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Clinical paper

Association of time from arrest to percutaneous coronary intervention with survival outcomes after out-of-hospital cardiac arrest☆

Joo Jeong [a,b], Young Sun Ro [b,*], Sang Do Shin [b,c], Kyoung Jun Song [b,c], Ki Jeong Hong [b,d], Ki Ok Ahn [b]

[a] Department of Emergency Medicine, Seoul National University Bundang Hospital, Republic of Korea
[b] Laboratory of Emergency Medical Services, Seoul National University Hospital Biomedical Research Institute, Republic of Korea
[c] Department of Emergency Medicine, Seoul National University College of Medicine, Republic of Korea
[d] Department of Emergency Medicine, Seoul National University Boramae Medical Center, Republic of Korea

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ABSTRACT

Background: Timely post-resuscitation coronary reperfusion therapy is recommended; however, the timing of immediate coronary reperfusion for out-of-hospital cardiac arrest (OHCA) has not been established. We studied the effect of the time interval from arrest to percutaneous coronary intervention (PCI) on resuscitated OHCA patients.

Methods: All witnessed OHCA patients with a presumed cardiac etiology received successful PCI at hospitals between 2013 and 2015, excluding cases with unknown information regarding the time from arrest to PCI and survival outcomes. The main exposure of interest was the time interval from arrest to ballooning or stent placement in coronary arteries, and cases were categorized into five groups of 0–90, 90–120, 120–150, and 150–180 min and 3–6 h. The endpoint was survival with good neurological recovery. Multivariable logistic regression analysis was performed, adjusting for patient-community, prehospital, and hospital factors.

Results: A total of 765 patients (24.1% received PCI within 90 min; 31.0% in 90–120 min; 17.8% in 120–150 min; 12.3% in 150–180 min; 14.9% in 3–6 h after arrest) were included. Good neurological recovery was more frequent in the early PCI groups than the delayed PCI group (63.6%, 55.3%, 47.8%, 33.0%, and 42.1%, respectively). The adjusted OR (95% CI) for good neurological recovery compared with the most early PCI group was 0.86 (0.53–1.39) in the PCI group between 90 and 120 min; 0.76 (0.45–1.31) in the PCI group between 120 and 150 min; 0.42 (0.22–0.79) in the PCI group between 150 and 180 min; and 0.53 (0.30–0.93) in PCI group after 3 h.

Conclusions: Among resuscitated OHCA patients with a presumed cardiac etiology and successful PCI, patients who received a delayed coronary intervention after 150 min from arrest were less likely to have neurologically intact survival compared to those who received an early intervention.

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Background

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death. Despite recent advances in post-resuscitation care, only less than half of OHCA patients who achieved return of spontaneous circulation (ROSC) are successfully discharged with minimal neurological impairment [1,2]. The poor prognosis of cardiac arrest is largely attributable to post-cardiac arrest syndrome, a condition that includes increased susceptibility to hypoxia and ischemic reperfusion injury after cardiac arrest, which in turn produces abrupt biochemical damages in the brain and heart [1,3,4]. Timely post-resuscitation interventions, including coronary reperfusion therapy and targeted temperature management, are aimed at improving the prognosis of resuscitated OHCA patients. Emergent coronary angiography and intervention are recommended for OHCA with a suspected cardiac etiology and ST-segment elevation on electrocardiography (ECG), and it should also be considered for comatose patients after OHCA of suspected cardiac etiology
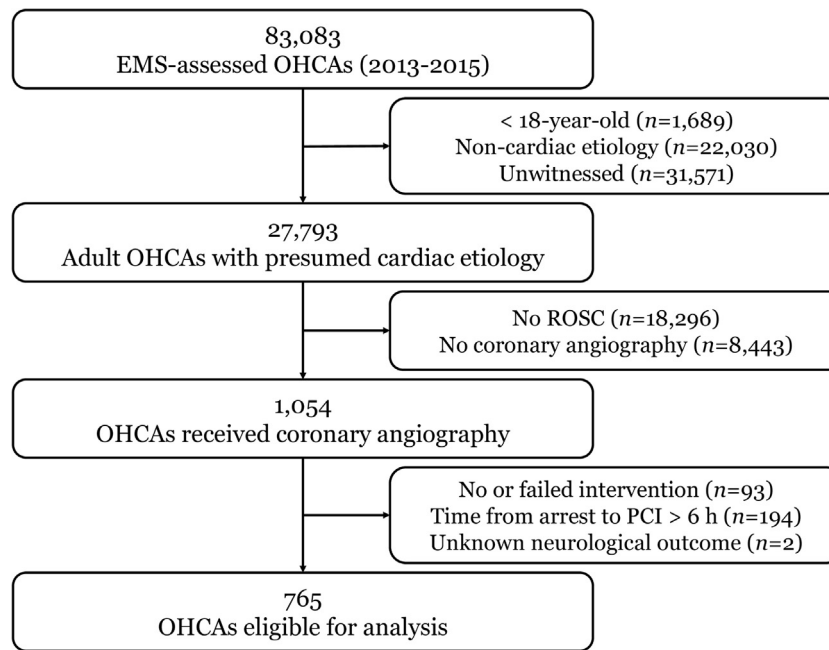

