Clinical Research

Predictors for development of multiple organ dysfunction syndrome in elderly patients with acute myocardial infarction

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Objective Multiple organ dysfunction syndrome (MODS) is one of the leading causes of death in ICU patients. However, there have been few studies on the role of MODS as a cause of death in patients with acute myocardial infarction (AMI), particularly in those at advanced age. Our study aimed to investigate the incidence and to identify the predicting factors of MODS in elderly patients with AMI. Methods We identified consecutive patients with AMI who were discharged from the Chinese PLA General Hospital between January 1993 to June 2006. Medical records of 800 consecutive patients aged 60 years or over were analyzed retrospectively. Multivariate logistic regression was used to determine factors predicting in-hospital development of MODS. Results Twenty-seven (3.4%) patients developed MODS within 30 days after AMI. Compared with patients without MODS, patients with MODS had higher in-hospital mortality rates (55.6% vs 11.6%, \(P<0.001\)) and more frequent complications of cardiogenic shock (25.9% vs 6.2%, \(P<0.001\)), heart failure (HF) (59.3% vs 18.2%, \(P<0.001\)), cardiac arrhythmia (44.4% vs 26.4%, \(P<0.05\)) and pneumonia (55.6% vs 16.3%, \(P<0.001\)). Multivariate logistic regression analysis showed the major predictors for the occurrence of MODS secondary to AMI were advanced age (≥ 75 years, odds ratio 2.64, 95% confidence interval [CI] 1.13 to 6.61), heart rate ≥ 100 bpm on admission (odds ratio 1.74, [CI] 1.14 to 2.64), in-hospital complication of HF (odds ratio 3.03, [CI] 1.26 to 7.26) and pneumonia (odds ratio 2.82, [CI] 1.18 to 6.77). Conclusions MODS is not the uncommon complication in elderly patients with AMI and is associated with poor prognosis. Advanced age, heart failure and pneumonia are predictors of the development of MODS in patients with AMI. \(J\) Geriatr Cardiol 2008; 5:199-202

Key words Aging, multiple organ dysfunction syndromes, acute myocardial infarction

Introduction

Multiple organ dysfunction syndrome (MODS) is one of the leading causes of death in ICU patients. However, there have been few studies on the role of MODS as a cause of death in patients with acute myocardial infarction (AMI) in the elderly. The definition of AMI complicating MODS is that two or above systems dysfunction genesis simultaneously or secondarily after AMI. The characteristics include advanced age, more concomitance disease, more involved systems, larger infarction region, lower heart function and higher mortality. \(^1\) MODS is an evolving clinical complex triggered by various stimuli. It is the main cause of morbidity and mortality in patients admitted to intensive care units (ICU). \(^2\) Thus, we hypothesized the identification of patients at increased risk of MODS in the immediate post-MI period could aid in targeting more aggressive treatment, thereby leading to improved outcomes in these patients.

Patients and methods

Patients

We retrospectively analyzed the data of hospitalized patients who were 60 years of age or older, and were admitted to the Chinese PLA General Hospital from January 1993 to June 2006, with the primary diagnosis of AMI. Medical records of 800 consecutive patients with confirmed AMI according to the ESC/ACC criteria \(^3\) (CK or CK-MB ≥ twice the upper limit of normal; electrocardiogram evidence of AMI: alternative biomarker, scintigraphic, echocardiographic, or autopsy evidence indicative of AMI) were abstracted.

Diagnosis of MODS

MODS was diagnosed with criteria suggested by a Chinese expert consensus, which was specifically proposed for the diagnosis of MODS in elderly, non-surgical critically-ill patients (Table 1). \(^4\) MODS was defined as simultaneously or sequentially developed dysfunction in 3 or more of the following organ systems.

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vs 18.2%, shock (25.9% vs 6.2%, P<0.001), and more frequent complications of cardiogenic shock, heart failure (HF) (59.3% vs 26.4%, P<0.001), ventilator pneumonia (55.6% vs 16.3%, P<0.001). Multivariate logistic regression analysis showed the major predictors for the occurrence of MODS secondary to AMI were advanced age (≥75 years, odds ratio 2.64, 95% confidence interval [CI] 1.13 to 6.61), heart rate ≥100 bpm on admission (odds ratio 1.74, [CI] 1.14 to 2.64), in-hospital complication of HF (odds ratio 3.03, [CI] 1.26 to 7.26) and pneumonia (odds ratio 2.82, [CI] 1.18 to 6.77).

Discussion

The life expectancy of the elderly is longer than many clinical investigators estimated. A significant portion of older patients can be expected to live even longer.1 However, aging is associated with physiologic changes and an increased susceptibility to disease, all of which renders older patient more susceptible to the critical ill, for example cardiac disease, tumor, surgical stress.

MODS is the sequential failure of several organ systems after a trigger event, like sepsis or cardiogenic shock. Mortality rate of MODS is high, which is up to 70%.2 MODS often begins with respiratory failure, followed by intestinal, hepatic, renal, hematologic, and cardiac failure; the exact order of organ failure may vary because of preexisting disease.3 Mortality is strongly correlated with the number of failed organs, as well as age and duration of organ failure.4

AMI is frequently complicated by potentially lethal events that can be categorized as vascular, myocardial or mechanical, pericardial, and electrical. A majority of complications occur within the initial 72 hours of infarction; however, the early risk period extends to the first 4 to 6 weeks. MODS with AMI are acute, occurring suddenly. For this reason, clinicians involved directly in the management of patients with AMI must be well-versed in a broad range of diagnostic and treatment strategies to rapidly provide the highest possible level of care and to achieve optimal outcomes.

