

Original Article

Impact of improved prehospital emergency medical service system on the time management of chest pain patients in the emergency department

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Abstract: Objectives: To investigate the impact of an improved prehospital emergency medical service system (EMSS) on the time management of chest pain (CP) patients in the Emergency Department in our hospital and define the role of the improved prehospital EMSS in the treatment of CP patients. Methods: All patients with ST-elevation myocardial infarction (STEMI) undergoing coronary artery stent placement (CASP) in our hospital from August 2011 to December 2012 were included in this study, and were randomly divided into a study group (SG) and control group (COG) by the random number table method. The critical time periods [e.g., time to dispatch ambulance upon the receipt of the call to 120, time from hospital entrance to the Emergency Department, time from arrival at hospital to: first treatment, to first electrocardiogram (ECG), to monitoring of vital signs, to establishment of venous access device (VAD), and to entrance to catheter room in the two groups were sorted out for statistical analysis. Results: Improved prehospital EMSS can markedly shorten the time to dispatch ambulance upon the receipt of the call to 120, time from hospital entrance to the Emergency Department, and time to first treatment, time to first ECG, to monitoring of vital signs, to establishment of VAD, and to entrance to the catheter room; it also prolonged the 5-year survival rate ($P < 0.05$). Conclusion: Improved prehospital EMSS can significantly improve the time management of CP patients in the Emergency Department.

Keywords: Prehospital emergency medical services, emergency department, time management, chest pain, acute myocardial infarction

Introduction

Chest pain (CP) is a common symptom in the Emergency Department (ED). The statistical analysis shows that more than 8 million CP patients receive treatment in the ED annually [1]. Among them, approximately 25% of CP patients experience acute coronary syndromes (ACS) including ST-elevation myocardial infarction (STEMI) and non-ST elevation-acute coronary syndrome (NSTEMI) [2]. Multiple studies suggest that early first-aid measures can noticeably improve the prognosis and reduce the mortality rate in CP patients [3-5]. Therefore, a well-developed prehospital EMSS plays an instrumental role in the management of CP patients in the ED.

Emergency medical service system (EMSS) is an essential part of medical treatment, which

is designed to provide patients with the medical treatment and care from onset to admission, including field first aid, in-transit monitoring, and basic medical approaches to save the lives of patients and maintain basic vital signs [6]. Prehospital first aid includes basic life support (BLS) and basic trauma life support (BTLS) [7]. The success rate of cardiopulmonary resuscitation (CPR) can be taken as one of the criteria for evaluation of the level of EMSS [8]. A well-developed EMSS can noticeably improve the effects of prehospital first aid, the prognosis, and the mortality rate in patients [9]. With the burgeoning economic development and the increasingly aging population in China, improved prehospital emergency medical services and social assistance are required. The traditional prehospital EMSS shows multiple issues (e.g., the restricted design of emergency mode and oper-

ating range, the serious staff shortage in the first-line treatment, low pay and benefits, and high risks) [10].

In order to further improve the operating efficiency of prehospital EMSS, shorten the therapeutic duration, and ensure the life and well-being of CP patients, this study analyzed the impact of the improved prehospital EMSS on the time management of CP patients.

Methods

This study is a single center retrospective study in the First People's Hospital of Fuyang Hangzhou (Hangzhou City, China). The medical records of all patients with STEMI undergoing coronary artery stent placement (CASP) in the ED in our hospital from August 2011 to December 2012 were selected as the study data. This study has been approved by the Ethics Committee of the First People's Hospital of Fuyang Hangzhou (No. NCT02123684). All patients met the following inclusion and exclusion criteria:

Inclusion criteria: (1) compliance with the clinical diagnostic criteria for acute STEMI; (2) patients seek medical advice in the ED in our hospital immediately after onset; (3) the informed consent form was voluntarily signed by patients or their families; and (4) patients with the first onset of acute STEMI. This study was pre-reviewed and pre-approved by the Hospital Ethics Committee.

Exclusion criteria: (1) refusal to participate in this study; (2) severe hepatic and renal dysfunction.

