Prehospital and Hospital Care of Acute Coronary Syndrome

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Abstract: The pathologic conditions caused by total or subtotal occlusion of the coronary artery as a result of the disruption of coronary plaque and subsequent thrombus formation are known as acute coronary syndrome (ACS). In determining treatment policies, it is important to differentiate between acute myocardial infarction and other conditions. For this purpose, biochemical tests that measure troponin and heart-type fatty acid-binding protein (H-FABP) as well as CK-MB are useful. In the treatment of ACS, hospital care that takes into account the severity of the disease should be based on an evaluation and stratification of risks. As antianginal drug therapy, the use of non-dihydropyridine Ca antagonists should be considered in addition to continuous intravenous infusion of nitroglycerine, antiplatelet drugs, and β-blockers, in view of the fact that the frequency of coronary artery spasm is high in Japanese patients. Although percutaneous coronary intervention (PCI) is thought to be useful for the treatment of drug-resistant ACS, no general consensus has been reached as to the timing of such intervention. A prospective intervention trial on this issue will be necessary in this country.

Key words: Acute coronary syndrome; H-FABP; Troponin T

Introduction

In 1992, Fuster et al.1,2) defined the pathologic conditions caused by total or subtotal occlusion of the coronary artery as a result of the disruption of coronary plaque and subsequent thrombus formation as acute coronary syndrome (ACS). This syndrome includes unstable angina, acute myocardial infarction, and ischemic cardiac death. Since the benefit of thrombolytic therapy differs, these conditions are broadly divided on the basis of the electrocardiogram into the type with ST-segment elevation and the type with non-ST-segment elevation. In this paper, ACS of the type with electrocardiographic non-ST-segment elevation will be described, with reference to the relevant ACC/AHA guidelines.3)
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Vulnerable plaque

Fibrous cap
Tunica media
Lumen Shoulder
Lipid core
Vulnerable plaque

Stable plaque

Lumen
Lipid core

T cell
Macrophage
Foam cell (tissue factor
Activated intimal smooth muscle cell
(HLA-DR
Normal medial smooth muscle cell

Fig. 1 Vulnerable plaque and stable plaque


Lipid pool
Crack
Thrombus
Mural thrombus
Angina pectoris
Acute myocardial infarction
Sudden death

Fig. 2 Occurrence of acute coronary syndrome associated with plaque disruption

Management of ACS

Graphy should be repeated at intervals to allow comparison. Diagnosis should not be based on the results of a single resting ECG.

Among blood biochemical tests, CK-MB (creatine kinase MB isoenzyme derived from the myocardium) is currently in wide use as a serum marker of myocardial injury. However, it has certain limitations in specificity. When ACS is suspected, serial rather than one-point measurement seems to increase the diagnostic value of the test. Heart-type fatty acid-binding protein (H-FABP) is considered useful for diagnosing hyperacute myocardial infarction. Cardiac troponin T and troponin I are more sensitive and specific than CK-MB. The effectiveness of a simple rapid diagnostic kit has been demonstrated, making it the diagnostic standard for acute myocardial infarction. This test is recommended in guidelines issued in western countries.

Table 2 shows biochemical myocardial markers for patients with suspected ACS in whom no ST-segment elevation is found on the 12-lead ECG. In addition to forming the initial diagnosis on the basis of clinical history, physical findings, 12-lead electrocardiogram, and biochemical myocardial markers, it is necessary to determine the severity of the condition (Table 3) to formulate treatment policy and to consider necessary measures (Fig. 3).

Prehospital Care

If a patient reports chest discomfort by telephone, no assessment should be made at that...

ACS with Non-ST-Segment Elevation

1. Disease status

Rupture of vulnerable coronary atherosclerotic plaques plays an important role in the pathogenesis of ACS. A fibrous cap overlies the plaque and vascular lumen. The boundary area between the lumen and lipid core is considered liable to disruption in vulnerable plaques (Fig. 1). If a crack occurs in the cap to cause plaque disruption, thrombus formation is elicited, leading to ACS. Depending on the grade of thrombogenesis and plaque disruption, the patient may develop stable effort angina or unstable angina, or progress to acute myocardial infarction and sudden death (Fig. 2).

2. Diagnosis and differentiation

In history taking, it is important to obtain the features of chest pain, particularly “since when” and “under what situations” the patient recognized the pain, and “for how long” it continued. Immediate emergency treatment may be necessary depending on the frequency and duration of chest pain. Chest pain may not necessarily be typical, but may be attributable to diabetes mellitus. Some cases are pain free. Therefore, it is necessary to obtain the patient’s past history and associated risk factors. Table 1 shows diseases with chest pain that require differentiation from ACS.

Electrocardiography (ECG) is indispensable for early diagnosis, and it is particularly important to observe changes in the electrocardiogram. When ACS is suspected, electrocardiography should be repeated at intervals to allow comparison. Diagnosis should not be based on the results of a single resting ECG.

