20°C for testing. A Troponin I kit (Shanghai Jianglai Biotechnology Co., Ltd.) was used in strict accordance with

Figure 1. The baseline data of the two groups. There were no significant differences in age or gender between the two groups (P>0.05, t=1.776; P>0.05, X²=0.083).
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Table 1. The occurrence of comorbidities in the two groups (mean ± s, n (%))

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Hypertension</th>
<th>Diabetes</th>
<th>Pre-infarction angina</th>
<th>Anterior wall infarction</th>
<th>Inferior wall infarction</th>
<th>ECG ∑ST (mV) on admission</th>
<th>Elective PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>58</td>
<td>33 (56.90)</td>
<td>17 (29.31)</td>
<td>13 (22.41)</td>
<td>37 (63.79)</td>
<td>21 (36.21)</td>
<td>0.49 ± 0.31</td>
<td>27 (46.55)</td>
</tr>
<tr>
<td>Observation group</td>
<td>78</td>
<td>43 (55.13)</td>
<td>23 (29.49)</td>
<td>15 (19.23)</td>
<td>54 (69.23)</td>
<td>28 (35.90)</td>
<td>0.74 ± 0.55</td>
<td>35 (44.87)</td>
</tr>
<tr>
<td>t/X²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

Results

Comparison of the baseline data

The average ages in the OG and the CG were (59.1 ± 8.7) years and (61.3 ± 11.2) years, respectively. There were 69 males and 9 females in the OG, and 50 males and 8 females in the CG. There were no significant differences in age or gender between the two groups, which were comparable (P>0.05, t=1.776; P>0.05, X²=0.083) (Figure 1).

Complications at admission

The OG showed higher ∑ST and a lower incidence of pre-infarction angina than the CG (P<0.05). There were 30 cases of occlusion of the right coronary artery (51.72%) and 28 cases of occlusions of a circumflex coronary artery branch (48.27%) in the CG. Meanwhile, in the OG, there were 29 cases of proximal occlusion of the mid anterior descending branches (37.17%), 38 cases of occlusions of the right coronary artery (48.71%), and 11 cases of mid, distal anterior descending branches (14.10%) (Table 1).

Changes in cardiac function during the hospitalization in both groups

The area of myocardial infarction and TnT of the OG after hospitalization were significantly lower than they were in the CG (P<0.05), and the LVEF and CK-MB levels of the OG were higher than they were in the CG (P<0.05). The OG showed significantly upregulated peak cTnI and NT-proBNP levels than the OG (P<0.05), indicating that the cardiac function indicators in the CG were worse than they were in the OG (Figure 2).

Complications during the hospitalization in both groups

The CG showed increased arrhythmia, heart failure or shock, inpatient mortality, and ven-
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<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Arrhythmia</th>
<th>Heart failure or shock</th>
<th>Inpatient mortality</th>
<th>Ventricular aneurysm</th>
<th>Reinfarction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group (n=58)</td>
<td>14</td>
<td>24.14</td>
<td>16 (27.59)</td>
<td>10 (17.24)</td>
<td>12 (20.69)</td>
<td>8 (13.79)</td>
</tr>
<tr>
<td>Observation group (n=78)</td>
<td>10</td>
<td>12.82</td>
<td>11 (14.10)</td>
<td>7 (8.97)</td>
<td>9 (11.54)</td>
<td>5 (6.41)</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>
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</table>

Table 2. The incidences of complications in the two groups [n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Hypersensitive troponin I (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OG</td>
<td>78</td>
<td>14.89 ± 3.14</td>
</tr>
<tr>
<td>CG</td>
<td>58</td>
<td>31.64 ± 4.56</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>18.440</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 3. A comparison of the changes in the serum hypersensitive troponin I levels in both groups (X ± s)

Occlusions of the coronary artery caused by AMI lead to corresponding changes on the ECG. Therefore, the continuous changes of the ECG can be measured from the leads in the area of the ischemia [15, 16]. On basis of the changes in the ECG, the patients are usually classified into 3 grades. In this study, the patients were divided into grade II and III myocardial ischemia according to their ECGs. The results showed that there was no difference in the common symptoms such as hypertension, diabetes, pre-infarction angina, etc. It was found that the anterior wall myocardial infarction occurred at the proximal end of the anterior descending branch, and the ST segment of the infarction shifted toward the bottom of the myocardium, so the inferior wall leads points away from lateral wall, resulting in the ST segment decreasing. The myocardial infarction was located proximal to the descending branch, thereby enlarging the area of ischemic infarction and directly affecting the left ventricular function [7, 17]. 80%-90% of patients with acute inferior myocardial infarction are accompanied by ST segment elevations in leads II, III, and aVF due to RCA blockage, and some patients have ST segment elevation due to LCX circumflex branch occlusion [18, 19].

Studies have shown that the classification of myocardial ischemia at admission has an important clinical significance. Myocardial ischemia is closely related to hospital complications, ventricular function, infarct size and mortality. Patients with grade III ischemia have a significantly faster progression or a larger area of necrosis than patients with grade II ischemia, which may be related to the ischemia and to less lateral circulation [20, 21]. Some studies have used 99mTeSPECT to estimate the infarct size, and it was found that the differences in overall left ventricular function in patients with grade III and grade II ischemia are significantly related to the severity of the dysfunction in the area involved [16, 22, 23].
In summary, patients with grade III myocardial ischemia have a poorer prognosis than the patients with grade II myocardial ischemia, suggesting that the use of ECGs to classify patients with myocardial infarction when admitted has an important clinical diagnostic significance for the evaluation of the prognosis and the selection of the treatment.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Disclosure of conflict of interest

None.

Address correspondence to: Xianchun Li, The First People’s Hospital of Fuyang Hangzhou, No. 429 North Ring Road, Fuchun Street, Fuyang District, Hangzhou 311400, Zhejiang Province, China. Tel: +86-13067719033; E-mail: lxcchun33@163.com

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