In this study, all patients were randomly divided into study group (SG) and control group (COG) in accordance with the random number table method. Among them, the emergency medical service plans in the COG were as follows: The patients were pre-examined and triaged, and cardiologists inquired about the patients' conditions and diagnosed the causes of CP, and performed 12/18 lead electrocardiogram (ECG). Upon confirmation of STEMI, the patients were admitted to hospital with their vital signs monitored, and inhaled a certain

amount of oxygen. Additionally, the venous access device (VAD) was established for subsequent collection of venous blood. Upon collection of venous blood, the blood samples were sent to the laboratory, and multiple enzymes (e.g., myocardial enzymes) were tested in accordance with the regimen. Upon receipt of drugs, the nurse adopted the intravenous infusion in accordance with the regimen. After the protocol for emergency percutaneous coronary intervention (PCI) was determined, the nurses assisted the patients and their families to make preparations, and the patients' families learned about the drugs in accordance with the physician's advice before surgery. The nurses responsible for transferring the patients sent the prepared oxygen bags, defibrillators and rescue medications to the catheter room of the patients.

The emergency medical service plans in the SG were as follows: Based on the treatment in the COG, the SG additionally achieved all-round improvement, including the improvement of the overall clinical skills of medical staff and the issues regarding the low pay of physicians. In the ED, several nurses of CP were added to perform their duties and send necessary items or CP patients to corresponding places. The triage nurses and nurses of CP shared necessary information with each other. Nurses of CP understood the symptoms of patients, and made arrangements so that CP patients were placed in sickbeds and received the 12/18 lead ECG and blood pressure monitoring. Finally, the urgent care center (UCC) was equipped with GPS and Internet. In this way, UCC could locate the emergency vehicles, follow up the status of patients, dispatch vehicles dynamically in real time, and improve the efficiency of emergency medical services.

Evaluation indices

The critical time periods (e.g., time to dispatch ambulance upon the receipt of the call to 120, time from hospital entrance to the ED, time from arrival at hospital to first treatment, time from arrival at hospital to first ECG, time from arrival at hospital to monitoring of vital signs, time from arrival at hospital to establishment of VAD, time from arrival at hospital to entrance to

Table 1. General baseline information

Baseline information	Study group (n=337)	Control group (n=337)	P value
Gender			
Male	188	179	0.751
Female	149	158	0.862
Age (years)	57.22±1.49	56.84±1.54	0.644
BMI	22.38±1.21	23.19±1.03	0.771
Heart rate (per minute)	75.44±11.32	77.32±10.56	0.86
Respiratory rate (per minute)	17.33±2.66	17.14±3.21	0.981
Blood pressure (mmHg)			
Systolic pressure (mmHg)	146.45±23.54	148.67±22.98	0.792
Diastolic pressure (mmHg)	97.34±18.54	96.98±18.97	0.648

Statistical analysis

SPSS 20.0 software was used for statistical analysis. The measured data were indicated by mean ± standard derivation (SD), and the measured data between groups were compared by the *t*-test for the two independent samples. The enumerated data were indicated by the number of cases (%), and the counted data differences between groups were detected by χ^2 test. $P < 0.05$ indicated statistical significance.