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Table 2  Biochemical Cardiac Markers of the Evaluation and Management of Patients with Suspected ACS but Without ST-Segment Elevation on 12-Lead ECG

<table>
<thead>
<tr>
<th>Marker</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Point of Care Test Available?</th>
<th>Comment</th>
<th>Clinical Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK-MB</td>
<td>1. Rapid, cost-efficient, accurate assays</td>
<td>1. Loss of specificity in setting of skeletal muscle disease or injury including surgery</td>
<td>Yes</td>
<td>Familiar to majority of clinicians</td>
<td>Prior standard and still acceptable diagnostic test in most clinical circumstances</td>
</tr>
<tr>
<td></td>
<td>2. Ability to detect early reinfarction</td>
<td>2. Low sensitivity during very early MI (&lt;6 h after symptom onset) or later after symptom onset (&gt;36 h) and for minor myocardial damage (detectable by troponins)</td>
<td></td>
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<tr>
<td>CK-MB isoforms</td>
<td>Early detection of MI</td>
<td>1. Specificity profile similar to CK-MB</td>
<td>No</td>
<td>Experience to date predominantly in dedicated research centers</td>
<td>Useful for extremely early (3–6 h after symptom onset) detection of MI in centers with demonstrated familiarity with assay technique</td>
</tr>
<tr>
<td>Myoglobin</td>
<td>1. High sensitivity</td>
<td>1. Very low specificity in setting of skeletal muscle injury or disease</td>
<td>Yes</td>
<td>More convenient early marker than CK-MB isoforms because of greater availability of assays for myoglobin Rapid-release kinetics make myoglobin useful for noninvasive monitoring of reperfusion in patients with established MI</td>
<td>Should not be used as only diagnostic marker because of lack of cardiac specificity</td>
</tr>
<tr>
<td></td>
<td>2. Useful in early MI detection of MI</td>
<td>2. Rapid return to normal range limits sensitivity for later presentations</td>
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<td>3. Detection of reperfusion</td>
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<td></td>
<td>4. Most useful in ruling out MI</td>
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<tr>
<td>Cardiac troponins</td>
<td>1. Powerful tool for risk stratification</td>
<td>1. Low sensitivity in early phase of MI (&lt;6 h after symptom onset) and requires repeat measurement at 8–12 h, if negative</td>
<td>Yes</td>
<td>Data on diagnostic performance and potential therapeutic implications increasingly available from clinical trials</td>
<td>Useful as a single test to efficiently diagnose NSTEMI (including minor myocardial damage), with serial measurements; clinicians should familiarize themselves with diagnostic “cutoffs” used in their local hospital laboratory</td>
</tr>
<tr>
<td></td>
<td>2. Greater sensitivity and specificity than CK-MB</td>
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<td></td>
<td>3. Detection of recent MI up to 2 wk after onset</td>
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<td></td>
<td>4. Useful for selection of therapy</td>
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<td>5. Detection of reperfusion</td>
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</table>

CK-MB: creatine kinase MB isoenzyme derived chiefly from the myocardium  
MI: myocardial infarction; NSTEMI: non-ST-segment elevation myocardial infarction  
(From ACC/AHA Guidelines for the Management of Patients with Unstable Angina and Non-ST-Segment Elevation Myocardial Infarction, JACC 2000; 36, as were Table 3, Fig. 3 and Fig. 4.)

time. Rather, the patient should be told to come to the hospital. The initial diagnosis and treatment policy should be determined at the time of the patient’s visit. Initial treatment is required even before the treatment policy has been established.
1. Primary care

(1) Antianginal drug therapy

As antianginal drug therapy, a sublingual tablet or spray of nitroglycerine and subsequent continuous intravenous infusion of the drug should be carried out while monitoring blood pressure reduction. Since a number of different guidelines indicate that the administration of nitrates is contraindicated for patients within 24 hours after taking sildenafil (Viagra®), it is necessary to determine that no sildenafil has been employed during that period. If chest pain persists, the use of β-blockers under pulse rate and blood pressure monitoring should be considered. In addition, since the frequency of coronary vasospasm is high among Japanese patients, the use of a non-dihydropyridine calcium antagonist (diltiazem) is also effective, taking into account its prophylactic benefit.

(2) Antithrombotic drug therapy

Aspirin therapy should be initiated as soon as possible unless the patient is hypersensitive to the drug or has gastrointestinal bleeding. The therapy consists of an initial dose of 162–325 mg/day, followed by prolonged administration of 50–100 mg/day. Heparin is reported to be beneficial when combined with aspirin.