Fig. 1. Study population.
EMS: emergency medical service; OHCA: out-of-hospital cardiac arrest; ROSC, return of spontaneous circulation; PCI: percutaneous coronary intervention.

who present without ST-segment elevation [5]. Early coronary angiography with prompt recanalization of infarct-related artery can salvage the myocardium and reduce ventricular arrhythmia as well as electrical instability of the heart [6,7]. Hemodynamic deterioration from ongoing myocardial ischemia accounts for almost all deaths in the early phase after ROSC, although neurological injury is the most common cause of death after OHCA [8–10]. Therefore, the heart is a good intervention target during the early phases of post-resuscitation care, and increasing clinical evidence recommends the application of earlier reperfusion therapy in patients with cardiac arrest. However, the international guidelines are less clear for the timing of immediate coronary reperfusion therapy [5], and the definition of timing for immediate coronary angiography in previous studies varied from before admission to within 12 h after arrest [11–16]. Furthermore, studies on the effects of the time interval from arrest to percutaneous coronary intervention (PCI) after OHCA on clinical outcomes are limited.

We hypothesized that an earlier coronary intervention after arrest would be strongly associated with a higher likelihood of favorable survival outcomes after OHCA. The aims of this study were to test the association of the time interval from arrest to PCI and survival outcomes for witnessed OHCA patients with a presumed cardiac arrest.

Methods

Study setting

In Korea, the emergency medical services (EMS) system is exclusively operated by the national fire department. All EMS-assessed patients are transported to a hospital [17]. There are approximately 460 emergency departments (EDs), which are designated by the Ministry of Health and Welfare. The EDs are categorized into different levels to reflect the level of care available in EDs that based on capacity and resource measures such as staffing, equipment, and size of the department. Level 1 (n = 20) and 2 EDs (n = 110) provide the highest level of emergency care services in the country. In accordance with the EMS Act, all EDs participate annually in

a nationwide functional performance evaluation program administered by the Ministry of Health and Welfare. All EDs generally perform acute cardiac care and post-resuscitation care in accordance with the international standard guidelines, and physicians are responsible for making decisions for care [7].

Study design and data sources

This was a cross-sectional study using a nationwide, prospective registry of OHCAs in Korea. Data were collected from the following sources: EMS run sheets for ambulance operation information, EMS cardiac arrest and dispatcher cardiopulmonary resuscitation (CPR) registries for the Utstein factors, and National OHCA registry for hospital care and outcomes, which was extracted by medical record reviewers of the Korea Centers for Disease Control and Prevention (CDC).

Provincial EMS headquarters, which are operated by the national fire department, store electronic EMS run sheets. EMS providers record the EMS cardiac arrest registry for all EMS-assessed OHCAs. For each eligible patient, the EMS cardiac arrest and dispatcher CPR registries are linked to the national fire department's electronic database using the ambulance dispatch number, and the event is integrated as a single episode.

Using the abovementioned registries, the Korea CDC reviewed the medical records of all OHCA patients transported to hospitals by EMS personnel, and clinical information was extracted using structured forms based on the Utstein template. A quality management committee composed of emergency physicians, epidemiologists, statistical experts, representatives from the fire department, and medical record review experts ensured the quality of the medical record review processes. The quality management committee educated all medical record reviewers prior to joining the project, provided a standard manual for data abstraction, provided feedback to the reviewers on a monthly basis, and provided consultations in equivocal cases as needed.