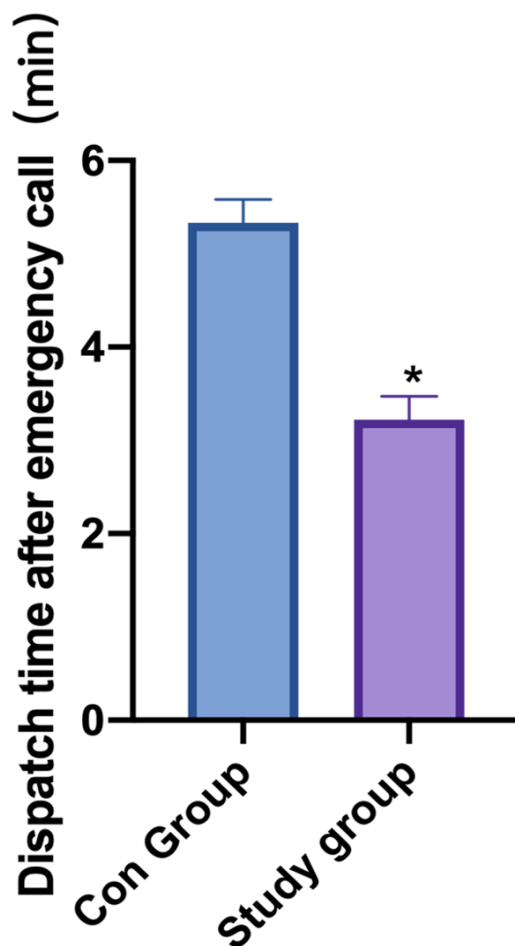


Figure 1. Time to dispatch the ambulance after the emergency call is dialed in the two groups. * $P < 0.05$, compared with the control group. Study group: improved prehospital EMSS group; Con group: control group.

catheter room, and 5-year survival rate) in the two groups were statistically analyzed.

Results*Comparison of basic data between the two groups*

A total of 674 CP patients receiving treatment in the ED in our hospital from August 2011 to December 2012 were included, and randomly divided into SG and COG in accordance with the random number table method.

The statistical analysis suggested that there was no significant difference in the general baseline data such as age, gender, blood pressure, body mass index (BMI), heart rate, and respiratory rate between the two groups, and the data were comparable (**Table 1**).

Comparison of time to dispatch ambulance upon the receipt of the call to 120 between the two groups

The comparison of time to dispatch ambulance upon the receipt of the call to 120 between the two groups revealed that the SG had a markedly shorter time to dispatch ambulance upon the receipt of the call to 120 compared with the COG ($P < 0.05$) (**Figure 1**).

Comparison of time from hospital entrance to ED between the two groups

The comparison of time from hospital entrance to ED between the two groups demonstrated that the SG had a much shorter time from hospital entrance to emergency department compared with the COG ($P < 0.05$) (**Figure 2A**).

