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Original article

Incidence and prognosis of cardiopulmonary arrest due to acute myocardial infarction in 85 consecutive patients

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ABSTRACT

Background: Studies involving long-term follow-up analysis of patients who have survived cardiopulmonary arrest (CPA) due to acute myocardial infarction (AMI) are rare. This study aimed to determine the incidence and prognosis of CPA in patients with AMI.
Methods: We retrospectively analyzed our database of AMI patients examined between January 2012 and September 2017. The characteristics of those who experienced CPA due to MI were compared to those who did not (CPA group and non-CPA group).
Results: A total of 549 consecutive patients were included in this study (age: 67 ± 12 years; male: 73%). Of those, 85 (15%) patients were transported with CPA on arrival. Five hundred and eight (93%) patients underwent initially successful percutaneous coronary intervention (PCI). The incidence of major adverse cardiovascular events (MACEs) was significantly higher in the CPA group than in the non-CPA group (59% vs. 23%, $p < 0.001$). This difference was attributed mainly to elevated levels of cardiac death, ventricular arrhythmias (VAs) between 48 h and 7 days after AMI onset, and VAs 7 days after AMI (41% vs. 6.0%, $p < 0.001$, 13% vs. 2.8%, $p < 0.001$, and 20% vs. 7.8%, $p < 0.001$, respectively). After a mean period of 36 ± 20 months, the CPA group showed significantly worse composite endpoints with more MACEs and total deaths than did the non-CPA group (both $p < 0.001$).
Conclusions: The clinical outcomes in our patients who were resuscitated after CPA and treated with PCI were remarkably good. However, the risk of cardiac death and recurrence of VA was high in the CPA group. Intensive medication and use of implantable cardioverter defibrillators should be strongly considered in this population.

Introduction

Acute myocardial infarction (AMI) can induce lethal ventricular arrhythmias (VAs), such as ventricular fibrillation (VF) [1]. Improvements in revascularization in AMI have contributed to decreased mortality due to cardiovascular disease over the past few decades [2–8]. However, patients with cardiopulmonary arrest (CPA) due to VAs still have a higher rate of mortality than do those without CPA [9].

Previous studies have documented the short- and long-term prognoses of patients with AMI [4,5,7,10–13]. In these studies, the 30-day and 1-year all-cause mortality rates were 7–10% and 11–15%, respectively. Advanced age, diabetes mellitus, higher serum creatinine level, acute-phase heart failure, and low left ventricular ejection fraction (LVEF) at the onset of AMI were reported as poor prognostic factors.

However, there are limited data regarding long-term follow-up analysis in patients who have survived CPA due to AMI. This study was designed to determine the incidence and prognosis of consecutive patients with CPA during AMI.

Materials and methods

Study design and patient population

We performed a retrospective analysis of our database of AMI patients who had been admitted to Chiba University Ho\spital between January 2012 and September 2017. AMI was defined using

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the third universal definition of myocardial infarction [14]. Criteria for AMI were detection of a rise and/or fall of cardiac biomarker values (preferably cardiac troponin) with at least one value above the 99th percentile upper reference limit, as well as at least one of the following: (i) symptoms of ischemia, (ii) new or presumed new significant ST-segment-T wave (ST-T) changes or new left bundle branch block (LBBB), (iii) the development of pathological Q waves on electrocardiogram (ECG), (iv) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality, and (v) identification of an intracoronary thrombus by angiography or autopsy. We excluded patients less than 20 years of age. The hospital's ethics committee approved this study.

Coronary angiography and percutaneous coronary intervention

Coronary angiography was performed using standard techniques. When the operator determined that revascularization of the culprit vessel was required, percutaneous coronary intervention (PCI) was performed using a drug-eluting stent (DES), bare-metal stent (BMS), balloon angioplasty with a drug-coated balloon, or coronary-artery bypass grafting (CABG). When PCI was performed, aspirin (100 mg) and clopidogrel (300 mg) or prasugrel (20 mg) were administered. Coronary imaging methods, such as intravascular ultrasonography or optical coherence tomography, were used in all cases.

Patient follow-up, outcome measures, and adjudication of clinical events

Clinical data were obtained during outpatient clinic visits or by telephone when needed. The primary outcome was occurrence of a major adverse cardiovascular event (MACE), such as cardiac death, ventricular arrhythmia, non-fatal myocardial infarction, target vessel revascularization, and hospitalization for heart failure. The secondary outcome was death.