The severity of illness, the number of failed organs and the age of the patients can significantly influence the outcome. According to our present result, HR on the first day of admission, in-hospital complication of HF and pneumonia were the independent impact factors of MODS with AMI in the elderly.

We found rapid HR can predict advancing risk of MODS on the first day of when AMI patients were admitted. Rapid HR is a reliable indicator to estimate whether adrenergic nerve was excess activated.5 Hamaad A et al. described that enhancing sympathetic activity is an important source of inflammatory reaction in acute coronary syndrome (ACS).6-12 At the same time, rapid HR also can increase oxygen consumption, myocardial ischemia, metabolism, and free radical and reduce heart reserve, which would further impair the life expectancy of elderly patients.

Table 1 Diagnostic criteria of MODS

<table>
<thead>
<tr>
<th>Organ system</th>
<th>Diagnostic criteria of organ dysfunction</th>
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<tbody>
<tr>
<td>Heart</td>
<td>EF ≤ 0.40, PCWP ≥ 20 mmHg, manifestations of HF</td>
</tr>
<tr>
<td>Lung</td>
<td>PO2 ≥ 50 mmHg, SO2 ≥ 80%, pH≥7.30, FiO2 ≤ 200 mmHg, ventilation</td>
</tr>
<tr>
<td>Kidney</td>
<td>UPD&lt;20ml/h, Cr&gt;265.2umol/L, UNa&gt;40 mmol/L (or above-mentioned indexes to worsen over 20%), dialysis</td>
</tr>
<tr>
<td>Peripheral circulation</td>
<td>UPD&lt;20 ml/h, limbs cold and cyanosis, MBP&lt;50 mmHg (excluding hypovolemia)</td>
</tr>
<tr>
<td>Liver</td>
<td>TBIL ≥ 103 μmol/L (or ALT ≥ 2 times), hepatocerebral disease</td>
</tr>
<tr>
<td>Stomach intestine</td>
<td>Obvious abdominal distension, absent bowel sounds, stress ulcer complicating hemorrhage or perforation, enteritis necroticans, spontaneous perforation of gallbladder</td>
</tr>
<tr>
<td>Central nerve system</td>
<td>severely disseminated damage in NS, no reaction to stimulation, Glasgow ≤ 8</td>
</tr>
<tr>
<td>Coagulation function</td>
<td>PLT ≤ 500×10^9/L, FIB&lt;2 g/L, PT or TT extended 3s, D-dipolymer ≥ 2 times, obvious hemorrhage</td>
</tr>
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</table>

Statistical analysis

Categorical variables are expressed as frequencies and percentages, and continuous variables are expressed as mean ± SD. Continuous variables were analyzed using the Student’s t tests and categorical variables were analyzed using the chi-square test. Factors associated with the development of MODS were identified using stepwise, multivariate, logistic regression analysis. Variables included in the initial model were those factors associated with MODS at a significance level of P<0.25. Criteria for entry and for removal of candidate variables in the stepwise analysis were assigned a significance level of P<0.05. Adjusted odds ratios and 95% Wald confidence intervals were computed. A P value of <0.05 was considered significant for all tests. All analyses were performed using SPSS software (versions 13.0).

Results

Baseline characteristics of patients

Of the 800 patients, 27 patients (3.4%) developed MODS within 30 days after AMI. Baseline and clinical characteristics with and without MODS are detailed in Table 2. Compared with patients without MODS, patients with MODS had higher in-hospital mortality rates (55.6% vs 11.6%, P<0.001) and more frequent complications of cardiogenic shock (25.9% vs 6.2%, P<0.001), heart failure (HF) (59.3% vs 18.2%, P<0.001), cardiac arrhythmia (44.4% vs 26.4%, P<0.05) and pneumonia (55.6% vs 16.3%, P<0.001).
functions of various organ systems in AMI patients and lead to the development of MODS.

HF is an important predictor of poor outcome after AMI. The occurrence of HF in patients with AMI has been consistently recognized as a strong predictor of increased morbidity and mortality since 1960s. However, limited data exist about the clinical significance of HF in MODS with AMI. Our study indicated that HF is one of prognostic factors for the occurrence of MODS with AMI. The mechanism is that necrotic cardiocyte lost of contractile function, decreased stroke volume and increased end-systolic volume, end-diastolic volume, and diastolic filling pressure. Then hemodynamic instability may induce occurrence of MODS.

Any organ system can be affected in MODS, but the pulmonary systems are often the first one to be involved. The increased frequency and severity of pneumonia in older persons has been attributed to the higher incidence of MODS in the elderly. Our results offered evidence that pneumonia is a crucial factor to predict the development of MODS in elderly AMI patients. The mechanism may include hypoxemia, disturbance of acid-base balance, electrolyte imbalance, hemodynamics changed and various inflammatory reaction. In conclusion, we found that HR on the first day of admission, in-hospital complication of heart failure and pneumonia were the independent impact factors of MODS with acute myocardial infarction in the elderly. To minimize the likelihood and severity of MODS critical care-related problems, planning should be directed at the predictable problems that can be expected when an elderly patient is physiologically and psychologically stressed. The earlier you identify possible risk factors, the earlier the treatment can begin, and the sooner treatment is started, the better chance your patient to survive.

References
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