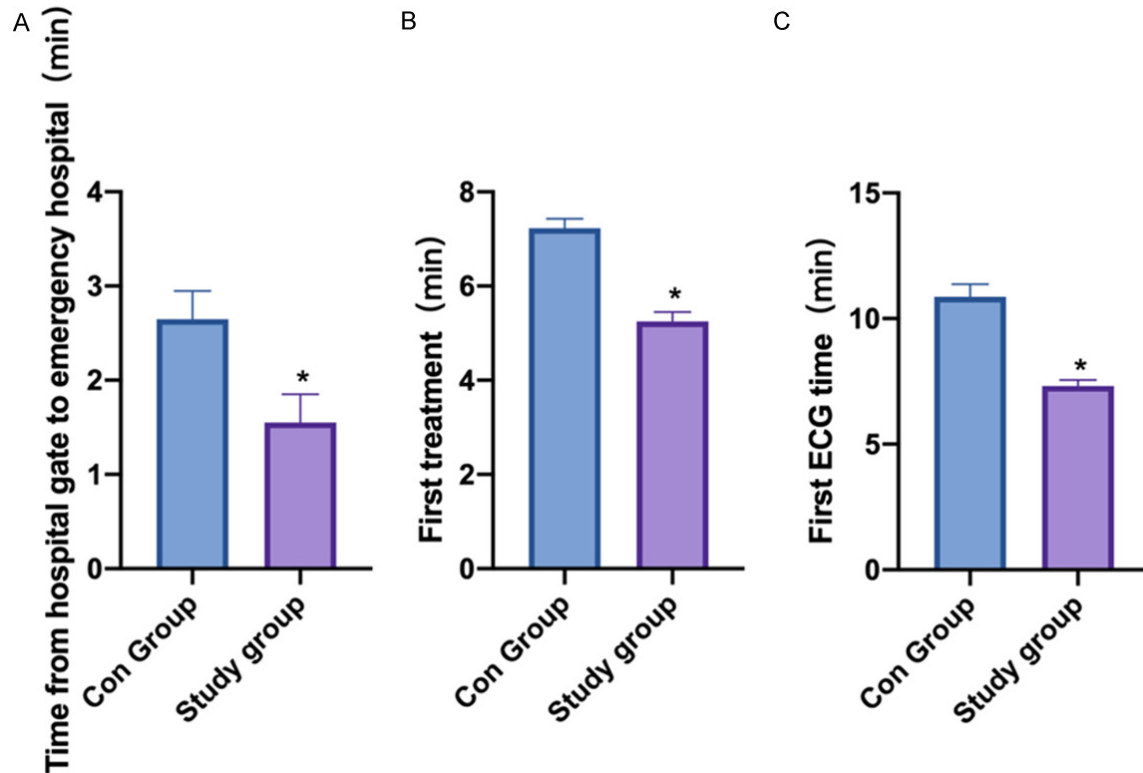


Figure 2. Time from hospital entrance to emergency department, time to first receive treatment and time to receive first ECG in the two groups. A: Time from hospital entrance to emergency department; B: Time to first receive treatment in the two groups; C: Time to receive first ECG. * $P < 0.05$, compared with the control group. Study group: improved prehospital EMSS group; Con group: control group.

Comparison of time from arrival at hospital to first treatment between the two groups

The comparison of time from arrival at hospital to first treatment between the two groups exhibited that the SG had a much shorter time from arrival at hospital to first treatment compared with the COG ($P < 0.05$) (**Figure 2B**).

Comparison of time from arrival at hospital to first ECG between the two groups

The comparison of time from arrival at hospital to first ECG between the two groups showed that the SG had a noticeably shorter time from arrival at hospital to first ECG compared with the COG ($P < 0.05$) (**Figure 2C**).

Comparison of time from arrival at hospital to monitoring of vital signs between the two groups

The comparison of time from arrival at hospital to monitoring of vital signs between the two

groups suggested that the SG had a noticeably shorter time from arrival at hospital to monitoring of vital signs compared with the COG ($P < 0.05$) (**Figure 3**).

Comparison of time from arrival at hospital to establishment of VAD between the two groups

The comparison of time from arrival at hospital to establishment of VAD between the two groups revealed that the SG had a remarkably shorter time from arrival at hospital to establishment of VAD compared with the COG ($P < 0.05$) (**Figure 4**).

Comparison of time from arrival at hospital to entrance to catheter room between the two groups

The comparison of time from arrival at hospital to establishment of venous access between the two groups demonstrated that the SG had a markedly shorter time from arrival at hospital to

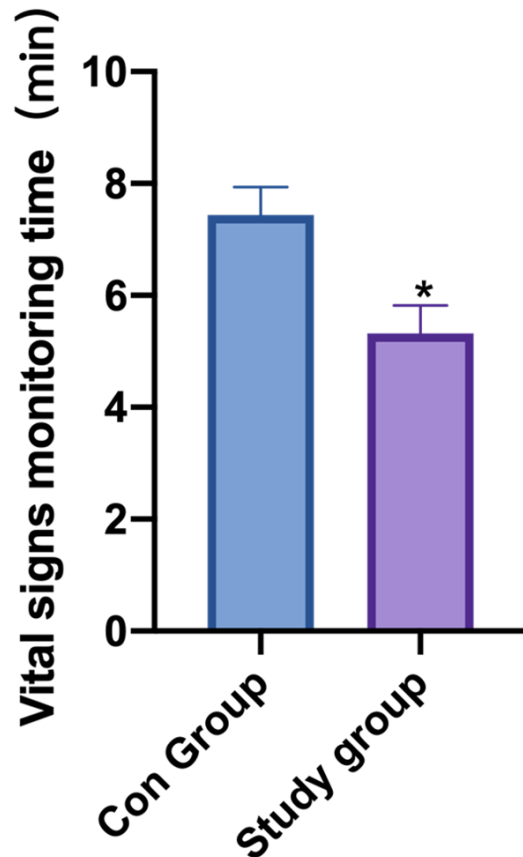


Figure 3. Time to monitoring of vital signs in the two groups. * $P < 0.05$, compared with the control group. Study group: improved prehospital EMSS group; Con group: control group.