Table 3 Short-Term Risk of Death or Nonfatal MI in Patients with UA

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Risk (At least 1 of the following features must be present)</th>
<th>Intermediate Risk (No high-risk feature but must have 1 of the following features)</th>
<th>Low Risk (No high- or intermediate-risk feature but may have any of the following features)</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Accelerating tempo of ischemic symptoms in preceding 48 hrs.</td>
<td>Prior MI, peripheral or cerebrovascular disease, or CABG; prior aspirin use.</td>
<td>New-onset CCS Class III or IV angina in the past 2 wk with moderate or high likelihood of CAD.</td>
</tr>
<tr>
<td>Character of pain</td>
<td>Prolonged ongoing (&gt;20 min) rest pain.</td>
<td>Prolonged (&gt;20 min) rest angina, now resolved, with moderate or high likelihood of CAD. Rest angina (&lt;20 min or relieved with rest or sublingual NTG).</td>
<td></td>
</tr>
<tr>
<td>Clinical findings</td>
<td>Pulmonary edema, most likely related to ischemia. New or worsening MR murmur S3 or new/worsening rales Hypotension, bradycardia, tachycardia Age&gt;75 y.</td>
<td>Age&gt;70 y.</td>
<td></td>
</tr>
<tr>
<td>ECG findings</td>
<td>Angina at rest with transient ST-segment changes. 0.05 mV Bundle-branch block, new or presumed new Sustained ventricular tachycardia.</td>
<td>T-wave inversions. 0.2 mV Pathological Q waves Pathological Q waves. Normal or unchanged ECG during an episode of chest discomfort.</td>
<td></td>
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<tr>
<td>Cardiac markers</td>
<td>Markedly elevated (eg, TnT or TnI &gt;0.1 ng/ml)</td>
<td>Slightly elevated (eg, TnT&gt;0.01 but&lt;0.1 ng/ml)</td>
<td>Normal.</td>
</tr>
</tbody>
</table>

UA: unstable angina; MI: myocardial infarction; CABG: coronary artery bypass grafting; CCS: Canadian Cardiovascular Society; ECG: electrocardiogram; TnT: troponin T; TnI: troponin I

An estimation of the short-term risks of death and nonfatal cardiac ischemic events in UA is a complex multivariable problem that cannot be fully specified in a table such as this. Therefore, the table is meant to offer general guidance and illustration rather than rigid algorithms.

in comparison with heparin monotherapy. Although not approved in Japan, GP IIb/IIIa inhibitors are also promising antiplatelet drugs. However, further testing and consideration of indications is necessary for this class of drugs because differences in their efficacy according to the method of administration have been noted.

2. Hospitalization and patient transfer
If symptoms do not improve, and even if the patient’s condition is stable, hospital care needs to be based on the severity of the patient’s disease. Timely transfer to a medical institution for admission, or to a CCU if possible, should be considered.

**Hospital Care**

1. **Intervention**
For patients with ACS who have recurrent ischemic events that are resistant to drug therapy, emergency coronary angiography/intervention aimed at revascularization should be considered. However, there are several different views as to the timing of elective coronary angiography/intervention in patients with stable ACS of the type with non-ST-segment elevation, and no general consensus has been reached (Fig. 4).

Coronary angiography/intervention as an early invasive strategy within 24 hours after onset has merit, in that the severity of the lesion can be confirmed before aggravation of
Recurrent ischemia and/or ST segment shift, or Deep T-wave inversion, or Positive cardiac markers

Aspirin  
Beta blockers  
Nitrates  
Antithrombin regimen  
GP IIb/IIIa inhibitor  
Monitoring (rhythm and ischemia)

Early invasive strategy  
Immediate angiography  
12–24 hour angiography

Early conservative strategy  
Recurrent symptoms/ischemia  
Heart failure  
Serious arrhythmia

Patient stabilizes  
Evaluable LV function  
EF ≤ 0.40  
EF ≥ 0.40

Stress test

Not low risk  
Low risk

Follow on medical Rx

Rx indicates therapy.

Fig. 4 Acute ischemia pathway

The Japanese Circulation Society has been preparing guidelines for the diagnosis and treatment of cardiovascular diseases since 1998. Through joint research in 2000–2001, “guidelines for the diagnosis and treatment of acute coronary syndrome (Study Group led by Tetsu Yamaguchi)” were prepared and published. The need for accumulated evidence in Japa-

Prospective, controlled intervention trials need to be performed in Japan in the future.

Conclusion

The Japanese Circulation Society has been preparing guidelines for the diagnosis and treatment of cardiovascular diseases since 1998. Through joint research in 2000–2001, “guidelines for the diagnosis and treatment of acute coronary syndrome (Study Group led by Tetsu Yamaguchi)” were prepared and published. The need for accumulated evidence in Japa-

the disease to allow risk stratification and decision-making as to treatment policy. On the other hand, the early conservative strategy has merit in that invasive tests and treatment can be avoided if ischemia is controlled by medical treatment after the patient is out of the acute phase, and if high risk is denied. In Japan, attention to the cost-effectiveness of care has been less pronounced because of differences from the medical care systems in some Western countries. However, it is now impossible to avoid this issue in light of projected future medical expenditures.
nese patients is clear, in view of possible future revision of the guidelines.

REFERENCES