Statistical analysis

Categorical variables are expressed as number and percentage. The normality of distribution of continuous variables was determined using the Kolmogorov–Smirnov test. Differences between patients with and without cardiopulmonary arrest on arrival (CPAOA) were evaluated using the two-sample t test and Mann–Whitney *U* test, as appropriate. Categorical variables were tested using a Pearson's χ^2 test and Fisher's Exact Test. The related variables in the univariate analysis ($p < 0.10$) were used as variables in the multivariable logistic regression analysis, which was used to calculate the odds ratio (OR) and 95% confidence interval (95% CI) after simultaneously controlling for potential confounders of CPAOA. For clinical outcomes, Kaplan–Meier estimates and curves were generated and compared using the log-rank test. IBM SPSS Statistics 23.0 software (IBM Corp., Armonk, NY, USA) was used to perform all analyses. A p-value <0.05 indicated statistical significance.

Results

Characteristics of patients and lesions

A total of 549 consecutive post-MI patients were included in this study (age: 67 ± 12 years; male: 73%). Fig. 1 shows the flow diagram of this study. Of the 549 AMI patients, 85 (15%) patients experienced CPAOA. Of the 326 (59%) ST-elevation myocardial infarction (STEMI) and 223 (41%) non-STEMI patients, 68 (21%) and 17 (7.6%) patients experienced CPA, respectively. Table 1 summarizes the baseline characteristics of all patients. There were more patients with hypertension and dyslipidemia in the non-CPA group than in the CPA group (75% vs. 55%, $p < 0.001$ and 64% vs. 34%, $p < 0.001$, respectively). There were more patients who developed STEMI and developed MI via occlusion within the left main trunk (LMT) in the CPA group (80% vs. 56%, $p < 0.001$ and 14% vs. 6.0%, $p < 0.0084$, respectively). High serum peak creatine kinase (CK) (more than 5000 U/L) and depressed LVEF (less than 35%) were also more prevalent in the CPA group (48% vs. 10%, $p < 0.001$ and 47% vs. 15%, $p < 0.001$, respectively). Multivariable logistic regression analysis demonstrated that an EF ≤35% (OR, 2.302; 95% CI, 1.28–4.24; $p = 0.008$), serum peak CK >5000 IU/L (OR, 4.81; 95% CI, 2.74–8.42; $p < 0.001$), and STEMI (OR, 2.30; 95% CI, 1.28–4.24; $p = 0.008$) were potential risk factors for CPAOA (Table 2). PCI was performed in 91% of the patients with CPA and 93% of those without CPA.

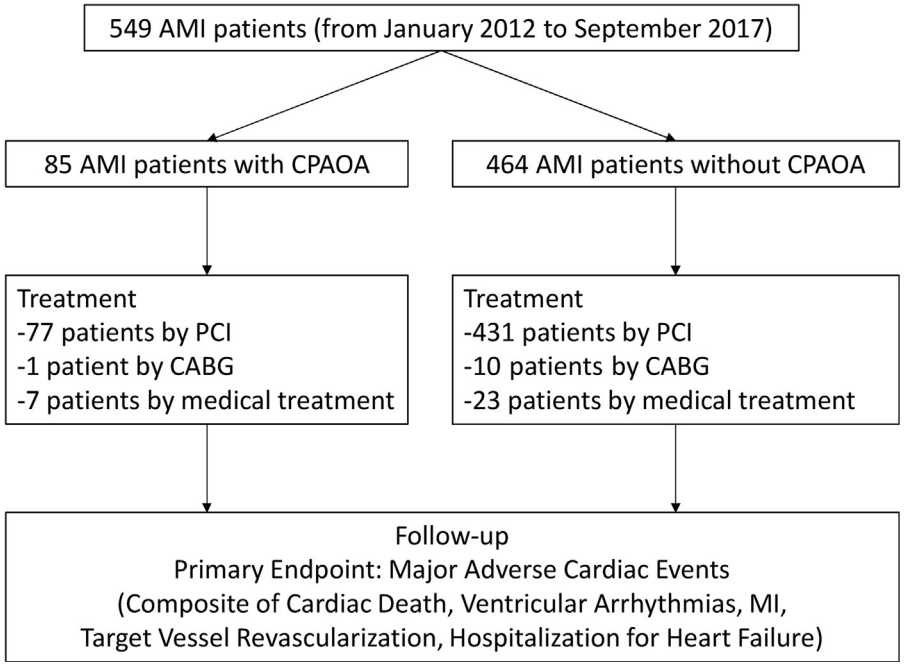

Fig. 1. Study flow chart. AMI, acute myocardial infarction; CPAOA, cardiopulmonary arrest on arrival; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft; MI, myocardial infarction.