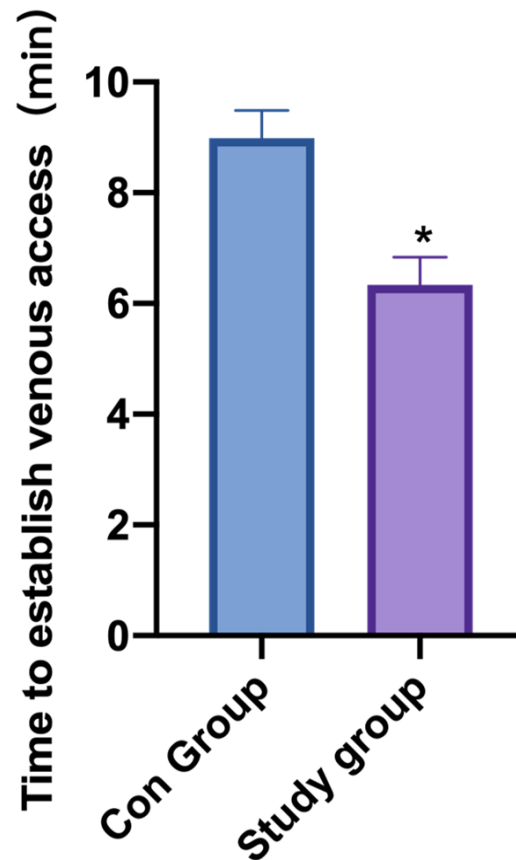


Figure 4. Time to establishing venous access in the two groups. * $P < 0.05$, compared with the control group. Study group: improved prehospital EMSS group; Con group: control group.

establishment of venous access compared with the COG ($P < 0.05$) (Figure 5).

Comparison of 5-year survival rate between the two groups

We compared the 5-year survival rate of the two groups. Results showed that the 5-year survival rate of the SG was significantly higher than that of the COG ($P < 0.05$) (Figure 6).

Discussion

Most of CP patients in the ED are patients with STEMI, which is a multiple emergency in the Department of Cardiology, and it suddenly occurs and leads to a high mortality rate, and may lead to death if not treated in time [11, 12]. PCI plays a pivotal role in clinical diagnosis and treatment of CP, which requires an excellent time control. An earlier surgery indicates a high-

er rescue and cure rate [13, 14]. Therefore, the optimization and improvement of the prehospital emergency treatment process and the EMSS contribute significantly to the time management of CP patients. The results suggested that the improved EMSS could markedly shorten the time to dispatch ambulance upon the receipt of the call to 120, time from hospital entrance to the ED time from arrival at hospital to first treatment, time from arrival at hospital to first ECG, time from arrival at hospital to monitoring of vital signs, time from arrival at hospital to establishment of VAD, time from arrival at hospital to entrance to catheter room, and prolong 5-year survival rate ($P < 0.05$). Time management is crucial for CP patients in the ED.

Relevant studies show that the improved prehospital EMSS can effectively shorten the duration of emergency medical services, and thus

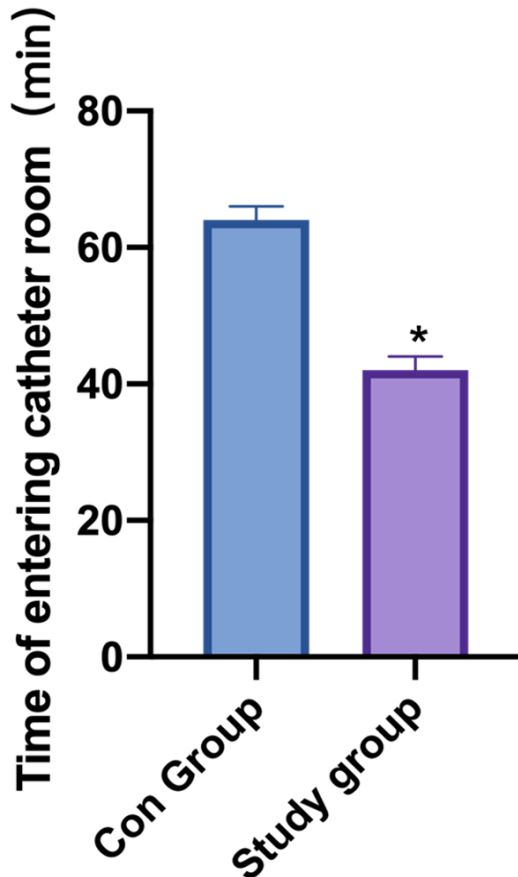


Figure 5. Time until entrance to the catheter room in the two groups. * $P < 0.05$, compared with the control group. Study group: improved prehospital EMSS group; Con group: control group.

improve the therapeutic effects and prognosis [6, 15-17]. A study indicates that improvement of Internet construction in emergency vehicles can remarkably shorten the time from the call to 120 to arrival of an ambulance [18]. Our study results have demonstrated that the improved prehospital EMSS can greatly shorten the patients' duration of visit. This is attributed to use of the Internet and installation of GPS devices in emergency vehicles enable personnel in the ED to follow up the patients' status at any time and places, dispatch vehicles based on the patients' locations, monitor road conditions and vehicle information at any time using GPS technique, select the appropriate road, send the patients to the hospital as soon as possible, and shorten the latency time after the emergency call is dialed and the arrival time of the emergency vehicle.

Additionally, the improved prehospital EMSS further optimizes the allocation of medical per-

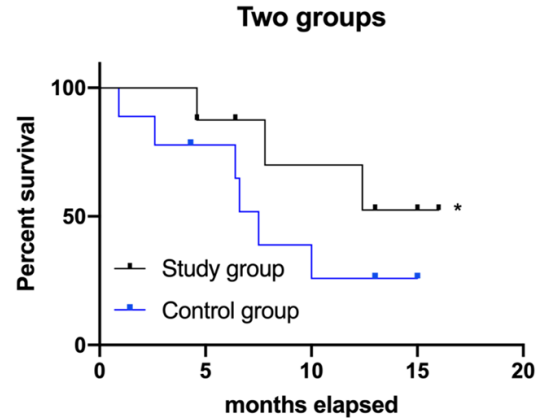


Figure 6. 5-year survival rate between the two groups. * $P < 0.05$, compared with the control group. Study group: improved prehospital emergency system group; Con group: control group.

sonnel resources in the ED, and allocates more specialists and nurses with excellent clinical skills to the ED, so that patients can complete the first ECG examination in the shortest time possible upon arrival at the hospital to determine whether ACS occurs, thus laying a foundation for early diagnosis of patients with ACS [19]. A study suggests that when the asystole is 4-6 min, intracerebral cells begin to die; when the asystole is > 10 min, massive intracerebral cells die irreversibly, and the lesions in nervous tissues lead to irreversible consequences [20]. After 15 min of asystole, the mortality rate is as high as 95% [21, 22]. After 30 min of asystole, there is almost no possibility of survival. The survival rate of patients can be increased by 10% [23, 24] every time the treatment mode is initiated 1 min in advance. Therefore, early ECG is of great significance to the prognosis of patients and the reduction of mortality rate.

The improved prehospital EMSS focuses on improving the professional knowledge, theory, and clinical skills of health-care personnel and related personnel and the emergency medical services, thus shortening the therapeutic duration. In addition, our team proposed procedures for CP performed by several nurses, so as to truly embody the concept of "Time is Life" in the improved prehospital EMSS.

The procedures reduce the time consumption necessary to admission procedures and multiple examinations after admission, improve the emergency treatment delay caused by various admission procedures and long wait time for

examinations in many hospitals, shorten the time from diagnosis of acute myocardial infarction to coronary artery stent implantation, and significantly prolong the 5-year survival rate.

The study data are based on real world samples, and the sample size is large. Therefore, the results obtained based on the data have a high reference value. However, the restricted number of samples in each group leads precluded considering the impact of patients' age on the observation criteria, suggesting some limitations.

In summary, our study results exhibit that the improved prehospital EMSS can markedly shorten the time from onset to implementation of PCI, and offer more time for myocardial salvage. Therefore, the improved prehospital EMSS is worthy of promotion and implementation in the ED in medical institutions.

Disclosure of conflict of interest

None.

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